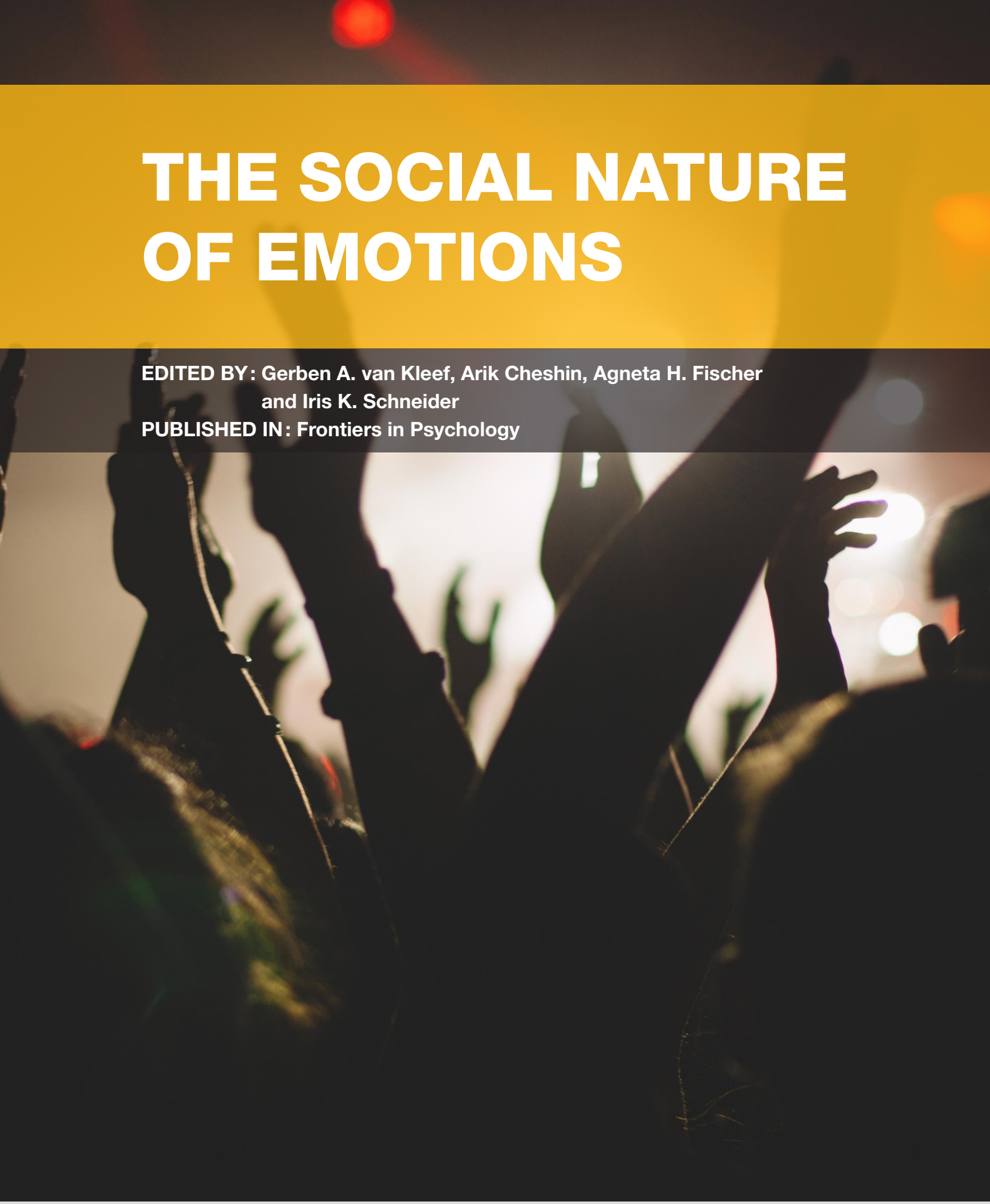
THE SOCIAL NATURE OF EMOTIONS



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THE SOCIAL NATURE OF EMOTIONS

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People enjoying a concert.
Image by Daniel Nanescu: http://www.splitshire.com/people-enjoying-concert/

Emotion is a defining aspect of the human condition. Emotions pervade our social and professional lives, they affect our thinking and behavior, and they profoundly shape our relationships and social interactions. Emotions have traditionally been conceptualized and studied as individual phenomena, with research focusing on cognitive and expressive components and on physiological and neurological processes underlying emotional reactions. Over the last two decades, however, an increasing scholarly awareness has emerged that emotions are inherently social – that is, they tend to be elicited by other people, expressed at other people, and regulated to influence other people or to comply with social norms (Fischer & Manstead, 2008; Keltner & Haidt, 1999; Parkinson, 1996; Van Kleef, 2009). Despite this increasing awareness, the inclusion of the social dimension as a fundamental element in emotion research is still in its infancy (Fischer & Van Kleef, 2010). We therefore organized this special Research Topic on the social nature of emotions to review the state of the art in research and methodology and to stimulate theorizing and future research.

The emerging field of research into the social nature of emotions has focused on three broad sets of questions. The first set of questions pertains to how social-contextual factors shape the experience, regulation, and expression of emotions. Studies have shown, for instance, that the social context influences the emotions people feel and express (Clark, Fitness, & Brissette, 2004; Doosje, Branscombe, Spears, & Manstead, 2004; Fischer & Evers, 2011). The second set of questions concerns social-contextual influences on the recognition and interpretation of emotional expressions. Studies have shown that facial expressions are interpreted quite differently depending on the social context (e.g., in terms of status, culture, or gender) in which they are expressed (Elfenbein & Ambady, 2002; Hess & Fischer, 2013; Mesquita & Markus, 2004; Tiedens, 2001). The third set of questions has to do with the ways in which people respond to the emotional

expressions of others, and how such responses are shaped by the social context. Studies have shown that emotional expressions can influence the behavior of others, for instance in group settings (Barsade, 2002; Cheshin, Rafaeli & Bos, 2011; Heerdink, Van Kleef, Homan, & Fischer, 2013), negotiations (Sinaceur & Tiedens, 2006; Van Kleef, De Dreu, & Manstead, 2004), and leadership (Sy, Côté, & Saavedra, 2005; Van Kleef, Homan, Beersma, & Van Knippenberg, 2010).

This Research Topic centers around these and related questions regarding the social nature of emotions, thereby highlighting new research opportunities and guiding future directions in the field. We bring together a collection of papers to provide an encyclopedic, open-access snapshot of the current state of the art of theorizing and research on the social nature of emotion. The state of the art work that is presented in this e-book helps advance the understanding of the social nature of emotions. It brings together the latest cutting-edge findings and thoughts on this central topic in emotion science, as it heads toward the next frontier.

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EDITORIAL
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Editorial: The Social Nature of Emotions

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The Editorial on the Research Topic

The Social Nature of Emotions

Emotions are a defining aspect of the human condition. They pervade our social and professional lives, influence our thinking and behavior, and profoundly shape our relationships and social interactions. Traditionally, emotions have been conceptualized and studied primarily as individual phenomena, with research focusing on cognitive and expressive components and on physiological and neurological processes underlying emotional reactions. Over the last two decades, however, an increasing scholarly awareness has emerged that emotions are inherently *social*—that is, they tend to be elicited by other people, expressed toward other people, and regulated to influence other people or to comply with social norms (Parkinson, 1996; Van Kleef, 2009; Fischer and Manstead, in press). Despite this increasing awareness, the inclusion of the social dimension as a fundamental element in emotion research is still in its infancy (Fischer and Van Kleef, 2010). To stimulate further theorizing and research in this area, the current research topic brings together the latest cutting-edge research on the social nature of emotions.

A growing literature supports the notion that emotions are tightly weaved into the fabric of our social lives (for a comprehensive review, see Van Kleef, 2016). For instance, research has demonstrated that social-contextual influences (e.g., norms, group membership) systematically shape the experience, regulation, and expression of emotions (e.g., Doosje et al., 1998; Clark et al., 2004; Fischer and Evers, 2011). Other studies have begun to uncover how social factors such as power differentials and culture influence the recognition and interpretation of emotional expressions (e.g., Elfenbein and Ambady, 2003; Mesquita and Markus, 2004; Stamkou et al., 2016). Still other work has documented how (behavioral) responses to the emotional expressions of other people are shaped by the social context, for instance in close relationships (e.g., Clark and Taraban, 1991; Guerrero et al., 2008), group settings (e.g., Barsade, 2002; Cheshin et al., 2011; Heerdink et al., 2013), conflict and negotiation (Van Kleef et al., 2008; Adam et al., 2010), customer service (Staw et al., 1994; Grandey et al., 2010), and leadership (Sy et al., 2005; Van Kleef et al., 2010b).

The social nature of emotions can be meaningfully analyzed at four different levels of analysis: the individual, dyadic, group, and cultural level (Keltner and Haidt, 1999). Even though these levels of analysis are not always mutually exclusive and some studies can be situated at multiple levels, this typology affords a useful organizing principle for discussing the contributions to the current research topic, which shed new light on the social nature of emotions at each of these levels.

INDIVIDUAL LEVEL

At the individual level of analysis, critical research questions are how the social context influences the experience, regulation, and expression of emotions. Even when analyzed at the individual level

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of analysis, the deeply social nature of many emotions is apparent. An example of such an emotion is gratitude, which tends to arise in the context of social interactions with benevolent others and has been found to benefit mental health (Emmons and McCullough, 2003) as well as the quality of interpersonal relationships (Algoe et al., 2008; Lambert et al., 2010). As part of the current research topic, Fox et al. conducted one of the first studies into the neural underpinnings of this deeply social emotion. They found that ratings of gratitude correlated with brain activity in the anterior cingulate cortex and the medial prefrontal cortex, thus illuminating the neural networks that are activated when individuals are confronted with the goodwill of others.

Whereas the experience of gratitude implies that one is positively disposed toward another person, the experience of negative emotions such as schadenfreude (when observing the misfortune of another person) and gloating (when causing another's misfortune) imply a negative relationship. Even though schadenfreude and gloating are both associated with the adversity of others, Leach et al. argue that the two emotions can have very different consequences. They demonstrate in two studies that schadenfreude and gloating are distinct in terms of their associated situational features, appraisals, experience, and expression. These findings add nuance to the literature on (malicious) pleasure and begin to uncover the differential social roles that are played by schadenfreude and gloating.

Another inherently social emotion, nostalgia, involves a fond recollection of people and events in the past. Growing evidence indicates that nostalgia increases positive affect and decreases negative affect (Sedikides et al., 2008). Drawing on the social dimension of nostalgia, Cavanagh et al. argued and demonstrated that the alleviating effect of nostalgia on feelings of sadness depends on a person's social connectedness. Specifically, they found that memories of nostalgic vs. ordinary events influenced recovery from a sad mood depending on attachment insecurity, such that participants with low insecurity benefited from nostalgia whereas people with high insecurity did not. These findings indicate that the benefits of nostalgia depend on confidence in the quality of one's social relationships, further attesting to the intrinsically social constitution of the emotion.

Whereas some emotions (such as the ones discussed above) are almost necessarily social, other emotional responses may be elicited by social as well as non-social events. For instance, emotions such as pride or happiness may arise when non-social goals are achieved (e.g., succeeding at an exam), but they can also be elicited by the social evaluations of other people (e.g., praise). Wiggert et al. argued that emotional responses to social evaluations by others are modulated by gender. They found that positive evaluations expressed by men elicited stronger facial electromyography responses in both genders, whereas arousal was higher when positive evaluations were expressed by the opposite gender. These results suggest that emotionally evocative processes unfold differently depending on the gender of the interaction partners.

Despite the fact that research on the social nature of emotion is blossoming, developmental studies are relatively scarce. Extending classic work by Fridlund (1991) on the potentiating effects of the (implicit) presence of an audience on smiling, Visser et al. investigated the influence of the co-presence of a peer on children's expressions of happiness after winning a large first prize or a small consolation prize in a competitive game. They found that co-presence positively affected children's happiness only when receiving the first prize. Children who received the first prize were perceived as happier when they were in the presence of a peer who received the consolation prize than when they were alone. Conversely, children who received the consolation prize were rated as equally (un)happy when they were alone or in the presence of a peer. This indicates that children's smiling, much like adults' smiling, is influenced by the social context.

DYADIC LEVEL

At the dyadic level of analysis, dominant research themes revolve around how people perceive, interpret, and respond to the emotional expressions of interaction partners, and how such effects are shaped by the social context. One way in which emotional expressions influence observers is by proving information about the expresser's interpretation of a situation (Manstead and Fischer, 2001; Van Kleef, 2009). Integrating theorizing on attribution, appraisal processes, and the use of emotions as social information (EASI), the contribution by Van Doorn et al. examined how emotional expressions influence attributions of agency and responsibility under conditions of ambiguity. Across three studies, they found that expressions of regret fueled inferences that the expresser was responsible for an adverse situation, whereas expressions of anger signaled that someone else was responsible. These results show that emotional expressions can help people make sense of ambiguous social situations by informing attributions that correspond with the appraisal structures that are associated with discrete emotions.

In a more applied vein, Cheshin et al. examined how people use the emotional expressions of professional baseball pitchers to make predictions regarding their upcoming pitches. Participants in their study expected pitchers with happy expressions to throw more accurate balls, pitchers with angry expressions to throw faster and more difficult balls, and pitchers with worried expressions to throw slower and less accurate balls. Participants also expected that batters would be more likely to swing at balls thrown by pitchers showing happy facial expressions, and these predictions were marginally associated with batters' actual swinging. These findings provide first-time evidence that the information that is conveyed by emotional expressions can potentially be leveraged to enhance performance in professional sports.

A considerable body of research indicates that social decision making is strongly influenced by the emotional expressions of interaction partners (Van Kleef et al., 2010a). However, the majority of this work has been conducted with healthy participants. de la Asuncion et al. investigated responses to emotional expressions of interaction partners in the context of fair vs. unfair decisions among healthy individuals and patients with schizophrenia. They found that healthy

participants' behavioral responses to their interaction partners' unfair decisions were influenced by the partners' emotional expressions, whereas schizophrenia patients' decisions were not affected by the proposers' emotions. This finding indicates that schizophrenia patients have specific problems with processing and integrating emotional information, which jeopardizes the quality of their social relationships.

When a social relationship is threatened by a transgression, an apology by the offender can help to restore the relationship by eliciting forgiveness. For instance, apologizing for an outburst of anger has been found to alleviate negative consequences of the anger expression for impressions and desire for future interaction (Van Kleef and De Dreu, 2010). Extending the literature on the social effects of apologies, Beyens et al. found that participants who were punished by an interaction partner after a failure reacted less aggressively when the partner apologized afterward than when the partner did not apologize. They further found that female (but not male) participants held enhanced implicit attitudes toward the apologizing opponent. These findings confirm that apologies can dampen reactive aggression after wrongdoing.

Shifting the temporal perspective, Niven et al. investigated the role of emotions in the process of building new relationships, examining whether attempts to improve others' feelings can help people make connections in social networks. Across two studies, they found that the use of interpersonal emotion regulation strategies predicted growth in popularity in work and non-work interactions, although different strategies of interpersonal emotion regulation had differential effects. Behavioral strategies (e.g., providing comfort or reassurance) were positively associated with popularity, while cognitive strategies (e.g., changing a person's appraisals about the situation) were negatively associated with popularity. These findings shed new light on the role of emotions in the formation of new relationships.

The social signaling function of emotions may be particularly critical in settings where individuals are confronted with potentially threatening or harmful stimuli. In such circumstances, expressions of fear or pain may serve an important warning function (Williams, 2002). Accordingly, conscious observation of others' painful facial expressions has been found to increase pain perception in observers and to facilitate behavioral response tendencies. Extending this line of research, Khatibi et al. observed that ratings of the painfulness of aversive stimulation were higher following subliminal presentation of painful as opposed to happy expressions. Furthermore, they found that participants' tendencies to respond faster to targets in a computer task that were preceded by aversive stimulation was especially pronounced when participants were presented with subliminal painful expressions. This study indicates that even subliminal exposure to painful expressions can increase pain perception and enhance behavioral response tendencies.

In a related vein, Khatibi et al. examined how individuals respond to ambiguous painful facial expressions as a function of how they think about pain—more specifically, whether individuals have a tendency to "catastrophize" pain experiences. The authors created ambiguous pain expressions by morphing facial expressions of pain with facial expressions of happiness. In an incidental learning task, high (but not low) pain catastrophizers responded faster to targets appearing at the location predicted by painful expressions than to targets at the location predicted by happy expressions, suggesting that high pain catastrophizers are more likely to interpret ambiguous facial expressions of pain in a negative, pain-related manner. This interpretation bias was mitigated when explicit cues of threat vs. safety were provided, corroborating the notion that emotional expressions are particularly informative in the absence of more direct sources of information (Van Kleef, 2016).

GROUP LEVEL

At the group level of analysis, researchers study how emotional patterns in groups shape the evolution of group norms and goals, group cohesion, differentiation from other groups, and the behavior of individual group members, among other things. As part of the current research topic, Delvaux et al. investigated in three studies how group members' emotional fit with their group is associated with their level of identification with the group. A cross-sectional study and two longitudinal studies point to a positive and bidirectional association between group identification and emotional fit, such that group identification and emotional fit either mutually reinforce or mutually dampen each other over time. This finding sheds new light on the temporal emotional dynamics of group identification.

Group identification tends to develop more readily in groups of physically co-located individuals than in groups of individuals who are situated at different locations and who are communicating via computer-mediated technology. Järvelä et al. investigated how communicating via such technologies influences the synchronization of physiological activity across individuals, which has been proposed as an underlying mechanism of emotional contagion and resultant feelings of similarity and identification (Hatfield et al., 1993; Hess and Fischer, 2016). A text chat option provided intermittent communicative emotional expressions to the group, while heart rate visualization showed continuous information about each group member's physiological state and their dyadic linkage to other group members. The opportunity of text chat increased heart rate synchrony regardless of physical presence, whereas heart rate visualization only increased synchrony within non-co-located dyads. Järvelä and colleagues speculated that emotional contagion is a more natural pathway to interpersonal synchrony in physically co-located groups, which reduces the perceived informational value of physiological information about other group members.

When it comes to using emotional information from fellow group members to make sense of situations, a relevant question is how the emotional expressions of group members are combined. One type of information that may be gleaned from emotional expressions in groups is whether one's behavior is deemed acceptable, with expressions of happiness signaling acceptance and expressions of anger signaling rejection (Heerdink et al.,

2013). Heerdink et al. examined how many members of a group need to express their anger to influence a deviant group member. In two studies, they found that each additional angry reaction linearly increased the extent to which a deviant individual felt rejected. This felt rejection was found to promote conformity to the group norm when the deviant was motivated to seek reacceptance in the group and the shift toward conformity could be observed by the group. These findings highlight how emotional expressions may act in the interest of group goals by informing members about the desirability of their behavior.

Taking an intergroup approach, Furley et al. investigated responses to emotional expressions by teammates vs. opponents. Drawing on EASI theory (Van Kleef, 2009, 2016), Furley and colleagues argued and showed that emotional expressions take on different meanings and invite differential responses depending on whether they are emitted by members of one's own group or a competing outgroup. In particular, they found that pride expressions by opponents inspired negative emotions and cognitions and pessimistic expectancies regarding the performance of one's own team, whereas pride expressions by teammates instilled more positive emotions, cognitions, and performance expectations. These findings emphasize the importance of the social context in shaping the interpretation of emotional expressions.

CULTURAL LEVEL

At the cultural level of analysis, the challenge is to understand the emotional interface between the individual and his or her cultural surroundings, which includes cultural influences on the emotion process as well as the effects of cultural fit on emotional functioning. Culture-specific patterns of emotions reflect cultural values and priorities (Mesquita, 2003). Accordingly, individuals within a given culture tend to experience similar patterns of emotions when confronted with similar situations. As such, the extent to which an individual's emotions are similar to the culture's average emotional pattern in the situation reflects his or her adoption of cultural values and priorities. In their contribution to the current research topic, De Leersnyder et al. examined whether such "emotional fit with culture" is associated with psychological well-being. They measured emotional fit with culture by comparing respondents' emotional patterns to the average cultural pattern for the same type of situation, comparing individuals from Korea, Belgium, and the United States. The results revealed that psychological well-being was predicted by emotional fit with culture in autonomy-promoting situations at work in the United States, in relatedness-promoting situations at home in Korea, and in both autonomy-promoting and relatedness-promoting situations in Belgium. These findings suggest that the experience of culturally appropriate patterns of emotions contributes to psychological well-being.

The ability to show emotional or behavioral responses that fit with one's culture requires an awareness of prevailing cultural norms and values. Whenever, such norms are not apparent, people may infer them based on the emotional expressions of others (Hareli et al., 2013; Van Kleef, 2016). Hareli et al. examined cross-cultural differences in how individuals use group members' emotional expressions to learn group norms. Consistent with research at the group level of analysis (Heerdink et al., 2013; Heerdink et al.), across cultures anger expressions were perceived as a stronger signal of norm violations than were sad or neutral expressions. However, whereas people in Germany and Israel were better able to learn the norm based on expressions of anger, people in Greece were better able to learn the norm based on expressions of sadness. These results indicate that the interpersonal effects of emotional expressions vary across cultures, perhaps as a results of the differential appropriateness of certain emotional expressions in different cultural contexts (see Van Kleef, 2016).

CONCLUSION

There is a growing scholarly awareness that emotions are intrinsically social in that they are typically elicited, expressed, regulated, perceived, interpreted, and responded to in social settings. It is clear from the articles in this research topic that the study of the social nature of emotions is blossoming. The contributions cover a wide range of exciting new questions that span the individual, dyadic, group, and cultural levels of analysis. However, research at the group and cultural levels of analysis is comparatively underrepresented. This is no doubt due to the fact that such research is often complicated and time-consuming to conduct. These difficulties notwithstanding, research at the group and cultural levels of analysis is critical for our understanding of the social nature of emotions, and we call for more research in these domains.

It is notable that the contributions to this research topic employed a rich variety of methodologies, including correlational, longitudinal, and experimental designs involving behavioral, self-report, cardiovascular, and neurological measures. To reach the next frontier in the study of the social nature of emotions, it will be important to incorporate multiple measures in our research designs so as to facilitate cross-validation and interpretation of findings. Such integration promises to further enhance understanding of how individuals process their own and others' emotions, and how they respond to these emotions as a function of the relational, group, or cultural context.

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GvK wrote the article; AC, AF, and IS provided comments on the draft.

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Neural correlates of gratitude

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Gratitude is an important aspect of human sociality, and is valued by religions and moral philosophies. It has been established that gratitude leads to benefits for both mental health and interpersonal relationships. It is thus important to elucidate the neurobiological correlates of gratitude, which are only now beginning to be investigated. To this end, we conducted an experiment during which we induced gratitude in participants while they underwent functional magnetic resonance imaging. We hypothesized that gratitude ratings would correlate with activity in brain regions associated with moral cognition, value judgment and theory of mind. The stimuli used to elicit gratitude were drawn from stories of survivors of the Holocaust, as many survivors report being sheltered by strangers or receiving lifesaving food and clothing, and having strong feelings of gratitude for such gifts. The participants were asked to place themselves in the context of the Holocaust and imagine what their own experience would feel like if they received such gifts. For each gift, they rated how grateful they felt. The results revealed that ratings of gratitude correlated with brain activity in the anterior cingulate cortex and medial prefrontal cortex, in support of our hypotheses. The results provide a window into the brain circuitry for moral cognition and positive emotion that accompanies the experience of benefitting from the goodwill of others.

Keywords: affective neuroscience, fMRI, Holocaust testimony, pro-social behavior, altruism

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1. Introduction

How would you feel if in the middle of your most distraught moment, unbound from your every day comforts and scared for your survival, a complete stranger saved your life? When we are the beneficiaries of good human conduct, we can experience feelings of gratitude. The importance of gratitude and its benefit to sociality is stressed in philosophy and in religion. Cicero cited gratitude as the mother of all virtues, and the Roman Stoic Seneca conceived of gratitude as a fundamental motivational drive, critical for building interpersonal relationships. As a research theme, however, empirical investigations of gratitude are relatively rare (Emmons and McCullough, 2004), although this is beginning to change (Watkins, 2014). It has been shown that gratitude can be generated by gifts that largely fulfill two criteria: (1) they come as a result of perceived genuine effort from the giver and (2) they are valuable and fulfill important needs for the recipient (Tesser et al., 1968). Recent studies have shown that gratitude is associated with benefits to subjective well-being (Emmons and McCullough, 2003; Froh et al., 2008), increased resilience to trauma (Kashdan et al., 2006) and benefits to social relationships (Algoe et al., 2008; Lambert et al., 2010). Individuals vary in how grateful they tend to be, and those who are more grateful show enhanced psychological well-being (Wood et al., 2008a, 2009). The results from psychological investigations of gratitude have laid a foundation for what can be expected when we facilitate the experience of gratitude.

On the other hand, the cognitive and neural mechanisms behind the experience of gratitude itself have rarely been studied (Wood et al., 2008b). An investigation of the neural basis of

gratitude extends the reach of affective neuroscience beyond the study of basic emotions into the complex social emotions that are important for well-being. At the level of the brain, the investigation of the generation and experience of gratitude is just beginning. One study found that making moral judgments involving gratitude elicited activity in the right anterior superior temporal cortex (Zahn et al., 2008). One study of brain morphology found that individual differences in proneness to gratitude correlated with increased gray matter volume in the right inferior temporal gyrus and posteromedial cortices (Zahn et al., 2014). Another recent study found a correlation between individual differences in a genotype for oxytocin function and behavioral expressions of gratitude (Algoe and Way, 2014), pointing to gratitude's importance in social bonding. In a study of admiration and compassion, participants reported being grateful for their own well-being when they processed stories that evoked compassion for emotional pain, which is associated with brain activity in cortical midline structures such as the posteromedial cortices (Immordino-Yang et al., 2009). It is unknown, however, how the brain generates the range of feelings associated with gratitude. Knowledge of what the brain is doing during the experience of gratitude provides a window into gratitudes relationship to mental health and resilience (Wood et al., 2008b; Huffman et al., 2014). Examining the neural correlates of gratitude is relevant to the design of interventions for practicing gratitude and can resolve questions regarding the respective roles of reward and moral cognition in gratitude (Emmons and McNamara, 2006).

Gratitude is a social emotion that signals our recognition of the things others have done for us (Emmons and McNamara, 2006). The expression of gratitude may serve to communicate reciprocal engagement and to prevent being seen as a "free-loader," which could end in social punishment (de Quervain et al., 2004). Gratitude then, is an emotion that not only enhances our social relationships (Algoe et al., 2008), but also signals to others a recognition that we are a fair partner (Sigmund, 2007). It is an emotion critical to maintaining social standing, to indicate when we have received benefit, to reinforce beneficial behavior toward the recipient, and to motivate prosocial behavior in the future (McCullough et al., 2008).

The systematic identification of the thoughts, feelings and behaviors associated with gratitude is a difficult endeavor given the dramatically different reactions people have, even when experiencing similar exchanges. In addition, the scale of gratitude is wide; it can be as small as the gratitude felt for someone holding a door for you (Okamoto and Robinson, 1997), or it can be overwhelming as in the case of life-saving gifts such as organ donations (Gill and Lowes, 2008). Gratitude can be narrowly focused toward a specific benefactor (Tesser et al., 1968), or can be broad, focused on spirituality and thankfulness for life in general (McCullough et al., 2002; Baetz and Toews, 2009). In the present investigation, we focus on gratitude in the context of gift-giving, involving a donor, a recipient, and a gift; and we focus on the recipient of the gift. We use the term "gift" broadly to refer to both material gifts, such as food or clothing, and non-material gifts in the form of help or psychological support.

The gift-based stimuli used in our experiment were drawn from stories of survivors of the Holocaust, housed in the USC Shoah Foundation Institutes Visual History Archive. The archive is comprised of over 50,000 videotaped testimonies from survivors of the Holocaust. Many survivors tell stories from the midst of this tragedy in which their lives were saved or helped by others through the provision of food, shelter, or clothing. In these stories, the survivors often report strong feelings of gratitude. We selected a collection of these stories and transcribed them into first-person vignettes or scenarios. In the experiment, participants immersed themselves in the context of the Holocaust and experienced these scenarios. We created documentaries detailing the events of the Holocaust aimed at giving the participants an understanding of the Holocaust. Once participants were immersed in the time period, they viewed the series of gifts that were designed to elicit varying degrees of gratitude, and they were asked to imagine how they would feel if they were in the same situation. For each gift, participants rated how much gratitude they felt. Their ratings of gratitude were correlated to brain activity collected using functional magnetic resonance imaging (fMRI).

The reasons for adopting this approach are as follows. In previous studies of the determinants of gratitude, participants have read texts describing scenarios and placed themselves in specific settings while receiving gifts (Tesser et al., 1968; Lane and Anderson, 1976; Wood et al., 2010). We used a comparable text-based approach so that we could eventually compare our results to those in the existing literature. In addition, we used stimuli related to the Holocaust in an attempt to create an experience that would firmly engage the participants in the experiment and thus avoid habituation to the stimuli. The use of narrative-based stimuli to elicit realistic emotional responses in the scanner has also proven effective in prior research on related social phenomena (Immordino-Yang et al., 2009, 2014; Fox et al., 2013).

Our predictions are built around findings from previous psychological research on gratitude in combination with brain imaging studies of related phenomena. We hypothesized that ratings of gratitude would correlate with brain activity in circuits associated (1) with moral cognition; (2) with reward from the pleasure of receiving a benefit in social interactions; and (3) with social cognitive processes such as perspective-taking and theory of mind. Specifically, we hypothesized that the experience of gratitude would relate to changes in activity in the posteromedial and insular cortices, medial prefrontal cortices and nucleus accumbens (Bechara et al., 2000; Knutson and Cooper, 2005; Harbaugh et al., 2007; Immordino-Yang et al., 2009; Van Overwalle, 2011).

2. Materials and Methods

2.1. Participants

Twenty-six participants (13 female; average age: 21 2.21 years, range 18–28) were recruited using USCs psychology subject pool as well as posted fliers and advertisements on USCs University Park Campus. Three participants were removed due to computer and scanner malfunctions, leaving a final sample of 23 participants (12 female). All research participants gave

informed consent and all activities were done in accordance with and with approval from USCs Institutional Review Board policies on human subjects research. Participants were right-handed, native English speakers. The participants filled out an open-ended questionnaire regarding their personal experience with the Holocaust. No participants in this sample reported having extensive contact with anyone who went through the Holocaust, or significant educational experience with the Holocaust greater than a single lecture or exposure to the historical events beyond movies or books.

2.2. Procedure

The experiment was designed to immerse the participants in the events of the Holocaust, helping them respond to written gift-related stimuli (detailed below) using their own reactions. The experiment took place in four parts; each part dedicated to a different phase of the Holocaust. This approach was designed to mimic the experience of the United States Holocaust Museum, where visitors are asked to imagine living through the events of the Holocaust in the order that they occurred, often categorized into four chronological phases. The four phases were: 1. The rise of Nazism and Persecution, 2. Internment, 3. The Final Solution, 4. Final Months and Liberation. To enhance the context of the stories, the stimuli were designed to be specific to each phase. For example, stories of being helped by the Red Cross during liberation took place in the fourth phase. We chose to present the four phases in chronological order to provide historical context to the participants, to enhance the ecological validity of the experiment, and to maintain the participant's engagement.

Inside the scanner, each phase began with a short, in-house created documentary detailing the events of that phase of the Holocaust. The documentaries were about 2 min long and were created in collaboration with students from the USC School of Cinematic Arts. The documentaries relied on powerful images as well as a professional actor providing a voice-over description. We did not collect fMRI data during the viewing of the documentaries. After each documentary, participants viewed the stimuli related to that phase while we collected fMRI data.

The task (see **Figure 1**) consisted of four conditions presented in the following order: stimulus, reflection, probe and rest. Participants read the text of the stimuli on a screen reflected on a mirror mounted on the magnetic head coil. For each stimulus, they were given 10 s to read the text and understand the context of the stimulus. After the stimulus, participants were shown a light blue reflection screen. Participants were told during the reflection screen to feel, as much as possible, how they would feel if they were in the same situation as described by the stimulus. During this time, they were told to imagine themselves in the situation presented and to form as deep, personal and realistic of a reaction as they could. The reflection period lasted 12 s. Following the reflection period, participants rated how much gratitude they felt in response to the event on a scale from 1 to 4. Participants were told to scale their gratitude such that a 1-rating would be associated with a small amount of gratitude, as in receiving lunch from a friend, and a 4-rating indicated events that overwhelmed them with gratitude. Participants were given the option to advance from the stimulus to the reflection period manually, although this occurred on fewer than 1% of the trials. After the rating screen, the participants were given a jittered time of 12–16 s of rest, indicated by a black fixation cross on a light gray screen. This served as the baseline condition for our analyses. During the rest period, participants were told to put everything out of their mind from the previous event and to rest and return to their baseline. They were told to treat each stimulus as an independent event and not to compare their ratings from one event to the others. This was a within-subject experiment, stimuli within each phase were presented in random order for each participant.

After the scanning session, participants were asked to review the stimuli outside the scanner, this time rating each gift according to how much they felt the gift was needed, how much effort they felt the donor had taken to produce the gift and again how much overall gratitude they felt for the gift. The stimuli were designed to elicit varying degrees of gratitude as a product of how much the gift was needed and how much effort it took to provide (Tesser et al., 1968; Lane and Anderson, 1976). Because gratitude is built on these factors, it is possible that need and effort could also explain variance in the brain activity. Participants were told that need was an umbrella term that included the subjective value of the gift, the utility of the gift and also the gift's ability to fulfill important basic and psychological needs. Ratings for effort included the intention of the gift, the cost of the gift and the degree to which the donor's life was affected by giving the gift. We collected the ratings of need and effort to examine their correlation with gratitude, in order to establish a link to previous studies of the factors involved in the generation of gratitude (Tesser et al., 1968; Lane and Anderson, 1976; Wood et al., 2008b, 2011). This analysis was conducted using SPSS version 18. The ratings of need and effort were done post-scan so that the responses to the stimuli during the scan could be focused on gratitude alone.

Participants were asked to fill out personality questionnaires to assess how individual differences in personality affect how a gift was perceived. Participants filled out the Interpersonal Reactivity Index (IRI;Davis, 1983), the six-item gratitude questionnaire (GQ-6; McCullough et al., 2002), the Maslow need scale (Lester, 1990) and the Big Five Personality Index (BFI; John et al., 1991). Participants also completed a homemade questionnaire to assess their experience in the study. They were asked to rate items on a 7-point Likert scale where 1 referred to not at all and 7 referred to completely. The questions were: (1) How involved did you feel in the task/situations, (2) How similar do you think your feelings during the situations match what you would have felt if the experience was real? (3) How difficult was it to put yourself in the situations? and (4) How much do you feel that you have an increased understanding and sense of empathy for the Holocaust from going through this experiment? Following these four questions, we asked the following open-ended questions: (1) Were there any situations or stimuli that you found to be confusing that you can remember? (2) Were there any situations or stimuli that you found to be particularly moving or powerful? (3) What do you think this study was about? Where you focused on figuring this out during the study? (4) Do you have any personal experience or connections to the

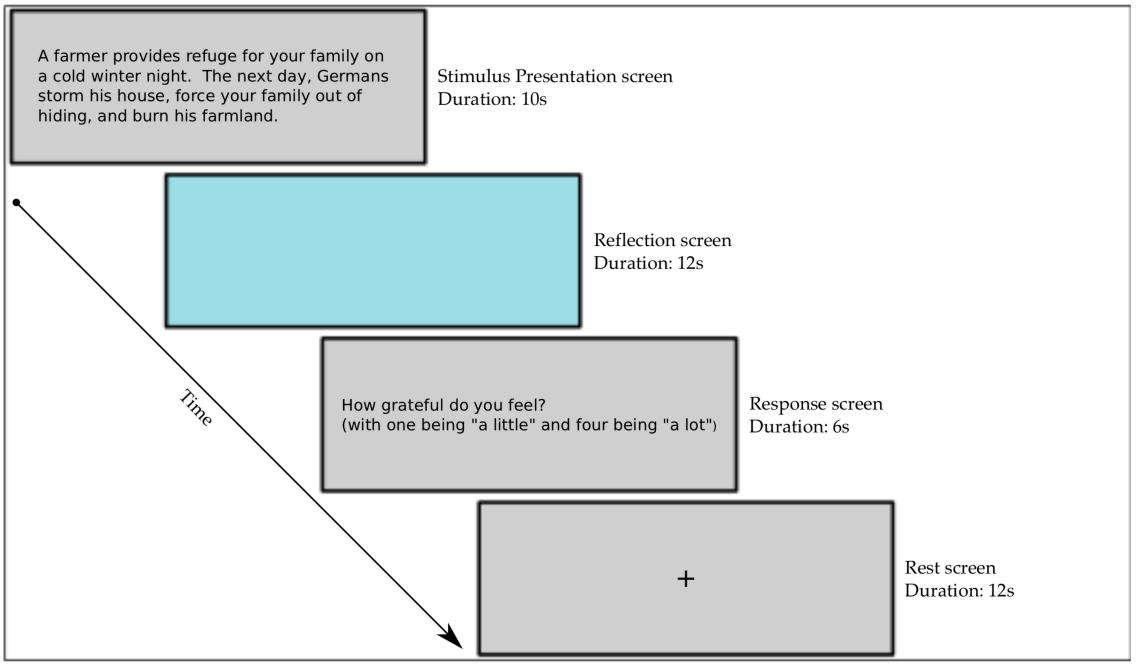

FIGURE 1 | Scanner stimuli presentation paradigm.

Holocaust? and (5) Did you have any previous knowledge of the Shoah Foundation Institute? The aim of these questions was to screen for participants whose personal history may have affected their responses and to assess the participant's involvement in the study. The answers to the likert scale questions were analyzed using a one-sample Student's *t*-test to test the hypothesis that the participants rated each question in a way that indicated that they were engaged in the experiment. See **Figure 2** for illustration of the order of events in the experimental session.

2.3. Stimuli

The goal of the study was to examine a wide range of gratitude experiences in the context of gift-giving. The stimuli consisted of a collection of stories based on testimony from survivors of the Holocaust. The stories were selected from testimony housed in the USC Shoah Foundation Instituteõs Visual History Archive, comprised of 50,000 videotaped Holocaust survivor testimonial. To create the stimuli, research assistants viewed testimonies and selected stories or scenarios in which the survivors tell of moments when aid was given, including shelter, food, clothing, or emotional support.

The scenarios described by the survivors were transcribed and condensed into texts ranging from 30 to 40 words and were rephrased to be in the first person. These short texts were used as stimuli. The stimuli were selected to vary according to how much need and effort were involved in the gift. Some gifts were given that fulfilled a high amount of need, but were given with very little effort. For example, during the early phase of the war, a local bakery leaves its unsold and old bread outside in the alley for you to eat. Other gifts came at a high degree of effort, but did not fulfill an important need. An example of this would be a gift in which a bed is offered to you in a concentration camp, but the bed is infested with rodents and insects. One can imagine having some gratitude for each of these gifts, but the reaction for these two gifts is unlikely to be the same. Finally, many of the gifts were given with high need and high effort, such as a fellow prisoner risking her life to steal food from the SS quarters and bring it to you while your are sick in the bunks. Comparing these diverse scenarios allows the investigation to move closer to the actual neural correlates of gratitude, as the range of experiences mimics the real life range of grateful experience. The goal of including these complexities in the stimuli is to leave only the portion of brain activity correlated with the varying experience of gratitude common throughout the stimuli. Through manipulating need and effort independently, we aimed to control for the amount of perspective-taking required, so as to average out confounds related to the success of taking someoneõs perspective and to de-correlate gratitude from simple needs to understand other peoplesõ perspective. The individual responses to each of the stimuli were expected to vary considerably, thus the participant's own responses were used in the analyses. There were a total of 48 stimuli, 12 from each of the four phases of the Holocaust (see **Figure 3**).

To validate the approach, the stimuli were tested with 42 participants (21 female) in a separate behavioral experiment. In this testing, the participants worked with a booklet of the stimuli and rated each gift according to how much gratitude they felt after receiving the gift, as well as how much they needed the gift and how much effort it took to provide the gift. The testing verified that the stimuli effectively and reliably elicited

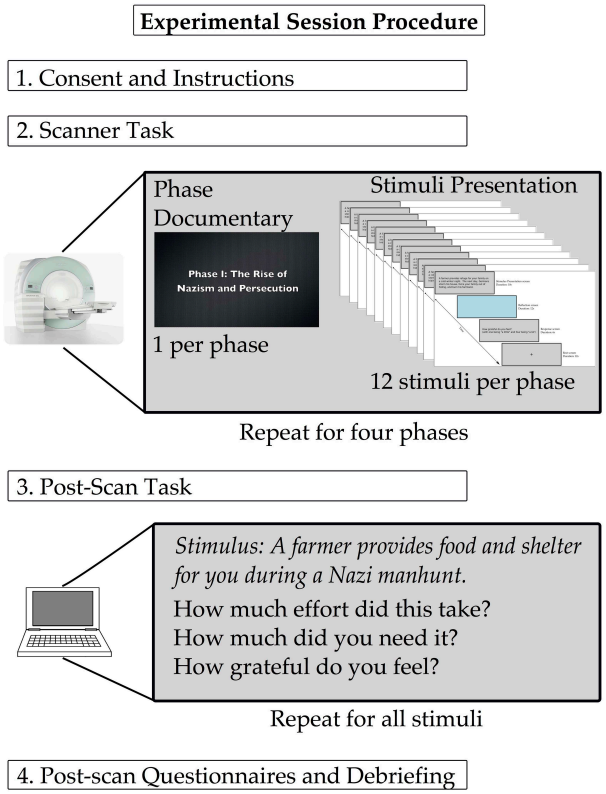

FIGURE 2 | Experimental session protocol. The stimuli presentation paradigm for the scanner (shown here in miniature) is detailed in **Figure 1**.

varied feelings of gratitude and that the stimuli were clear and understandable.

2.4. Image Acquisition

Functional and structural fMRI were performed at the Dana and David Dornsife Cognitive Neuroscience Imaging Center at USC on a Siemens 3T trio with TIM scanner. Four functional runs, one anatomical magnetization-prepared radio-frequency and rapid gradient-echo (MPRAGE) image and one T2 weighted image were acquired for each subject. Prior to performing the functional scans, structural images were collected with 176 slices, dimensions: 224 x 256 x 176 and then resampled with voxel dimensions 1 x 1 x 1 mm, $TR = 1950$ ms. For functional scans, 250 volumes were acquired, with 37 slices per volume. The TR used was 2000 ms, with an interslice time of 54 ms and a TE of 30 ms. Inplane resolution was 64 x 64. Voxel resolution was 3.5 x 3.5 x 3.5 mm, with no slice gap and the flip angle was 90°.

2.5. Analysis

The brain imaging data were primarily analyzed using the FSL (Smith et al., 2010) software package. FMRI data processing was carried out using FEAT (FMRI Expert Analysis Tool) Version (version 5.0.1), part of FSL (FMRIBs Software Library, www.fmrib.ox.ac.uk/fsl). Registration to high resolution structural and standard space images was carried out using FLIRT to coregister the participant's structural data to the MNI template space (Jenkinson and Smith, 2001; Jenkinson et al., 2002). The following pre-statistics processing was applied: motion correction using MCFLIRT (Jenkinson et al., 2002), slice-timing correction using Fourier-space time-series phase-shifting, non-brain removal using BET (Smith, 2002), spatial smoothing using a 5.0 mm FWHM Gaussian kernel, grand-mean intensity normalization of the entire 4D dataset by a single multiplicative factor and highpass temporal filtering (Gaussian-weighted least-squares straight line fitting, with sigma = 50.0 s corresponding to a cutoff of a period of 100 s, or 0.01 hz). Time-series statistical analysis was carried out using FILM with local autocorrelation correction (Woolrich et al., 2001). Z (Gaussianised T/F) statistic images were thresholded using clusters determined by $Z > 2.3$, corrected for multiple comparisons using random field theory, with a cluster size significance threshold of $p = 0.05$ (Worsley, 2001).

To identify neural correlates of gratitude at the whole brain level, a design matrix was created with four predictor functions in a standard general linear model. The design matrix included predictors for the prime, reflect and probe conditions as well as a parametrically varying predictor for the reflection time period whose height was determined by the level of gratitude reported for each trial. All four runs (corresponding to the phases) were combined using a fixed effects analysis. This parametric regressor was orthogonalized with respect to the main reflection period regressor; thus, the results presented for this regressor represent the variance explained in the blood oxygenation level dependent (BOLD) response by the subjects ratings of gratitude. Ratings were included on a trial-by-trial basis after being mean-corrected for each subject. In a follow-up analyses to visualize the percent BOLD signal chance for each rating in the participants, an ROI was created using the activity found in the MPFC in the whole brain analyses. This ROI was used to interrogate each participant's brain activity for each rating using FSL's Featquery package. The mean percent signal change was extracted for each level from each participant. The mean of all participant's percent signal change was calculated for each rating. In separate analyses, the ratings of need and effort were also used as regressors to examine if and how these ratings explain variance in brain activity. Subject level maps were then fed into a random effects analysis to estimate group level effects.

3. Results

Participants rated their gratitude for each gift on a scale of 1–4. The mean of the participants' gratitude ratings was 2.62 ($sd = 0.334$). The participants ratings on the post-experiment questionnaires revealed that participants felt involved in the experiment ($m = 5.08$; $sd = 1.16$), felt that their feelings were similar to if they were in the same situation ($m = 3.65$; $sd = 1.3$) and that they had an increase in their empathy and understanding for the Holocaust ($m = 4.91$; $sd = 1.33$). The participants reported that putting themselves in the situations of the experiment was not very difficult ($m = 3.04$; $sd = 1.12$). See **Table 1** for summary. The responses to the open-ended questions indicated that participants did not find any single stimulus to

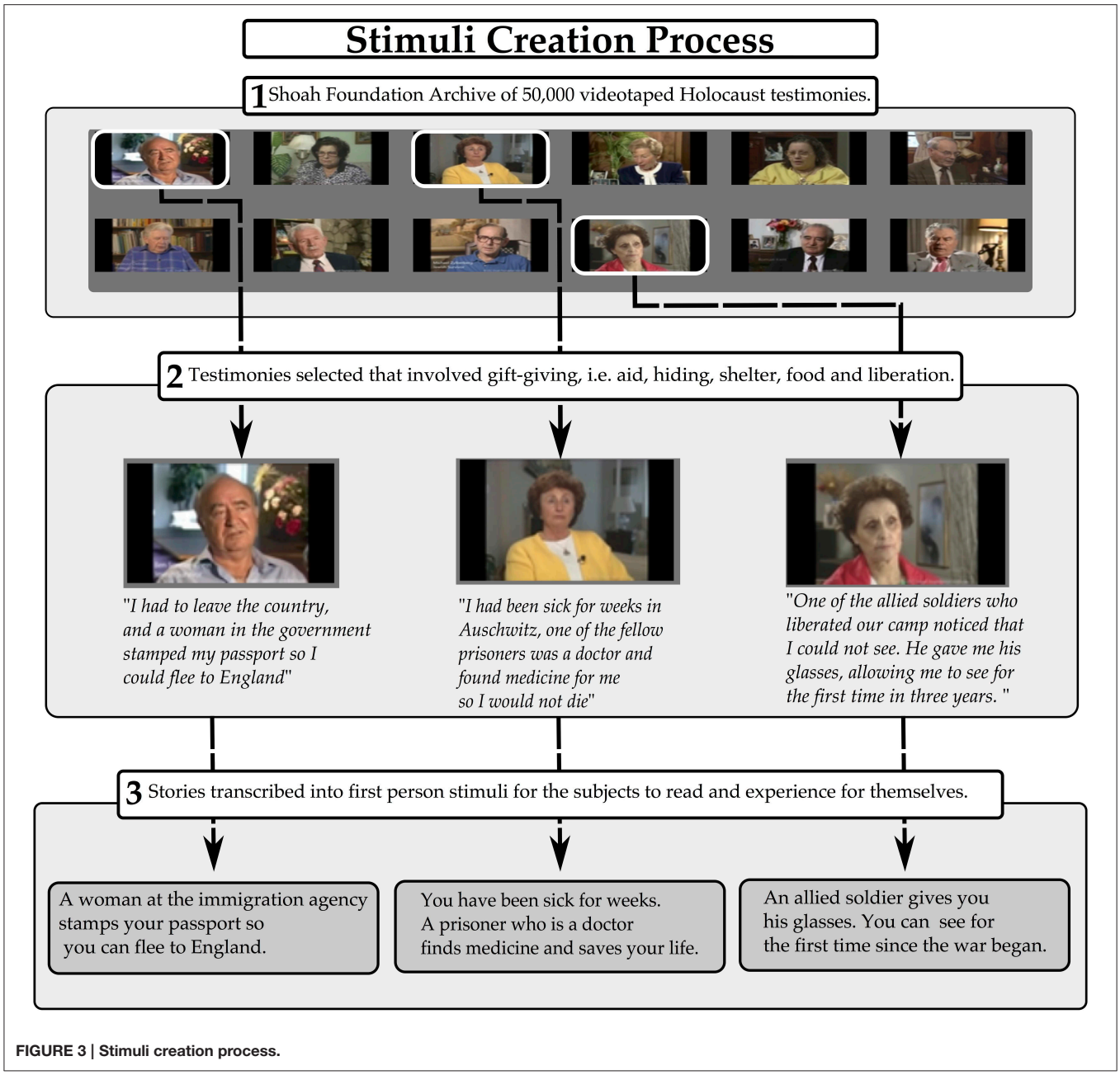

FIGURE 3 | Stimuli creation process.

TABLE 1 | Responses to post-scan questionnaire.

Question						95% CI	
	t	*df*	*P*	Mean	*sd*	Lower	Upper
How involved were you?	16.83	22	<0.001	5.08	1.16	4.58	5.59
How similar were your feelings?	9.78	22	<0.001	3.65	1.3	3.08	4.21
How much did the experiment increase your empathy for the Holocaust?	16.69	22	<0.001	4.91	1.33	4.42	5.39
How difficult was it to put yourself in the situations?	−10.97	22	<0.001	−3.04	1.12	−3.62	−2.47

The first three questions are compared to the lowest value in the likert scale and the fourth is to the highest value in the scale, since a higher score would mean a greater challenge immersing in the experiment.

be confusing, that participants did not figure out the experiment on their own, that few participants were trying to figure out the purpose of the study and that no participants had significant prior experience with the Holocaust or with the Shoah Foundation Institute.

Brain activity was first measured by comparing BOLD activity during the reflection period to baseline to assess participants' general response to the stimuli. The regions positively active during the reflection period, compared to baseline, included the right occipital cortex, the left superior frontal gyrus, the left and right caudate, the left and right temporal pole, the thalamus, the left superior temporal sulcus and the left middle frontal gyrus. Regions that were deactivated included the left and right posterior insula, the right superior temporal gyrus, the perigenual ACC, the right PCC and the left and right middle temporal gyrus (see **Figure 4** and **Table 2**).

The results showed, at the whole-brain level, that gratitude ratings explained variance in brain activity in a cluster covering multiple regions of the mPFC of both hemispheres (see **Figure 5**). The cluster included the frontal pole and the peri-genual ACC ($k = 816; Z = 3.48; x = -12, y = 40, z = 4; p = 0.009$). The local maxima within the cluster included the left perigenual ACC, the right ACC, the left subgenual cingulate cortex, the left and right orbitofrontal cortex and the dorsal mPFC (see **Table 3** for summary). To visualize the pattern of results across different gratitude ratings, mean percent signal change for each rating was calculated in each participant using an ROI created by the aforementioned mPFC activity. Percent signal change was calculated using FSL's Featquery tool, which estimates this value by scaling the parameter estimates from the GLM analysis according to the mean signal within the ROI and the peak-to-peak height of the model. Ratings 1 and 2 were marked by an average decrease in activity in the region, and the ratings 3 and 4 were associated with a positive percent signal change (see **Figure 6**).

Participants also rated each gift according to the level of felt-need and perceived effort. Need significantly correlated with gratitude [$r_{(21)} = 0.799, p < 0.001$] and with effort [$r_{(21)} = 0.342, p < 0.001$] and effort correlated with gratitude [$r_{(21)} = 0.508, p < 0.001$]. These correlations confirm findings from previous studies on the determinants of gratitude (Tesser et al., 1968). Need and effort ratings were independently examined to determine the correlation of each rating with brain activity during the reflection period. Need and effort ratings did not significantly explain variance in brain activity in any region.

TABLE 2 | Brain region peak voxel activity for reflection period compared to baseline.

Brain Region	Voxels	*p*	*z*-max	*z*-max *x* (mm)	*z*-max *y* (mm)	*z*-max *z* (mm)
POSITIVE CORRELATION						
Occipital Cortex	5039	1.69E-33	5.35	16	−102	12
L & R SFG	1390	2.66E-14	5.47	−4	12	70
L Striatum	1026	1.03E-11	5.3	−20	26	16
R Striatum	879	1.39E-10	5.82	18	8	22
L Temporal Pole	809	5.04E-10	5.64	−52	4	−26
R Temporal Pole	405	2.21E-06	5.29	50	12	−32
L & R Thalamus	380	3.93E-06	5.68	0	−28	8
L STS	229	0.0002	4.4	−50	−32	−8
L Posterior MFG	213	0.000317	4.52	−44	6	46
NEGATIVE CORRELATION						
Left Insula	1767	9.46E-17	5.15	−40	−6	−12
Right STG	1361	4.19E-14	5.17	64	−26	12
Right Insula	769	1.07E-09	5.48	42	−12	−4
ACC	403	2.26E-06	5.78	0	34	2
Right PMC	303	2.69E-05	4.71	12	−30	46
Right MTS	232	0.000184	4.95	50	−62	6
Left MTS	217	0.000282	4.45	−44	−64	2

Abbreviations: SFG, superior frontal gyrus; STS, superior temporal sulcus; MFG, middle frontal gyrus; ACC, Anterior Cingulate Cortex; PMC, posteromedial cortex; MTS, middle temporal sulcus. Brain regions, i.e., sulci and gyri, were identified using an neuroanatomy atlas locating the structures at specified MNI coordinates (Damasio, 1995).

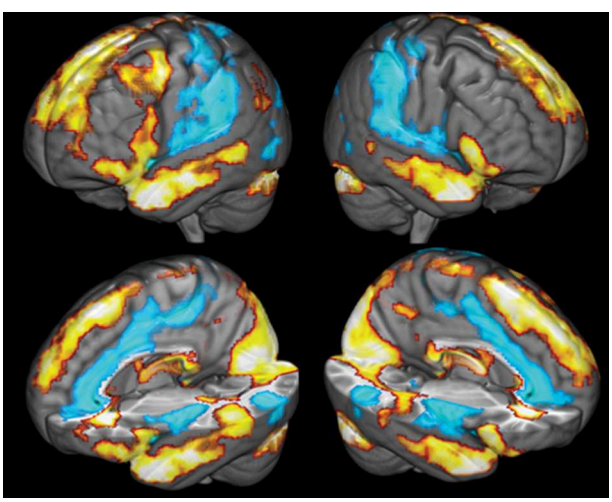

FIGURE 4 | Comparison of brain activity during the reflection period to baseline. Yellow colors covering the temporal lobes and superior frontal cortex indicate areas positively associated with the reflection predictor function, blue areas covering the ACC, the insula and secondary somatosensory cortices are negatively correlated with the reflection predictor.

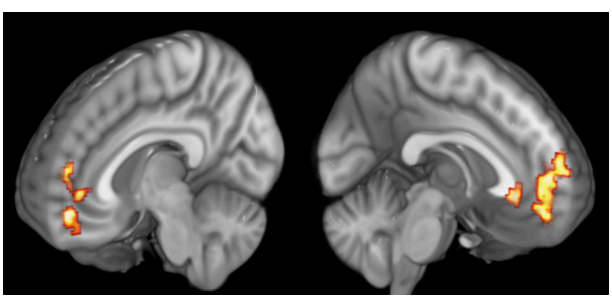

FIGURE 5 | Medial Prefrontal activity correlating with participants' gratitude ratings.

TABLE 3 | MNI coordinates of maximum voxel values.

Gratitude rating correlates						
Cluster Index	**Voxels**	***p***	***z*-max**	***z*-max x (mm)**	***z*-max y (mm)**	***z*-max z (mm)**
MPFC Cluster	816	0.009	3.48	−12	40	4
LOCAL MAXIMA WITHIN MPFC CLUSTER						
Left Perigenual ACC			348	12	40	4
Right ACC			3.24	2	54	−8
Left Subgenual ACC			3.11	−2	32	−2
Right OFC			3.11	6	52	−8
Left OFC			3.08	−6	48	4
Dorsal MPFC			3.08	0	56	12

The top line of data entered denotes the center for the primary cluster found to be active, the lower cells describe the local maxima within the main cluster of activity, revealing activity across sub regions of the MPFC. Abbreviations: MPFC, medial prefrontal cortex; ACC, anterior cingulate cortex; OFC, orbitofrontal cortex.

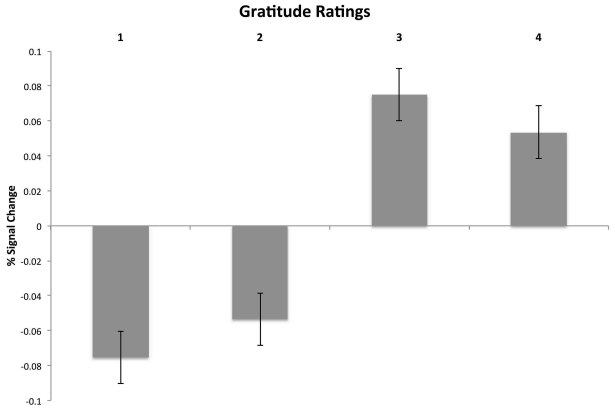

FIGURE 6 | Visualization of mean-corrected percent signal change for each subject's gratitude ratings during the reflection period. The signal was extracted from a functionally defined ROI mask of MPFC activity derived from the whole brain GLM analysis of gratitude ratings.

4. Discussion

This investigation sought to identify neural correlates of gratitude. We hypothesized that ratings of gratitude would correlate with BOLD signal magnitude in brain regions involved in moral cognition (MPFC, ACC), reward (vMPFC), and theory of mind (dorsal MPFC), and basic emotion (insula). In support of the hypotheses, ratings of gratitude correlated with activity in a region of the MPFC that encompassed the peri-genual ACC and the ventral and dorsal MPFC. Activity in these regions has been linked to reward and moral cognitive processes, such as reward from the relief of removing a stressor (Leknes et al., 2013), subjective value judgments (Kringelbach, 2005; D'Argembeau, 2013), fairness and economic decision-making (Tabibnia and Lieberman, 2007; Weber et al., 2009) and processes of self-reference (Denny et al., 2012; Araujo et al., 2013). Experiencing gratitude may coopt the MPFCs general role in evaluating the subjective value of a stimulus and calculating the mental states of others. This interpretation is consistent with previous investigations, meta-analyses and review articles implicating the MPFC in rewarding social interactions, empathic behavior, and theory of mind (Harris et al., 2007; van den Bos et al., 2007; Bzdok et al., 2012; Rameson et al., 2012). This being one of the first such studies of the neural bases of gratitude, interpreting the results presents a challenge. We consider our findings then, in terms of the general role of the MPFC in the domains of moral and social cognition, perspective taking, reward, and basic emotion, discussed in turn below.

Gratitude is often conceived of as a moral emotion (McCullough et al., 2001). Thus, the experience of gratitude should recruit brain regions associated with moral cognition. The maps elicited by Bzdok and colleagues in their meta-analysis showed that morality (studies involving judgments made about the appropriateness of people's actions, as in moral dilemmas) is consistently associated with activity in areas that overlap with those found in our data (2012). They also showed via conjunction analysis that morality, theory of mind and empathy elicited activity in the dorsomedial prefrontal cortex, similar to the regions active in our study. More specifically, their contrast of morality with empathy yielded brain activity in regions related to morality overlapping with our data, more so than the regions associated with empathy. In a related study of receiving help from others, Decety and Porges found that imagining being helped by another person elicited activity in the ACC, dorsomedial and ventromedial PFC and supplementary motor area (2011). There is a large degree of similarity between our study and Decety and Porges (2011), providing support to the notion that our stimuli were successful in eliciting brain activity related to the recognition of help from others, although their study did not address whether participants felt grateful.

Gratitude for gifts is also inherently social. The regions that we find to be active, particularly those in the ventral and subgenual regions of the MPFC, are commonly associated with social reward and interpersonal bonding. Van den Bos and colleagues found that the perigenual-ACC portion of the MPFC is active following rewarding social interactions (2007). The MPFC is also known to be active during social support and pain relief associated with viewing a loved one (Eisenberger et al., 2011). Literature reviews and meta-analyses have implicated the MPFC as a hub for processing the reward of social interactions and affective processing (Tabibnia and Lieberman, 2007; Fareri and Delgado, 2014), and pointed to its general role in binding affective stimuli with related perceptual cues (Shenhav et al., 2013).

It has been said that it is the thought behind a gift that drives gratitude (Ames et al., 2004), so it is reasonable that gratitude in the context of gift-giving will rely on brain circuits associated with theory of mind and emotion perception. The dorsal MPFC is associated with both emotion perception and theory of mind (Mitchell and Phillips, 2015). In our data, the area we see active in the dorsal region of the MPFC corresponds with results found in a meta-analysis of theory of mind and strategic games (Schurz et al., 2014). One review posits that activity in the MPFC is related to the mentalizing content of a stimulus and that the MPFC is

likely activated by cognitive reasoning due to the needs to infer social agency and theory of mind (Van Overwalle, 2011).

If gift-giving is partly related to understanding others, it stands to reason that some aspect of self-processing must also be involved. The MPFC is critical for self-processes (Araujo et al., 2013). Activity in the MPFC falls on a spatial gradient moving from ventral regions associated with self-related to dorsal regions associated with other-related judgment (Denny et al., 2012). Interestingly, the data from our study show some overlap with both the "self" and the "other" regions found in Denny et al. (2012), which may inform our conception of gratitude as it emerges from understanding others' minds in conjunction with our own needs.

Finally, gratitude as a social emotion is related to general affective processing. Meta-analyses of neural networks involved in affective processing have found data that overlap with the present study, pointing to gratitude as an emotion at the intersection of social processing and other more general affective processes. In a meta-analysis to determine networks involved in emotional processes, it was found that the MPFC, in a region similar to ours, functioned at the intersection of core affect and cognitive context, and was connected to the core limbic group (Kober et al., 2008). Building on this, others suggest that the MPFC is a neural hub, connected to parasympathetic function and is critical for generating "meaning" in a stimulus (Roy et al., 2012).

Given the important role of the MPFC in perspective-taking, we must consider the possibility that the regions active in our data correlate with task-related perspective-taking demands and not with feelings of gratitude *per se*. The stimuli were designed to involve a more or less uniform amount of context and complexity such that the correspondence between how much gratitude the gifts elicited was not inherently scaled to the amount of perspective-taking needed to understand the gift. We cannot exclude the possibility that participants were better able to generate gratitude when they were successful in perspective-taking. But while that may be the case, it should be noted that effort ratings, which may serve as a proxy for perspective-taking, did not correlate with brain activity. In fact, the ratings for how much a gift was needed were better predictors for the ratings of gratitude overall, which helps minimize the potential confound of perspective-taking as a primary component in explaining variance in brain activity during the experiment.

The gifts in our study are aimed, generally, at restoring life-functions. In other words, the gifts are designed to relieve the recipient of a stressor, to some varying degree. Interestingly, insular activity during the reflection period was decreased compared with the resting baseline. If we conceive of each stimulus as capable of relieving some degree of stress, then perhaps the insula's activity is mapping some aspect of this relief, although it is unclear why activity in the insula was not correlated with gratitude ratings. This is commensurate with recent studies showing that insula activity decreases when pain decreases through analgesia or long-term meditation training, respectively (Schmid et al., 2013; Nakata et al., 2014; Meier et al., 2015). More broadly, given the overlap with our results and investigations of pain and empathy (Singer et al., 2004; Jackson et al., 2006; Lamm et al., 2007), the relationship between gratitude, pain, and empathy may provide important insight into the means by which gratitude is associated with improved health outcomes (Huffman et al., 2014), benefits to relationships (Algoe et al., 2008) and subjective well-being (Emmons, 2008).

One limitation to the study is that the participants did not receive gifts themselves, and instead were asked to imagine the experience. Nevertheless, we believe that participants in our study felt real gratitude for a number of reasons. Participants were told to use their own reactions to rate the stimuli and to feel based on their own perspective; these responses were the bases for the analyses, thus decreasing the chance that experimenter bias would influence their responses. In addition, participants reported that their feelings during the study were similar to what they would have felt if they were in the same situation, that they felt involved in the experiment, that the experiment was not difficult, and even that the experience increased their empathy for and understanding of the Holocaust. Given our study design, the results can also be compared to prior results on gratitude in the context of gift-giving (Tesser et al., 1968; Lane and Anderson, 1976; Wood et al., 2010). These studies used brief scenarios in which the participants were asked to feel how much gratitude they would experience in a given situation. Our paradigm relies on a similar approach, strengthened by the reference to powerful historical events. Our design is also similar to related studies of social emotions such as compassion, admiration and empathy, which used rich and realistic narrative-based stimuli to elicit complex social emotions (Immordino-Yang et al., 2009; Decety and Porges, 2011; Fox et al., 2013). Additionally, reading emotional stories to elicit emotional experiences has been shown to elicit strong and realistic emotional responses (Mar et al., 2011).

In the historical setting of the Holocaust, in which receiving even a small gift could mean another day of survival, our results serve as reminders that in the midst of tragedy there can be acts of compassion, sacrifice, and profound human dignity.

Author Contributions

GF designed the study and conducted the research, analyzed the data, and wrote the manuscript. JK contributed to study design, data analysis and manuscript preparation. HD and AD contributed to study design and manuscript preparation.

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Parsing (malicious) pleasures: schadenfreude and gloating at others' adversity

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We offer the first empirical comparison of the pleasure in seeing (i.e., schadenfreude) and in causing (i.e., gloating) others' adversity. In Study 1, we asked participants to recall and report on an (individual or group) episode of pleasure that conformed to our formal definition of schadenfreude, gloating, pride, or joy, without reference to an emotion word. Schadenfreude and gloating were distinct in the situational features of the episode, participants' appraisals of it, and their expressions of pleasure (e.g., smiling, boasting). In Study 2, we had participants imagine being in an (individual or group) emotion episode designed to fit our conceptualization of schadenfreude or gloating. Individual and group versions of the emotions did not differ much in either study. However, the two pleasures differed greatly in their situational features, appraisals, experience, and expression. This parsing of the particular pleasures of schadenfreude and gloating brings nuance to the study of (malicious) pleasure, which tends to be less finely conceptualized and examined than displeasure despite its importance to social relations.

Keywords: schadenfreude, gloating, pride, joy, satisfaction, emotion, group, competition

INTRODUCTION

> To see others suffer does one good, to make others suffer even more: this is a hard saying but an ancient, mighty, human, all-too-human, principle to which even the apes might subscribe
>
> (Nietzsche, 1887/1967, p. 67).

Nietzsche had a less than generous view of human nature. He argued that other people's adversity was an important source of pleasure. However, in his view, passively observing others' adversity provides a different pleasure than actively causing others' adversity oneself by directly defeating them in competition. Was Nietzsche correct? We offer the first empirical comparison of the pleasure in passively observing (i.e., schadenfreude) and in actively causing (i.e., gloating) others' adversity.

Because emotion words can be imprecise descriptions of emotion concepts, and because schadenfreude and gloating are lesser-known emotion words, in a first study we asked participants to recall and report an episode of a "positive feeling" that conformed to our conceptualization of schadenfreude or gloating (as well as pride or joy). Thus, we made no reference to emotion words in our prompts. We examined the situational features of the episode, participants' appraisals of it, and their expression of pleasure (e.g., smiling, boasting) about the episode. In a second study, we parsed more finely the experience and the expression of schadenfreude and gloating by having participants imagine being in a particular episode of our design. Because previous research on schadenfreude has focused on *either* individual or group instances, our two studies compared such instances of schadenfreude and gloating. Our parsing of the particular pleasures of schadenfreude and gloating seeks to bring the sort of nuance routinely applied to dysphoric emotions to the less finely conceptualized and examined euphoric emotions. As important as this nuance is conceptually, it is also important to understand the ways in which schadenfreude and gloating may be dramatically different orientations to the adversity of other people with distinct implications for social relations (Leach et al., 2003).

PARSING (MALICIOUS) PLEASURES

Although common decency may limit malicious pleasure, it is clear that people do sometimes enjoy the adversity suffered by other individuals (e.g., Smith et al., 1996; van Dijk et al., 2005) and out-groups (e.g., Leach et al., 2003; Combs et al., 2009). Popular discussions use the term schadenfreude to describe many malicious pleasures, including pleasure at witnessing others' foibles on "reality TV"; pleasure at a celebrity's narcissistic self-destruction through pills, spills, or untoward thrills; and pleasure at seeing those of questionable virtue punished or otherwise given their comeuppance (for discussions, see Kristjánsson, 2006, Chap. 3; Lee, 2008). At least since Heider's (1958, Chap. 11) influential analysis, psychologists have paralleled popular discussions and used the term schadenfreude to describe any pleasure at any adversity that befalls another party (for discussions, see Feather, 2006; Koenig, 2009; Leach et al., 2014). This broad definition of schadenfreude is also used in philosophy (e.g., Portmann, 2000; Ben-Ze'ev, 2001; but see Kristjánsson, 2006) and in a variety of other disciplines (for a review, see van Dijk and Ouwerkerk, 2014). This use of schadenfreude to describe any and all pleasure at another's adversity is part of a more general trend in the study of positively experienced emotion. Generally speaking, pleasures are conceptualized and examined less finely than displeasures (Averill, 1980; de

Rivera et al., 1989; more generally, see Frijda, 1986; Shaver et al., 1987; Ortony et al., 1988; Lazarus, 1991).

It seems clear, however, that all pleasure at adversity is not the same. Misfortune, direct defeat, deserved failure, and comeuppance are very different types of adversity. Thus, it seems reasonable to expect that the pleasure experienced at each of these adversities is different. Indeed, pleasure at a rival's misfortune is about something very different than pleasure at defeating a rival oneself or at seeing a rival deservedly punished. One important way in which emotion concepts can be differentiated conceptually is to specify what the experience of pleasure or displeasure is about (Frijda, 1986; Lazarus, 1991; Solomon, 1993, Chap. 5). For example, pride works well as an emotion concept because it is conceptualized as pleasure about the particular advantage of a deserved success that is distinct from the pleasure of joy or love (Frijda, 1986; Ortony et al., 1988; Lazarus, 1991).

Defining schadenfreude as (any) pleasure at (any) adversity suffered by another party is akin to defining pride as (any) pleasure at (any) good fortune for the self. Such a general definition undermines the value of specific emotion concepts. For this reason alone, schadenfreude should be defined as a specific pleasure about a particular kind of adversity that can be conceptually and empirically differentiated from other pleasure at adversity (such as gloating), in terms of its situational features, typical appraisals, and the quantity and quality of the experience and expression of pleasure. More practically, a finer conceptualization of pleasure at adversity can clarify how malicious emotions like schadenfreude and gloating constitute different ways of relating to those suffering adversity. Emotions can be conceptualized as relational states, in the sense that they both reflect and arguably constitute social relationships. Lazarus (1991) argued that emotions are characterized by 'core relational themes' that capture the relational meaning of an encounter for the individual. Although Lazarus' primary focus was on the person–environment relationship, other people are key features of the environment in many emotional episodes. The result is that some of Lazarus' core relational themes (e.g., those for guilt, pride, envy, jealousy, love, and compassion) are social-relational in nature. Other theorists (e.g., de Rivera, 1984; Parkinson, 1996; Tiedens and Leach, 2004; Parkinson et al., 2005) have adopted a more explicitly social-relational view of emotions, arguing that emotions both reflect and shape ongoing social relationships. Considered from this perspective, it should be possible to distinguish schadenfreude and gloating in terms of the position of the self relative to the other party. For example, the wish to flaunt the pleasure of gloating puts the self above the defeated party, who is belittled.

SCHADENFREUDE vs. GLOATING

Nietzsche (1887/1967) described schadenfreude as pleasure at the passive observation of another party's misfortune. Because the observer does nothing to "earn" schadenfreude, Nietzsche viewed the pleasure of schadenfreude as lesser than pleasure that is actively earned. He also suggested that those experiencing schadenfreude are less empowered than those who actively "make others suffer" by directly defeating them in competition. Pleasure in actively and directly causing a rival's adversity may be referred to as *gloating*, especially when it is experienced as an empowered state of superiority that is lorded over the defeated rival (Ortony et al., 1988). Like Nietzsche, we believe that the emotion concept of schadenfreude should describe a particular pleasure at adversity that is distinguishable from other pleasure (e.g., pride and joy). We also believe that schadenfreude should describe a particular pleasure at another's adversity that is distinguishable from other pleasure at another's adversity (e.g., gloating). More specifically, the malicious pleasures of schadenfreude and gloating should be *experienced* differently, with schadenfreude less pleasurable, less empowering, and more passive and indirect than gloating. Schadenfreude and gloating should also be *expressed* differently, because gloating should be boastful and triumphant in nature and schadenfreude should be more furtive. The experience and expression of schadenfreude and gloating should be corroborated by the quite different ways that the two malicious pleasures position the self in social relations. Whereas gloating is an experience and expression of superiority over others, the muted pleasure of schadenfreude is based in passivity and concerns about inferiority and powerlessness. Thus, the distinctions between schadenfreude and gloating can be conceptualized in terms of the (1) features of the event, (2) appraisals of the event, (3) experience of pleasure, and (4) expression of pleasure. These distinctions are shown in **Table 1**.

We expect that the features of the event that precipitates schadenfreude will be quite different than those of the event that

Table 1 | Conceptual distinctions between schadenfreude and gloating.

	Schadenfreude	Gloating
Features of event		
Competition	Indirect, moderate	Direct, high
Comparison	Moderate	Moderate
Self-benefit	Indirect, moderate	Direct, high
Vantage point	(passive) Observer	Actor
Appraisals		
Agency	External	Internal
Power	Low	Moderate to high
Status	Moderate	High
Performance	Moderate	High
Experience		
Degree of pleasure	Moderate	High
Activity	Moderate	High
Elevated		High
Triumphant		High
Emboldened		High
Expression		
	Suppressed	Expressed
	Private	Public
Smiling	Moderate (suppressed)	High
Celebration/glee	Low to moderate	High
Flaunting/boasting	Low to moderate	High

precipitates gloating. As shown in **Table 1**, we follow Nietzsche in expecting that schadenfreude is characterized by a moderate level of indirect competition, in contrast to the high level of direct competition that should characterize gloating. Because of the direct competition, there should be more direct material benefit to the self in gloating events; the gain in schadenfreude is more psychological (see also Leach et al., 2003; Leach and Spears, 2009).

A central feature of schadenfreude is that one is a passive observer of the event rather than an active actor (Ben-Ze'ev, 2001, Chap. 12; Leach et al., 2003). Thus, schadenfreude and gloating should differ dramatically in appraisals of agency. Whereas something or someone other than the self should be appraised as the agent of the other's adversity in schadenfreude (see also Ben-Ze'ev, 2001, Chap. 12; Leach et al., 2014), the self should be appraised as the agent in gloating (see also Ortony et al., 1988). And, in comparison to schadenfreude, gloating should be characterized by greater appraisals of the self as having power and status, and performing successfully (see Nietzsche, 1887/1967; Ortony et al., 1988).

As Nietzsche (1887/1967) argued, the experience of gloating should be more pleasurable than schadenfreude. We also expect the experience of the two pleasures to differ in quality. In comparison to passive schadenfreude, the phenomenological experience of gloating should be embodied as a state of physical activation and arousal. Gloating should also be embodied as a greater state of physical elevation, as people should feel "10 feet tall" and "on top of the world" when they defeat a rival in this way. This elevated phenomenology is consistent with the appraisals of power and status that characterize gloating and schadenfreude (for a general discussion, see Schubert, 2005). Thus, those experiencing gloating should also feel more triumphant (i.e., victorious, proud) and emboldened (i.e., bold, fearless) than those experiencing schadenfreude.

As shown in **Table 1**, we also expect the expression of pleasure to be quite different in schadenfreude and gloating. A central part of gloating is to express openly one's pleasure at defeating a rival (see also Ortony et al., 1988). This should include smiling and may include celebrating and expressing glee. It may even include the more malicious expressions of boasting and flaunting one's pleasure in front of the defeated rival. Such expressions are less characteristic of schadenfreude. In fact, the passive and indirect nature of schadenfreude, and its muted pleasure, suggests that it may be furtive in expression (see Leach et al., 2003). As a more private pleasure, those experiencing schadenfreude seem likely to suppress their public expression of pleasure. They may hide a smile, in part because they feel bad about taking "unearned" pleasure in another's adversity.

INDIVIDUAL vs. GROUP-BASED EMOTION

Since Smith's (1993) call for greater attention to emotions about group and inter-group events, much research has been conducted. However, only a few papers have examined schadenfreude about group adversity (Leach et al., 2003; Leach and Spears, 2008, 2009; Combs et al., 2009) and no papers have examined gloating about groups. In addition, none of the work on schadenfreude, and little of the work on other emotions, has directly compared emotions about individual and group events (for reviews, see Parkinson et al., 2005; Iyer and Leach, 2008). Thus, we thought it important to examine both individual and group schadenfreude and gloating. As long as individual and group events are equally relevant to the corresponding level of self, individual and group-based emotions should have similar signatures (Iyer and Leach, 2008). Indeed, if group-based emotion is genuine emotion, it should operate in ways parallel to individual emotion. Where individual and group emotion are most likely to differ is in those aspects of emotion most affected by social sharing with others, which may be more likely within groups having a shared experience (e.g., watching the Olympics together with co-nationals; for discussions, see Tiedens and Leach, 2004; Parkinson et al., 2005).

STUDY 1

Our main purpose was to compare the appraisals and expressions characteristic of schadenfreude and gloating, about both individual and group events. However, we also thought it important to compare these two malicious pleasures to more benign pleasures. Thus, we also compared schadenfreude and gloating to two widely discussed pleasures – pride and joy.

We used a variation of emotion recall methodology. The typical technique would involve asking participants to recall and report on a recent episode of "schadenfreude," "gloating," "pride," or "joy." However, this technique makes the potentially problematic assumption that participants have a clear and consensual understanding of the emotion words with which they are presented (Wierzbicka, 1992). This assumption is clearly wrong in the case of schadenfreude, a word that has only recently been imported into English. Although the emotion words gloating, pride, and joy are less obscure than schadenfreude, it also seemed unwise to assume that participants would share our formal definitions of these emotion concepts. In fact, it is clear that emotion words operate in everyday language as "fuzzy concepts" whose meaning is variable (Shaver et al., 1987; Ortony et al., 1988; Wierzbicka, 1992). Thus, we eschewed the use of emotion words and instead asked participants to recall an episode that we described in terms consistent with our definitions of schadenfreude, gloating, pride, and joy. This approach focuses on the idea that an emotion can be clearly defined by what it is about (Solomon, 1993). As such, our method is freer of individual and cultural particularities than methods that ask participants to recall an experience labeled with an ambiguous emotion word (Wierzbicka, 1992).

METHOD

Participants

One hundred and nine (91 women, 18 men) students at a British university participated for partial course credit[1]. They identified as English (53), British (24), Welsh (13), Irish (2), Scottish (1), or "other" (16). Participants ranged in age from 18 to 33, $M = 20.5$, SD $= 2.46$. Ethical approval for both this study and

[1]One-hundred and twenty-one students (103 women, 18 men) were originally recruited. They identified as English (60), British (28), Welsh (14), Irish (2), Scottish (1), or "other" (16). Out of concern that participants might not report appropriate narratives in the more complicated case of schadenfreude, we assigned 40 participants to this condition. Two independent coders examined whether the schadenfreude narratives conformed to instructions. We were most concerned about the schadenfreude narratives actually being examples of gloating. Thus, coders identified ostensible schadenfreude narratives that referred to instances of directly

Study 2 (below), was obtained in advance from the departmental research ethics committee, conforming to American Psychological Association and British Psychological Society guidelines (e.g., all participants gave informed consent, were advised that they could withdraw at any time without penalty, and were fully debriefed at the end of their participation).

Design

This study employed a 4 (Emotion recalled: schadenfreude, gloating, pride, joy) × 2 (Level: individual vs. group-based emotion) × 2 (Order: individual vs. group first) design. Level and order were within-participants factors. Emotion recalled was a between-participants factor. There were between 26 (gloating) and 28 (schadenfreude, pride) participants in each condition. Because order had no statistically significant effects, it is not discussed further.

Given the complexity of our design, it was necessary to treat some factors as within-participant. Because we expected the distinction between individual and group-based emotion to be subtle we chose to maximize statistical power for this comparison by treating it as a within-participants factor. Because we expected the distinctions between the four pleasures to be larger, statistical power should be adequate with emotion as a between-participants factor. It was also advantageous to treat emotion as a between-participants factor because this would obscure our interest in comparing the four pleasures from participants. Having each participant report on all four emotions would have likely made our research interests obvious and would have likely led to demand characteristics that would distort results. We expected participants to be less reactive to being asked about both individual and group-based examples of a given emotion.

Procedure

In the first part of the study, participants were asked to "Think back to a specific time in your life when you had a **positive feeling**. . . (emphasis in original)." They were then asked to "give as much detail as you can about how you felt at this time and try to say what it was *precisely* that made you come to feel **good** in the way that you did." In each condition, the positive feeling was described in a way consistent with our conceptualization of schadenfreude, gloating, pride, or joy. Thus, in the schadenfreude condition, participants were asked about "a **positive feeling** resulting from someone else (a group to which you did **not** belong) suffering a defeat, failure, or other negative outcome [. . .] even though you (your group) **played no role** in causing this outcome." In the gloating condition, we asked about "**positive feelings** resulting from (a group to which you belonged) **triumphing over**, or defeating, another person (group)." In the pride condition, we asked about "strong **positive feelings** (as a member of a group,) resulting from an individual (group) achievement." And, in the joy condition, we asked about a "sudden and intense **positive feeling** (as a group member), resulting from something pleasurable happening."

Equivalence checks

To be sure that each emotion condition was equivalent, we included a series of checks based in items used by Roseman et al. (1990). All items asked participants to indicate to what degree "my feelings were caused by. . ." Responses were presented in a 9-point bi-polar scale anchored by statements at each end (see **Figures 1A,B**).

The perceived pleasure of the emotion episodes was measured with two questions that asked to what degree participants' feelings were caused by "believing that what happened improved things"

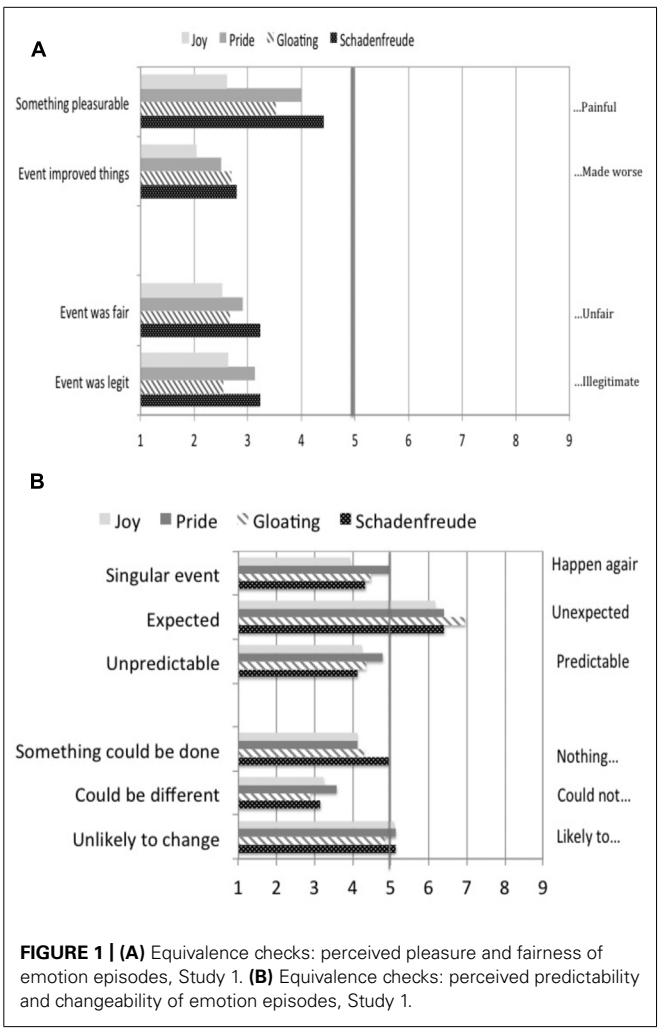

FIGURE 1 | (A) Equivalence checks: perceived pleasure and fairness of emotion episodes, Study 1. **(B)** Equivalence checks: perceived predictability and changeability of emotion episodes, Study 1.

outperforming another party. The coders agreed in 90% (i.e., 72) of the 80 cases. Disagreements were settled by discussion.

The coders found that 12 of the 40 participants in the schadenfreude conditions reported pleasure at directly outdoing a rival in both their individual and group narrative. Such events are examples of gloating or pride, rather than schadenfreude. Indeed, these 12 participants tended to describe their feelings as "smug," "proud," or "superior." For example, when asked for an example of individual schadenfreude, a participant reported an event involving an "intelligent" classmate whose parents "would always try to brag about her and compare her to me." The participant reported that the two girls got "almost identical" grades, except for in Spanish where the participant received an A and her rival received a C. She summarized her feeling as "satisfaction/smugness." This is an example of gloating rather than schadenfreude in our view.

Eliminating the 12 participants who failed to produce any narrative that conformed to schadenfreude left 28 participants in this condition. Of the 56 (individual + group) narratives that they produced, 16 involved outdoing a rival. Thus, only 71% of these narratives are "pure" cases of schadenfreude. However, we chose to retain all 56 narratives in the schadenfreude condition to keep cell sizes near equal. It is important to note that this approach makes our comparison of the schadenfreude conditions to the others a more conservative test of our hypotheses.

(1) or "...made things worse" (9) and "wanting to get or keep something pleasurable" (1) or "wanting to get rid of or avoid something painful" (9). The perceived fairness of the episode was measured with questions that asked whether the episode "...was fair" (1) or "was unfair" (9) and "...was legitimate" (1) or "was illegitimate" (9).

The perceived predictability of the episodes was measured with questions that asked whether "feelings were caused by [...] thinking that I was unable..." (1) or "...able to predict what was going to happen" (9); "perceiving something as expected" (1) or "...as unexpected" (9); and "...what happened was a one-off event" (1) or "...likely to happen again" (9). The perceived changeability of the emotion episodes was measured with three questions that asked to what degree participants' feelings were caused by thinking that what happened "was due to a situation that was unlikely to change" (1) or "...likely to change" (9); "...what happened could have turned out differently" (1) or "...could *not* have turned out differently (9); and "...something could be done about this situation" (1) or "...nothing could be done" (9).

Appraisals

Based on Roseman et al. (1990), we assessed a series of appraisals by asking participants to indicate to what degree "my feelings were caused by..." Responses were presented in a 9-point bi-polar scale anchored by statements at each end.

Agency. The agency in the precipitating event was measured with three questions that assessed to what degree participants' feelings were caused by thinking that "...what happened was not at all due to me" (1) or "...was very much due to me" (9); "...what happened was not at all due to someone else" (1) or "...was very much due to someone else" (9); and "...I had a central role in what happened" (1) or "...I was an observer of what happened" (9).

Power. The participants' appraisal of their power in the precipitating event was measured with questions stating that "I had the resources to affect what happened" (1) or "I did not have the resources..." (9); and "...I had the power to change what happened" (1) or "...I was powerless..." (9).

Performance. Participants' appraisal of their performance in the event was assessed with two questions asking if their feelings were caused by thinking that "...I had failed" (1) or "...I had succeeded" (9); and "...I was unsuccessful" (1) or "...I was successful" (9).

Status. Participants' appraisal of their status in the event was assessed with two questions asking if their feelings were caused by thinking that "...I was worse than the other person" (1) or "I was better..." (9); and "...I was inferior" (1) or "...I was superior..." (9).

Actions

In a series of questions, we asked participants "to indicate the extent to which" they "actually engaged" in the following behavior during the emotion episode: "I smiled," "I kept the feeling of pleasure to myself," "I celebrated," "I "freely expressed my glee," "I flaunted my feelings of pleasure" and "I boasted about what happened." All items were presented with a 9-point response scale that ranged from *not at all* (1) to *very much so* (9).

Table 2 | Quantitative coding of event features and appraisals in emotion narratives, Study 1.

Coding categories	Emotion narratives			
	Joy	Pride	Gloating	Schaden-freude
Direct competition[a]	23%	15%	**67%**	26%
$\chi^2(3) = 38.25$, $p < 0.001$				
Direct benefit from misfortune[a]	39%	30%	**56%**	23%
$\chi^2(3) = 22.75$, $p < 0.001$				
Direct comparison[a]	08%	09%	**41%**	**37%**
$\chi^2(3) = 27.04$, $p < 0.001$				
Agency[b]				
Self (individual or group)	85%	96%	90%	**39%**
$\chi^2(3) = 12.00$, $p = 0.007$				
Other (individual or group)	08%	00%	04%	**20%**
$\chi^2(3) = 13.24$, $p = 0.001$				
Third party (individual or group)	00%	00%	00%	**30%**
$\chi^2(3) = 39.27$, $p < 0.001$				
Luck/happenstance[c]	06%	00%	06%	**11%**

Frequencies found to most differ from others in the same row are shown in bold. [a] *Coded as either "not mentioned" (0) or "mentioned" (1).* [b] *This Chi-square uses Yates's correction for continuity to improve the accuracy of tests that include cells with small or zero values (see Preacher, 2001).* [c] *Small frequencies in three conditions precluded a statistical test.*

RESULTS

Coding of emotion narratives

Two coders examined the emotion narratives for specific features of the event and explicitly stated appraisals of agency. The coders agreed 81% of the time. Disagreements were settled by discussion. Results are presented in **Table 2**. In a pairwise comparison, gloating involved more direct competition than schadenfreude, $\chi^2(1) = 17.77$, $p < 0.001$, as well as more direct competition than joy and pride, both $p < 0.001$[2]. Also as expected, gloating involved more direct benefit than schadenfreude, $\chi^2(1) = 19.49$, $p < 0.001$, as well as more than joy, $\chi^2(1) = 7.28$, $p = 0.007$, and pride, $\chi^2(1) = 13.14$, $p < 0.001$. Although the gloating and schadenfreude conditions did not differ from each other in the degree of direct comparison, $\chi^2(1) = 0.154$, $p = 0.690$, gloating and schadenfreude involved greater comparison than joy or pride, all $p < 0.001$. Lastly, schadenfreude was characterized by the least self-agency, $\chi^2(3) = 12.00$, $p = 0.007$. Consistent with this, others [$\chi^2(3) = 13.24$, $p = 0.001$], and third parties [$\chi^2(3) = 39.27$, $p < 0.001$] were more frequently said to be agents in narratives of schadenfreude.

Equivalence checks

These single questions were analyzed individually in a mixed-model analysis of variance (ANOVA). Because of the numerous

[2] These Chi-square tests use Yates's correction for continuity to improve the accuracy of tests that include cells with small or zero values (see Preacher, 2001).

statistical tests conducted, it is important to attend to the η_p^2 index of effect size as well as the actual *p*-value of "statistical significance." Larger effect sizes and smaller *p*-values offer more secure statistical inference in light of the number of tests we report. Results are shown in **Figure 1A**.

There was a significant effect of emotion condition on the perception that the event was about "wanting to get or keep something pleasurable," $F(3,108) = 5.73$, $p = 0.001$, $\eta_p^2 = 0.144$. However, pairwise comparisons showed that the pride, gloating, and schadenfreude conditions were seen as equally pleasurable (all *p*s > 0.10). There was no effect of emotion condition on the perception that the event "improved things," $F(3,108) = 1.70$, $p = 0.171$, $\eta_p^2 = 0.046$. There were no significant main effects or interactions involving individual vs. group emotion, all *p*s > 0.092.

As shown in the bottom half of **Figure 1A**, the precipitating event was seen as equally "fair," $F(3,108) = 1.13$, $p = 0.342$, $\eta_p^2 = 0.031$. There was no significant main effect or interaction involving individual vs. group emotion, all *p*s > 0.260. The event was also seen as equally "legitimate" across the four emotion conditions, $F(3,105) = 1.42$, $p = 0.242$, $\eta_p^2 = 0.039$. However, the group emotions ($M = 2.64$, SE = 0.148) were appraised as more legitimate than the individual emotions ($M = 3.12$, SE = 0.210), $F(3,108) = 4.88$, $p = 0.029$, $\eta_p^2 = 0.044$. There was no two-way interaction, $F(3,108) = 0.236$, $p = 0.718$, $\eta_p^2 = 0.007$.

It can be seen in the top half of **Figure 1B** that the precipitating events were judged to be equally predictable across the four emotion conditions, all *p*s > 0.250, all $\eta_p^2 < 0.038$. However, the individual emotion events ($M = 6.88$, SE = 0.203) were seen as more unexpected than those for group emotions ($M = 6.09$, SE = 0.204), $F(3,108) = 10.49$, $p = 0.002$, $\eta_p^2 = 0.091$. The precipitating events were seen as equally changeable, all $p > 0.214$, all $\eta_p^2 < 0.042$. There were no significant main effects of individual vs. group emotion, all $p > 0.482$, all $\eta_p^2 < 0.005$. Together, these results established that the four emotions were equivalent in these numerous ways, ruling out these appraisals as alternative explanations of our results.

Appraisals

These single questions were again analyzed individually in a mixed-model ANOVA.

Agency. As shown in first section of **Figure 2**, participant's appraisal that their feeling was caused by something "due to me" was affected by the emotion condition, $F(3,104) = 60.46$, $p < 0.001$, $\eta_p^2 = 0.636$, with the lowest endorsement in the schadenfreude condition, all pairwise comparisons $p < 0.001$. Individual vs. group emotion was not significant, both *p*s > 0.339. The appraisal that what happened was "due to someone else" was also affected by the emotion condition, $F(3,105) = 12.89$, $p < 0.001$, $\eta_p^2 = 0.269$, with the highest endorsement in the schadenfreude condition (all pairwise *p*s < 0.001). The appraisal that the event was "due to someone else" was also higher in the group ($M = 4.73$, SE = 0.219) than the individual ($M = 3.87$, SE = 0.232) emotion conditions, $F(3,105) = 8.02$, $p = 0.006$, $\eta_p^2 = 0.071$. Lastly, there was only an effect of emotion condition on the appraisal that the participant was an observer of what happened, $F(3,105) = 41.18$, $p < 0.001$, $\eta_p^2 = 0.541$, with the highest endorsement in the schadenfreude condition (all *p*s < 0.001). Individual vs. group emotion was not significant, both *p*s > 0.241.

Power. As shown in second section of **Figure 2**, participants' appraisal that they did "not have the resources to affect what happened" was affected by emotion condition, $F(3,104) = 16.48$, $p < 0.001$, $\eta_p^2 = 0.322$, with endorsement highest in the schadenfreude condition (all *p*s < 0.001). Individual vs. group emotion was not significant, both $p > 0.074$. In addition, the appraisal that they were "powerless to change what happened" was significantly affected by emotion condition, $F(3,105) = 14.06$, $p < 0.001$, $\eta_p^2 = 0.287$, with endorsement highest in the schadenfreude condition (all $p < 0.001$). Appraisals of power were higher in the individual ($M = 4.34$, SE = 0.214) than group ($M = 3.82$, SE = 0.204) emotion conditions, $F(3,105) = 5.46$, $p = 0.021$, $\eta_p^2 = 0.049$.

Performance. As shown in the third section of **Figure 2**, participants' appraisal that they were "successful" was affected by emotion condition, $F(3,104) = 12.24$, $p < 0.001$, $\eta_p^2 = 0.255$, with endorsement lowest in the schadenfreude condition (all $p < 0.001$). Also, participants' appraisal that they "succeeded" rather than "failed" was only significantly affected by emotion condition, $F(3,104) = 13.09$, $p < 0.001$, $\eta_p^2 = 0.269$, with the schadenfreude condition lower than all others (all *p*s < 0.001). Individual vs. group emotion had no significant main or interaction effect.

Status. As shown in the final section of **Figure 2**, participants tended to appraise themselves as having the highest status in the gloating condition, although these effects were small and statistically marginal. Specifically, participants' appraisal that they were better than the other person was marginally affected by emotion condition, $F(3,105) = 2.59$, $p = 0.057$, $\eta_p^2 = 0.069$. Pairwise comparisons showed the gloating condition to be significantly higher than the joy ($p = 0.025$) and pride ($p = 0.012$) conditions, but not the schadenfreude condition ($p = 0.109$). Surprisingly, there was also an interaction between emotion condition and individual vs. group emotion, $F(3,105) = 4.65$, $p = 0.004$, $\eta_p^2 = 0.117$. The pattern of results was inconsistent across emotion conditions. Participants' appraisal that they were superior was marginally affected by emotion condition, $F(3,104) = 2.21$, $p = 0.091$, $\eta_p^2 = 0.060$. Pairwise comparisons showed the gloating condition to be significantly higher than the pride ($p = 0.040$) condition, but not the joy ($p = 0.997$) or schadenfreude ($p = 0.153$) conditions.

Actions

These single questions were analyzed individually in mixed-model ANOVAs. Means are shown in **Table 3**. The least smiling was reported in the schadenfreude condition, all *p*s < 0.026. In addition, the schadenfreude condition yielded the least celebration, all *p*s ≤ 0.001. Also, glee was more freely expressed in the gloating than in the schadenfreude condition, $p = 0.005$, and pleasure was flaunted more in the gloating than in the schadenfreude condition, $p = 0.033$. Participants boasted only marginally more in the gloating than in the pride ($p = 0.076$) and schadenfreude ($p = 0.100$) conditions.

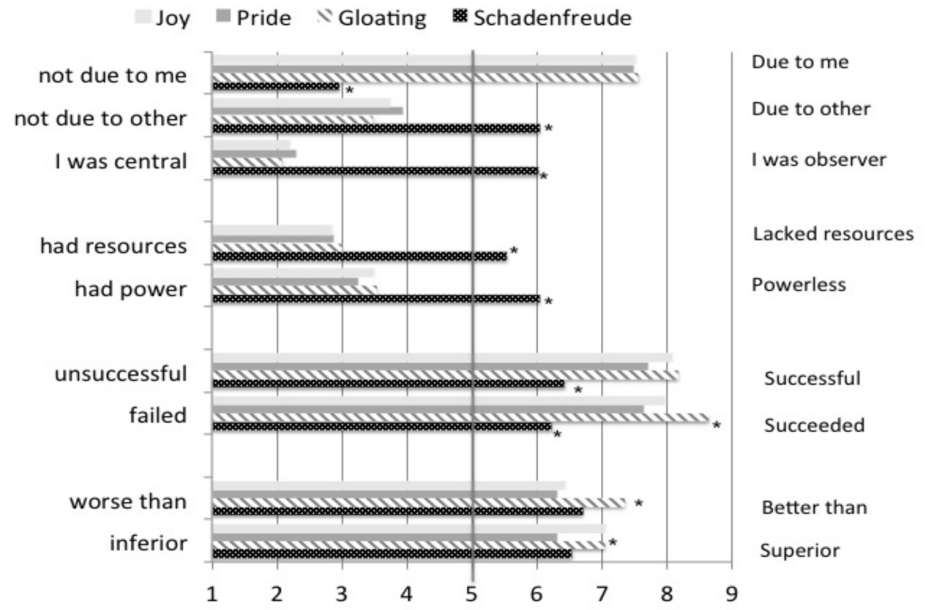

FIGURE 2 | Appraisals of agency, power, performance, and status, Study 1. Asterisks show that the emotion condition in question differed significantly from one or more of the other emotion conditions.

Table 3 | Reported expression of pleasure by emotion condition, Study 1.

	Emotion narratives			
	Joy ***M* (SE)**	**Pride** ***M* (SE)**	**Gloating** ***M* (SE)**	**Schadenfreude** ***M* (SE)**
Smiled	8.19 (0.263)	7.84 (0.259)	7.69 (0.268)	**6.87** (0.246)
$F(3,105) = 4.90$, $p = 0.003$, $\eta_p^2 = 0.120$				
Kept pleasure to myself	**2.87** (0.335)	3.64 (0.329)	3.73 (0.342)	4.02 (0.329)
$F(3,105) = 2.16$, $p = 0.097$, $\eta_p^2 = 0.058$				
Celebrated	7.32 (0.361)	6.66 (0.355)	6.54 (0.368)	**4.89** (0.337)
$F(3,105) = 8.96$, $p < 0.001$, $\eta_p^2 = 0.199$				
Expressed my glee	6.69 (0.319)	5.73 (0.313)	5.87 (0.325)	**4.61** (0.298)
$F(3,105) = 7.72$, $p < 0.001$, $\eta_p^2 = 0.177$				
Flaunted my pleasure	**6.07** (0.346)	4.82 (0.340)	5.19 (0.352)	4.16 (0.323)
$F(3,105) = 5.65$, $p < 0.001$, $\eta_p^2 = 0.136$				
Boasted	**5.65** (0.377)	4.41 (0.370)	5.37 (0.384)	4.50 (0.352)
$F(3,108) = 2.78$, $p = 0.044$, $\eta_p^2 = 0.072$				

Means found to most differ from others in the same row are shown in bold.

DISCUSSION

Study 1 generally confirmed our predictions regarding the signature of schadenfreude. Thus, schadenfreude was characterized by appraisals that others, rather than the self, were the agent of the precipitating event. Schadenfreude was also unique in being experienced as a state of lower power and performance. Unlike, gloating, joy, and pride, the pleasure in schadenfreude was expressed somewhat furtively; there was less reported smiling and less glee, boasting, and flaunting of participants' pleasure.

As well as being distinct from schadenfreude, gloating tended to be as pleasurable as joy – the most pleasurable emotion we examined. Gloating and joy also tended to be about equal in openly expressing pleasure. This further confirms the intense pleasure of "making others suffer" by defeating them in direct competition. Importantly, gloating was also characterized by greater boasting

than was pride. Although we performed a good number of statistical tests to examine every specific appraisals, experiences, and expressions of the four pleasures, observed differences tended to be consistent, highly "statistically significant," and moderate to large in size. This gives us confidence that these differences are unlikely to be due to the greater chance introduced by the number of statistical tests we conducted.

Importantly, the equivalence checks showed that the emotion conditions were equivalent in a number of important ways. The gloating, schadenfreude, joy, and pride episodes were seen as equally fair and legitimate, and as equally predictable and changeable. Thus, there was little difference in what participants had "at stake" in the schadenfreude and gloating situations, or in the individual or group situations. This rules out the alternative explanation that the schadenfreude and gloating episodes differed so much because the schadenfreude episode was less important to participants than the gloating episode. The possibility that the observed differences between schadenfreude and gloating reflect a response bias that encouraged less expression of everything related to schadenfreude was also ruled out. As expected, schadenfreude was rated higher on a number of appraisals (e.g., powerlessness, other-agency).

The present results are also notable for the consistent pattern of parallel effects across the individual and group instances of the emotions. The manipulation of individual vs. group emotion rarely had effects on the experience or the expression of the pleasures. However, as expected, the group-based pleasures were occasionally expressed more openly. Importantly, the individual and group instances of schadenfreude and gloating did not tend to differ from each other. This demonstrates the generalizability of the findings across individual and group instances.

STUDY 2

In Study 2 we aimed to corroborate and extend Study 1 in several ways. First, we focused more precisely on the differences between schadenfreude and gloating by examining only these two emotions. Second, we wished to complement the emotion recall procedure of Study 1, in which participants generated their own, somewhat idiosyncratic, episodes of emotion, by using a vignette method in which participants were asked to imagine a particular episode of pleasure that conformed to our conceptualization of schadenfreude or gloating. Third, we aimed to corroborate our findings regarding the similarity between individual and group schadenfreude and gloating using a between-participants design. This complements the within-participants design in Study 1, which may have encouraged participants to respond in similar ways in individual and group instances of the emotions. Fourth, we extended our measures beyond those used in Study 1 to make more elaborate assessments of the ways in which the pleasures differ in experience (i.e., form of pleasure, physical activity, elevated phenomenology) and expression (gloating, smiling, celebrating, flaunting, suppressing).

METHOD

Participants and design

Participants were 125 students (25 men and 100 women) at the same university as Study 1. They were rewarded either with course credit or payment of £3. Participants' ages ranged from 17 to 45, $M = 21$, SD $= 4.0$. Participants were randomly assigned to one of the four experimental conditions in a 2 (individual vs. group emotion) $\times$ 2 (schadenfreude vs. gloating) between-participants design.

Procedure

After providing consent and completing some demographic questions, participants were asked to vividly imagine taking part in an event. In the interpersonal condition, the participant was asked to imagine that s/he was an individual competing against a rival for a place on the university's field hockey team. In the intergroup condition, the participant was asked to imagine that s/he was a member of the university hockey team competing against rival universities. A second section of the vignette then offered the participants an opportunity for gloating or schadenfreude. The gloating opportunity was presented by having participants imagine succeeding against their rival. The schadenfreude opportunity was presented by having their rival fail against a third party.

Measures

Measures included checks on the equivalence of the vignettes, four kinds of emotion experience and five kinds of emotion expression.

Equivalence checks. Participants were asked to indicate to what degree they felt "a sense of rivalry," "hostile" toward their rival, and "threatened" after reading the vignette. Responses were given on a 6-point scale ranging from 0 (*not at all*) to 5 (*extremely*). At the end of the study, we also asked participants to indicate their agreement with the statements, "I am interested in hockey" and "I am interested in sport" (see also Leach et al., 2003). The response scale ranged from *strongly disagree* (1) to *strongly agree* (7).

Experience: pleasure. Participants were then asked to indicate the degree to which they felt each of 10 positive emotions (presented with negative emotions to make our purpose less obvious). Responses were given on a 6-point scale ranging from 0 (*not at all*) to 5 (*extremely*). The 10 positive emotions were designed to assess feelings of being generally pleased (i.e., joyful, happy, pleased, jubilant, satisfied), emboldened (i.e., bold, fearless), and triumphant (i.e., triumphant, victorious, proud). A Principal-axis Factor Analysis with maximum likelihood extraction and Oblimin rotation produced these three factors, which were correlated 0.69–0.81. Thus, we constructed scales of feeling generally pleased ($\alpha = 0.96$), emboldened ($\alpha = 0.83$), and triumphant ($\alpha = 0.93$). To capture a particular quality of schadenfreude, we also asked participants whether their "feelings were caused by" "...wanting to get or keep something pleasurable" (1) or "...wanting to get rid of or avoid something painful" (9), based in Roseman et al. (1990).

Experience: activity. Based on Roseman et al. (1990), questions regarding behavioral tendencies asked how much the participant "would feel like" "... jumping up and down" or "...going for it" in the situation they had just read about. Responses were given on a 9-point scale, ranging from 1 (*not at all*) to 9 (*very much so*).

Experience: elevated phenomenology. Participants were next asked how much they would feel the phenomenological experience of elevation that we expect to be most characteristics of gloating:

"I would feel '10 feet tall,'" "...like I was walking on air," "...on top of the world." Responses were given on a 6-point scale ranging from 0 (*not at all*) to 5 (*extremely*). Together these items formed a reliable scale ($\alpha = 0.89$).

Expression: gloating. Although our method did not rely on participants knowing the meaning of the word gloating, as a face valid test we asked participants if they "would feel like gloating." Responses were given on a 6-point scale from 0 (*not at all*) to 5 (*extremely*).

Expression: smiling. Based on Roseman et al. (1990), we asked participants if they "...would feel like smiling" or "...would smile" in the situation they had just read about. Responses were given on a 9-point scale, ranging from 1 (*not at all*) to 9 (*very much so*).

Expression: celebrating. To assess their outward expression of celebrating, we asked participants if they "...would feel like celebrating" and "...would feel like holding my head up high." Responses were given on a 9-point scale, ranging from 1 (*not at all*) to 9 (*very much so*).

Expression: flaunting. Three items assessed the flaunting of pleasure: "...would feel like freely expressing my glee," "...would feel like flaunting my pleasure," and "...would feel like boasting." Responses were given on a 9-point scale, ranging from 1 (*not at all*) to 9 (*very much so*).

Expression: suppressing. We asked participants if they would "...feel like stopping myself visibly smiling" and "...stop myself visibly smiling." Responses were given on a 9-point scale, ranging from 1 (*not at all*) to 9 (*very much so*). We also asked participants if they would feel "... ashamed for feeling good." Responses were given on a 6-point scale ranging from 0 (*not at all*) to 5 (*extremely*).

RESULTS

Equivalence checks

The equivalence checks were examined in a series of ANOVAs that treated participants' sex, schadenfreude vs. gloating vignette, and individual vs. group emotion as factors that could interact. Given the possibility that women and men might differ in their interest in the sport of field hockey we included sex as a factor in these initial analyses.

The feeling of rivalry with the other party was unaffected by the examined factors (all ps > 0.13, all $\eta_p^2 < 0.020$, $M = 3.63$ to 4.15). In addition, hostility toward the rival was consistent across factors (all ps > 0.21, all $\eta_p^2 < 0.015$, $M = 2.49$ to 2.72). Also, participants felt equally "threatened" across emotion conditions, $F(1,117) = 0.022$, $p = 0.882$, $\eta_p^2 < 0.001$. However, they did feel more threatened in the individual than in the group conditions, $F(1,117) = 4.75$, $p = 0.031$, $\eta_p^2 < 0.039$. No other effects were significant, all $p > 0.18$, all $\eta_p^2 < 0.015$.

Participants showed equal interest in sport ($M = 4.24$, SD $= 1.88$) and in field hockey ($M = 2.52$, SD $= 1.63$) across conditions, all $p > 0.18$ and all $\eta_p^2 < 0.001$. As such, this variable was excluded from further analysis. Participants' sex was also excluded from further analysis because it had little effect here or below.

Experience: pleasures

As shown in the top of **Table 4**, participants in the schadenfreude condition attributed their feeling to wanting to avoid pain more than those in the gloating condition. Individual vs. group emotion had no significant main effect, $F(1,121) = 0.043$, $p = 0.835$, $\eta_p^2 < 0.001$, or interaction effect, $F(1,121) = 0.800$, $p = 0.373$, $\eta_p^2 = 0.007$.

The three measures of pleasure were analyzed together in a multivariate ANOVA (MANOVA), which showed emotion condition to have a highly significant and large effect (see

Table 4 | The experience of gloating and schadenfreude, Study 2.

	Gloating *M* (SE)	Schadenfreude *M* (SE)	*F*(df)	*p*	Effect size (η_p^2)
Want to avoid pain	3.17 (0.251)	4.49 (0.257)	13.60 (1,121)	<0.001	0.101
Pleasures[a]			78.51 (3,119)	<0.001	0.664
General pleasure	4.47 (0.123)	2.28 (0.126)	153.66 (1,121)	<0.001	0.559
Triumphant	4.30 (0.135)	1.50 (0.136)	209.66 (1,121)	<0.001	0.634
Emboldened	2.78 (0.159)	1.47 (0.163)	32.92 (1,121)	<0.001	0.214
Activity[b]			15.80 (2,119)	<0.001	0.210
Jumping up and down	5.94 (0.304)	3.53 (0.309)	31.04 (1,120)	<0.001	0.205
Going for it	6.08 (0.280)	4.71 (0.285)	11.69 (1,120)	<0.001	0.089
Elevated phenomenology[a]			29.53 (3,119)	<0.001	0.427
10 feet tall	3.32 (0.165)	1.89 (0.169)	36.79 (1,121)	<0.001	0.233
Walking on air	2.96 (0.165)	1.36 (0.169)	46.06 (1,121)	<0.001	0.276
On top of the world	3.46 (0.147)	1.47 (0.150)	89.26 (1,121)	<0.001	0.425

[a] *Response scale ranged from 0 (not at all) to 5 (extremely).* [b] *Response scale ranged from 1 (not at all) to 9 (very much so).*

Table 4). Participants reported feeling much more general pleasure, triumphant, and emboldened in the gloating than in the schadenfreude condition. The multivariate effect of Individual vs. Group Emotion was not significant, $F(3,119) = 1.72$, $p = 0.167$, $\eta_p^2 = 0.042$. The two-way interaction was significant, $F(3,119) = 6.89$, $p < 0.001$, $\eta_p^2 = 0.148$, although none of the univariate effects was significant (all ps > 0.072, $\eta_p^2 = 0.026$).

Experience: activity

The two indicators of activity were analyzed together in a MANOVA, which showed emotion condition to have a highly significant and moderate effect (see **Table 4**). Participants reported that they would feel like "jumping up and down" and "going for it" more in the gloating than in the schadenfreude condition. Individual vs. group emotion did not produce a significant multivariate main effect, $F(2,119) = 1.15$, $p = 0.321$, $\eta_p^2 = 0.019$, or two-way interaction, $F(2,119) = 0.557$, $p = 0.575$, $\eta_p^2 = 0.009$.

Experience: elevated phenomenology

The three indicators of elevated phenomenology were analyzed together in a MANOVA, which showed emotion condition to have a highly significant and moderate effect (see **Table 4**). Participants reported that they would feel "10 feet tall" "like I was walking on air" and "on top of the world" more in the gloating than the schadenfreude condition. Individual vs. group emotion had a marginally significant multivariate effect, $F(3,119) = 2.33$, $p = 0.078$, $\eta_p^2 = 0.055$, although none of its univariate effects was significant. The two-way interaction was not significant, $F(3,119) = 0.704$, $p = 0.552$, $\eta_p^2 = 0.017$.

Expression: gloating and smiling

As shown in the first section of **Table 5**, participants imagined "gloating" more in the gloating than in the schadenfreude condition. Neither individual vs. group emotion, $F(1,120) = 3.49$, $p = 0.064$, $\eta_p^2 = 0.028$, nor the two-way interaction, $F(1,120) = 0.172$, $p = 0.679$, $\eta_p^2 = 0.001$, was significant.

The two questions about the expression of smiling were analyzed together in a MANOVA, which showed emotion condition to have a large and significant effect. Participants reported that they "would feel like smiling" and "would smile" more in the gloating than the schadenfreude condition. Individual vs. group emotion had a small but significant multivariate effect, $F(2,120) = 4.31$, $p = 0.016$, $\eta_p^2 = 0.067$. Participants reported that they "would smile" more in the group ($M = 6.95$, SE $= 0.250$) than the individual ($M = 6.03$, SE $= 0.248$) emotion condition, $F(2,120) = 6.82$, $p = 0.010$, $\eta_p^2 = 0.053$. The multivariate two-way interaction was not significant, $F(2,120) = 1.68$, $p = 0.190$, $\eta_p^2 = 0.027$.

Expression: celebrating

The two questions about celebrating were analyzed together in a MANOVA, in which emotion had a large and significant effect (see **Table 5**). Participants "would feel like celebrating" and "would feel like holding my head up high" more in the gloating than in the schadenfreude condition. Individual vs. group emotion had a marginal multivariate effect, $F(2,119) = 3.02$, $p = 0.052$, $\eta_p^2 = 0.048$. The two-way interaction was not significant, $F(2,119) = 1.55$, $p = 0.216$, $\eta_p^2 = 0.025$.

Table 5 | The expression of gloating and schadenfreude, Study 2.

	Gloating *M* (SE)	Schadenfreude *M* (SE)	*F*(df)	*p*	Effect size (η_p^2)
Gloating[a]	2.02 (0.165)	1.37 (0.170)	7.43 (1,120)	0.007	0.058
Smiling[b]			29.43 (2,120)	<0.001	0.329
Feel like smiling	7.99 (233)	5.86 (0.239)	40.51 (1,121)	<0.001	0.251
Would smile	7.84 (0.246)	5.14 (0.252)	59.34 (1,121)	<0.001	0.329
Celebrating[b]			45.84 (2,119)	<0.001	0.435
Celebrating	7.99 (0.237)	4.88 (0.241)	84.47 (1,120)	<0.001	0.413
Hold head up high	7.51 (0.235)	5.50 (0.239)	35.95 (1,120)	<0.001	0.231
Flaunting[b]			45.84 (3,119)	<0.001	0.154
Freely express glee	6.68 (0.259)	5.01 (0.265)	20.51 (1,121)	<0.001	0.145
Flaunting pleasure	5.94 (0.289)	4.42 (0.296)	13.46 (1,121)	<0.001	0.100
Boasting	6.24 (0.292)	5.04 (0.299)	8.25 (1,121)	0.005	0.064
Suppressing			11.99 (3,119)	<0.001	0.232
Feel like stop smiling[b]	4.20 (0.321)	4.83 (0.329)	1.82 (1,121)	0.180	0.015
Stop smiling[b]	3.06 (0.286)	5.02 (0.293)	22.79 (1,121)	<0.001	0.158
Ashamed[a]	0.84 (0.177)	2.09 (0.181)	24.66 (1,121)	<0.001	0.169

[a] *Response scale ranged from 0 (not at all) to 5 (extremely).*
[b] *Response scale ranged from 1 (not at all) to 9 (very much so).*

Expression: flaunting

The three questions about flaunting one's pleasure were analyzed together in a MANOVA, in which emotion had a significant and moderate-sized effect (see **Table 5**). Participants "would feel like freely expressing my glee," "would feel like flaunting my pleasure," and "would feel like boasting" more in the gloating than in the schadenfreude condition. Individual vs. group emotion had a small, significant multivariate effect, $F(3,119) = 3.08$, $p = 0.030$, $\eta_p^2 = 0.072$. Participants said that they would more freely express their glee in the group ($M = 6.32$, SE $= 0.263$) than in the individual ($M = 5.37$, SE $= 0.261$) condition, $F(1,121) = 6.64$, $p = 0.011$, $\eta_p^2 = 0.052$. The two-way interaction was not significant, $F(3,119) = 0.094$, $p = 0.963$, $\eta_p^2 = 0.002$.

Expression: suppressing

The three questions about suppressing one's pleasure were analyzed together in a MANOVA, in which emotion had a significant medium-sized effect (see **Table 5**). Participants "would feel that I had to stop myself visibly smiling," feel "...ashamed for feeling good" and "would stop myself visibly smiling" more in the schadenfreude than the gloating condition. Individual vs. group emotion was also significant, $F(3,119) = 6.35$, $p < 0.001$, $\eta_p^2 = 0.138$, as participants expected to stop smiling and to feel ashamed more in the individual than in the group emotion condition (both $p < 0.001$, $\eta_p^2 > 0.08$). The two-way interaction was not significant, $F(3,119) = 0.880$, $p = 0.454$, $\eta_p^2 = 0.022$.

DISCUSSION

Importantly, equivalence checks showed that participants were equally interested in sport in general, and field hockey in particular, across the experimental conditions. In addition, participants' sense of rivalry, their hostility, and their feeling threatened by the events described, were equivalent across experimental conditions. Thus, there was little difference in what participants had "at stake" in the schadenfreude and gloating situations, or in the individual and group situations. This eliminates an obvious alternative explanation of our findings, namely that the events were viewed differently in other important respects to those manipulated.

Despite the fact that the schadenfreude and gloating conditions were of similar relevance to participants, they expected to experience these two situations quite differently. Those who were led to imagine that they (or their university team) had passively observed a rival fail anticipated feeling much less pleasure than those who imagined outdoing the rival themselves. Those in the schadenfreude condition also expected to feel less of the empowered pleasure assessed with feeling triumphant and emboldened. Consistent with this, schadenfreude was expected to be a less active experience than gloating. And, gloating was seen as involving much more of the embodied experience of elevation than schadenfreude. Thus, gloating was thought to make one feel "on top of the world." In sum, Study 2 corroborated and extended Study 1 by showing that gloating and schadenfreude situations are characterized by different experiences of pleasure. As Nietzsche (1887/1967, p. 67) argued, "to see others suffer does one good, to make others suffer even more."

Participants also reported quite dramatic differences in how they expected to express their pleasure in gloating and schadenfreude. We expected that defeating a rival oneself would lead to outright gloating and much more smiling and celebrating. Indeed, participants expected to flaunt their pleasure much more in the case of gloating than schadenfreude. Overall, the expression of pleasure at simply observing a rival's failure was expected to be moderate at best. In fact, participants actually expected to suppress their visible smiling and to feel ashamed about feeling the pleasure of schadenfreude. This is consistent with our suggestion that schadenfreude is seen as being of questionable legitimacy and is thus furtive in nature (see Leach et al., 2003).

There were again few differences between the individual and group examples of gloating and schadenfreude. Where there were differences, they tended to be small. One trend was for group emotions to be expressed more freely and for individual emotions to be slightly more furtive. This probably reflects the fact that group-based emotions offer the potential for a relatively consensual appraisal of events, whereby fellow group members can be expected to share and thereby validate the emotional experience (for discussions, see Tiedens and Leach, 2004; Parkinson et al., 2005).

GENERAL DISCUSSION

Together these studies offer a multi-method examination of the distinctions between two pleasures at other's adversity – schadenfreude and gloating. The emotion recall and vignette methodologies produced similar results. In both cases we avoided reference to emotion words in our methods. Thus, we were able to define the pleasures of interest more precisely, without relying on participants' potentially idiosyncratic understanding of emotion words. Across both studies there were few differences between the individual and group examples of gloating and schadenfreude. Group-based emotions seemed to increase expression slightly, likely because individuals can presume that such emotions are shared and thus socially validated (for discussions, see Tiedens and Leach, 2004; Parkinson et al., 2005). Although there are ways in which individual and group-based emotion may differ, the appraisals, phenomenology, and motivation that we examined here should be similar if the precipitating events are similarly self-relevant (Iyer and Leach, 2008).

It is worth acknowledging possible limitations of our approach. The most obvious of these is our reliance on self-report, a method with well-known drawbacks. Nevertheless, self-report seemed to be the most appropriate way to access the detailed and complex dimensions (i.e., appraisals, feeling states, and action tendencies) that define complex emotions such as schadenfreude and gloating. Although alternative methodologies that capture emotional experience less explicitly (e.g., EEG, fMRI, facial expressions) might be able to provide important complementary evidence, the differences we observe between schadenfreude and gloating represent an important first step in establishing the distinctions between these malicious pleasures. Indeed, it is not clear how many of these distinctions could be studied with methods that do not rely on the conscious reporting of the subjective meaning of these emotions.

A second possible limitation is our use of vignettes in Study 2. Such methodologies have been criticized on the grounds that they present participants with hypothetical scenarios and thereby elicit responses guided by lay theories (Parkinson and Manstead, 1993). However, it is important to note that Study 1 used personally experienced rather than hypothetical events, yet yielded similar results to Study 2. This echoes the evidence that vignettes designed to study emotional experience can generate results that parallel those found with non-vignette methodologies (Robinson and Clore, 2001). It likely helped that the vignettes used in Study 2 were designed to mimic real-life individual and group competition relevant to the participants.

EMOTION AS RELATIONAL

People who express emotion, like those who study emotion, share a rich and varied vocabulary for dysphoric feelings. Our language for euphoric feelings is more limited (Averill, 1980; de Rivera et al., 1989; more generally, see Frijda, 1986; Shaver et al., 1987; Ortony et al., 1988; Lazarus, 1991). Yet, it is evident that all pleasures are not the same. The elation at winning the lottery is different from the pride in seeing a daughter graduate or the joy in watching the sun set. Although pleasures at bad things that happen to other people have a certain malice in common, they too are different from one another. The conflation of schadenfreude and gloating in academic and popular discussion masks the ways in which these two pleasures differ in terms of situational features, appraisals, experience, and expression. Just as Nietzsche suggested, schadenfreude is a modest, furtive, guilty pleasure that does little to empower those who experience it. Gloating is a very different pleasure. It is about a direct and active outperformance of another party who is then made to witness one's pleasure at their defeat. Gloating is not only a greater experience of pleasure. In contrast to schadenfreude, gloating is experienced as a physical invigoration and elevation of the body. People beam as they "walk on air," elevated above their defeated rivals. A little smile, and a quiet satisfaction, is all that people seem to get from schadenfreude.

The many distinctions observed between schadenfreude and gloating illustrate the ways in which emotional experience and expression is situated in social relations. Despite being close cousins within the broader family of pleasures, and siblings within the family of pleasures at other's adversity, gloating and schadenfreude are very different ways of relating to the social world. Although taking pleasure in another's adversity necessarily positions one against the other, the pleasure of schadenfreude was not flaunted. In fact, it was suppressed to some degree. As such, schadenfreude seems unlikely to lead to more direct derogation or more active mistreatment of the other party (see Leach et al., 2003; Leach and Spears, 2009). What is gained in schadenfreude is a modest psychological boost for the self (Leach and Spears, 2009). In contrast, gloating is a more active and direct opposition to the other party. The pleasure of gloating was not only experienced more intensely, it was expressed more intently. These emboldened expressions of presumed superiority seem much more likely to fuel further antagonism. Gloating may even encourage the defeated rival to seek revenge or retribution for the indignity they have been made to suffer. As such, gloating may present a greater risk to social relations than schadenfreude because the experience and expression of gloating empower more, and more direct, antagonism. By parsing the malicious pleasures of gloating and schadenfreude, we have taken a first step toward understanding how these two emotions are likely to affect the (individual or group) relations within which they are embedded.

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Lost or fond? Effects of nostalgia on sad mood recovery vary by attachment insecurity

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Nostalgia involves a fond recollection of people and events lost to time. Growing evidence indicates that nostalgia may ameliorate negative affective states such as loneliness and boredom. However, the effect of nostalgia on sadness is unknown, and there is little research on how social connectedness might impact nostalgia's effects. Grounded in a theoretical framework whereby people with lower levels of attachment insecurity benefit more from nostalgia, we exposed participants to a mortality-related sad mood and then randomly assigned them to reflect on a nostalgic or an ordinary event memory. We examined changes in mood and electrodermal activity (EDA) and found that nostalgic versus ordinary event memories led to a blunted recovery from sad mood, but that this effect was moderated by degree of attachment insecurity, such that participants with low insecurity benefited from nostalgia whereas people with high insecurity did not. These findings suggest that nostalgia's benefits may be tied to the degree of confidence one has in one's social relationships.

Keywords: nostalgia, attachment, emotion, emotion regulation, sadness

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Introduction

> "True joy is a profound remembering; and true grief the same."—Clive Barker

Nostalgia is an intriguing phenomenon. On the one hand, nostalgia can be positive, imbued with a rosy glow of familiarity and belongingness. On the other hand, it can be negative, accompanied by longing, loss, and frustrated desire. Nostalgia often melds both positive and negative experiences. For instance, one of our participants shares his nostalgic reflection[1]:

> "As a family we went to Moosehead Lake after my brother had passed away. My family saw this vacation as a way to escape the feelings of tragedy. It was warm and sunny and we were able to play in our bathing suits. For an hour things felt normal and we were happy. I will always remember that day as the last day I spent with my family before it truly fell apart."

Fitting its blended nature, this nostalgic reflection involves both positive (unity, fun) and negative (death, tragedy) elements. In an attempt to elucidate the prototypical nature of nostalgic experiences, Hepper et al. (2012) conducted seven experiments suggesting that nostalgia is a

[1] Minor details changed to preserve anonymity. See Supplementary Material for additional representative reflections.

complex blend of both cognition and affect, characterized by recalling one's past experiences with central prototypical features of personal meaning, feelings of fondness, and a "rosy glow."

Nostalgia is rather common. A study by Wildschut et al. (2006) revealed that 79% of their undergraduate sample endorsed feeling nostalgic "once a week or more." Negative affect, particularly loneliness, was the most reported elicitor of nostalgia. The authors also demonstrated that a negative mood induction resulted in higher state nostalgia than a positive or neutral induction. Subsequent research has supported the idea that a variety of negative affective states trigger nostalgic recollections, including social exclusion (Seehusen et al., 2013), boredom (van Tilburg et al., 2013), and meaninglessness (Routledge et al., 2011).

In terms of the *content* of nostalgic reflections, Wildschut et al. (2006) found that these reflections contain more positive than negative elements and that they feature the self embedded in a close social context. A "redemption" sequence (negative, then positive) is far more common than a "contamination" sequence (positive, then negative). Moreover, among participants asked to list desirable and undesirable features of nostalgia, 33% offered positive affect as a desirable feature, whereas 40% offered sadness as an undesirable feature.

Nostalgia therefore appears to involve an affective sequence whereby negative emotions trigger a nostalgic reverie, which is most often positive, and which ends on a redemptive (albeit often bittersweet) note. This sequence suggests that nostalgia may be instrumental in modulating negative affective states like sadness, either voluntarily or automatically. Indeed, Stephan et al. (in press) propose a theoretical model and supporting evidence suggesting that nostalgic experiences may serve to regulate affect. This model proposes that aversive experiences activate nostalgia, which then amplifies positive affective states, thus reflecting "a broader capacity of nostalgia to offset psychological distress and maintain psychological equanimity" (p. 5). In proposing such, the authors suggest that the negative affect automatically triggers the nostalgic memory. There is a rich literature supporting the idea that many of the processes we engage in to regulate our emotions occur involuntarily and even without conscious awareness (Mauss et al., 2007), and evidence that negative affective states in particular seem to elicit a tuning in toward positive information in undergraduate participants (DeWall et al., 2011).

Importantly, these associations between nostalgia and recovery from negative affective states may be impacted by the broader social context of the nostalgic reverie. For example, in the reflection shared by our participant above, it is evident that this participant felt that at least some of the social connections present in the nostalgic memory had since been irrevocably lost. It may be that he felt worse following his reflection than would someone who trusts that the social connections associated with his/her nostalgic reflection will extend into the future. Thus, if perceptions of social connectedness are a central feature of nostalgia, the degree of trust people can place in their social networks may influence the effect nostalgia has on affective states.

Nostalgia has indeed been found to increase feelings of social connectedness (Hepper et al., 2012). Although social others are of course not suddenly present during nostalgic recall, they do become present in mind. Aptly, Hertz (1990) termed this "peopling one's mind." Supporting this peopling of the mind during nostalgia, Zhou et al. (2008) observed an indirect effect whereby loneliness increased perceived social support by way of increasing nostalgia. In addition to enriching perceptions of social connectedness, Routledge and colleagues provide evidence that nostalgia (both state and trait) may blunt the effects of terror primed by perceptions of mortality, and that it does so through enhancing a sense of meaning in life (Routledge et al., 2008; Juhl et al., 2010). Finally, van Tilburg et al. (2013) provided evidence that nostalgia also enhances a sense of meaning in the face of induced and dispositional boredom.

These data all suggest that nostalgia can be adaptive, diminishing unpleasant feelings associated with one's own death, and enhancing a sense of meaning. However, an extensive literature suggests that there are large individual differences in whether and to what extent people regulate their affective states, and also whether these attempts are successful (John and Eng, 2014). Considering this, alongside our reasoning that people's broader perception of their social context may inform the emotional outcomes of nostalgia, we propose a theoretical model in which the security of one's attachments may predict the effects of nostalgia on mood.

Adult attachment conceptualizes degree of trust in social relationships (Mikulincer et al., 2003), which grew out of Mary Ainsworth's classic literature (Ainsworth et al., 1978) on attachment between children and their caregivers. People with more secure attachments may benefit from nostalgia more than people with insecure attachments. If you distrust the reliability of your social relationships, calling them to mind may have little beneficial effect. Indeed, Wildschut et al. (2010) illustrated that the relationship between loneliness and nostalgia (including its reparative effects) may be particular to people low in insecure attachment.

Although work on nostalgia and its emotional implications has burgeoned in recent years, there are still notable gaps in our understanding of this elusive state of being. First, nearly all of the work investigating the nature of nostalgia has relied solely on self-reported measures of affect. While the work is commendable, thorough, and theoretically meaningful, studies including more objective measures (e.g., physiological response) are needed, as self-report is an important variable but one that is limited by degree of insight and numerous reporting biases.

Second, we do not know if nostalgia may serve to reduce negative affect other than mortality terror and boredom. To our knowledge, there has been no experimental investigation of whether nostalgia affects sadness, even though sadness is one of the most common negative emotions (Carstensen et al., 2000), and is highly relevant to depression, a form of mental distress with devastating costs to the individual and to society (Murray and Lopez, 1996).

These gaps stand in the way of a full understanding of nostalgia's role in people's emotional lives. Clarifying these open questions could refine our theoretical models of nostalgia and potentially pave the way for future applications in therapeutic contexts. We conducted the present study to test whether

calling to mind a nostalgic versus an ordinary event memory would lead to greater recovery from a sadness induction and to evaluate whether attachment insecurity moderated these effects. We focused specifically on mortality-related sadness given the past literature on nostalgia and mortality terror and because the theme of threatened social ties (i.e., loss through death) might be a context in which attachment insecurity might be particularly relevant.

Situated in our review of the past literature and our theoretical model whereby the degree to which one trusts social attachments should impact the effect of nostalgic reflection on a sad mood state, we predicted that: (1) overall, following a mortality-related sad mood induction, people would feel better (i.e., higher decreases in sadness and increases in happiness) when this induction was followed by a nostalgic versus an ordinary event reflection, but that (2) this effect would be moderated by insecurity of attachment, such that people higher in attachment insecurity would not exhibit this nostalgia-related benefit.

Materials and Methods

Participants

Seventy-one Assumption College undergraduates participated in this study (43 female; 51 Caucasian, age $M = 20.19$, $SD = 2.00$). The second- and third-largest ethnic groups self-reported as American Indian/Alaskan (six participants) and Hispanic/Latino (five participants). A power analysis for a linear regression analysis with a medium *a priori* effect size of $f^2 = 0.15$, power (1-beta) of 0.80, two predictors, and alpha = 0.05 suggested a necessary N of 68 to detect effects. We are therefore well-positioned to detect effects of interest in our hypothesis tests below. Participants were randomized to one of two memory conditions (nostalgia, ordinary event), described below. All procedures were approved by the Assumption College Institutional Review Board, and participants provided written informed consent.

Memory Reflection

For the nostalgic/ordinary event memory reflections, we followed the methods of Hepper et al. (2012). Participants randomly assigned to the nostalgia condition were given a list of the 12 prototypical features of nostalgia (reminiscence, keepsakes, dwelling, rose-tinted memories, familiar smells, wanting to return to the past, family/friends, longing, feeling happy, childhood, emotions, personal) and asked to "bring to mind an event in your life that is relevant to or characterized by at least five of these features." Also as specified by Hepper and colleagues, participants randomly assigned to the ordinary event memory reflection were encouraged to "bring to mind an ordinary event in your daily life. Specifically, try to think of a *past* event that is ordinary". Participants were asked to draw forth a memory appropriate to their condition and alert the experimenter when they were ready. In both conditions they were asked to spend 2 min quietly reflecting on the memory, following which they were asked to write a short narrative describing the event they chose. We submitted these narratives to analysis in LIWC (Linguistic Inquiry and Word Count; Francis and Pennebaker, 1993) software to obtain the following scores for these narratives: overall word count, and number of words related to: past, present, future, social words, positive emotion, negative emotion, sadness, and death. See **Table 1** for descriptive statistics on these and all major study variables.

Mood Ratings

Participants rated their current mood on 11 dimensions (relaxed, sad, amused, energetic, anxious, happy, tired, fearful, irritated, content, bored) on 5-point Likert style scale four times: at Baseline, Pre-Sad Clip, Post-Sad Clip, and Post-Memory. Given the focus of this paper on people's reactions to unpleasant stimuli specifically targeting loss we analyzed the sad and happy items separately rather than more global negative and positive affect ratings[2]. We did not collapse sad and happy into a bipolar mood scale due to our a-priori interest in investigating nostalgia's effects on both negative and positive affect separately, and because the negative correlations between these items were only weak to moderate (see **Table 2**).

TABLE 1 | Descriptive statistics (means, standard deviations) for major study variables, separately by memory reflection condition.

Variable	Nostalgia mean (SD)	Ordinary event mean (SD)
SADNESS RATINGS		
Pre-clip sad	0.343 (0.765)	0.200 (0.531)
Post-clip sad	2.800 (0.797)	2.686 (1.231)
Post-memory sad	1.629 (1.374)	0.600 (0.775)
HAPPY RATINGS		
Pre-clip happy	2.229 (1.031)	2.171 (1.043)
Post-clip happy	0.743 (0.886)	0.943 (0.938)
Post-memory happy	2.200 (1.410)	1.886 (1.022)
EDA		
Neutral aquatic	11.238 (9.356)	12.489 (10.824)
Sad film clip	12.836 (10.459)	14.320 (11.426)
NARRATIVE CONTENT		
Word count	67.690 (40.097)	52.600 (41.383)
Past words	5.116 (4.685)	3.599 (5.218)
Present words	1.191 (2.147)	2.610 (4.210)
Future words	0.865 (1.980)	0.238 (0.654)
Social words	4.490 (6.357)	2.045 (3.921)
Positive emotion words	3.180 (2.946)	2.161 (2.202)
Negative emotion words	1.259 (1.606)	0.621 (1.341)
Sad words	2.249 (2.779)	0.697 (1.929)
Death words	5.349 (5.370)	2.437 (4.565)
Attachment insecurity	30.324 (9.993)	31.426 (10.877)

[2]Repeating our analyses using positive and negative affect revealed similar (albeit weaker in the case of negative) results as using the more targeted items. Moreover, while a multiple-item measure of sadness and happiness may have maximized our ability to detect important relationships, single-item measures of mood responses have been demonstrated as reliable and valid by previous research (e.g., Hürny et al., 1996; Zimmerman et al., 2006).

TABLE 2 | Pearson correlations (and *p*-values) between happy and sad ratings at designated times of measurement.

	r (p)
Pre-clip	−0.188 (0.199)
Post-clip	−0.260 (0.030)
Post-memory reflection	−0.484 (<0.0001)

Psychophysiology

Electrodermal activity (EDA) was selected as a pure measure of sympathetic activation of the autonomic nervous system. Two disposable Ag/AgCl electrodes pregelled with 0.5% chloride isotonic gel (1 cm circular contact area) were attached to the distal phalanges of the index and middle fingers on the non-dominant hand. EDA level was recorded with DC coupling and constant voltage electrode excitation at 35 Hz (sensitivity = 0.7nS). Offline, EDA was smoothed with a 1 Hz low-pass filter, decimated to 10 Hz, and further smoothed with a 1-s prior moving average filter. Offline data filtering and reduction were completed using using ANSLAB routines (Wilhelm and Peyk, 2005) routines in Matlab (Mathworks, Natick, MA).

We recorded EDA during a neutral aquatic clip (to serve as a neutral comparison to the sad clip) and during the sad film clip. We collected EDA for the entirety of the film clips, and used the mean skin conductance level as our dependent measure. Participants with average EDA levels greater than three standard deviations from the grand mean were excluded[3].

In a review of the literature on the autonomic profiles of various emotional states, Kreibeig and colleagues (Kreibig, 2010) found that when sadness is loss-related and induces crying, sympathetic activation (including increases in skin conductance level) is typically observed, whereas for non-loss, non-crying sadness, sympathetic withdrawal (including decreases in skin conductance level) is typically observed. Studies using film clips were represented in both of these categories, though more studies using film clips found deactivation than activation (for a representative exception, see a paper by the same author (Kreibig et al., 2007) using loss-related film clips). Given the strong theme of loss present in our film clip (parent losing a child) and the anecdotal information that several of our participants used tissues at the conclusion of the sad film clip, we predicted a greater elevation of electrodermal response in the sad film clip measurement than the neutral baseline.

Adult Attachment

Adult attachment was assessed with 13 items from the Relationship Scale Questionnaire (RSQ; Griffin and Bartholomew, 1994; see Supplementary Material for included items). Brennan et al. (1998) suggest that the best fitting model for adult attachment involves two dimensions: *anxiety*, involving fear of separation and an excessive need for approval, and *avoidance,* involving fear of intimacy and an excessive self-reliance. People scoring high on either (or both) dimension(s) are considered to have insecure attachment, whereas people scoring low on both have secure attachments (Wei et al., 2007). We included nine items relevant to anxious attachment (e.g., "I worry about being abandoned") and four items relevant to avoidant attachment (e.g., "I worry about others getting too close to me"). Items were rated on a 5-point scale, from "not at all like me" to "very like me.[4]"

Procedure

Following consent and psychophysiological setup, all participants viewed a 5 min, 44 s neutral aquatic clip to establish a low-arousal baseline. All participants then rated their mood (Pre-Sad Clip) and viewed a 6 min, 07 s film clip taken from the movie *My Sister's Keeper*. This clip portrays a mother's last conversation with her dying teenage daughter, and concludes with the girl's death. Participants rated their mood again (Post-Sad Clip), and then were randomly assigned to engage in either a nostalgic or an ordinary event reflection. Following the memory reflection, participants rated their mood a final time (Post-Memory) and then filled out questionnaires assessing demographic information and the adult attachment measure via SurveyMonkey.com.

Results

Preliminary Analyses

Did We Induce a Sad Mood State?

To determine whether we successfully induced a sad mood state with the film clip, we submitted participants' mood ratings Pre-Sad Clip and Post-Sad Clip to paired samples *t*-tests. This analysis revealed significant increases in sadness from pre- to post- the sad clip, $t_{(69)} = 18.582$, $p < 0.0001$, $d = 2.858$, and reductions in happiness, $t_{(69)} = 10.959$, $p < 0.0001$, $d = 1.310$. Paired samples *t*-tests also revealed that average skin conductance levels were significantly higher during the sad clip than during the neutral baseline clip, $t_{(61)} = 5.581$, $p < 0.0001$, $d = 0.162$. Moreover, there was a trend toward a positive association between skin conductance level during the sad film clip and changes in rated sadness from Pre-Sad Clip to Post-Sad Clip, $r_{(62)} = 0.227$, $p = 0.071$. The direction of this association is consistent with the notion that sympathetic activation during the film clip is associated with increases in sadness participants experienced. Together, these findings suggest a successful induction of a sad mood state.

Did the Memory Reflection Conditions Differ from One Another in Content of the Reflections?

To explore how the conditions differed in the narrative content of the reflections, we conducted a series of univariate ANOVAs where the between-subjects variable was memory condition and the dependent variables were overall word count, words per sentence, and number of words related to past, present, future, sociality, positive emotion, negative emotion, sadness, and death. The narratives did not significantly differ from one another in overall word count or number of words that related to

[3]We also collected corrugator electromyography, but due to multiple problems with the equipment, these data were not analyzed and are not presented.

[4]Other self-report measures were collected for a student thesis but as they are not relevant to the current paper, are not reported.

past, present, or future, suggesting that participants in the two conditions recalled memories from the past and described them with a similar level of complexity (at least as measured by number of words used to describe said event). The two conditions also did not differ in the number of positive words or negative words used. However, people in the nostalgia condition reported narratives that contained more words related to death ($p = 0.029$, η^2 partial = 0.081), sadness ($p = 0.015$, η^2partial = 0.099), and a trend toward more words related to sociality ($p = 0.080$, η^2 partial = 0.053).

Did the Abbreviated Measure of Adult Attachment Yield Valid Psychometric Properties?

Since we were using an abbreviated measure of a validated scale, we took two approaches to demonstrate that our measure had acceptable psychometric properties. First we examined all of the items together in an exploratory factor analysis to see how the items converged, and then we examined the internal consistency of the subscales and the overall measure using Cronbach's alpha. Both approaches suggested that after dropping one item that did not load well onto the main factor ("I am comfortable without close emotional relationships"), the items loaded onto a single factor. The best fit for the factor analysis, according to the coefficient values and visual inspection of the scree plot, was a single-factor solution. Moreover, Cronbach's alpha was moderate for the subscales (0.864 for anxious and 0.668 for avoidant), whereas it was extremely strong for the scale as a whole (0.904). Therefore, we conceptualized this scale as representing insecure attachment in general, with low scores representing more secure attachment, and high scores representing insecure (fearful-avoidant) attachment.

Hypothesis Testing

Did Engaging in Nostalgic Vs. Ordinary Event Memory Reflections Result in Differential Changes in Self-reported Mood or Electrodermal Activity?

To test whether the nostalgic vs. ordinary event memory reflections resulted in differential changes in mood following the sadness induction, we submitted the mood ratings (sadness, happiness) to three 2 × 2 general linear models (GLMs) with one between-subjects factor (memory reflection: nostalgic, ordinary event) and one within-subjects factor (time: post-sad, post-memory). The GLM for sadness ratings revealed main effects of time, $F_{(1, 68)} = 103.724$, $p < 0.0001$, η^2 partial = 0.604 (greater sadness after the film clip than after the memory reflection), a main effect of memory reflection, $F_{(1, 68)} = 8.024$, $p = 0.006$, η^2 partial = 0.106 (collapsing across time, greater sadness in the nostalgia condition), and an interaction of time of assessment and memory reflection, $F_{(1, 68)} = 8.173$, $p = 0.006$, η^2 partial = 0.107 (greater reductions in sadness in the ordinary event memory vs. the nostalgic condition, see **Figure 1**). The GLM for happy ratings revealed a main effect of time of assessment, $F_{(1, 68)} = 72.479$, $p < 0.0001$, η^2 partial = 0.516 (greater happiness after the memory condition than after the film clip), no main effect of memory condition, $F_{(1, 68)} = 0.069$, $p = 0.793$, η^2 partial = 0.001, and only a weak trend toward a significant interaction of time and memory condition, $F_{(1, 68)} = 3.328$, $p = 0.072$, η^2 partial = 0.047 (higher increases in happiness in the nostalgia condition). The GLM for EDA revealed a main effect of time of assessment, $F_{(1, 59)} = 37.068$, $p < 0.0001$, η^2 partial = 0.386 (greater EDA in the memory reflection than in the sad mood induction), no main effect of memory condition, $F_{(1, 59)} = 0.055$, $p = 0.816$, η^2 partial = 0.001, and no interaction of time and memory condition, $F_{(1, 59)} = 0.131$, $p = 0.718$, η^2 partial = 0.002.

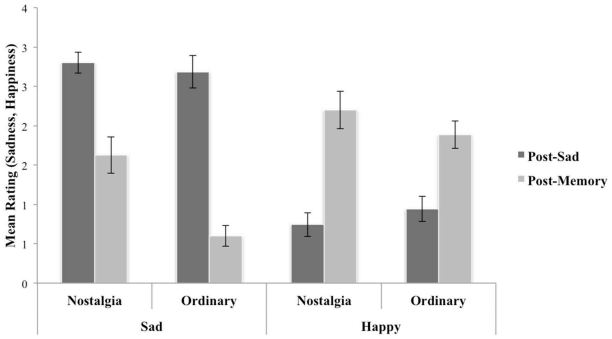

FIGURE 1 | Mean ratings of sadness and happiness following the sad film clip and following the memory reflection, separately by memory condition, illustrating that people in the nostalgic condition had smaller decreases in sadness from post-film clip to post-memory reflection than people in the ordinary event condition. Participants also experienced greater elevations in happiness in the nostalgic condition, but this effect was only a trend ($p = 0.072$).

Were Individual Differences in Attachment Insecurity Predictive of Mood Change Following Memory Reflection?

To test whether attachment insecurity moderated the relationship between memory condition and sadness recovery, we computed separate linear regression models using PROCESS in SPSS (Hayes, 2013) for sadness and happiness changes. For sadness, we used as the dependent measure difference scores computed as (Post-Film sadness ratings—Post-Memory Reflection sadness ratings), where higher scores indicate greater *reductions* in sadness (thus conceptualizing mood recovery). Conversely, for happiness, we used as the dependent measure difference scores computed as (Post-Memory sadness ratings—Post-Film sadness ratings), where higher scores indicate greater *elevations* in happiness (thus conceptualizing mood recovery).

The models were constructed such that memory condition predicted mood changes (changes in sadness, happiness). We entered relationship attachment as the moderator of this relationship to test whether the association between nostalgia condition and mood changes depends on the degree to which one trusts one's social relationships.

For sadness, the overall model was significant, $R^2 = 0.216$, $F_{(3, 65)} = 5.958$, $p = 0.001$. Memory condition exhibited near-significant trend toward predicting lower sadness recovery, $b = -1.9007$, $p = 0.056$, 95% CI [−3.8529, 0.0516]. Moreover, levels of insecure attachment did predict lower sadness recovery,

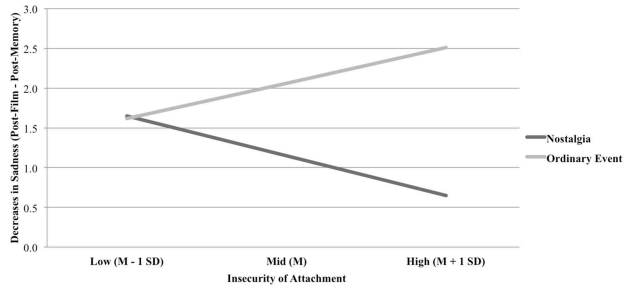

FIGURE 2 | Memory condition and attachment insecurity as predictors of decreases in sadness (Post-Film minus Post-Memory). Low, medium, and high attachment insecurity on the x-axis represent values that are one standard deviation below the mean, the mean, and one standard deviation above the mean, respectively. We observed an interaction of Attachment Insecurity × Memory Condition such that nostalgic condition (dark line) only predicted worse recovery from sadness for those with medium or high levels of attachment insecurity.

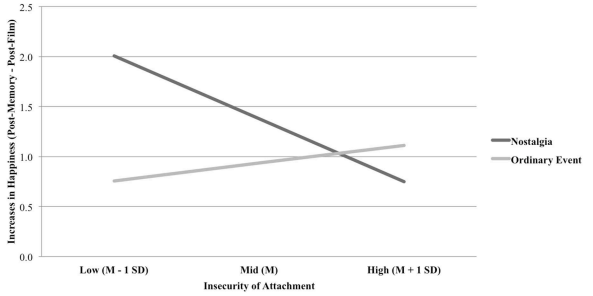

FIGURE 3 | Memory condition and attachment insecurity as predictors of increases in happiness (Post-Memory minus Post-Film). Low, medium, and high attachment insecurity on the x-axis represent values that are one standard deviation below the mean, the mean, and one standard deviation above the mean, respectively. We observed an interaction of Attachment Insecurity × Memory Condition such that nostalgic condition (dark line) predicted greater elevations of happiness only in those with low levels of attachment insecurity.

$b = -0.1393$, $p = 0.006$, 95% CI [−0.2372, −0.0415]. Critically, these two main effects were qualified by an interaction effect of Attachment Insecurity x Memory Condition, $b = 0.0911$, $p = 0.004$, 95% CI [0.0310, 0.1512], where nostalgic memory condition was associated with lower recovery from sadness for those medium to high in attachment insecurity, $b = 0.9129$, $p = 0.004$, 95% CI [0.2961, 1.5297] and $b = 1.859$, $p = 0.0001$, 95% CI [0.9791, 2.7397], respectively. Importantly, this was not apparent among participants low in attachment insecurity, $b = -0.0336$, $p = 0.9392$, 95% CI [−0.9085, 0.8414] (see **Figure 2**). This result supports our hypothesis that indulging in nostalgia results in lower recovery from mortality-related sadness *only* in the presence of higher levels of attachment insecurity.

For happiness, the overall model was significant, $R^2 = 0.178$, $F_{(3, 65)} = 4.689$, $p = 0.005$. Here, memory condition significantly predicted happiness elevation, $b = -2.845$, $p = 0.001$, 95% CI [−4.524, −1.167]. Moreover, levels of insecure attachment did predict lower happiness elevation, $b = -0.138$, $p = 0.002$, 95% CI [−0.222, −0.054]. Critically, these two main effects were qualified by an interaction effect of Attachment Insecurity × Memory Condition, $b = 0.078$, $p = 0.004$, 95% CI [0.026, 0.129], where memory condition was associated with higher elevations in happiness for participants low in attachment insecurity, $b = -1.252$, $p = 0.002$, 95% CI [−2.005, −0.500] but not for those medium to high in attachment insecurity, $b = -0.444$, $p = 0.100$, 95% CI [−0.975, 0.087] and $b = 0.363$, $p = 0.958$, 95% CI [−0.394, 1.120], respectively (see **Figure 3**). This result supports our hypothesis that indulging in nostalgia results in higher elevations of happiness following mortality-related sadness, but *only* for those low in attachment insecurity.

Discussion

Engaging in a nostalgic reflection following a mortality-related sad mood resulted in significantly *lower* mood recovery (at least in terms of decreases in sadness) than engaging in an ordinary event memory. Considered by itself, this finding did not support our associated hypothesis. Importantly, however, this effect was moderated by insecurity of attachment, such that nostalgic reflections led to *worse* recovery in people with medium to high levels of attachment insecurity (lower decreases in sadness and no effect on happiness relative to the control condition) but led to *better* recovery in people with low levels of insecure attachment (higher elevations in happiness and no effect on sadness relative to the control condition).

Nostalgic Reflections Led to Lesser Recovery from Sad Mood

Rather than nostalgic reflections benefiting participants' moods overall, we observed a relative blunting of recovery from sadness in the medium and high insecure attachment participants and no difference between nostalgic and ordinary event reflections in the low insecure attachment participants. There are several possible explanations for these effects. It may be that nostalgia is not an effective tool for regulating sadness. Its bittersweet nature may mean that while it can alleviate existential terror (Routledge et al., 2008) and boredom (van Tilburg et al., 2013), it is less effective for sadness, an emotion already associated with loss. Alternatively, it may be that the lingering of sadness combined with positive affect (we observed numerically higher rates of positive affect in the nostalgic condition, not lower, and people with secure attachments benefited from nostalgia in terms of happiness) is simply reflective of nostalgia's blended nature. Nostalgia may not nullify sadness, but rather introduce a poignant positivity to the still-present negativity.

Nostalgia might have differential effects on other, non-social-loss related negative emotions like anxiety or disgust. "Peopling one's mind" may only introduce some positivity to negative experiences when the negative experiences are specifically social. Subsequent examinations may benefit from

a consideration of the effect of nostalgia on these non-social emotions.

Second, it may be that nostalgia *was* effective in regulating emotion (all participants experienced significant decreases in sadness following the memory reflection), but the ordinary event memory may have been *even more* effective. Distraction is a very effective form of emotion regulation (Sheppes and Meiran, 2007), and thinking of a relatively neutral past event from one's everyday life may have been a welcome distraction from sadness. While having a memory-based neutral control condition is important, future designs could implement additional controls to address distraction. Moreover, the nostalgic memory may have been more cognitively demanding than the ordinary event memory and thus been associated with slower recovery from sad mood. While the reflections did not differ in the number of "past" words used, given the nature of nostalgic memory, participants in the nostalgic condition were probably calling to mind memories of events deeper in the past than the ordinary event condition.

Third, it is unclear whether these observed relationships are unique to the experience of nostalgia. For instance, it could be that one would observe these relationships for any evocation of social experiences, not just ones characterized by nostalgia. Focusing on the "rosy glow" aspect of nostalgia, it could also be that these observed relationships would be present for any over-idealized mental simulation characterized by longing, such as fantasizing about an unrequited romance or imagining quitting one's responsibilities to live on a sailboat. Given our desire to clarify the effects of *nostalgic* experiences in particular, we did not test these other possibilities. Nonetheless, these considerations highlight the fact that nostalgia is a multifaceted experience, and we need more work to investigate which specific aspects (idealization, longing, memory, negativity/positivity, sociality) are contributing to the observed relationships, as well as work that distinguishes it from similar but distinct experiences such as regret (Gilovich and Medvec, 1995) or life longings (Scheibe et al., 2007).

Effects of Nostalgia on Sad Mood Moderated by Insecurity of Attachment

When one considers the moderation effect, it appears that these main effects of nostalgia on mood recovery are being driven by those with medium to high levels of attachment insecurity. Underscoring Wildschut et al.'s (2010) past findings regarding loneliness, nostalgia's reparative effects may be reserved for those with the perception that their social connections are stable. Nostalgia may deliver warm, connected memories from the past in order to create feelings of safety and meaning for the future—but only if you can trust your relationships to remain stable into that unknown future. This finding joins a growing literature on retrospective and prospective mental simulation (Markman and Dyczewski, 2013) and is consistent with research by Cheung et al. (2013) suggesting that nostalgia might increase optimism for the future—but qualifies a boundary condition where this may only be true for those with secure attachments. In any consideration of therapeutic applications of nostalgia, especially for those struggling with losses such as bereavement, it might be worthwhile to first consider the security of a person's existing attachments so as not to inadvertently make people feel worse.

Of course, attachment insecurity is only one measure of the quality of one's social relationships. Size and quality of one's social network, perceived social support, and frequency of positive social interactions are just a few measures that could relate to either/both attachment insecurity and response to nostalgia. Moreover, past social experiences could relate to both current attachment insecurity and one's particular reaction to nostalgia. Any of these potential third variables could explain the observed relationship between attachment insecurity and nostalgia, or could contribute their own effects. Future research is indicated to tease out these complicated relationships between social history, social perceptions, and response to nostalgia.

Strengths and Limitations

Strengths of this paper include the experimentally controlled investigation of nostalgia's effects on a common and sometimes destructive mood (sadness), the inclusion of multiple channels of the emotional response (self-report, physiology), and the partial confirmation of our theoretical model predicting that nostalgia's ability to reduce negative affect and bolster positive affect after a sad mood induction may vary by one type of social connectedness (adult attachment).

In terms of limitations, we do not know whether our results are specific to sadness or generalizable to other forms of negative affect. Given that other researchers have found restorative effects of nostalgia on mortality terror (Routledge et al., 2008) and boredom (van Tilburg et al., 2013), these results may indeed be specific to mortality-related sadness. Future research will need to tease out which negative affective states are positively and negatively affected by nostalgia, including varieties of sadness not related to personal loss. Second, while we collected physiological data, our significant findings were all in the domain of self-report. As EDA is a relatively non-specific measure of autonomic arousal activity (Dawson et al., 2007), it may be that nostalgia's blend of both negative and positive emotion make this a non-ideal measure for assessing reaction to nostalgia. Third, our measure of attachment insecurity was limited in nature. Though our measure demonstrated high levels of internal consistency, these results need to be replicated with a full, psychometrically validated scale.

Fourth, we acknowledge that including our attachment measure after the sadness and memory reflections could have resulted in differential self-reported attachment levels by condition (i.e., state effects). However, we were concerned that had we included the attachment measure first, it may have primed participants to think about the security of their relationships *before* the sadness induction and memory reflection and thus altered their reactions to these manipulations. Moreover, in our design, participants engaged in a series of tasks between the memory reflection and completion of questionnaires, including writing out the content of the reflections, being detached from psychophysiological equipment, and the completion of mood ratings and other measures. Therefore, we had good reason to expect that these intermediate tasks would weaken or nullify any potential priming effects. Thankfully, the concern that our

memory manipulations would differentially impact ratings of attachment insecurity did not manifest in the present data, as there was no suggestion of differences in attachment insecurity between the nostalgic and the ordinary event conditions, $F_{(1,\ 67)} = 0.192, p = 0.663, \eta^2$ partial $= 0.003$. However, in future work we recommend that participants complete such measures in a pre-screening to avoid confounds in either direction.

Finally, while laboratory investigations of affective phenomena like nostalgia constitute an important first step, a true understanding of the role nostalgia plays in people's emotional lives will require more sophisticated methodology that explores the causes, correlates, and effects of nostalgia in an intra-individual design sensitive to the effects of situational context.

Conclusions and Future Directions

In conclusion, the poignant nature of nostalgia and the likelihood that sadness may elicit memories of loss may mean that engaging in nostalgia leads to a lingering of sadness. Intriguingly, this effect seemed to vary by one's trust in relationships, such that those with insecure attachments responded more negatively to nostalgia and those with more secure attachments respond more positively. Future research should clarify whether these effects are specific to sadness, whether subtypes of insecure attachment relate differently to nostalgia's effects, and whether choosing a nostalgic memory based on the theme of the mood induction impacts the mood effects of the nostalgic reverie.

Author Contributions

SC, RG, PO designed, conducted, and analyzed the experiment. RJ took primary responsibility for data collection. SC took primary responsibility for the written work, with contributions from RJ and PO at multiple stages of manuscript preparation.

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Supplementary Material

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/article/10.3389/fpsyg.2015.00773/abstract

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Gender differences in experiential and facial reactivity to approval and disapproval during emotional social interactions

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Negative social evaluations represent social threats and elicit negative emotions such as anger or fear. Positive social evaluations, by contrast, may increase self-esteem and generate positive emotions such as happiness and pride. Gender differences are likely to shape both the perception and expression of positive and negative social evaluations. Yet, current knowledge is limited by a reliance on studies that used static images of individual expressers with limited external validity. Furthermore, only few studies considered gender differences on both the expresser and perceiver side. The present study approached these limitations by utilizing a naturalistic stimulus set displaying nine males and nine females (expressers) delivering social evaluative sentences to 32 female and 26 male participants (perceivers). Perceivers watched 30 positive, 30 negative, and 30 neutral messages while facial electromyography (EMG) was continuously recorded and subjective ratings were obtained. Results indicated that men expressing positive evaluations elicited stronger EMG responses in both perceiver genders. Arousal was rated higher when positive evaluations were expressed by the opposite gender. Thus, gender differences need to be more explicitly considered in research of social cognition and affective science using naturalistic social stimuli.

Keywords: sex differences, social evaluation, emotion, facial electromyography, social interaction

Introduction

Gender differences have been fascinating scientists and lay people alike. Differences in physical characteristics such as height, weight, and brain size reveal a large body of literature (e.g., Faith et al., 2001; Rosenfeld, 2004; Cahill, 2006; Kirchengast and Marosi, 2008). Furthermore, the influence of cognitive abilities, behavior, and personality traits on gender differences is also well documented (e.g., Bussey and Bandura, 1999; Taylor et al., 2000; Chapman et al., 2007). However, gender differences in general reactivity to emotional stimuli such as affective pictures or films are less studied (e.g., Bradley et al., 2001; Derntl et al., 2009, 2010; Bagley et al., 2011). Research focusing on gender differences in *interpersonal emotional contexts* that examines

both the stimulus side (expresser gender) and the perceiver side (participant gender) is even more scarce. It may reasonably be argued that this scarcity of research contrasts with the multitude of gender stereotypes regarding emotions in social interactions in the general population. The present study was designed to shed more light on this issue.

Social interactions encompass a coherent set of facial expressions, vocal components, and postural/gestural markers (Keltner and Haidt, 1999; Schweinberger and Schneider, 2014). Such rich communicative cues are thought to facilitate and disambiguate communication on multiple levels. Positively valenced social interactions expressing compliments, approval, and support are thought to signal sympathy and indicate affiliation or even attraction. In contrast, negatively valenced social interactions expressing criticism, disapproval, and discouragement repel the interaction and express antipathy or even hostility. Valenced social communication has a wide ranging psychological effect on the perceiver. For instance, positive evaluations may evoke emotions of happiness and pride and positively affect self-esteem (Fleming and Courtney, 1984). Negative social evaluations represent frequent and powerful stressors, eliciting anger, sadness, fear or embarrassment that may decrease self-esteem (Leary et al., 2006). In the following, we review existing behavioral, observational, and psychometric research on how gender modulates these response patterns while distinguishing between the expression (*expresser*) and the perception (*perceiver*) side.

Gender differences in the expression of emotions during social interactions (*expresser* side) have revealed a female susceptibility of emotional expressions (Dimberg and Lundquist, 1990; Kring and Gordon, 1998). Behaviorally, women have been shown to express positive evaluations like compliments more frequently than men (Holmes, 1993), possibly to enhance bonding with their interaction partners (Brown and Levinson, 1987) whereas men utilize compliments less often (Holmes, 1993). In contrast, negative social evaluations are used by both genders with similar frequency (Björkqvist et al., 1992). Furthermore, differences of emotion expressivity also depend on context and nature of the expressed emotion: women report more sadness, fear, shame or guilt and tend to engage more in related expressive behaviors in social encounters whereas men tend to exhibit more aggressive behavior than women when they feel angry (Biaggio, 1989; Pasick et al., 1990; Sharkin, 1993; Fischer et al., 2004a; Carré et al., 2013). Regarding the etiology of such gender differences both biological and cultural accounts have been put forward (Buck et al., 1974; Ekman and Friesen, 1982). Regarding the latter, the influence of social *display rules* may modulate an emotional response displayed by facial expressions (Buck, 1984). For instance, the expression of negative emotions might be more culturally acceptable for men than for women. Regarding the first (biological account), it is important to consider the evolutionary importance of mating situations and the role of positive expressions between opposite sex interaction partners to support affiliation and mating. Consistent with this account, emotional facial expressions of the opposite gender have been shown to result in faster detection times than emotional facial expressions of one's own gender (Hofmann et al., 2006).

When perceiving negative emotions and evaluations (*perceiver* side) involving verbal aggression, women tend to attribute these to stress and the loss of self-control whereas men tend to view aggressive behavior as a tool to control others and demonstrate status (Campbell and Muncer, 1987). In response to positive evaluation, by contrast, men feel uncomfortable especially when perceiving them as compliments (Holmes, 1993). Gender differences have also been observed for accuracy of facial expression recognition and results mostly indicate better performances of women regardless of the displayed emotion (Thayer and Johnson, 2000; Hall and Matsumoto, 2004; Guillem and Mograss, 2005) and allegedly documenting the superiority of women in social communicative skills. However, several studies did not replicate these differences (for review see Kret and De Gelder, 2012) suggesting that the discrepancy between women and men might be task-related. In fact, in simple emotion recognition tasks with intense facial expressions women and men show similar performances (Lee et al., 2002; Hoheisel et al., 2005; Habel et al., 2007). In addition, women tend to exhibit better performances in recognizing self-conscious emotions (e.g., pride, Tracy and Robins, 2008) whereas men seem to be faster in recognizing anger (Biele and Grabowska, 2006).

Gender differences have not only been examined on subjective but also on physiological measures. Facial electromyography (EMG) research has shown rapid and spontaneous mirroring of emotional expressions in static facial displays (Buck, 1984; Dimberg, 1997) and may therefore contribute to answering questions regarding gender differences. Specifically, positive facial expressions such as happiness evoke increased zygomaticus major muscle activity (lifting the lips to smile) in contrast to negative facial expressions such as anger which elicit increased corrugator supercilii muscle activity (responsible for frowning; Dimberg, 1990). Research examining basic emotions by using short video clips, revealed that the corrugator muscle showed increased activity to expressions of anger, sadness, and disgust, and pronounced relaxation toward happy expressions (Hess and Blairy, 2001). Several studies investigating gender differences utilized static emotional faces and found that women generally exhibited greater facial EMG responses which were most pronounced to positive facial expressions (Dimberg and Lundquist, 1990). In contrast, research using general emotional images from the International Affective Picture System (IAPS; Lang et al., 1997) did not show differences in facial EMG activity between genders (Bianchin and Angrilli, 2012). However, it is important to note that research has also put forward a dynamic facial expression approach to better represent social encounters and observed greater emotion consistent EMG activity to dynamic as compared to static expressions (e.g., Weyers et al., 2006). Importantly, dynamic facial anger expressions of avatars elicited increased corrugator muscle activity in male perceivers whereas dynamic facial happy expressions elicited higher zygomaticus muscle activity in female perceivers (Soussignan et al., 2013).

Two relevant aspects have largely been neglected in the research reviewed above. First, the perceiver and the expresser perspective have rarely been considered jointly (Biaggio, 1989; Lee et al., 2002; Hall and Matsumoto, 2004; Guillem and Mograss, 2005; Bianchin and Angrilli, 2012; Carré et al., 2013). Obtaining a complete picture of social interactions requires fully crossing perceiver and expresser gender in a 2 (perceiver gender) × 2 (expresser gender) design. Second, static images of emotional facial expressions lack the dynamic complexity of naturalistic social-emotional interactions and therefore have limited external validity. Interestingly, Kret et al. (2011) showed increased brain activation in a widespread network including the fusiform gyrus, superior temporal sulcus, and the extrastriate body area in men compared to women by using different stimulus material such as postures vs. faces. Male observers showed these increased activation patterns particularly when exposed to threatening vs. neutral male body postures but not to facial expressions. This study evidenced the importance of considering the interaction of gender and specific stimulus types in emotion perception research. In line with this, some researchers have recently called for 'more naturalistic stimuli' and that 'taking into account the sex of the actor could provide further insight into the issues at stake'(Kret and De Gelder, 2012, p. 1212). Addressing these aspects we have recently developed a naturalistic video set (Blechert et al., 2013) aiming at maximizing external validity within the laboratory context. This video set (termed *E.Vids*) is balanced in gender to facilitate perceiver gender × expresser gender studies. Emotional valence-specific subjective, facial, and neural (electrocortical, hemodynamic) responses have been documented for this video set (Blechert et al., 2013; Reichenberger et al., 2015; Wiggert et al., 2015).

Based on previous findings, we expected that videos with negative expressions of male actors compared to female actors will be rated as more unpleasant and arousing by both female and male perceivers (Blechert et al., 2013; Reichenberger et al., 2015; Wiggert et al., 2015). In contrast, we expected that videos with positive expressions of female actors compared to male actors will be rated as more pleasant and arousing by both female and male perceivers. To the degree that these experiential effects translate into specific facial expressions (Rinn, 1984; Cacioppo et al., 1992; Bunce et al., 1999; Neumann et al., 2005), more positive valence ratings should be reflected by increased zygomaticus muscle activity and more negative valence should be reflected by increased corrugator muscle activity. Moreover, these effects may be modulated by perceiver gender. For instance, women may respond more negatively to negative evaluations delivered by men. Likewise, positive evaluations may be perceived as more pleasant and arousing when expressed by the opposite actor gender, both contributing to a three-way Emotion condition × perceiver gender × expresser gender interaction effect. The present study allows for a reexamination of gender differences in response to neutral and negatively valenced social stimuli (mainly based on static images). Furthermore, this study extends previous research by including positively valenced and naturalistic stimuli in a fully crossed, participant gender X stimulus gender design. Finally, following a multi-method approach, both experiential as well as facial-muscular responses are collected.

Materials and Methods

Participants

A sample of 58 participants (32 female) with an average age of 22.9 years ($SD = 2.5$) was recruited through online advertisement and in psychology classes. Participants reported no current mental or neurological disorders, no current use of prescriptive medication except contraceptives, and no current alcohol or drug dependence. Men and women did not differ in age, years of education or body mass index (BMI), $ts(56) < 1.13$, $ps > 0.061$. Eligible participants read and signed a consent form that was approved by the ethics committee of the University of Salzburg and received monetary compensation or course credit for participation.

Video Set

The *E.Vids* video set (Blechert et al., 2013) comprises 3000 ms duration videos of eight negative, eight neutral, and eight positive sentences delivered by 20 actors (10 female) alongside the respective facial and gestural expressions in a naturalistic untrained manner. Negative sentences were chosen to express social criticism/disapproval (e.g., "I hate you", "You are embarrassing!"), whereas positive sentences were chosen to express compliments and approval (e.g., "I'm proud of you", "You've got it!") and neutral sentences express neutral conditions (e.g., "It's 4 o'clock.", "The train goes fast."). Expressers were instructed to act spontaneously and naturalistically and to speak directly to the camera to facilitate the perception of a real interaction in observers. Each video started with a neutral facial expression, which transitioned into the sentence with an associated facial expression after an average of 602.50 ms ($SD = 220.32$ ms). The present study utilized all sentences of 18 of the 20 expressers of *E.Vids*.

Stimulus-Condition Assignment

In research with static faces multiple expresser identities are used for displaying different basic emotions. The emotional condition matches the expresser identity with relevance for *emotion recognition* (e.g., Phillips et al., 1998; Goeleven et al., 2008). It may reasonably be argued that assessing *emotion reactivity* should incorporate unequivocal condition and expresser assignment. Thus, in the present task, a given expresser was always (and repeatedly, but different sentences) presented within one emotional condition (negative or neutral or positive) for a given participant but expressers 'cycle' through conditions across participants (Pejic et al., 2013; Hermann et al., 2014) to avoid confounding expresser identity with emotional condition. Another unique feature of the present stimulus set is that the sentences spoken by a given expresser within one condition vary for a given perceiver (five out of eight sentences). This allows us to create a more varied and supposedly more capturing/naturalistic experience of the stimuli. The present passive viewing task included 90 different expresser/sentence combinations in 30

neutral, 30 negative, and 30 positive videos. In each of these three conditions, each perceiver watched six different expressers (three male) delivering five different sentences (to validate the whole stimulus set a different set of five sentences were drawn from the eight sentences available for each condition so that, across perceivers each sentence was presented with equal frequency).

Procedure

The laboratory assessment started with sensor application for peripheral physiological measurements followed by a 4-min quiet sitting baseline and a 3-min heartbeat perception phase (results not reported here). Before the start of the task, perceivers (participants) were asked to imagine a real interaction with the displayed expressers. This was done to facilitate emotional engagement with the stimuli (Blechert et al., 2012, 2015). The 90 three-second videos were presented on a 23-inch LCD monitor with a resolution of 1920 × 1080 pixel and 120 Hz refresh rate, using E-Prime 2.0 Professional (Psychology Software Tools, Inc., Sharpsburg, PA, USA). The intertrial interval varied randomly between 5600 and 6400 ms. Video volume (delivered via external active speakers (X-140 2.0 PC-speaker system 5 W RMS, Logitech, Apples, Switzerland) was constant across perceiver. After completion of the task and sensor removal, perceiver completed several questionnaires and were then debriefed and compensated (10€) for participation.

Self – Report Measures

Valence and arousal self-reports were assessed via a horizontal on-screen visual analog scale ("How would you feel meeting this person?"). Immediately following each video, perceivers were asked to rate their emotional response to the stimulus by indicating (un)pleasantness (0 = pleasant to 100 = unpleasant) and arousal (0 = calm to 100 = aroused/excited).

Psychophysiological Measures: Recording, Offline Analysis, and Response Scoring

Psychophysiological data were recorded with a REFA 8-72 digital amplifier system (TMSi) with 24 bits resolution at 400 Hz, streamed to disk and displayed on a PC monitor for online monitoring of data quality. Facial EMG electrodes for the bipolar recording of the corrugator supercilii and zygomaticus major activities were placed according to international guidelines (Fridlund and Cacioppo, 1986) on the left side of the face. *Offline data inspection* and manual artifact rejection for EMG was done in ANSLAB 2.6, a customized software suite for psychophysiological recordings (Wilhelm et al., 1999; Wilhelm and Peyk, 2005). EMG preprocessing comprised a 28 Hz high-pass filter, a 50 Hz notch filter, rectification, low pass filtering (15.92 Hz), and a 50 ms moving average filter. Responses were defined as averages across the 3000 ms of the video plus one second after video-end (interval before ratings, since preliminary analyses revealed continued responding after video offset) referenced to a 2000 ms baseline immediately before start of the video. Separate averages were created for all positive, negative, and neutral videos as well as for expresser gender.

Data Reduction and Statistical Analysis

Subjective ratings of valence and arousal were analyzed in two separate 2 (Expresser gender: male vs. female) × 3 (Condition: positive, neutral, negative) × 2 (Perceiver gender: male vs. female) repeated measures analyses of variance (ANOVAs) with perceiver gender as a between subject factor. The EMG measures of the corrugator and the zygomaticus muscle activity were submitted to two separate repeated measures ANOVAs as described for subjective ratings. The alpha level for all analyses was set to 0.05 and significant main or interaction effects were followed up using pairwise comparisons for repeated measure designs applying the Sidák correction (Mean differences = *MeanDiff*, significance levels, and 95% confidence intervals (CI) are displayed). Effect sizes are reported as partial eta squared η_p^2. When sphericity assumption was violated in ANOVAs, the Greenhouse-Geisser correction for repeated measures was applied with nominal degrees of freedom and epsilon ε being reported. All statistical analyses were performed using PASW Statistics 21 (SPSS Inc., Chicago, IL, USA).

Results

Self-Report Measures

Valence

The 2 (Expresser gender: male vs. female) × 3 (Emotion condition: negative, neutral, positive) × 2 (Perceiver gender: male vs. female) repeated measures ANOVA of valence revealed a main effect of Expresser gender, $F(1,56) = 4.16$, $p = 0.046$, $\eta_p^2 = 0.07$, with male expressers being perceived as more unpleasant than female expressers (*MeanDiff* = 0.92, $p = 0.046$, 95% $CI_{\text{male expresser}-\text{female expresser}}$ [0.017, 1.83]). As expected from previous research with this stimulus set, there was a main effect of Emotion condition, $F(2,112) = 351.00$, $p < 0.001$, $\eta_p^2 = 0.86$, $\varepsilon = 0.69$. Negative videos were rated as more unpleasant than neutral videos, which in turn were rated as more unpleasant than positive videos (*MeanDiffs* > 24.80, *p*s < 0.001, 95% $CI_{\text{neg-neu}}$ [25.80, 34.69], 95% $CI_{\text{neu}-pos}$ [20.89, 28.72]; **Figures 1A,B**). However, no main effect of Perceiver gender, $F(1,56) = 0.003$, $p > 0.05$ and no interactions of Expresser gender x Emotion condition or Perceiver gender × Emotion condition, *Fs* < 2.16, *p*s > 0.121, emerged.

Arousal

The ANOVA of arousal ratings revealed a significant Emotion condition effect, $F(2,108) = 100.52$, $p < 0.001$, $\eta_p^2 = 0.65$ showing that negative videos were rated as more arousing than positive and neutral videos (*MeanDiffs* > 23.79, *ps* < 0.001, 95% $CI_{\text{neg-neu}}$ [27.99, 41.20], 95% $CI_{\text{neg-pos}}$ [18.24, 29.35]). In addition, negative and positive videos were rated as more arousing than neutral videos (*MeanDiffs* > −34.60, *p*s < 0.001, 95% $CI_{\text{neu-neg}}$ [−41.20, −27.99], 95% $CI_{\text{neu-pos}}$ [−17.05, −4.56]) indicating that emotional videos elicit more arousal than

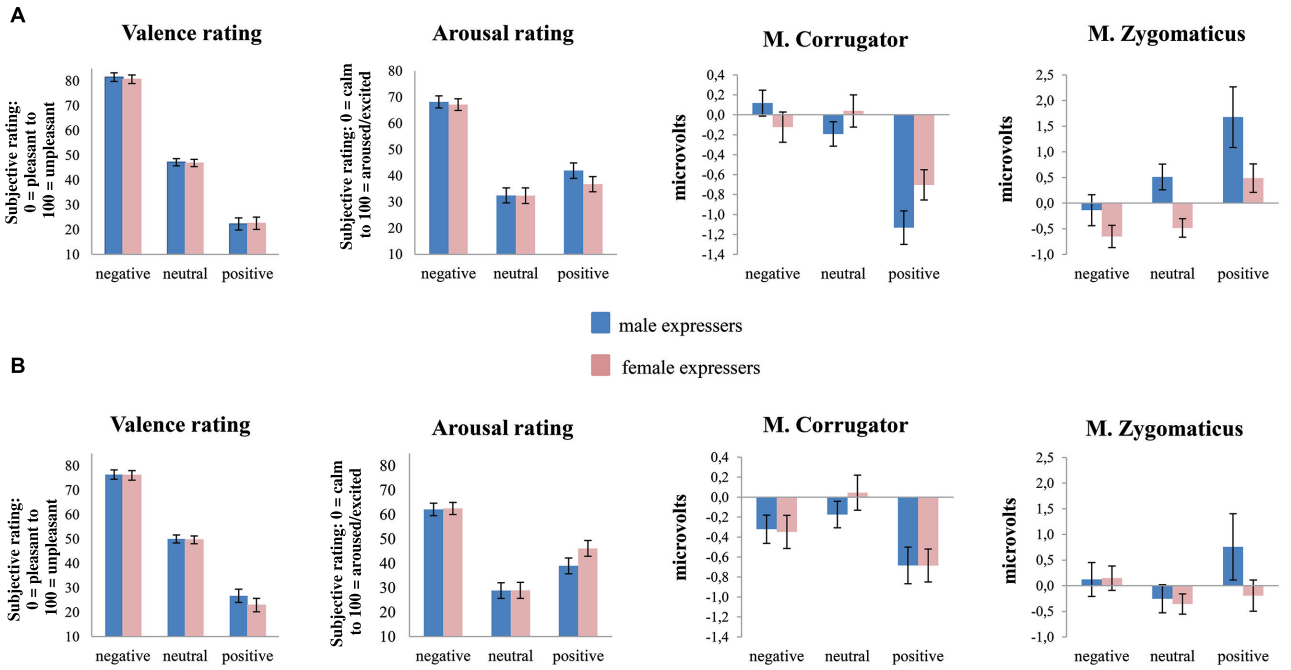

FIGURE 1 | (A) Shows response patterns of female participants for valence and arousal ratings as well as M. corrugator and M. zygomaticus activity as a facial expressive response to emotion-evocative video-clips (negative, neutral, positive). **(B)** Shows response patterns of male participants for valence and arousal ratings as well as M. corrugator and M. zygomaticus activity. Line bars indicate standard error.

neutral videos. Moreover, a significant two-way interaction by Expresser gender × Perceiver gender $F(1,54) = 12.00$, $p = 0.001$, $\eta_p^2 = 0.18$ as well as a significant three-way interaction of Expresser gender × Emotion condition × Perceiver gender, $F(2,108) = 9.63$, $p < 0.001$, $\eta_p^2 = 0.15$, $\varepsilon = 0.88$, emerged. In line with our hypotheses, follow-up analyses showed that female perceivers rated positive videos of male expressers as more arousing than those of female expressers (*MeanDiff* = 5.28, $p = 0.014$, 95% $CI_{\text{male expresser-female expresser}}$ [1.12, 9.43]; **Figure 1A**) with a reverse pattern in male perceivers: they rated positive videos of female expressers as more arousing than those of male expressers (*MeanDiff* = 7.14, $p = 0.002$, 95% $CI_{\text{male expresser-female expresser}}$ [2.68, 11.60]; **Figure 1B**).

Facial EMG

Corrugator Supercilii Muscle

The 2 (Expresser gender: male vs. female) × 3 (Emotion condition: negative, neutral, positive) × 2 (Perceiver gender: male vs. female) repeated measures ANOVA revealed a significant Emotion condition effect, $F(2,110) = 24.24$, $p < 0.001$, $\eta_p^2 = 0.31$, with positive videos eliciting consistent corrugator muscle relaxation in both perceiver genders (*MeanDiffs* > −0.73, *ps* < 0.001, 95% $CI_{\text{pos-neg}}$ [−0.94, −0.32], 95% $CI_{\text{pos-neu}}$ [−1.02, −0.44]) relative to the other two conditions which in turn were not different from each other (*MeanDiff* = −0.10, $p = 0.676$). Moreover, significant Emotion condition × Perceiver gender, $F(2,110) = 3.13$, $p = 0.048$, $\eta_p^2 = 0.05$, and Emotion condition × Expresser gender interactions, $F(2,110) = 6.78$, $p = 0.002$, $\eta_p^2 = 0.11$, occurred. Both two-way interactions were qualified by a three-way interaction, $F(2,110) = 4.37$, $p = 0.015$, $\eta_p^2 = 0.07$ (**Figures 1A,B**). The three-way interaction was due to stronger condition effects in female perceivers, particularly when confronted with male expressers: Only in this combination (female perceivers/male expressers) all three conditions reliably differed (*MeanDiffs* > −1.25, *ps* < 0.001, 95% $CI_{\text{pos-neg}}$ [−1.71, −0.79], 95% $CI_{\text{pos-neu}}$ [−1.34, −0.54]) with an increase from positive to neutral to negative evaluations.

In contrast, male perceivers did not show different corrugator muscle responses for male vs. female expressers (*MeanDiff* = −0.06, $p = 0.479$) but different condition responses were also found in male perceivers, $F(2,50) = 10.16$, $p < 0.001$, $\eta_p^2 = 0.29$, with unexpected larger corrugator relaxation to positive compared to neutral videos (*MeanDiff* = 0.63, $p = 0.002$, 95% $CI_{\text{neu-pos}}$ [0.19, 1.05]). In sum, corrugator activity suggested that male expressers elicit linear and strong emotion effects in female perceivers, with an overall special role for positive sentences (**Figure 1A**).

Zygomaticus Major Muscle

This pattern was partially mirrored by zygomaticus activity, the 2 (Expresser gender: male vs. female) × 3 (Emotion condition: negative, neutral, positive) × 2 (Perceiver gender: male vs. female) repeated measures ANOVA revealed a significant Emotion condition effect, $F(2,110) = 6.70$, $p = 0.004$, $\eta_p^2 = 0.11$, $\varepsilon = 0.81$, indicating that positive videos elicited smiling in both perceiver genders (*MeanDiffs* > 0.81, *ps* < 0.026, 95% $CI_{\text{pos-neg}}$ [0.08, 1.55], 95% $CI_{\text{pos-neu}}$ [0.15, 1.51]) relative to the other two conditions which in turn were not different from each

other (*MeanDiff* = 0.01, $p = 1.00$) The significant Emotion condition × Perceiver gender interaction, $F(2,110) = 3.38$, $p = 0.048$, $\eta_p^2 = 0.06$, $\varepsilon = 0.81$ revealed that female perceivers showed more reliable and condition consistent zygomaticus responses (paralleling corrugator muscle findings) than male perceiver. Pairwise comparisons revealed that female perceivers' zygomaticus muscle activity showed increasing responses from negative to positive and from neutral to positive conditions, irrespective of expresser gender (*MeanDiffs* > 1.07, *ps* < 0.018, 95% $CI_{pos\text{-}neg}$ [0.48, 2.47], 95% $CI_{pos\text{-}neu}$ [0.15, 1.99]; **Figure 1A**). In male perceivers Emotion condition effects did not reach significance (*MeanDiffs* < 0.59, $p > 0.311$) regardless of expresser gender. The Emotion condition × Expresser gender interaction, $F(2,110) = 5.47$, $p = 0.009$, $\eta_p^2 = 0.09$, $\varepsilon = 0.84$ revealed that positive videos of male expressers triggered enhanced smiling responses in both perceiver genders in the positive video condition relative to neutral or negative videos (*MeanDiffs* > 1.09, *ps* < 0.020, 95% $CI_{pos\text{-}neg}$ [0.29, 2.16], 95% $CI_{pos\text{-}neu}$ [0.14, 2.04]; **Figures 1A,B**) which was underlined by the main effect of Expresser gender, $F(1,55) = 11.84$, $p = 0.001$, $\eta_p^2 = 0.18$. However, the three-way interaction was not significant, $F(2,110) = 0.83$, $p = 0.440$.

None of the dependent variables were significantly correlated (all *ps* > 0.05).

Discussion

Gender differences are biologically and culturally influenced (Rudman and Glick, 2010) and multiple different approaches have been put forward for their explanation. However, a large number of inconsistent findings challenge the test of their respective validity. The current study aimed to contribute to further clarify this issue. We addressed several limitations of previous research by studying social interactions considering both the expresser and the perceiver gender using a well validated, naturalistic emotion-evocative, social-evaluative video set.

Self-Report Data

In line with our prediction, we found an opposite sex preference for positive sentences (compliments/approval) on arousal ratings supporting an unequivocal interpretation that both genders are more open to such evaluation when expressed by the opposite sex, even if these are not explicitly sexual in nature. This result is in line with previous research in the context of gender differences and positive emotions (e.g., Hofmann et al., 2006). Thus, an arousal effect by the opposite gender is generally consistent with the biological evolutionary approach emphasizing that mating strategies supporting reproduction influence positively valenced communication between the sexes (cf., Darwin, 1871). Possessing positive traits, expressing them, and perceiving them in potential opposite-sex mates have evolutionary significance since they predict successful partnership and can be passed on to the offspring. Positive statements of the opposite gender elicit excitement and associated physical arousal may support effort of approach. Interestingly, valence ratings did not show this distinct pattern of gender differences, possibly because ratings of pleasantness of expresser videos were more influenced by idiosyncratic preferences. However, valence ratings underlined the expected emotional condition effects in both perceiver genders indicating more subjective pleasantness toward positive evaluations and more unpleasantness toward negative evaluations.

EMG Responses in the Context of One's Own Gender Evaluations

Corrugator and zygomaticus muscles showed distinct activity patterns of perceiver genders in relation to expresser genders. In the context of one's own gender, female perceivers exhibited an increasing corrugator response from positive to negative evaluations of female expressers. This was partially mirrored by the zygomaticus activity decreasing from positive to negative female evaluations. Similarly, male perceivers exhibited an analog pattern from positive to negative evaluations of male expressers. Both perceiver genders showed the expected valence consistent zygomaticus response to positive evaluations (smiling). This suggests that positive evaluations conveying acceptance and appreciation may elicit positive emotions such as happiness and pride which in turn may elevate self-esteem (Fleming and Courtney, 1984). However, both perceiver genders did not display the expected "frowning" response of the corrugator muscle to negative evaluations of their own gender. According to research of *emotional mimicry* which is conceptualized as a tendency to imitate the emotional expression of interaction partners particularly when people are motivated to bond with each other (Hess and Fischer, 2013), positive emotion displays are assumed to be mimicked whereas facial expressions perceived as offensive, are not mimicked (Fischer et al., 2012). In the present study, a happy face may have been mimicked by the perceiver because it was accompanied by positive evaluations which underline an affiliative intention. In contrast, negative evaluations of one's own gender may have been considered as particularly hostile leading to an inhibition of facial responding.

EMG Responses in the Context of Opposite Gender Evaluations

Interestingly, in the context of opposite gender evaluations, female perceivers were most responsive to male expressers, with corrugator activity increase from positive to neutral and from neutral to negative. This was further supported by the zygomaticus activity indicating an activity increase from negative to neutral and from neutral to positive evaluations. This is in line with prior research suggesting that facial expressions have been associated with higher emotional responses to happiness and anger in female than male perceivers (Biele and Grabowska, 2006). The evolutionary approach (Darwin, 1871) may point toward a particular female sensitivity to affective states of potential male partners and future caregivers. Women may respond more accurately and faster to anger expressions of men because the often physically stronger men may represent greater threats than women (for an overview see, Rudman and Glick, 2010). Additionally, female perceivers have been reported to exhibit an enhanced corrugator muscle activity compared to men when exposed to anger-eliciting stimuli (Schwartz et al., 1980;

Kring and Gordon, 1998; Bradley et al., 2001). In contrast, other studies have shown that men respond faster and more precisely to anger eliciting stimuli specifically when those are posed by other males (Goos and Silverman, 2002; Seidel et al., 2010). This is incongruent to the present finding of male perceivers who only responded differentially to positive evaluations regardless of the expresser gender. This particular finding may suggest that compliments expressed by men are scarce in Western societies (Holmes, 1993) and therefore it may have demonstrated a more pleasant and surprising event leading to increased smiling by both perceiver genders toward positive social evaluations of male expressers.

According to the more distinctively emotional facial muscular responses in female than male participants, women were overall more emotionally responsive than men. This is in line with our expectation and the majority of studies investigating gender differences in emotionality using EMG and facial expressions (e.g., Greenwald et al., 1989; Thunberg and Dimberg, 2000; Bradley et al., 2001). Furthermore, according to the biological approach, those gender differences of responsiveness may also be due to differences in *emotional contagion* which is defined as "catching another person's emotion" (Hatfield et al., 1993), automatically mimic this emotion, and in turn through interoceptive feedback mechanisms also feeling this emotion (Flack, 2006). Positive associations between facial imitative responses and empathy have been revealed in previous research (Sonnby-Borgstrom, 2002; Sonnby-Borgstrom et al., 2003) where women tend to exhibit higher empathy scores than men (Baron-Cohen and Wheelwright, 2004; Rueckert and Naybar, 2008; Derntl et al., 2010).

Unexpectedly, male expressers of positive social evaluations elicited higher responses (on corrugator and zygomaticus activity), specifically when perceived by women (corrugator activity). This result is contrary to our expectation and previous findings showing faster responses in women to angry male faces (Rotteveel and Phaf, 2004) and stronger responses and activation patterns in specific brain areas (e.g., ACC, visual cortex) in men to threatening male stimuli (Mazurski et al., 1996; Fischer et al., 2004b). However, Seidel et al. (2010) showed that happy male faces were rated more positively than happy female faces, in contrast to angry and disgusted male faces that were rated more negatively than female faces. Our current subjective ratings do not match those previous findings but facial muscle activity partially matches this set of prior subjective results. Although such discrepancies are commonplace and not always well understood, they point to the fact that much of our non-verbal communication is not well represented in our conscious experiential systems. This indicates that some populations might show dysfunctional facial-communicative behavior without explicitly being able to report or become aware of this discrepancy, leading to ambivalent or disturbing expressions or perceptions. Concordance between self-report and psychophysiological measures is often low which highlights the importance of assessing variables from both domains in emotion research (Evers et al., 2014).

It has been suggested that women are generally more emotionally expressive than men (Kring and Gordon, 1998) but as reviewed above, angry male faces tend to elicit stronger responses in both genders. According to our results, male expressers eliciting stronger responses is not limited to negative social evaluations but encompasses positive social encounters as well. Stimulus differences may explain the extended finding in the positive emotion condition. Prior research predominantly utilized basic facial emotions, thus disregarding social environments/contexts and higher-order emotions such as pride, appreciation or embarrassment. However, research has shown that gender differences in expressive behavior are context-dependent, socialized due to display rules, and emotion-dependent (for review, Kret and De Gelder, 2012). The majority of experienced emotions in our daily lives occurring in social interactions appear to be dynamic and multifaceted in nature rather than static and similar. Hence, our study is emphasizing naturalistic, dynamic stimuli with multimodal expressions (speech, gesture, and movements).

Limitations

Our study has several limitations. We did not assess sexual orientation of participants. Furthermore, assessing contraceptive use and cycle phase in women, which have been associated with emotion recognition (Derntl et al., 2008, 2013) may further clarify variances in emotion reactivity in women. Additionally, the measurement of more facial EMG channels could give further insight to the involvement of specific emotions (for review see, Hess and Fischer, 2013). Future research may utilize this stimulus set for facial action coding (Ekman and Friesen, 1978) to more precisely map emotion expressions relating to social interactions. In this context we cannot rule out differential cognitive emotion regulation strategies in men and women. It is generally difficult in this type of research to disentangle emotion reactivity due to emotional contagion from emotional mimicry. Furthermore, the sample here was chosen to match age of the actors. Language of the stimuli was age – appropriate for university students between 20 and 30 years. Thus, the present results are probably more applicable to this age group and to peer – interaction. Other age groups or between generation interaction might well show different response patterns. This limits the generalization of the results and points to new avenues of research.

Conclusion

In summary, the current study contributes to further clarification of gender differences in emotional social interactions utilizing a more ecologically valid and naturalistic paradigm. Specifically, in the positive social evaluation condition, valence congruent facial muscular responses of both perceiver genders have been displayed. Furthermore, this study takes the first step in revealing pronounced positive expressive communication patterns in men (male expressers) during social interactions. Therefore, gender differences in positive social encounters associated with both perspectives (perceiver and expresser) deserve more attention in future research.

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Supplementary Material

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Children's spontaneous emotional expressions while receiving (un)wanted prizes in the presence of peers

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Although current emotion theories emphasize the importance of contextual factors for emotional expressive behavior, developmental studies that examine such factors are currently thin on the ground. In this research, we studied the course of emotional expressions of 8- and 11-year-old children after winning a (large) first prize or a (substantially smaller) consolation prize, while playing a game competing against the computer or a physically co-present peer. We analyzed their emotional reactions by conducting two perception tests in which participants rated children's level of happiness. Results showed that co-presence positively affected children's happiness only when receiving the first prize. Moreover, for children who were in the presence of a peer, we found that eye contact affected children's expressions of happiness, but that the effect was different for different age groups: 8-year-old children were negatively affected, and 11-year-old children positively. Overall, we can conclude that as children grow older and their social awareness increases, the presence of a peer affects their non-verbal expressions, regardless of their appreciation of their prize.

Keywords: emotional expressions, contextual factors, social presence, development, (re)appraisals, mistaken-gift-paradigm, dissappointment

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Introduction

In December 2011, an enormous hit on YouTube followed when an American talk show host, Jimmy Kimmel, asked members of his audience to film their kids when they were given a Christmas present their parents were sure they would not like (Jimmy Kimmel Live! ABC 2011). While unwrapping their brand new onion or deodorant stick, most children screamed, got rather upset and eventually threw the unwanted gift away. However, when they were in the company of a sibling, the children's reactions tended to alter considerably, in that, depending on the context, the presence of the other child occasionally seemed to increase the level of frustration, or, interestingly enough, turn the child's initial disappointment into a more positive feeling. This was especially the case when their brother or sister was given a present that the child would judge as a (slightly) better or worse alternative. In of one of the Jimmy Kimmel video clips[1], a boy appeared to be relatively excited about the Christmas present he received, a well-sized potato, as he seemed to judge this as a better gift than his older brother's, who got paper letters spelling "3DS" (which is the name of a then popular game console). While his younger brother appeared

[1]The Jimmy Kimmel fragment can be found on YouTube, via the link https://www.youtube.com/watch?v=yWXKUPt7a-U

to get more and more content with his gift, the older boy seemed to become more distressed with his own. Perhaps, observing the enjoyment of his younger brother was important for the boy's evaluation of his own gift.

This example demonstrates that the presence of a peer may urge children to express their feelings more intensely, in either a positive or negative direction. It is likely that if both siblings in the Jimmy Kimmel fragment had been alone while unpacking their gifts, their emotional expressions would have been different, since they would not have to take each other's disappointment or enjoyment into account for the evaluation of their own present. Indeed, a review of existing theories of emotion reveals that researchers have claimed that external factors like social context may affect the way emotions are expressed (e.g., Frijda, 1986; Russell and Feldman Barrett, 1999; Scherer et al., 2001; Scherer, 2009; Mumenthaler and Sander, 2012). However, to our knowledge, so far no studies have examined how these context-dependent emotion theories apply to the way other people's responses affect children's emotional expressions. In this study, we concentrate on three factors that may influence children's non-verbal expressions.

The first factor we consider is the presence or absence of a peer, where we examine whether this influences how children display different emotional expressions in response to disappointing or satisfying presents. In general, children may be expected to react politely (e.g., by smiling) when they receive a present, regardless of whether they appreciate it or not (e.g., Kieras et al., 2005). Earlier studies on this topic focused on factors like age (Saarni, 1984; Cole, 1986; Garner and Power, 1986; Kieras et al., 2005; Kromm et al., 2015), culture (Garrett-Peters and Fox, 2007), the presence of parents (Zeman and Garber, 1996) and particular response strategies children may use when receiving a disappointing gift (Baaken, 2005; Tobin and Graziano, 2011). Surprisingly, to the best of our knowledge, no research has focused on the presence of peers when expressing emotions when receiving presents, although it is known that children in general tend to be more expressive when a peer is present (Zeman and Garber, 1996; Shipman et al., 2003; Shahid et al., 2008). Moreover, the presence of an audience, like co-present peers, when receiving reward appears to increase the tendency toward moralistic punishment and one interpretation of this is that an audience may enhance the desire for fairness (Kurzban et al., 2007). Therefore, in the current study, we will take the presence of peers into account when examining emotional expressions after receiving presents.

Secondly, we consider to what extent this effect of peers on children's expressive behavior interacts with age as a potential factor. Children's social awareness is known to develop fundamentally between the age of 8 and 11 (Saarni, 1981, 1984). In the Jimmy Kimmel example, the likability of the gift seemed to affect the older sibling's emotional expressions more than those of the younger boy. Perhaps, the latter did not consider the potato to be the most desirable gift, but he might just have been less aware of his brother's emotional state than vice versa. In view of theories of developmental differences in social awareness, we may expect older children to be more affected by the presence of a peer than younger ones in their emotional responses (e.g., Piaget, 1950; Saarni, 1984; Ekman, 1992). Indeed, in earlier studies, we found that for 8-year-old children, the social context they found themselves in was of less relevance for the way they expressed their emotions than it was for 11-year-old children (Visser et al., 2014a,b). The current study aims to further explore whether 8-year-old children would express their emotions differently from 11-year-old children, as a function of the event that leads to this emotion (receiving a disappointing or a satisfying present) and the context (in the absence or co-presence of a peer).

Finally, we explore how these emotional expressions may change in the course of a child's response, where we are specifically interested in the extent to which changes in their assessment of the social context have an impact on the child's expressive behavior. The Jimmy Kimmel example demonstrated that children's initial reaction may differ from their later reaction, which appeared to depend on the fact that they became more aware of their peer's reaction to their Christmas gift. Indeed, emotional expressions are not static experiences, but progress over time (Scherer, 2009). The relative influence of different factors may change in the course of emotional reactions, as people reconsider motives for expressing their emotions in a certain way (Banse and Scherer, 1996; Scherer, 2009). Therefore, we examine how children's expressions change as a function of how they assess their social context, in particular when they compare their own present with the one another person has just received. We operationalize this by focusing on participants' expressive behavior before and after they make eye contact with their peer. Before we describe the study in more detail, we first present a short discussion of relevant earlier research.

Background

A large part of earlier research on emotion has focused on discrete, basic emotions and their universal character (e.g., Tomkins, 1962; Izard, 1971; Ekman, 1992; Darwin, 1998). Discrete emotion theories suggest that children learn to express their emotions through affect programs (Ekman, 1992). These programs are directly linked to the motivational cognitive system and provide people with the ability to experience six prototypical emotions, or a combination of those, which may be accompanied by specific facial expressions (Tomkins, 1962). According to such discrete emotion theories, facial expressions of emotion are considered as universal and similar for all individuals. However, this implication has been questioned by several other (dimensional) approaches on emotions. For example, Russell and Feldman Barrett (1999) started with referring to named emotions (like anger or sadness) as prototypical episodes of core affects (affective feelings), which are not necessarily defined as "basic" or similar to all individuals. According to their theory, emotions are supposed to vary on a continuum of two factors, arousal (passiveness to activeness) and valence (unpleasantness to pleasantness).

Recently, emotion research has been focusing on subjective aspects of emotions, and various studies showed that an individual's evaluation of a situation may also have an

impact on emotional expressions (e.g., Parkinson, 1996; Scherer and Ellgring, 2007; Scherer, 2009; Mumenthaler and Sander, 2012; Fernández-Dols and Crivelli, 2013). According to the componential model of emotions (e.g., Scherer and Ellgring, 2007; Scherer, 2009), emotions are defined as on-going processes in which individuals are continuously estimating and evaluating the significance of situations for their well-being. Various characteristics of the situation may be important for emotion elicitation; for example, the novelty, pleasantness and relevance of the event determine to a large extent the valence and intensity of any emotional response. In this way, emotional expressions are not universal *per se*, but constructed by an individual's subjective assessment (or *appraisal*) of a situation, which depends on the validation of personal needs, goals and values (e.g., Frijda, 1986; Scherer et al., 2001; Scherer, 2009; Mumenthaler and Sander, 2012). As a result, different people may express the same emotion differently, depending on a variety of appraisals (Mumenthaler and Sander, 2012). Therefore, appraisal theorists claim that emotions are not necessarily static and universal experiences, as these may vary as a function of appraisals (Scherer et al., 2001; Scherer, 2009). In the current experimental set-up, the event of winning the first prize will most likely trigger positive appraisals, and therefore elicit emotions like happiness, while the event of receiving the consolation prize may be expected to trigger more negative appraisals and elicit emotions like disappointment.

Arguably, however, emotional expressions of happiness and disappointment may also be affected by contextual factors, such as the co-presence of a peer. In general, the importance of contextual factors for the construction of emotional expressions has been explained in terms of push and pull effects (e.g., Banse and Scherer, 1996). Push effects of emotions represent how one's internal state influences the display of emotions. In addition, these expressions need to meet requirements of sociocultural specific models shaped by one's contextual environment, also known as pull effects. The presence or absence of addressees or spectators, and the interdependence we experience with them in specific situations partly shape this social context (Fridlund, 1991; Parkinson, 1996; Kelley et al., 2003). The concept of pull effects on emotions suggests that people express emotions in the presence of others according to certain social rules that fit the situation they are in (Ekman and Friesen, 1975). These social rules, sometimes referred to as display rules, dictate what kind of expressive behavior is socially appropriate or desirable in certain social contexts and give directions as to how, where, when, and to whom people should express their emotions (Garrett-Peters and Fox, 2007). This implies that the co-presence of peers may affect children's expressive behavior when receiving disappointing or satisfying presents. Therefore, the first research question we try to answer in this study is formulated as follows:

RQ1: How does the co-presence of a peer influence non-verbal emotional expressions in children when being given a disappointing or satisfying present?

So far, studies have shown that children regulate their emotional expressions to some extent after receiving a *disappointing* present in the presence of *adults* (Saarni, 1984; Cole, 1986; Garner and Power, 1986; Baaken, 2005; Kieras et al., 2005; Garrett-Peters and Fox, 2007; Tobin and Graziano, 2011; Kromm et al., 2015). In experiments applying variations of the so-called mistaken-gift-paradigm, children were asked to rate their desire for a number of toys and books. Next, they were presented with two gift-wrapped boxes in a random order; one box contained their favorite listed item, and the other box contained their least favorite one. Facial expressions in reaction to both presents were videotaped and analyzed. Using this paradigm with children in primary school, studies found that older children smiled more than younger children, even when the present was not the one they desired, whereas younger children's expressions revealed some level of disappointment when they got the present they desired the least (Saarni, 1984; Garrett-Peters and Fox, 2007).

This can be interpreted as a sign of an increased social awareness, as it shows that older children take into account what is expected from someone who gets a present and use display rules for reacting politely (e.g., by smiling) regardless of whether they appreciate the present or not. Similar studies conducted with younger participants (between the age of three and five) revealed that these children tend to show their disappointment more (Cole, 1986; Garner and Power, 1986; Kieras et al., 2005). Taken together, these results suggest that children gradually learn to regulate their emotional expressions when receiving a disappointing present, which is in line with developmental studies concerning display rules (Saarni, 1981; Gnepp and Hess, 1986; Saarni et al., 2006). According to Gnepp and Hess (1986), a developmental shift across the elementary-school years can be observed, in which children, as they grow older, demonstrate an increased understanding of the appropriateness of specific emotional expressions in specific situations. As children grow older, they are better able to adapt their emotional expressions in order to meet their personal goals and to meet the demands and expectations of their surroundings (Shipman et al., 2003). As we noted above, children's social awareness and ability to regulate their emotions develops fundamentally between the age of eight and eleven (Saarni, 1981, 1984; Kromm et al., 2015). Around the age of 10, children appear to possess the complex understanding of why certain emotional expressions are appropriate or not in specific situations (Kromm et al., 2015). Indeed, in earlier studies, we found that for 8-year-old children, the social context they found themselves in was of less importance for the way they non-verbally expressed their emotions than it was for 11-year-old children (Visser et al., 2014a,b). Therefore, this study aims to further explore whether children adjust their emotional expressions as a function of the absence or presence of peers and whether this is affected by their age and abilities to regulate their emotional expressions. So, the second research question is formulated as follows:

RQ2: Does age affect children's expressive behavior in the co-presence of a peer when receiving a disappointing or satisfying present?

Researchers studied the way children respond on disappointing presents using the mistaken-gift-paradigm by focusing on age (Cole, 1986; Garner and Power, 1986; Kieras et al., 2005), culture (Garrett-Peters and Fox, 2007), and strategies

children use for regulating their emotions (Zeman and Garber, 1996; Baaken, 2005; Tobin and Graziano, 2011; Kromm et al., 2015). However, to our knowledge, no research so far used a variation of the mistaken-gift-paradigm to study a possible effect of presence of peers. Still, we know that, in general, when people are rewarded for accomplishments, they evaluate and compare their compensations with those of others (e.g., Andreoni et al., 2002). The level of fairness of outcomes tends to trigger more emotional responses than the evaluation of the outcome itself (Barry et al., 2004; Hamilton, 2006). Such reactions appear to be quite instinctive in nature (De Waal, 1997; Brosnan and de Waal, 2003; De Waal and Davis, 2003; Brosnan and de Waal, 2014). De Waal (1997), Brosnan and de Waal (2003), and De Waal and Davis (2003), for example, conducted multiple studies in which capuchin monkeys carried out a task that was rewarded with grapes (food these primates prefer) or pieces of cucumber (food they prefer less than grapes). These monkeys rejected cucumber as a reward once they had been compensated with grapes. Even more relevant for the current research is that they also rejected cucumber once they noticed that other monkeys were being rewarded with grapes. This shows that capuchin monkeys measure reward in relative terms, and they evaluate and compare these reward with those of others. Using a variation of the mistaken gift paradigm, we study whether our child participants act in a similar way.

When children compare their prize with the prize their peer was given, they may adjust the evaluation of their own prize. This implies that emotional reactions, like evaluating individual compensations with those of others, are dynamically adjusted over time, and could vary as a function of changes in appraisals (Scherer, 2009). In other words, events are likely to continuously being re-appraised (Ellsworth and Scherer, 2003). For instance, instinctive initial reactions can evolve into more regulated, socially appropriate secondary reactions. Moreover, although there is support that brief segments of expressive behavior accurately reflect expressive behavior over long durations (Ambady and Rosenthal, 1992), current research suggests that lengthening studied data segments may reveal some sort of second emotional episode in a response, especially in the case of adjusting non-verbal emotional behavior by applying display rules that fit a social context (Garrett-Peters and Fox, 2007). Therefore, it is likely that within the course of receiving an unwanted gift, conflicting appraisals unfold in time (Ellsworth and Scherer, 2003). In this respect, it is interesting to take the role of gaze into account, as it has been argued that the level of social contact is very much influenced by patterns in gaze behavior between people (Argyle and Dean, 1965; Shahid et al., 2012; Borras-Comes et al., 2014). The experience of making eye contact is an important feature for the course of emotional expressions. For example, Shahid et al. (2012) studied how eye contact between children can influence the experience of shared emotions like enjoyment or disappointment. While interacting in a game, children who had direct eye contact with each other showed more enjoyment than children who had no direct eye contact. Therefore, we will not only compare emotional reactions of children who play a game alone and in the presence of a peer, but also compare expressive behavior of the latter before and after they have made eye contact. In this way, we are able to examine how children's expressions change as a function of how they assess their social context, in particular when they compare their own present with the one another person has just received. Therefore, the third research question is formulated as follows:

RQ3: Do changes in children's assessments of the social contact affect their expressive behavior in the course of their response when receiving a disappointing or satisfying present?

Taking stock, even though the unwanted gift paradigm has revealed interesting insights into how children respond non-verbally to (un)wanted gifts, to the best of our knowledge no earlier studies have looked into how children respond to wanted and unwanted gifts when they are in the presence of a peer who receives a different (better or worse) gift. This is what we study in the current paper, where in addition, we study whether this non-verbal response is different for younger and older children, and whether there are differences between initial (before eye contact) and secondary (after eye contact) responses.

Present Study

In the current study, we examined whether the presence of peers affects children's expressive behavior during the course of a positive or negative event, in particular while receiving a consolation prize (small gift) or a first prize (large gift). In the production experiment, we invited 8- and 11-year-old children to play a game alone (in which they had to compete against the computer) or in pairs (in which they had to compete against each other). The course of the game was manipulated in such a way that it always resulted in a tie, between the child and the computer or between the two children. Subsequently, the experiment leader randomly presented participating children with either the top prize or the consolation prize. In this way, we elicited particular emotional expressions, which we analyzed by conducting two subsequent perception tests, in which we asked third-party judges to rate children's level of happiness in muted video clips. This research tests whether contextual factors are important for positive and negative emotional expressions (like happiness and disappointment). Due to these factors, people are expected to adjust their emotional expressions with the purpose that someone else will perceive them (Banse and Scherer, 1996). Perception (or judgment) tests are known to be valuable instruments for assessing changes in socially embedded expressive behavior, as the perceptual meaning of expressions is rated by multiple judges (e.g., Kromm et al., 2015). In the first perception test, children's complete reactions upon receiving their gift were shown to third-party judges. We examined whether these reactions differed depending on whether an opponent was physically present or not for two different age groups. In the second perception test, judges were shown only the reactions of children who had participated in the "in presence of a peer" condition. We split the reactions of participants into two parts, with the moment of mutual eye gaze between the opponents as the cutting point. In this way, we explored how children's expressive behavior progressed, i.e.,

before and after they became explicitly aware of their social context.

Lastly, the current studies were carried out in accordance with the recommendations of APA guidelines for conducting experiments, the Netherlands Code of Conduct for Scientific Practice and the Code for Use of Personal Data in Scientific Research (KNAW). The studies were waived by the ethics committee at Tilburg University. All parents gave written consent to the use of their children's recordings. For the perception studies, all participants gave consent to the use of their data.

Data Collection

Method

Participants

A total of 86 children participated in this study, of which 41 were 8 years old (M = 101.93 months, SD = 3.42 months, 27 girls) and 45 were 11 years old (M = 137.27 months, SD = 3.58 months, 23 girls). Children were randomly assigned to a game condition (competing the computer or a physically present peer) and a reward condition (receiving the consolation prize or the first prize). **Table 1** displays the distribution of child participants across experimental conditions. The experiment was conducted at two primary schools in Zoetermeer, The Netherlands. Beforehand, the parents of the participants were informed about the experimental procedure and asked for their signed permission for their children's participation and recordings of their performance.

Experimental Procedure

Children were seated behind a table, facing the experimenter. In the "present peer" condition, they were placed next to each other and were able to see each other's face and upper body. They were told that they were about to play a game. In the "computer" condition, there was only one child in the experimental room, who had to compete against the computer. Apart from this, the experimental procedures were identical for both conditions. All children were filmed by separate camera's standing in front of them (see **Figure 1**). The experimenter acted as the game leader, but kept the interaction between her and the children as limited as possible, by leading the game according to a script. She avoided making eye contact with children in both conditions by looking at her computer screen in front of her, which was supposed to be the electronic game board. Before the game, the experimenter explained that the player (either the actual participant in the "present peer" condition, or the virtual participant in the "computer" condition) who would collect most game points would win the first prize, and the other player would receive the consolation prize (again, either the actual participant in the "present peer" condition, or the virtual participant in the "computer" condition). Both gifts were wrapped in paper, so the children could not see what the prizes were. However, the wrapped gifts were shown to them before the game started, and were markedly different, with the first prize being rather big and the consolation prize being considerable smaller (see **Figure 2**). After this introduction, children were asked to indicate how much they would like to win the consolation prize and the first prize, respectively, on a five-point Likert scale, using specific facial representations of the items, a method that is standard in research with children (e.g., Lockl and Schneider, 2002; Visser et al., 2014a,b). Specifically, an unhappy face (corners of the mouth pulled down) represented a score of 1 ("I don't want this prize at all"), and a happy face (corners of the mouth pulled up) represented a score of 5 ("I want this prize very much"). Children of both age groups had no difficulties in understanding this scale.

Next, children played a guessing game based on the Dutch television show "Wat vindt Nederland?" (English: "What does Holland think?"). Experiments in which children play games is developmentally appropriate for elementary school-aged children. They are familiar with playing structured games and become emotionally aroused easily in game situations because of their emphasis on the importance of winning or losing (Taylor and Asher, 1984). The experimenter presented a number of topics (for example "favorite animal", or "favorite soda drink") and asked both players to think of the most likely answer Dutch children of their own age would give (for example, "dolphins" or "Coca Cola"). The children had to write their answer down on a small chalkboard on the table in front of them. Children were told that they were not allowed to give the same answer and the participant who was fastest could remain with their choice. The slowest participant was allowed to come up with a new answer. After the children revealed their answers to the experimenter, she pretended to search in the computer database for the correct answer and assigned one game point to the player whose answer was claimed to be most similar to the answer of most Dutch children. Unbeknownst to the children, this decision was in fact predetermined.

In total, 10 game points were to be divided between the two children (or between the child and the computer, in the "computer" condition). However, the progress of the game was manipulated: each child or pair of children was randomly assigned to one of two scripted game narrations, which always ended in a tie. The course of the game was constructed in such a way that this tie outcome was not revealed before the presentation of the 10th and final concept (in other words, after nine concepts the score was always 4–5). In this way, we tried to maximize engagement for the child participants.

When the game was completed, and had ended in a tie, the experimenter remained acting according to the script, and expressed doubts about what to do in this unexpected situation. After some hesitation, she decided about which gift each child received. In the "present peer" condition, one child received

TABLE 1 | Distribution of child participants across experimental conditions.

Age	Game context	Consolation prize	First prize	Total for each condition
8-year-olds	Computer	10	9	19
	Present peer	11	11	22
11-year-olds	Computer	11	10	21
	Present peer	12	12	24
				Total of 86 participants

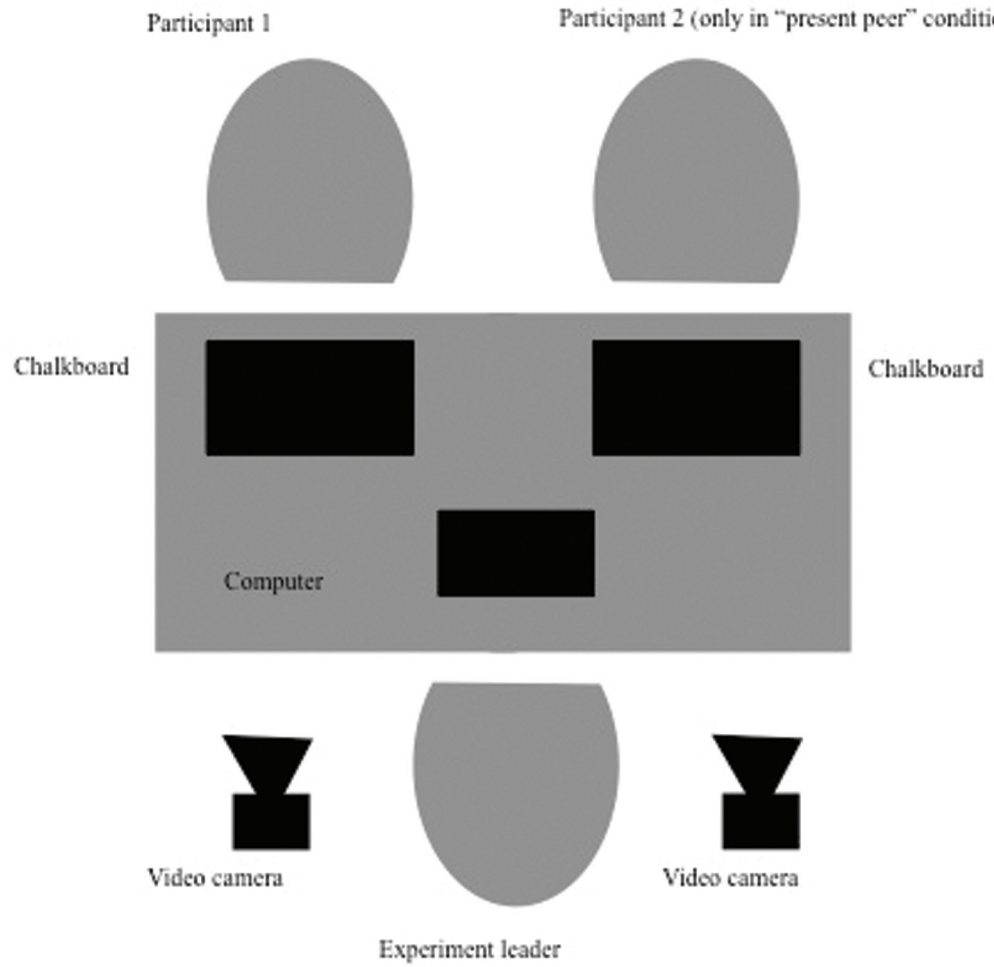


FIGURE 1 | Experimental setting.

the first prize and the other the consolation prize. In the "computer" condition, children were awarded either the first or the consolation prize, depending on the experimental condition they were in. The experiment leader emphasized that this was a random decision, made intermittent eye contact with the child participants to monitor for understanding and otherwise remained neutral in affect so as not to influence their expressive behavior. Research has shown that the concept of fairness is mainly based on the distribution of gains (Andreoni et al., 2002; Falk et al., 2003). Children gradually learn social rules dictating that expressing negative emotions is unacceptable when losing against a peer who is playing fairly (Hubbard, 2001). By following a script, in which chances of winning were equally distributed for both players through the course of the game, we tried to minimize the risk of emotional expressions of frustration due to a sense of unfairness (although obviously we did expect to encounter expressions of happiness or disappointment). Please note that the experimenter only told children which prize they were awarded with, but did not actually hand it over to them. The children were not given the opportunity to touch or open the present.

Directly following the awarding of the prizes (with a maximum interval of 10 s), the experimenter asked children to indicate how happy they were with their prize, again with the help of the facial representations of a five-point Likert scale. After this, all children were debriefed, and were told they had taken part in an experiment. We asked them if they had noticed anything strange during the game and none of them appeared to be aware of our manipulations. Regardless of the prize they had received after the game, all children were offered a small reward (not dependent on game outcome) for their participation (games and stickers). Each experimental session lasted around 20 min.

Manipulation Check

Before focusing on how social appraisals affect children's expressive behavior, we assessed if our game-like experimental paradigm worked as intended. For this, we analyzed children's self-reported attraction to the first prize and the consolation prize before the game and their self-reported happiness with their gift afterward, using a five-point Likert scale. Naturally, we expected children to indicate a higher desire for the first prize over the

FIGURE 2 | Representations of first prize and consolation prize (respectively the large and the small package).

FIGURE 3 | Stills illustrating representative examples of children's typical reactions in different experimental conditions (top left: computer/first prize; top right: present peer/first prize; bottom left: computer/consolation prize; bottom right: present peer/consolation prize).

consolation prize, and that, accordingly, they would indicate to be happier when they had been given the first prize rather than the consolation one.

We indeed found that children reported a higher desire for the first prize ($M = 4.90$, $SD = 0.34$) than for the consolation prize ($M = 2.27$, $SD = 1.04$), $t(85) = 21.69$, $p = 0.000$. Apparently, all children, regardless of their age or the presence of a peer, wanted to win the first prize over the consolation prize. Moreover, children's desire scores for both the consolation prize and first prize correlated with the degree of happiness they felt after being appointed with one of the prizes (first prize: $r = 0.23$, $n = 86$, $p = 0.040$; consolation prize: $r = 0.29$, $n = 86$, $p = 0.010$). The more children wanted to have a particular prize, the happier they felt afterward.

An ANOVA with prize, game context and age as factors and indication of happiness afterward as the dependent variable shows that in general, children were happier when being awarded the first prize ($M = 4.86$, $SD = 0.35$) than when being awarded the consolation prize ($M = 2.95$, $SD = 1.25$), $F(1,84) = 92.41$, $p = 0.000$, $\eta_p^2 = 0.52$. We found no effects of age and game context, age: $F(1,84) = 0.27$, $p = 0.607$; presence: $F(1,84) = 1.21$, $p = 0.275$.

These results showed that the manipulation worked as intended. Children in all conditions were keener on being awarded the first prize than the consolation prize. Moreover, regardless of their age or of whether they played the game competing the computer or a physically present peer, children reported to be happier with the first price than with the consolation prize. **Figure 3** displays stills from representative reactions of children in all experimental conditions. In the next sections, we analyzed their expressive behavior by letting third-party judges rate children's level of happiness in two perception experiments.

Perception Experiment 1 – Complete Fragments

To analyze how children's expressive behavior is perceived by others, we conducted two perception experiments. In this first perception experiment, we showed third-party judges video clips of complete reactions of children who received either a consolation prize or a first prize.

Method

Participants

In total, 42 adults (24 women), with a mean age of 23 years ($SD = 6.01$) performed as third-party judges in this perception test. All participants were students of Tilburg University who received partial course credits for their participation.

Stimuli

For the stimuli in the perception test, we used as many utterances as possible of the ones we recorded in the production experiment, and also made sure that equal numbers of children were selected from the two age groups (8- and 11-year-olds), the two game contexts (competing the computer and competing a physically present peer) and the two game outcomes (first prize and consolation prize). This resulted in a semi-random selection of 72 video fragments of children's reactions after having been appointed a prize. The selected video fragments were presented to participants and contained children's reactions to the decision about the distribution of the prizes, from the moment the experimenter determined the winner of the first prize to the moment children were asked to indicate how much they appreciated their prize, with an average length of 8.13 s ($SD = 2.27$). Please note that the fragments did not show children unpacking their prize. The video clips were muted, as the verbal

comments of the experimenter announcing who received which gift was likely to influence judgments' ratings.

Procedure

Participants were presented with all 72 video fragments in one of two random orders, to compensate for any order effects due to habituation. Following an identification number (1–72), the actual stimuli were presented one by one. During an inter-stimulus interval of 2.5 s, participants were asked to rate how happy the child appeared to be with the prize it won, on a seven-point Likert scale. To ensure that participants were familiar with the task, the experiment was preceded by a training phase containing four stimuli. Participants completed the perception task individually in a soundproof cubicle.

Results

A repeated measure ANOVA with prize, game context and age as within-subject factors, and perception of happiness as dependent variable, revealed several main effects and two- and three-way-interactions. Before describing the three-way interaction effect of prize, game context and age on the perceived level of children's happiness, we will briefly report the main and two-way interaction effects.

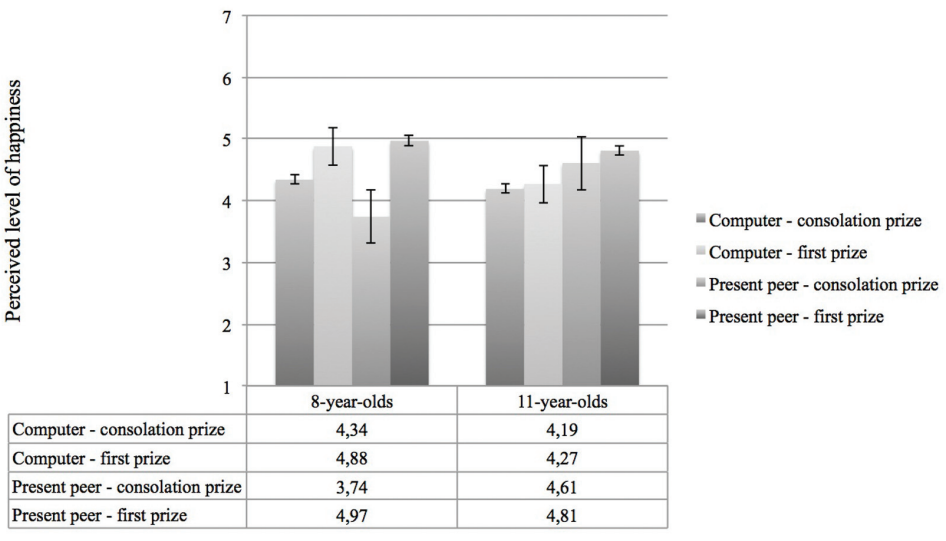
First, prize appeared to affect the perception of happiness. As expected, children who won the first prize were perceived to be happier ($M = 4.73$, $SD = 0.52$) than children who won the consolation prize ($M = 4.22$, $SD = 0.58$). Moreover, we found a small main effect of game context on the perception of happiness. Children who played the game in the presence of a peer were perceived happier ($M = 4.53$, $SD = 0.60$) than children who played the game against the computer ($M = 4.42$, $SD = 0.50$). We found no main effect of age. Overall, participants judged 8-year-old and 11-year-old children as equally happy ($M_{8-year-olds} = 4.48$, $SD_{8-year-olds} = 0.55$; $M_{11-year-olds} = 4.47$, $SD_{11-year-olds} = 0.55$).

We did find a significant two-way interaction between age and the prize children were presented with on participants' perception of children's happiness. A Bonferroni *post hoc* test showed that 8-year-old children were rated as happier when they received the first prize than when they received the consolation prize ($M_{firstprize} = 4.93$, $SD_{firstprize} = 0.51$; $M_{consolationprize} = 4.04$, $SD_{consolationprize} = 0.65$). For 11-year-old-children, the type of prize did not affect participants' perception of their happiness ($M_{firstprize} = 4.54$, $SD_{firstprize} = 0.57$; $M_{consolationprize} = 4.40$, $SD_{consolationprize} = 0.58$).

The factor age also interacted with game context on participants' happiness ratings. *Post hoc* tests (using the Bonferroni method) revealed that when 8-year-old children were playing the game against the computer, they were generally rated as happier than when they were playing against a physically present peer ($M_{computer} = 4.61$, $SD_{computer} = 0.50$; $M_{presentpeer} = 4.35$, $SD_{presentpeer} = 0.68$). For 11-year-old children, analyses showed an opposite effect; they were perceived as happier when they played the game together with a physically present peer, than when competing against the computer ($M_{computer} = 4.23$, $SD_{computer} = 0.53$; $M_{presentpeer} = 4.71$, $SD_{presentpeer} = 0.62$).

Prize and game context also interacted on the perception of children's happiness. A Bonferroni *post hoc* test showed that only when receiving the first prize, the physical presence of a peer affected children's expressions of happiness ($M_{computer} = 4.57$, $SD_{computer} = 0.53$; $M_{presentpeer} = 4.89$, $SD_{presentpeer} = 0.60$). When receiving the consolation prize, it did not matter if children were playing against the computer or against a peer, as they were rated as equally (un)happy ($M_{computer} = 4.27$, $SD_{computer} = 0.52$; $M_{presentpeer} = 4.17$, $SD_{presentpeer} = 0.67$).

Finally, we found a three-way interaction between prize, game context and age on perceived happiness. **Figure 4** shows that for 8-year-old children, physical presence of a contestant was not important when receiving the first prize; they appeared to



	8-year-olds	11-year-olds
Computer - consolation prize	4,34	4,19
Computer - first prize	4,88	4,27
Present peer - consolation prize	3,74	4,61
Present peer - first prize	4,97	4,81

FIGURE 4 | Perceived level of happiness as a function of age, game context and prize.

be equally happy with it while playing against the computer. However, when 8-year-old children received the consolation price, they seemed to be happier when they played the game against the computer than when they played the game against a peer. In contrast, 11-year-old children who played the game in the "present peer" condition were perceived as happier with both the consolation prize as the first prize. When 11-year-olds played the game competing the computer, they were perceived to be relatively unhappy with both prizes.

All details of the ANOVA analysis can be found in **Table 2**. These results show there is indeed an effect of the co-presence of a peer on how happy children are perceived when being awarded with a disappointing or satisfying prize. In the next section, we zoom in on the emotional expressivity of children who are in the co-presence of a peer and explore how these children's emotional behavior progressed after receiving a particular present, i.e., before and after they became explicitly aware of their social context (i.e., in the co-presence of a peer). We expected that older children would take the co-presence of a peer even more into account than younger children, as they are more known with appropriate behavior in such situations (Kieras et al., 2005).

Perception Experiment 2 – Split Fragments

Next, we tested the perception by third-party judges of children's happiness when receiving a prize in different fragments of the child's reactions. For this, we only used clips from the "present peer" condition, in which we focused on children's behavior before and after the moment of eye contact between contestants.

Method

Participants

In a second perception task, 42 adults (34 women, $M = 21.02$, $SD = 2.23$) judged a series of video fragments. Again, participants were students of Tilburg University who participated for partial course credit. None of the participants of the second perception task had participated in the first perception task.

TABLE 2 | Overview ANOVA's with perceived level of happiness as independent variable for full fragments.

Factor(s)	*F*	*df*	*p*	η_p^2
Age	<1	(1, 41)	ns	0.00
Prize	159.83	(1, 41)	0.000	0.80
Game context	7.11	(1, 41)	0.01	0.15
Age * Prize	106.29	(1, 41)	0.000	0.72
Age * Game context	72.82	(1, 41)	0.000	0.64
Prize * Game context	26.95	(1, 41)	0.000	0.40
Age * Prize * Game context	15.13	(1, 41)	0.000	0.27

TABLE 3 | Selection of stimuli for split fragments perception test.

		Phase before eye contact	Phase after eye contact	Total for each condition
8-year-olds	Consolation prize	8	8	16
	First prize	8	8	16
11-year-olds	Consolation prize	6	6	12
	First prize	11	11	22
				Total of 66 stimuli

Stimuli

For this second perception test, we selected all reactions of children who had searched for eye contact with their opponent. The remaining children who where not selected had constantly looked either at the experimenter or simply gazed in front of them. By selecting only children who search for eye contact we were able to precisely define secondary reactions and compare those of both age groups. These reactions were split in two phases; the first phase consisted of children's initial reaction to their gift before making eye contact with their opponent, the second phase contained their behavior after the moment of eye contact, when they were supposedly more aware of the presence (and gift) of their peer. This resulted in a total amount of 66 video clips, containing initial and secondary reactions of 33 children. All children came from the "present peer" condition, since in the "computer" condition there was no opponent for the participants to make eye contact with. For an overview of the distribution of experimental conditions in the stimuli used in the perception test, see **Table 3**. Similar to the first perception test, stimuli were presented without sounds.

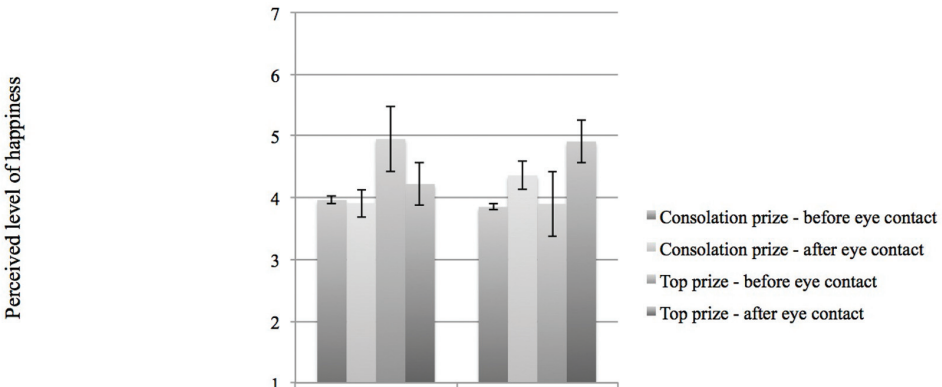
Procedure

Since the overall procedure for the second perception test was similar to the procedure of the first perception experiment, we refer to the corresponding section for a more detailed description.

Results

We analyzed children's expressions of happiness according to third-party judges by performing a repeated measures ANOVA with age (8- or 11-year-old), prize (consolation prize or first prize) as between-factors and phase of children's reaction (before or after eye contact) as within-factor. Again, we found a complex three-way interaction effect of age, prize and phase on the perceived level of children's happiness. In order to understand this interaction better, we will briefly report the main and two-way interaction effects first.

Similar to the results of the first perception test with complete fragments, we found that the type of the prize affected how third-party judges perceived children's level of happiness. A Bonferroni *post hoc* test showed that children who received the consolation prize were perceived as less happy ($M = 4.02$, $SD = 0.47$) than children who received the first prize ($M = 4.50$, $SD = 0.41$). Moreover, age did not have a main effect on the perceived level of happiness.



	8-year-olds	11-year-olds
Consolation prize - before eye contact	3,96	3,85
Consolation prize - after eye contact	3,91	4,36
Top prize - before eye contact	4,95	3,9
Top prize - after eye contact	4,22	4,91

FIGURE 5 | Perceived level of happiness as a function of age, prize and reaction.

Again, similar to results of the first perception test, there was an interaction effect of age and the nature of the prize children received on participants' perception of happiness. A *post hoc* test (Bonferroni method) showed that 8-years-old children were perceived to be happier with the first prize than with the consolation prize ($M_{\text{firstprize}} = 4.58$, $SD_{\text{firstprize}} = 0.45$; $M_{\text{consolationprize}} = 3.94$, $SD_{\text{consolationprize}} = 0.49$), whereas 11-year-old children seemed as happy with first prizes as with consolation prizes ($M_{\text{firstprize}} = 4.41$, $SD_{\text{firstprize}} = 0.43$; $M_{\text{consolationprize}} = 4.11$, $SD_{\text{consolationprize}} = 0.51$).

Since the aim of this second perception test was to focus on differences in initial an secondary phases of children's reactions, we were mainly interested in effects including the factor "phase." First, we found that in general, participants judged children to appear happier in the second phase, so after eye contact ($M = 4.35$, $SD = 0.45$), than in the initial phase, so before eye contact ($M = 4.17$, $SD = 0.44$). Moreover, children's age interacted with phase on the perception of their happiness. A Bonferroni *post hoc* test revealed that 8-year-old children appeared happier in the initial phase of their reaction than after they had eye contact with their peer ($M_{inital} = 4.46$, $SD_{initial} = 0.45$; $M_{secondary} = 4.07$, $SD_{secondary} = 0.49$). However, for 11-year-old children, the opposite was the case; they were initially perceived as less happy, whereas they appeared happier after they had eye contact with their peer ($M_{inital} = 3.88$, $SD_{inital} = 0.47$; $M_{secondary} = 4.64$, $SD_{secondary} = 0.49$). There was no interaction between prize and phase. Regardless of eye contact, children were generally perceived happier being awarded the first prize than the consolation prize.

Finally, we found an interaction between age, prize and phase on the perceived level of happiness. As shown in **Figure 5**, 8-year-old children seemed to be less happy with their first prize as time passed. However, 11-year-old children were perceived to be happier in their reaction after they had eye contact with their opponent, compared to their reaction before they had eye contact, regardless of the type of prize.

Details of the statistical analyses are summarized in **Table 4**.

General Discussion and Conclusion

When Jimmy Kimmel asked parents to give their offspring disappointing Christmas presents, this set-up led to interesting reactions of children, which appeared to be in line with what could be predicted based on recent emotional (appraisal) theories that suggest that a variety of social factors are likely to affect emotional expressive behavior (e.g., Manstead and Fischer, 2001; Scherer and Ellgring, 2007; Mumenthaler and Sander, 2012; Fernández-Dols and Crivelli, 2013). The current research systematically investigated how children's assessments of gifts, the co-presence of a peer and their age may impact their non-verbal expressions of emotion.

The first research question we tried to answer in this study related to how different contextual factors would affect children's emotional expressions. More specifically, we were interested in

TABLE 4 | Overview ANOVA's with perceived level of happiness as independent variable for split fragments.

Factor(s)	*F*	*df*	*p*	η_p^2
Age	<1	(1, 41)	ns	0.00
Prize	158.40	(1, 41)	0.000	0.79
Phase	21.52	(1, 41)	0.000	0.34
Age * Prize	23.37	(1, 41)	0.000	0.36
Age * Phase	249.30	(1, 41)	0.000	0.86
Prize * Phase	1.71	(1, 41)	ns	0.04
Age * Prize * Phase	60.08	(1, 41)	0.000	0.59

how the absence or co-presence of a peer would influence non-verbal emotional expressions in children when being confronted with a disappointing or satisfying event. We found that, in general, children awarded the first prize were perceived as happier than children awarded the consolation prize; similarly, results showed that children who played the game against a physically present contestant were perceived to be happier than children who were playing "alone" against the computer, regardless of the prize they won. Apparently, playing games with a physically present peer was perceived to be more enjoyable than when playing a game alone, which is in line with earlier research (e.g., Shahid et al., 2008). However, to examine how different social appraisals may affect our participants' emotional reactions, we were specifically interested in any interaction effect of co-presence and prize. Indeed, results showed that when receiving the first prize, children were happier when they were in the presence of a peer who received the consolation prize than when they were alone. On the other hand, when receiving the consolation prize, it did not matter if children were alone or in the presence of a peer, as they were rated as equally (un)happy. Answering our first research question, we can conclude that children's emotional expressions were indeed affected by contextual factors, albeit only for satisfying events, like being awarded a first prize. However, all children, both those who were playing the game alone and those playing together with a peer, seemed equally disappointed when being awarded the consolation prize. This is in contrast with the results of De Waal (1997), Brosnan and de Waal (2003, 2014), De Waal and Davis (2003); they repeatedly found that primates' behavior was affected when receiving a disappointing reward, if their peer received a better alternative. An explanation for this may be that these primates lacked certain social skills compared to children, and therefore were less influenced by the social setting than the child participants in our study. However, we need to consider a possible general effect of the experimenter's presence on the perceived happiness of children in our experiment in the consolation prize condition. It might be that receiving a disappointing present by the experimenter (which can be perceived as rather unfriendly) affected emotional expressions of both children alone and in the co-presence of a peer. Although, we did keep any interaction between the experimenter and the participants as limited as possible (i.e., by following a written script and avoiding any eye contact), due to the nature of the experiment (eliciting spontaneous expressions in a game setting), we were not able to fully control the interaction between the experimenter and the participating children.

The second research question asked whether the concept of age is meaningful in understanding children's expressive behavior in the co-presence of a peer. As children grow older, they develop certain social skills that may be important for the occurrence of social appraisals for giving meaning to their emotions (Saarni, 1984; Manstead and Fischer, 2001; Saarni et al., 2006; Scherer, 2009). Indeed, when we compared the perceived level of happiness of 8- and 11-year-old children, we found small effects of both prize and co-presence of peers. For 8-year-old children, the physical presence of a contestant was not important when receiving the first prize; they appeared to be equally happy with it. However, when they received the consolation price, they seemed to be happier when they played the game alone than when they played the game together with a peer. This is in line with outcomes of De Waal (1997), Brosnan and de Waal (2003), De Waal and Davis (2003), and Brosnan and de Waal (2014) studying capuchin monkeys. In contrast, 11-year-old children who had played the game with a peer were perceived as happier than 11-year olds who had played against the computer, regardless of which prize they received. When 11-year-olds played the game against the computer, they were perceived to be relatively unhappy with both prizes. These findings supported the view that children gradually learn to adjust their expressive behavior, depending on their social environment. This is in line with studies that used the mistaken gift paradigm, which have shown that age affected children's reactions while receiving disappointing presents, in a sense that older children showed less disappointment than younger children (Cole, 1986; Garner and Power, 1986; Kieras et al., 2005). However, as we asked judges in our perception tests how *happy* children in presented video clips were; we need to be careful making any assumptions on how *disappointed* children in our study were when receiving the consolation prize. We can only draw conclusions on the perception of their *happiness*. The expression of being less *happy*, as our participants sometimes were perceived as such, may differ from expressions of being *disappointed*, like children studied in the research by Kieras et al. (2005). Therefore, in future research, it would be interesting to study how judges would rate the presence or intensity of other emotions, for example disappointment.

Still, we can conclude that as children grow older, social appraisals get more important and they would show more happiness when receiving a seemingly more disappointing present. So, this study not only provides evidence for an effect of social appraisals when receiving disappointing or satisfying events, but the way children respond emotionally seems to be affected by developmental factors as well.

Finally, we asked how changes in children's assessments of the social contact, also known as re-appraisals, may affect their expressive behavior in the course of their response. Emotion processes are non-static and dynamically adjusted over time, and have been argued to vary as a function of alternating appraisals (Scherer, 2009). Hence, in the second perception experiment, participants' expressions were analyzed not only right after they were presented with either the first prize or consolation prize, but also after they had their first post-gift eye contact with their co-present peer. First, we found a small main effect of phase. In general, children were perceived happier after eye contact than before. However, looking at the interaction with age suggests a more nuanced picture. Our findings showed different expressive behavior for both age groups, indicating that eye contact affected the expressive behavior of 8-year-old children in a negative way and that of 11-year-old children in a positive way. The latter seemed happier after they had eye contact with their peer, compared to their initial expression. Similar results were found in a three-way interaction of age, prize and phase.

For 11-year-old children, we found no effect of prize and phase for their expressions of happiness, in contrast with 8-year-old children. This again indicated that as children grow older and develop their social skills, their social awareness increases and they adjust their expressive behavior by smiling in the presence of a peer regardless of whether they appreciate their prize or not.

Overall, this research contributes to the idea that emotional expressions are by no means isolated concepts, but are constructed by the evaluation of a (social) context (i.e., social appraisals). Additionally, we have shown that as children's social awareness increases, their expressions are affected by social appraisals, which may alternate during the course of their response.

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Deriving meaning from others' emotions: attribution, appraisal, and the use of emotions as social information

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Emotional expressions constitute a rich source of information. Integrating theorizing on attribution, appraisal processes, and the use of emotions as social information, we examined how emotional expressions influence attributions of agency and responsibility under conditions of ambiguity. Three vignette studies involving different scenarios indicate that participants used information about others' emotional expressions to make sense of ambiguous social situations. Expressions of regret fueled inferences that the expresser was responsible for an adverse situation, whereas expressions of anger fueled inferences that someone else was responsible. Also, expressions of anger were interpreted as a sign of injustice, and expressions of disappointment increased prosocial intentions (i.e., to help the expresser). The results show that emotional expressions can help people understand ambiguous social situations by informing attributions that correspond with each emotion's associated appraisal structures. The findings advance understanding of the ways in which emotional expressions help individuals understand and coordinate social life.

Keywords: emotion, emotional expression, attribution, social appraisal, emotions as social information, sense-making

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Introduction

At times we may find ourselves thoroughly disliking a situation in which we don't know what is happening. Unfortunately, social situations are often ambiguous; it may be unclear what others have done, or what they will do next. Such ambiguity can make people uncertain, a state they are motivated to reduce through sense-making (Kagan, 1972; Wong and Weiner, 1981; Heine et al., 2006; Rutjens et al., 2012). These sense-making processes, in turn, are closely related to the experience of emotions. As Frijda (1988, p. 349) put it, "emotions arise in response to the meaning structures of given situations; different emotions arise in response to different meaning structures."

Our own emotions can help us make sense of situations. For example, appraisal theory states that our emotions are accompanied by inferences about the situation, or environment, we are in (Smith and Ellsworth, 1985; Frijda, 1986, 1988; Scherer, 2001; Scherer and Ellsworth, 2003; Clore and Ortony, 2008). Moreover, the emotional expressions[1]

[1]The 'emotional expression' is often used to denote *facial* expressions of emotion. In this paper, we use the term to refer to the expression of emotion through words. Whether or not the effects observed in this paper also occur when facial expressions are being used is a question that is beyond the scope of this paper. We return to this issue in the General Discussion.

of other people can impact our sense-making processes, by providing information to those people observing their expression (Keltner and Haidt, 1999; Van Kleef, 2009; Van Kleef et al., 2010; Hareli and Hess, 2012).

Imagine a teacher in elementary school who walks into the schoolyard to find a boy crying angrily, or a jury which hears the tale of a defendant who looks away guiltily. Regardless of *what* the teacher or the jury members infer, it seems plausible that they will also use the emotion expressed by the boy or the defendant to inform their judgments of responsibility—that is, to ascribe agency. In the current research, we approach the theoretical relationship between emotional expressions and sense-making. We do so by examining whether emotional expressions can help people resolve ambiguity regarding the causes of events by providing information about agency – that is, who are responsible for a certain state of affairs.

Ascribing Meaning to Social Events: Attribution and Appraisal

One common way in which people give meaning to their social environment is by analyzing the causes of events. The role that others' emotional expressions play in this process has been researched in two research traditions: attribution theory and theory on emotion as information. Attribution theory (Weiner, 1985, 2014) holds that people make sense of situations on three dimensions: whether an event is controllable or uncontrollable, internally caused (i.e., by him or herself) or externally caused (i.e., by others or by situational factors), and stable or unstable over time (Weiner, 1985). People attribute causes to own and others' emotions using a laypersons' theory (Hareli, 2014), making attribution theory a type of appraisal theory (Weiner, 2014). Because people attribute causes to others' emotions, attribution theory extends the idea of appraisal to the interpersonal domain (Weiner, 2014).

Recent theorizing on emotion as information has focused on the process by which people respond to the emotions of others. Emotions as social information (EASI) theory (Van Kleef, 2009; Van Kleef et al., 2010, 2011) holds that people who observe an emotional expression may respond to it based on inferential processes and/or affective reactions. Observers may make two types of inferences about the emotion of another person (de Melo et al., 2014). A reverse appraisal involves inferring which appraisal the person experiencing the emotion must have made (Hareli and Hess, 2012), a social appraisal involves inferring aspects of the social situation which then trigger appraisals and emotions in the observer (Manstead and Fischer, 2001).

Inferences from Others' Emotions

Attribution theory and emotion as information theory have yielded a substantial body of research on inferences regarding others' emotional expressions. People may use expressions of emotion to infer the cooperativeness (Van Doorn et al., 2012) and level of risk (e.g., Sorce et al., 1985; Parkinson and Simons, 2009; Parkinson et al., 2012) of the situation in which the expression takes place. Other inferences may include whether the target of the expression performed sufficiently well on a task (Weiner et al., 1979, 1982; Van Doorn et al., 2014). Finally, observers may infer qualities of the person expressing the emotion, such as personality (e.g., Knutson, 1996; Hess et al., 2000; Hareli and Hess, 2010), status (e.g., Tiedens, 2001), moral beliefs (e.g., Horberg et al., 2013), and the likely next behavior of an emotional counterpart in a negotiation (e.g., Van Kleef et al., 2004, 2006; Wubben et al., 2009; de Melo et al., 2014).

In most of the studies above in which social inferences were studied (save for Knutson's, 1996 work on the inference of stable personality traits), emotion expressions were relatively contextualized, with clear antecedents such as another person's performance on a test (Weiner et al., 1982), or balloon task (Parkinson et al., 2012), or a bid in a round of negotiations (de Melo et al., 2014). While such contextualization helps draw conclusions regarding the inferences that people make based on an expressed emotion within a specific social context, they say little about social contexts in which an observation is made without an antecedent for the emotion expression being clear. If we are to argue that emotion provides observers with information, it seems important to establish whether its communicative value can be predicted under ambiguity. The aim of this paper, therefore, is to examine whether inferences of agency can reliably be predicted from emotional expressions of anger, regret and disappointment in relatively ambiguous social contexts.

Anger and Regret as Cues of Agency

People commonly express anger or regret in response to a negative event or outcome (Van Dijk and Zeelenberg, 2002). These emotions differ in the amount of control they imply over the event or outcome. Anger usually involves the attribution of a negative outcome to an external agent, often a person (Averill, 1982; Berkowitz and Harmon-Jones, 2004). It involves the perception that this agent is responsible or blameworthy (Van Dijk and Zeelenberg, 2002; Berkowitz and Harmon-Jones, 2004; Kuppens and Van Mechelen, 2007; Carver and Harmon-Jones, 2009). The experience of regret, in contrast, involves an attribution of self-agency, or internal responsibility, for a negative outcome (Zeelenberg et al., 2000; Van Dijk and Zeelenberg, 2002) implying that the person experiencing the emotion is to be considered responsible or blameworthy. As such, the information which these emotions convey with regards to agency maps onto causality, a central dimension of attribution theory (Weiner, 1985, 2014).

In line with earlier, contextualized differentiations of these emotions with regards to blameworthiness (e.g., de Melo et al., 2014), we expect that in situations in which no clear antecedent for the experience of these emotions is given, a discrepancy in communicated control should lead to different inferences between these emotions with regards to agency. To test this hypothesis, we formulated vignettes describing how another person expressed emotion in an ambiguous situation. We expected that perceivers would associate expressions of anger with attributions of agency to a third person and expressions of regret with attributions of agency to the expressing person.

Study 1

Method

Participants and Design

Respondents were 70 people from the United States (37 women, age $M = 35.66$, SD = 11.55, range 18–62 years) who participated via Amazon's Mechanical Turk website (Buhrmester et al., 2011). Participants completed a 10-min survey in exchange for $0.50 USD (a regular rate on the Mechanical Turk website). We asked participants to read one of two different scenarios, in which either anger ($N = 36$) or regret ($N = 34$) was expressed.

Materials and Procedure

Participants logged in via the Amazon website, and were redirected to a survey. They read that we were interested in the inferences people make based on minimal information. We prepared a short scenario description, which read: "Suppose you meet a good friend, whom you have not seen for a while. While you are catching up, this friend recalls something that recently happened. Your friend placed an online order for a new cell phone. The phone would be delivered to a store, where your friend could pick it up. As your friend went to the store, a salesperson was there to handle the order. Your friend goes on to tell you the whole story. While telling you what happened, your friend is [getting really angry/feeling very regretful]. Your friend expresses [anger/regret] several times."

After reading this description, participants completed a questionnaire. First, they indicated attributions with regards to the cause of the emotion expressed by their friend, by ascribing agency to their friend (three items; e.g., "Do you think the emotion of your friend was caused by his or her own behavior?" $\alpha = 0.96$), another person (three items; e.g., "Do you think the emotion of your friend was caused by another person?" $\alpha = 0.97$), and the situation (two items; e.g., "Do you think the emotion of your friend was caused by circumstances beyond anyone's control?" $r = 0.80$, $p < 0.001$).

Please note that because it would not be possible for participants to make inferences regarding a specific antecedent to the expression of emotion, we asked participants to infer agency with regards to the cause of the emotion expressed in the vignettes throughout the studies reported in this paper. Subsequently, participants indicated the extent to which their friend had expressed anger and regret (one item each). All questions were answered on scales ranging from 1 (*not at all*), to 7 (*very much so*).

Results

Throughout this report, corrected degrees of freedom are reported for *t* tests whenever there was inequality of variances.

Manipulation Checks

Participants perceived their friend as more angry in the anger condition ($M = 6.36$, SD = 1.10) than in the regret condition ($M = 2.82$, SD = 1.82), $t(53.71) = 9.79$, $p < 0.001$, $d = 2.67$, $r = 0.80$, and as more regretful in the regret condition ($M = 6.35$, SD = 1.04) than in the anger condition ($M = 3.83$, SD = 1.67), $t(59.22) = 7.64$, $p < 0.001$, $d = 1.99$, $r = 0.70$. We therefore conclude that the emotional expression manipulation was successful.

Attributions of Agency[2]

Items for each group of dependent measures were averaged to form scales. We performed *t*-tests between the anger and regret conditions to compare participants' attributions about the cause of the emotion. As expected, participants attributed more agency to their friend when he or she expressed regret ($M = 3.76$, SD = 1.55) compared to anger ($M = 2.61$, SD = 1.45), $t(68) = 3.21$, $p = 0.002$, $d = 0.78$, $r = 36$. Additionally, participants made less agency attributions to another person when their friend expressed regret ($M = 4.71$, SD = 1.51) compared to anger, $M = 5.82$, SD = 1.03, $t(57.77) = 3.60$, $p = 0.001$, $d = 0.95$, $r = 0.43$. Participants' attributions of the incident to uncontrollable circumstances did not differ between the anger ($M = 4.01$, SD = 1.43) and regret conditions ($M = 3.97$, SD = 1.39), $t(68) = 0.83$, $p = 0.41$. This pattern of results is visually represented in **Figure 1**.

Discussion

Findings from Study 1 demonstrate that, as predicted, an expression of anger by a friend led to greater attribution of agency for the expressed emotion to other people and less attribution of agency to the person expressing the emotion, compared to expressions of regret. These findings provide initial evidence that people use others' emotional expressions as a source of information when attempting to ascribe meaning to ambiguous social situations, in a way that is congruent with the framework of attribution theory.

[2]In order to examine whether the attributions of agency that participants made following the various emotions were affected by gender, we re-ran the analyses reported above, this time including participant gender as an exploratory factor (there were at least 16 participants in each cell of the 2 × 2 design). No effects of gender were observed on attributions of agency to the friend, to other people, or to circumstances, all *F* values <1.17, all *p* values >0.28.

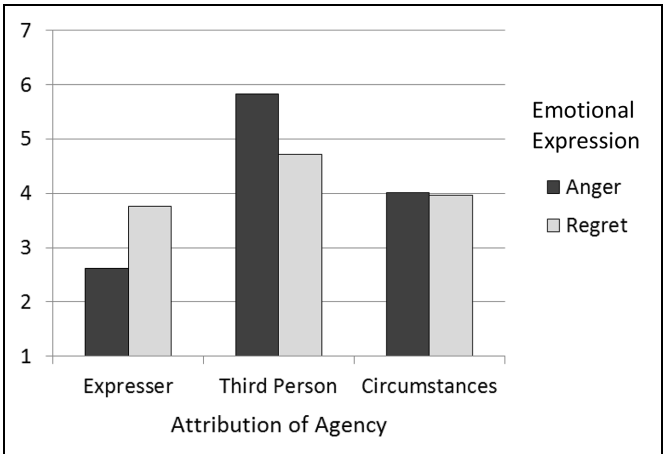

FIGURE 1 | Effects of emotional expressions on attributions of agency to the expresser, a third person, and circumstances (Study 1).

Study 2

Based on the findings from Study 1, a clear distinction can be made between anger and regret in terms of the agency that these emotions communicate when they are expressed. However, these differences are relative, in the sense that they were not compared to a control condition in which no emotion expression was mentioned. It is therefore impossible to tell whether the effects were driven by anger, regret, or both. Study 2 included a control condition to allow us to compare the effects of anger and regret to a non-emotional baseline. In addition, we used a scenario with a more severe outcome in Study 2, to examine whether results from Study 1 would generalize.

In addition to these methodological changes, we set out to explore whether the agency effects that we observed in Study 1 would generalize to conceptually related perceptions of responsibility. Anger often involves the appraisal that someone else is to blame for a negative outcome (Kuppens and Van Mechelen, 2007), whereas regret tends to involve the appraisal that oneself is to blame (Zeelenberg et al., 2000). Therefore, it seems plausible that expressions of anger and regret would have comparable effects on perceptions of responsibility and agency. We examined this possibility in Study 2. Finally, we included measures of perceived coping potential and behavioral intentions toward the expresser for exploratory purposes.

Method

Participants and Design

The experiment was completed by 179 participants from the United States (97 female; age M = 35.02, SD = 12.73 years, range 18–67 years), who were again recruited via Amazon's Mechanical Turk website. As in Study 1, participants completed a 10-min survey in exchange for $0.50 USD. We asked participants to read one of three different scenarios, which again included the anger (N = 62) and regret (N = 58) conditions, as well as a control condition (N = 59) in which no emotion was mentioned.

Materials and Procedure

Participants completed the same procedure as in Study 1, but with a different scenario. The scenario used in Study 2 read: "Suppose you meet a good friend, whom you have not seen for a while. While you are catching up, this friend tells you about a recent incident. Your friend was using the car to get to a party at another friend's place. During the ride, your friend was involved in an accident with another car. Your friend goes on to tell you the whole story. You can see that, while telling you what happened, your friend is [getting really angry/feeling very regretful]. Your friend expresses [anger/regret] several times." In the control condition, the last two sentences were omitted.

After reading this description, participants completed a questionnaire, consisting of the questions that were also used in Study 1 (emotion caused by friend: $\alpha = 0.93$; emotion caused by another person: $\alpha = 0.95$; emotion caused by uncontrollable circumstances: $r = 0.81$, $p < 0.001$) as well as questions regarding the extent to which their friend was responsible for the outcome of the situation ($\alpha = 0.92$); the extent to which another person was responsible for the outcome of the situation ($\alpha = 0.92$); the coping ability of the friend ($\alpha = 0.64$); and participants' intention to help their friend deal with the situation ($\alpha = 0.84$). Manipulation checks were the same as in Study 1.

Results

Means, standard deviations, and specific contrasts for the analyses in Study 2 are reported in **Table 1**.

Manipulation Checks

As expected, analyses of variance (ANOVA) on the manipulation checks showed that participants perceived their friend as more angry in the anger condition than in the other emotion conditions, $F(2,176) = 117.41$, $p < 0.001$, $r = 0.76$. Participants also perceived their friend as more regretful in the regret condition than in the other conditions, $F(2,176) = 70.54$, $p < 0.001$, $r = 0.67$.

Attributions of Agency[3]

Analyses of variances with planned contrasts comparing the anger, regret, and no emotion conditions showed that, as in the previous experiment, participants attributed more agency to their friend when their friend expressed regret, compared to when their friend expressed anger, $F(2,176) = 24.74$, $p < 0.001$, $r = 0.47$. Attributions of agency in the control condition fell in between the regret and anger conditions, and differed significantly from both.

As in Study 1, the opposite pattern was observed for attributions of agency to another person in the situation. Participants attributed less agency to another person when their friend expressed regret, compared to when their friend expressed anger, $F(2,176) = 29.93$, $p < 0.001$, $r = 0.50$. Attributions of agency in the control condition again fell in between the regret and anger conditions, and differed significantly from both.

Participants' attributions of cause to uncontrollable circumstances did not differ significantly between conditions, $F(2,176) = 0.97$, $p = 0.379$.

Exploratory Analyses

Differences in means, as indicated in **Table 1**, are based on *post hoc* tests with Tukey correction. As can be seen in this table, participants ascribed different levels of responsibility to their friend, $F(2,176) = 18.15$, $p < 0.001$, $r = 0.35$, and the other person, $F(2,176) = 12.27$, $p < 0.001$, $r = 0.12$, depending on the emotion that was expressed, and they judged their friend's coping potential in light of the expressed emotion, $F(2,176) = 6.64$, $p = 0.002$, $r = 0.41$. Moreover, participants' self-reported intention to help their friend cope with the situation also differed, $F(2,176) = 3,25$, $p = 0.041$, $r = 0.19$.

As **Table 1** shows, participants considered their friend most responsible when regret was expressed, and less so when either anger or no emotion were expressed. A similar pattern was found with regards to estimates of the friend's coping potential. Also, participants considered another person to be most responsible

[3]To examine effects of gender, we re-ran the analyses for all attributions of agency. All cells in the design included a minimum of 22 participants. No effects of gender (main or interaction) were observed on attributions of agency to the friend, other people, or circumstances, all F values <1.34, all p values >0.25.

TABLE 1 | Mean ratings on dependent measures in study 2.

	Anger		Regret		No emotion		Omnibus test	
Dependent measure	***M***	**SD**	***M***	**SD**	***M***	**SD**	***F***	***P***
Agency of friend	3.90^{a}	1.60	5.56^{b}	1.03	4.66^{c}	1.15	20.42	<0.001
Agency of others	5.27^{a}	1.45	3.36^{b}	1.26	4.13^{c}	1.36	21.65	<0.001
Agency of circumstances	4.19^{a}	1.68	4.08^{a}	1.29	4.46^{a}	1.55	0.89	0.446
Manipulation check anger	6.63^{a}	0.68	2.83^{b}	1.63	3.93^{c}	1.69	96.24	<0.001
Manipulation check regret	3.32^{a}	1.66	6.36^{b}	0.99	4.61^{c}	1.46	37.99	<0.001
Friend responsible	3.53^{a}	1.40	4.62^{b}	1.11	3.90^{a}	1.14	18.15	<0.001
Other responsible	4.65^{a}	1.35	3.39^{b}	1.02	3.90^{c}	1.06	12.27	<0.001
Friend's coping potential	3.11^{a}	1.01	3.68^{b}	0.70	3.29^{a}	0.87	6.64	0.002
Intention to help	$5.37^{a\dagger}$	0.79	$5.36^{a\dagger}$	0.75	$5.01^{b\dagger}$	1.04	3.25	0.041

Means with different superscripts (^{a,b,c}) differ at $p < 0.05$. Different superscripts accompanied by † denote a marginally significant difference ($p < 0.10$).

when anger was expressed and least when regret was expressed, with the control condition falling in between. Finally, participants were marginally more likely to help their friend when he or she expressed an emotion compared to when no emotion was expressed.

Discussion

In Study 2, we replicated and extended the pattern of findings from Experiment 1. Using a different scenario, we found that when their friend was said to express regret, participants again attributed more agency to their friend and less to another person. When their friend was said to express anger, participants attributed less agency to their friend, and more to another person. For both types of attributions, the control condition fell in between the anger and regret conditions, demonstrating that both anger and regret uniquely contribute to the communication of causal properties of the situation. Although including an outcome reduces the ambiguity of the scenario, it is worth noting that the results of the outcome for the person expressing the emotion were not specified beyond it being a negative event, leaving ambiguity with regards to the severity of the consequences.

Exploratory analyses further provided evidence that participants rated their friend as more responsible and better able to cope with the situation following regret than following anger or no emotion. Participants assigned more responsibility to another person in the anger condition, and less in the regret condition, compared to the control condition. Finally, results suggested that participants were somewhat more likely to help their friend deal with the outcome when their friend had expressed anger or regret as opposed to no emotion, although this effect did not reach conventional levels of statistical significance. These results indicate that others' anger and regret influenced participants' ascriptions of agency, related inferences regarding responsibility and coping potential, and intentions to help the friend deal with the situation.

Study 3

In Studies 1 and 2, participants reliably attributed more agency to their friend when (s)he expressed regret, and more agency to another person when their friend expressed anger. In the final study we aimed to extend our findings by examining the effects of expressions of disappointment. In previous research, people who recalled an experience of disappointment were found to appraise the cause of the situation to be due to circumstances beyond their control (Van Dijk and Zeelenberg, 2002). To test whether disappointment leads to similar attributions of agency when it is expressed by another person, we included it as a condition in Study 3. We expected that the disappointment condition would be similar to the control condition with respect to the amount of agency participants would attribute to their friend and another person, but that disappointment would lead to higher levels of attribution of agency to uncontrollable circumstances.

We changed the scenario used in Study 2, so that the friend now described a job interview. An important benefit of using this new scenario was that the expression of disappointment would be a more natural fit to this situation than it would in the scenarios used in the previous studies. As a second benefit, this scenario allowed us to once again leave the outcome ambiguous, replicating Study 2 without the outcome being mentioned explicitly. We also added a measure of perceived injustice. The perception of unfairness or injustice is a typical precursor to the experience of anger (Kuppens et al., 2007). Based on social appraisal accounts (Manstead and Fischer, 2001), a friend's expression of anger can therefore be expected to lead participants to perceive greater levels of injustice. The measure of perceived injustice was added to explore this possibility.

Method

Participants and Design

We recruited 125 participants from the United States (54 women, age $M = 30.06$, SD = 9.73, range 18–64 years) via Amazon's Mechanical Turk website. Participants again completed a 10-min survey in exchange for $0.50 USD. We asked participants to read one of four different scenarios, in which the focal person expressed anger ($N = 33$), regret ($N = 35$), disappointment ($N = 31$), or no emotion ($N = 26$).

Materials and Procedure

The procedure was identical to that used in Studies 1 and 2, but the scenario was different. It read: "Suppose you meet a good friend, whom you have not spoken to for a while. While you are catching up, this friend tells you about a recent job interview. Your friend applied for a position in a large company. A manager from the personnel department was there to assess whether your friend would be the person for the job. Your friend goes on to tell you the whole story. You can see that, while telling you what happened, your friend is [getting really angry/feeling really disappointed/feeling very regretful]. Your friend expresses [anger/disappointment/regret] several times." In the control condition, the last two sentences were omitted.

After reading this description, participants once again completed a questionnaire. Besides answering the questions that were also used in Study 2 (emotion caused by friend, $\alpha = 0.95$; emotion caused by another person, $\alpha = 0.96$; emotion caused by the situation, $r = 0.72$, $p < 0.001$; coping ability of friend, $\alpha = 0.83$; friend responsible for outcome, $\alpha = 0.88$; another person responsible for outcome, $\alpha = 0.88$; intention to help friend, $\alpha = 0.82$), participants were further asked to indicate how just they considered the application procedure to have been (four items; e.g., "Do you think the application procedure was fair?" $\alpha = 0.87$). Finally, manipulation checks were identical to those in the previous studies, except for the fact that one item was added to assess the accuracy of the disappointment manipulation.

Results

Means, SD, and contrasts for all analyses reported below are shown in **Table 2**.

Manipulation Checks

Analyses of variance on the emotion manipulation checks showed that participants perceived their friend as more angry in the anger condition than in the other emotion conditions, $F(3,121) = 39.86$, $p < 0.001$, $r = 0.71$. Participants also perceived their friend as more regretful in the regret condition than in the other conditions, $F(3,121) = 26.44$, $p < 0.001$, $r = 0.63$. Finally, participants perceived their friend as more disappointed in the disappointment condition than in the other conditions, $F(3,121) = 7.92$, $p < 0.001$, $r = 0.41$.

Attributions of Agency[4]

Analyses of variance revealed a significant effect of emotion on attributions of agency to the friend, $F(3,121) = 8.73$, $p < 0.001$. As can be seen in **Table 2**, attributions of agency to the friend were higher in the regret condition than in the anger condition. Levels of agency attribution in the disappointment and control conditions fell in between those in the regret and anger conditions, and did not differ from each other.

As in Study 2, the opposite pattern was observed for attributions of agency to another person in the situation, $F(3,121) = 12.97$, $p < 0.001$, $r = 0.49$. Participants attributed less agency to another person when their friend expressed regret, compared to when their friend expressed anger. In the disappointment and control conditions, such attributions again fell in between the regret and anger conditions, and did not deviate from one another.

No effects were found on attributions of agency to uncontrollable circumstances, $F(3,121) = 0.73$, $p = 0.534$. Contrary to our expectation regarding the communicative function of disappointment, participants' attribution of agency to uncontrollable circumstances did not differ between the disappointment and control conditions.

Exploratory Analyses

Differences in means, as indicated in **Table 2**, are based on post-hoc tests with Tukey correction. Participants ascribed different levels of responsibility to their friend, $F(3,121) = 5.08$, $p = 0.002$, $r = 0.33$, and to the other person, $F(3,121) = 12.22$, $p < 0.001$, $r = 0.48$, depending on the emotion expressed, and they also interpreted the friend's coping potential in light of the emotion expressed, $F(3,121) = 3.25$, $p = 0.024$, $r = 0.27$. Participants' self-reported intention to help their friend cope with the situation also differed between conditions, $F(3,121) = 2.83$, $p = 0.041$, $r = 0.26$. Finally, participants differed in the extent to which they considered the application procedure to have been just, $F(3,121) = 5.28$, $p = 0.002$, $r = 0.34$.

As **Table 2** shows, participants judged their friend as less responsible in the anger condition than in the regret condition, and they considered their friend's coping potential to be lower in the anger condition than in the other conditions. They also considered someone else's responsibility to be higher in the anger condition, compared to the other conditions. Interestingly, participants indicated greater intentions to help their friend deal with the situation when their friend expressed disappointment, compared to when no emotion was expressed. Finally, participants considered the application procedure to have been less just in the anger condition compared to the other conditions.

Discussion

Results from Study 3 replicate the pattern of agency attributions in the former two studies with a different scenario. We also replicated findings from Study 2 with regards to the inferred responsibility of friend and others and the friend's perceived coping ability. Moreover, participants considered the application procedure to have been less just in the anger condition, compared to the other conditions, providing additional evidence that the emotions expressed by the friend can (in the absence of other information) inform participants' assessment of the situation. Although a friend who expressed disappointment regarding his or her outcomes did not lead participants to attribute more agencies to uncontrollable circumstances, disappointment did increase intentions to help the friend cope with the situation, compared to when no emotion was expressed.

[4]To examine effects of gender, we again re-ran the analyses for all causal attributions. All cells in the design included a minimum of 10 participants. No effects of gender (main or interaction) were observed on attributions of agency to the friend, other people, or circumstances, all F values <1.73, all p values >0.16.

TABLE 2 | Mean ratings on dependent measures in Study 3.

	Anger		Disappointment		Regret		No emotion		Omnibus test	
Dependent Measure	***M***	**SD**	***M***	**SD**	***M***	**SD**	***M***	**SD**	***F***	***P***
Agency of friend	3.84^{a}	1.56	$4.31^{a,b}$	1.50	5.44^{c}	1.22	4.72^{b}	0.90	8.73	<0.001
Agency of others	5.51^{a}	1.29	4.77^{b}	1.42	3.54^{c}	1.33	4.67^{b}	1.19	12.97	<0.001
Agency of circumstances	3.95^{a}	1.61	3.61^{a}	1.36	3.54^{a}	1.35	3.46^{a}	1.31	0.73	0.53
Manipulation check anger	6.52^{a}	.90	3.35^{b}	1.89	3.09^{b}	1.46	3.62^{b}	1.39	39.86	<0.001
Manipulation check disappointment	5.82^{a}	1.31	6.55^{c}	0.93	$5.31^{a,b}$	1.45	4.81^{b}	1.94	7.92	<0.001
Manipulation check regret	3.91^{a}	1.44	4.97^{b}	1.54	6.54^{c}	0.98	3.85^{a}	1.64	26.44	<0.001
Friend responsible	3.12^{a}	1.39	$3.73^{a,b}$	1.29	4.27^{b}	1.16	$3.71^{a,b}$	0.92	5.08	0.002
Other responsible	4.85^{a}	1.10	$3.77^{b,c}$	1.13	3.20^{b}	1.35	$4.11^{a,c}$	0.87	12.22	<0.001
Friend's coping potential	$3.85^{a\dagger}$	1.37	$4.61^{b\dagger}$	1.25	$4.66^{a,b}$	1.32	$4.62^{b\dagger}$	0.86	3.25	0.024
Intention to help	$5.33^{a,b}$	0.82	5.63^{a}	0.65	$5.53^{a,b}$	0.75	5.09^{b}	0.81	2.83	0.041
Procedural justice	$3.87^{a\dagger}$	1.37	4.76^{b}	0.86	4.78^{b}	0.98	$4.56^{b\dagger}$	0.93	5.28	0.002

Means with different superscripts (^{a,b,c,d}) differ at $p < 0.05$. Different superscripts accompanied by † denote a marginally significant difference ($p < 0.10$).

General Discussion

Integrating theorizing on attribution (Weiner, 1985), social appraisal (Manstead and Fischer, 2001), and the use of emotion as social information (Van Kleef, 2009), we conducted three scenario studies to examine how emotional expressions influence attributions of agency and responsibility in ambiguous contexts. We found that expressions of regret about a particular state of affairs led perceivers to attribute greater agency and responsibility for the situation to the expresser, whereas expressions of anger resulted in greater attributions of agency and responsibility to a third person. These studies replicate effects found in previous research in which the expressed emotions had clear contextual antecedents (e.g., Van Kleef et al., 2004, 2006; de Melo et al., 2014). We also found that expressions of anger were interpreted as a sign of injustice, and that expressions of disappointment increased tendencies to help the expresser.

These results show that even when there is no clear antecedent to the expression of emotion by another person, people's inferences regarding the agency of the expresser and others correspond to the appraisal structures associated with the emotions. These results indicate that inferences that people make regarding the person expressing the emotion don't necessarily rely on a preceding outcome being known, and make an account of emotions as social information less sensitive to context and, therefore, stronger. Our results are novel in that under conditions of ambiguity, inferences of agency are a markedly more dynamic class of social inferences than inferences of stable personality traits (Knutson, 1996). Accordingly, one promising avenue for further research is to determine whether effects of emotional expressions on inferences about the situation in which the emotion is expressed, qualities of the expressing person, and qualities of the person to whom the expression is directed can be similarly decontextualized.

People may use social appraisal (Manstead and Fischer, 2001), reverse appraisal (Hareli and Hess, 2012), or a combination thereof to make inferences based on others' emotions (de Melo et al., 2014). When inferences result from one, or both, of these processes is currently unclear. In the current studies, social appraisals regarding agency and responsibility could reliably be made, despite a lack of a contextual antecedent of (cause of) the emotion expression. Because no antecedent event was described as a trigger for the emotion that was being expressed, however, it seems less likely that our participants engaged in the reconstruction of the appraisals of the person expressing an emotion (i.e., reverse appraisal; de Melo et al., 2014). The information needed to do so was simply not available to them. A promising line for future research could be to investigate which information observers use in order to reliably reconstruct the appraisals underlying an expression of emotion which they observe.

Interestingly, Study 3 revealed no evidence that the expression of disappointment influences attributions of agency and responsibility. It thus seems that the link between disappointment and situational agency, which was found in previous research (e.g., Van Dijk and Zeelenberg, 2002), did not translate to social appraisals, perhaps because the experience of disappointment often results in inaction (Zeelenberg et al., 2000). Understanding why someone does *not* act may be less important than understanding why someone does act, and may hence have less of an impact on the social appraisals (Manstead and Fischer, 2001) that observers themselves are likely to make of the situation. Interestingly, the expression of disappointment did increase self-reported intentions to help the expresser. This finding is in line with research on prosocial behavior (Van Doorn et al., 2015) and negotiation (Van Kleef et al., 2006; Lelieveld et al., 2013), which also yielded evidence that expressions of disappointment can elicit cooperative behavior. Whether disappointment reliably yields a social appraisal that someone should be helped, however, is a question for further research.

In interpreting the current findings, a number of potential limitations of our approach must be considered. First, we presented participants with hypothetical scenarios, rendering it unclear at this point to what extent the current findings generalize to actual situations. Although similar methodology

was used previously in research on attribution processes (e.g., Weiner, 1985), it will be important to replicate the current effects in more dynamic, real-world situations (Parkinson and Manstead, 1993). A second potential limitation of the present studies concerns the reliance on verbal descriptions of emotional expressions. Emotions may be expressed in various ways, including via facial displays, vocal cues, bodily postures, verbal expressions, and/or symbols such as emoticons. Despite the obvious qualitative differences between these various expressive modalities, there is increasing evidence that the interpersonal effects of emotional expressions are functionally equivalent in that the direction (but not necessarily the magnitude) of their effects on other individuals is the same across expressive channels (Van Kleef et al., 2011).

This observation is consistent with a social-functional approach to emotions (Darwin, 1872; Parkinson, 1996; Keltner and Haidt, 1999; Van Kleef, 2009; Fischer and Manstead, in press). For instance, a basic assumption underlying EASI theory is that individuals turn to each other's emotional expressions to make sense of ambiguous (social) situations, and that such disambiguating information can be gleaned from verbal as well as non-verbal expressions (Van Kleef et al., 2011). In line with this "functional equivalence hypothesis," recent studies on the role of emotional expressions in persuasion and conformity showed that effects were similar regardless of whether emotions were expressed in words, through facial displays, via emoticons, or via a combination of facial, vocal, and postural cues (Heerdink et al., 2013; Van Kleef et al., 2015). In light of this evidence, and earlier work by Knutson (1996) who found effects of facial expressions of emotion on inferences regarding the personality of the expressing person, we assume that we would have found similar effects in the current studies if we had manipulated emotional expressions using non-verbal cues. Clearly, however, future research is needed to substantiate this assumption.

Awaiting further investigations, we conclude that people use others' emotional expressions as a source of information when attempting to make sense of social situations. More specifically, individuals use the emotional expressions of others to arrive at inferences regarding others' agency and responsibility for a current state of affairs, which correspond with the appraisal structures associated with the emotions. These findings contribute to a growing body of research that speaks to the ways in which individuals draw on conceptual emotion knowledge to interpret the emotional expressions of others. Such inferential processes play an important role in the construal and navigation of social life.

Author Contributions

EvD, GvK, and JvdP developed the study hypotheses and designs, EvD collected and analyzed the data, EvD drafted the paper, GvK and JvdP provided feedback and made revisions, and GvK prepared the paper for submission. EvD revised the manuscript following reviews.

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Pitching Emotions: The Interpersonal Effects of Emotions in Professional Baseball

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Sports games are inherently emotional situations, but surprisingly little is known about the social consequences of these emotions. We examined the interpersonal effects of emotional expressions in professional baseball. Specifically, we investigated whether pitchers' facial displays influence how pitches are assessed and responded to. Using footage from the Major League Baseball World Series finals, we isolated incidents where the pitcher's face was visible before a pitch. A pre-study indicated that participants consistently perceived anger, happiness, and worry in pitchers' facial displays. An independent sample then predicted pitch characteristics and batter responses based on the same perceived emotional displays. Participants expected pitchers perceived as happy to throw more accurate balls, pitchers perceived as angry to throw faster and more difficult balls, and pitchers perceived as worried to throw slower and less accurate balls. Batters were expected to approach (swing) when faced with a pitcher perceived as happy and to avoid (no swing) when faced with a pitcher perceived as worried. Whereas previous research focused on using emotional expressions as information regarding past and current situations, our work suggests that people also use perceived emotional expressions to predict future behavior. Our results attest to the impact perceived emotional expressions can have on professional sports.

Keywords: emotion, interpersonal effects of emotion, social influence of emotion, competitive sports, anger, worry, happiness

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"... There was pride in Casey's bearing and a smile lit Casey's face.
And when, responding to the cheers, he lightly doffed his hat,
No stranger in the crowd could doubt 'twas Casey at the bat.

... The sneer is gone from Casey's lip, his teeth are clenched in hate,
He pounds with cruel violence his bat upon the plate;
And now the pitcher holds the ball, and now he lets it go,
And now the air is shattered by the force of Casey's blow.

Oh, somewhere in this favored land the sun is shining bright,
The band is playing somewhere, and somewhere hearts are light;
And somewhere men are laughing, and somewhere children shout,
But there is no joy in Mudville – mighty Casey has struck out."
— (from *Casey at the Bat* – Ernest Lawrence Thayer)

INTRODUCTION

Sports are a natural breeding ground for emotions, and baseball is no exception – as is evident from the famous poem by Ernest Lawrence Thayer. Scientific evidence, too, indicates that even the "masculine" context of professional American baseball is ridden with emotions, which are commonly expressed during matches (MacArthur and Shields, 2015). However, it remains unclear how observers respond to these emotional expressions. Here we report one of the first studies on the interpersonal consequences of emotions in the context of professional sports. Specifically, we investigated whether pitchers' perceived facial emotional displays influence how their pitches are assessed and responded to.

Emotions are not just private feelings – they tend to be expressed, oftentimes in the presence of others (Parkinson, 1996). This means that other people may perceive emotional expressions and may be influenced by them (Keltner and Haidt, 1999). According to emotions as social information (EASI) theory (Van Kleef, 2009), this influence may come about via two distinct processes. First, emotional expressions may evoke affective reactions in observers, which may in turn influence their behavior. A considerable body of research has documented evidence of various types of affective reactions and their downstream consequences, the most widely studied process being emotional contagion (Hatfield et al., 1993). This refers to the tendency of individuals to (unconsciously) "catch" the emotions of others. The resulting emotional states may in turn influence people's cognitions, attitudes, and behaviors (Forgas, 1995). Second, emotional expressions may elicit inferential processes in observers (Van Kleef, 2009). According to appraisal theories of emotion, emotions arise in response to events that are perceived as relevant to important concerns or goals (Frijda, 1986; Scherer et al., 2001; Ellsworth and Scherer, 2003). For example, anger tends to arise when one's goals are frustrated and blame can be ascribed, happiness tends to arise when goals are attained or good progress is being made, and worry tends to arise when there is uncertainty about the future attainment or thwarting of one's goals. Based on this notion, it is possible to glean information from others' emotional expressions by a reversal of the appraisal process, such that the emotional expressions of others are used as information about how the expresser interprets the situation (Manstead and Fischer, 2001; Hareli and Hess, 2010; Van Doorn et al., 2012). Thus, expressions of anger may be interpreted as a sign of goal blockage and other blame, expressions of happiness may be taken as a sign of goal achievement, and expressions of worry may be taken as a sign of insecurity about the future.

A growing body of research speaks to the social consequences of emotional expressions (for reviews, see Van Kleef et al., 2011, 2012). In particular, studies across a variety of domains have demonstrated that observers use others' emotional expressions to gain insight into the expresser's goals and desires and to inform their understanding of situations. Negotiators use emotional expressions of their counterparts to locate the counterpart's limits and to determine their own strategy (Van Kleef et al., 2004; Sinaceur and Tiedens, 2006). Individual group members use the emotional expressions of their fellow group members to gage their momentary levels of acceptance in the group and to decide whether they should conform to the majority or have the leeway to deviate (Heerdink et al., 2013). Service employees use the emotional displays of customers to determine the credibility of their complaints (Hareli et al., 2009). Work teams use the emotional displays of their leaders to gage the quality of their performance and to calibrate their effort expenditure (Sy et al., 2005; Van Kleef et al., 2009). Outside observers use the emotional expressions of team members to arrive at inferences regarding the team's cohesion, cooperation, and conflict (Magee and Tiedens, 2006; Homan et al., 2016). Thus, it is clear that emotions provide social cues for those who notice them.

When it comes to competitive sports, any information that may provide insight into how the opposing team is going to play is greatly sought after. Knowing the tendencies and preferences of specific players on the other team can greatly influence the tactics for the game. For example, in baseball, knowing a batter's tendency for swinging only at certain pitch types, or a pitcher's tendency to throw low balls in specific situations, can impact the way that a player prepares for a pitch or swing. This can be evident from the following quote from former professional baseball player and coach Charlie Metro:

The good hitters get their tip-off from the pitchers. And there are many, many ways that a pitcher tips off his pitches. He grips it like that [fingers straight over top of ball]; there's your fastball. When he throws a curveball, he chokes the ball [wedges it between his thumb and forefinger, gripping it on the side so it sticks out]. Now see how much white of the ball shows on a fastball? And how much more white shows on a curveball?... Another thing is when they bring the ball into the glove, when they come in with a flat wrist like that, that'll be a fastball. When they turn their wrist like that, it's a breaking pitch. There are many, many ways, and the good hitters pick out these things... facial expressions... human habits and characteristics will tell. (Carlson and Charlie, 1999, "Biological Baseball", para 4).

As a result, scouting reports for players are big business in baseball, as in any sports (consider the biographical Hollywood sports drama *Moneyball*).

In this paper we build on the general notion that emotional expressions provide relevant information (Parkinson, 1996; Keltner and Haidt, 1999; Manstead and Fischer, 2001; Van Kleef, 2009) to examine what type of information observers distil from perceived pitchers' emotional expressions during professional baseball games, and to investigate whether batters are indeed influenced by the pitcher's facial expressions, as Charlie Metro's quote suggests.

Although research on the effects of emotional displays in the context of sports is scarce (Friesen et al., 2013), there is some evidence that the emotional displays of players can indeed influence the trajectory of sports games. Totterdell (2000) examined processes of mood convergence and linkage among teammates during professional cricket matches. He found that the moods of players of the same team were more strongly linked than the moods of players of different teams, and that positive moods of players were associated with subjective ratings of performance. Totterdell's study thus provided evidence for the occurrence of affective reactions to others' emotional displays

in the context of professional sports as well as suggestive evidence that such affective reactions may be associated with team performance. The current study complements this earlier work by focusing on the role of inferential processes as opposed to affective reactions (see Van Kleef, 2009). Furthermore, whereas Totterdell's seminal study focused on how players' and teams' own moods were associated with their (subjective) performance, the current research examines how observers use the perceived emotional displays of sports players (in this case, pitchers in baseball) to make predictions about their actual subsequent, physical performance (i.e., how fast a ball is going to be thrown; how close the ball is going to be thrown to the target, etc.). Moreover, we examine the relationship between the pitcher's perceived emotional display and the batter's tendency response to these displays (either to approach the ball and swing or to avoid the ball and not swing).

In the current research we extend the theoretical notion of EASI (Van Kleef, 2009) to the domain of professional sports by asking the following questions: Is it possible that, in the brief few seconds prior to a pitch, the perceived emotional displays of the pitcher could provide information about what is about to occur? Would this information be detected by observers? Would this information be valid and valuable such that it could predict the quality of the throw by the pitcher and consequently the behavior of the batter? The relevance of any answers to these questions goes beyond the baseball context or the sports context more generally. Investigating what information observers' draw from others' perceived emotional displays in real-life settings contributes to a more complete understanding of the interpersonal effects of emotions.

This research further extends current knowledge by tying perceived emotional displays to predictions of physical actions and by focusing on predicting future behavior. Specifically, the outcomes we measure are how fast and how accurate a pitcher would throw a ball, and how likely another person would be to attempt to hit a ball that is thrown toward him. To date most research on inferences has been limited to character judgments (e.g., Knutson, 1996; Hareli and Hess, 2010), goals and intentions, (Van Kleef et al., 2004), past performance (e.g., Van Kleef et al., 2009), credibility of complaints (Hareli et al., 2009), and the construal of social situations (e.g., Van Doorn et al., 2012, 2015a). This work has shown that emotions of others serve as cues regarding a situation that has already occurred. None of this previous work has looked at predictions of future behavior, and even more specifically in our case the prediction of physical performance.

Setting – American Baseball

American Baseball is an ideal setting in which to investigate interpersonal effects of emotions in sports, because it involves a game situation wherein two individuals from opposing teams are set one against the other in a form of a duel. This duel has a clear outcome that can take several forms that can be objectively determined. It involves both parties facing each other, within viewing distance, where one initiates, and one responds. Moreover, video footage and records of actual qualities of pitches and reactions to pitches are available, making all of the reactions objectively quantifiable. To facilitate the reader's understanding of our procedure and analyses, Appendix 1 provides a short description of the game of baseball and **Figure 1** shows a diagram of the baseball field.

OVERVIEW OF THE CURRENT RESEARCH

We tested how observers of pitchers in baseball games make use of pitchers' facial displays to assess specific aspects of a pitch that is about to be thrown. We also examined the ability of observers to successfully predict the batter's response to the pitch. Using data from U.S. Major League Baseball games (the "World Series"), we presented short video clips to Dutch students, instructing them to assess various aspects of an upcoming pitch as well as the possible responses of the batter. We later matched the predictions of the students to the actual features of the pitches in those games.

Because it is not possible to survey professional baseball players on the emotions they recognized before they decided to respond to a pitch, we chose what we believe is the best available means for testing our predictions – using TV footage. The TV footage allows us to show the stimuli as they occurred in reality and "pause" that reality for an assessment of the emotion and prediction, and then "un-pause" the footage to test for the real-life result. Thus, our design uses real-life stimuli as well as real-life results taken from baseball games, while we rely on laboratory data and student participant assessments in order to test our predictions.

Although we aimed for the most ecologically valid methods to test our predictions, the design we used does come with imperfections. The real-life setting has the pitcher and the batter facing one another at a distance of about 18 m; while the footage of the pitcher that is viewed by student participants from TV-footage is enlarged due to the ability of the camera to focus and zoom in to enlarge the pitcher's body and face. This is not equivalent to the reality of the actual match. Moreover, the batter has in his line of sight many other aspects that the students participating in our lab study do not see. The batter sees the rest of the field, his teammates, the opposing team members, the crowed, etc. Our student participants focus solely on the pitcher. In addition, the batters are under pressure during the match which could determine the winners of the championship, and are required to not only assess the emotion but also to prepare themselves with a response. In the lab our student participants are not professional baseball players. They are not trained at assessing emotions, especially not those of pitchers who move as they are about to pitch a ball, nor are they under pressure to perform. To add to that, our sample (which will be described below) was made up of Dutch students, who have limited exposure to baseball. Thus, our design does not actually mirror reality. Yet, we have little doubt that batters do have the ability to view the pitchers' body and face and to assess their emotion, as is evident from the quote above from professional player and coach Charlie Metro. Players are trained at focusing on the pitcher and acquiring cues regarding the upcoming pitch, which includes assessing emotions of pitchers. Thus, the lack of training and ability of

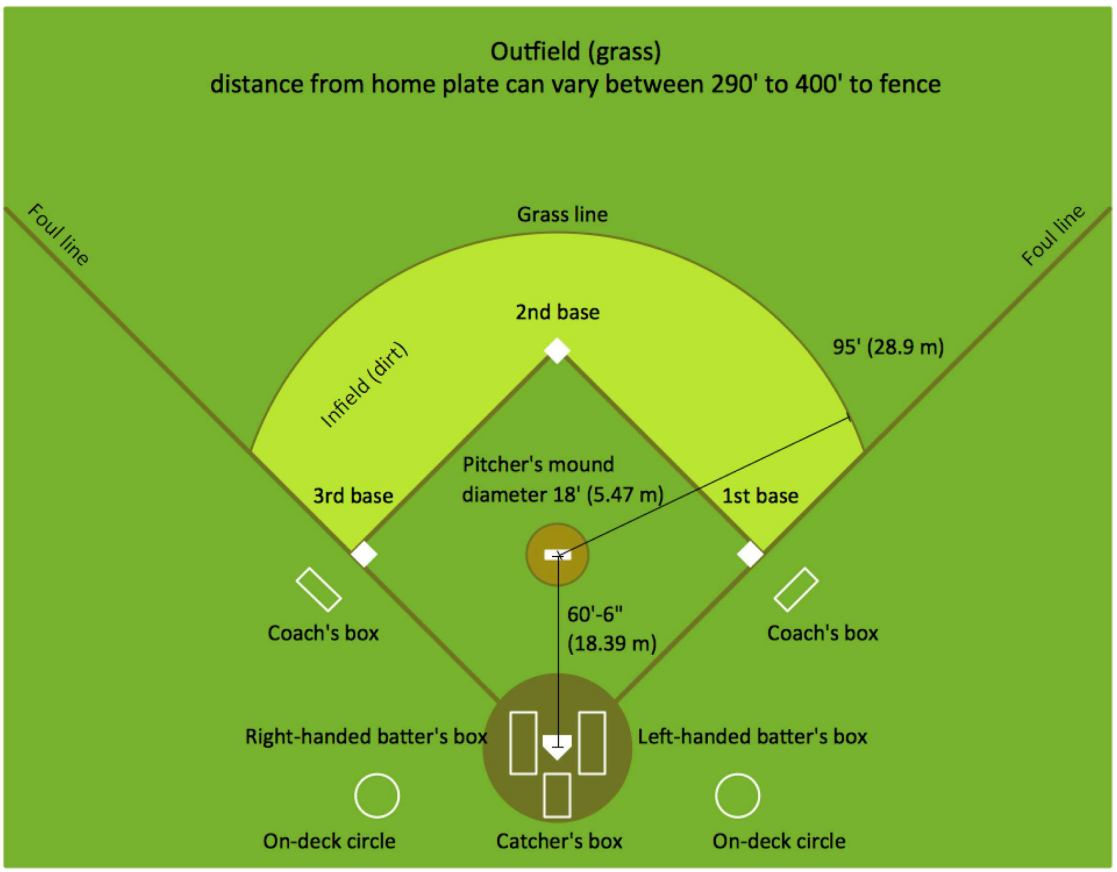

FIGURE 1 | A diagram of the baseball field – taken from http://www.conceptdraw.com/solution-park/sport-baseball.

our student participants in decoding the pitcher's emotional expression should partially compensate for their larger image of the pitcher, relative to the professional players.

We first collected the material – video clips showing facial expressions of pitchers before a pitch. Then the material was assessed for emotional cues – to see if emotions could be detected in a consistent manner. Once that had been established, we examined what kind of information naïve participants extracted from these identified emotions. The final step involved comparing the participants' assessments to actual game outcomes (i.e., from the World Series) regarding the pitch and the response to the pitch by the batter.

DATA ANALYSIS

To facilitate the understanding of the multilevel nature of our data and data analyses, we have summarized our analytical approach in **Figure 2**. On the participant level (lower half of **Figure 2**), we collected emotion display ratings (pre-studies) and predictions of pitch characteristics (main study). These ratings were aggregated to the higher clip level (upper half of **Figure 2**) and regressed on the actual outcomes of the pitch (as indicated by archival data from the MLB). Within one level of analysis, we used factor analyses, reliability analyses (assessed with Cronbach's α), and generalized linear models (GLMs). Some analyses involved multiple levels of analysis, like the assessment of inter-rater reliability and inter-rater agreement before aggregating rating from the participant level to the clip level, and the use of generalized mixed effects models (GLMMs) for analyses at both levels. We will discuss these analyses in turn.

Prior to aggregating participant-level ratings to the clip-level, we assessed both the inter-rater *reliability* and the inter-rater *agreement* of the individual perceived emotion display ratings (as recommended by LeBreton and Senter, 2008). Inter-rater reliability, commonly measured with intra-class correlation measures such as ICC(2) (Shrout and Fleiss, 1979), reflects the extent to which individuals reliably rank-order the clips in terms of the displayed emotions. The reported ICC(2) values were derived from a GLMM (see explanation below) that was fitted using the lme4 package (version 1.1.9; Bates et al., 2015) for R (version 3.2.2; R Core Team, 2015), and bootstrapped using the bootMer function (10,000 resamples). We report the 95% confidence interval for the ICC(2) statistic. Inter-rater agreement, which is commonly determined using the $r_{WG(J)}$ index, reflects the extent to which judges are equivalent in terms of the absolute perceived emotion display score they assign to

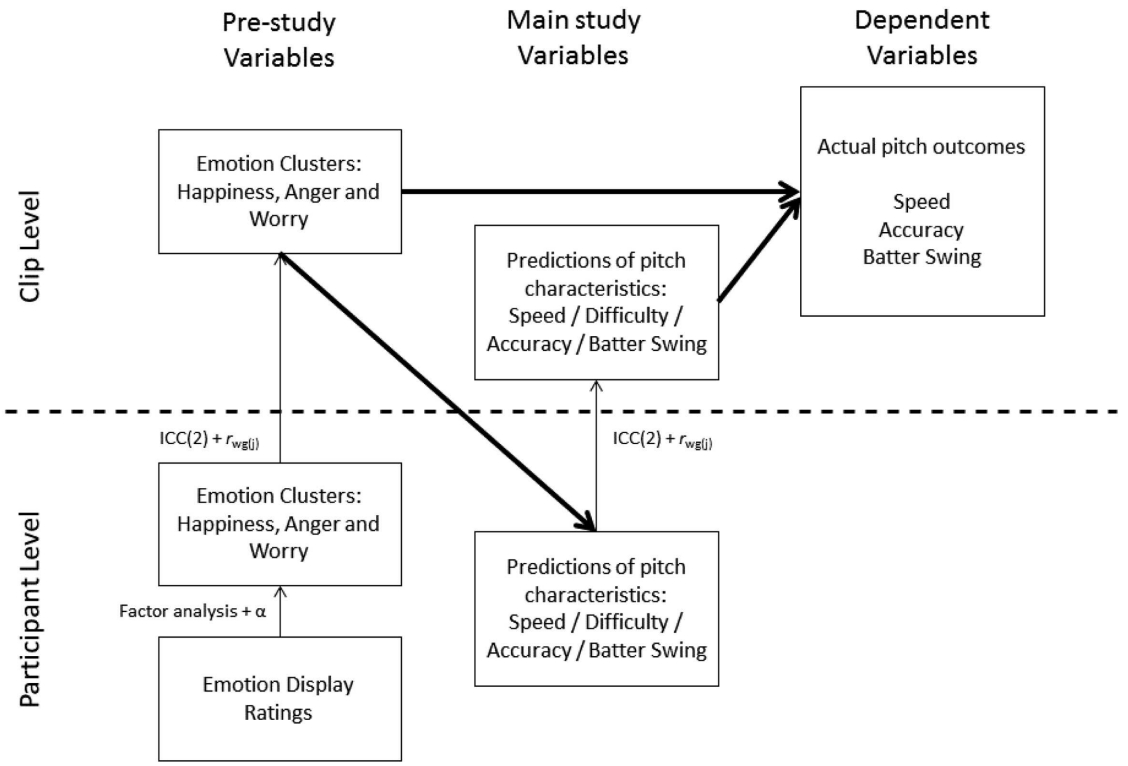

FIGURE 2 | Schematic representation of the multilevel nature of the data and the data analyses. Narrow arrows represent aggregation (the indicated analytical techniques were used as criteria before aggregation) and bold arrows represent IV to DV relations. Analyses within one data level (e.g., using only clip-level variables) were conducted using generalized linear models (GLMs), and analyses using variables from both levels were conducted using generalized mixed-effect models (GLMMs). The final mediation analysis is not indicated in this schematic overview for the sake of clarity.

a video clip. The reported $r_{WG(J)}$ values may be interpreted as follows: Values below 0.30 reflect a lack of agreement, values between 0.31 and 0.50 reflect weak agreement, values between 0.51 and 0.70 reflect moderate agreement, values between 0.71 and 0.90 reflect strong agreement, and values between 0.91 and 1.00 reflect very strong agreement (LeBreton and Senter, 2008). Because our main interest is in the consequences of *relative* differences in perceived emotion displays between clips, rather than in the absolute degree of perceived emotion displayed in the videos, we deemed satisfactory inter-rater reliability (i.e., ICC[2] $>$ 0.70, Bliese, 2000) more important than inter-rater agreement. We therefore used inter-rater reliability as our primary selection criterion and inter-rater agreement as a secondary criterion.

Whenever our analysis involved both a participant-level outcome and clip-level predictors, we used GLMMs that were fit using the (g)lmer function in the lme4 package (Bates et al., 2015) for R (R Core Team, 2015). An extensive discussion of GLMMs is beyond the scope of this article, but it is useful to note how the inclusion of both fixed and random effects in a model (which is what 'mixed-effect' in the name of the technique refers to), benefits our analyses. Fixed effects are identical to the parameters in a regular GLM, and refer to the effect of interest (e.g., the relation between anger displays and estimated pitch speed). The (one or more) *random* effects, however, are unique to mixed-effect models and allow controlling for higher-level covariance while estimating effects on a lower level. Thus, including a random effect for clip while regressing clip-level anger displays on participant-level estimates of pitch speed controls for clip-level variance in estimated pitch speed that is not accounted for by (and unrelated to) the fixed effects (e.g., due to unique clip characteristics such as an exceptionally muscular pitcher) that would otherwise obscure or inflate the estimated relation between anger displays and estimates of pitch speed. The use of a GLMM thus gives us a better focus on the effects of interest. For an introduction to mixed effect linear models and their application to multilevel data, see Field and Wright (2011), and for more extensive coverage of the topic, see West et al. (2014).

PRE-STUDY: SELECTING AND TESTING INSTANCES OF PERCEIVED EMOTIONAL DISPLAYS

We conducted a pre-study in which participants were asked to assess the emotional displays of various pitchers based on short video clips. The goal of this study was to test whether observers can reliably identify pitcher's emotion based on facial displays in these video clips. The study was carried out in accordance with

APA regulations and approved by the IRB at the University of Amsterdam.

Method

Participants

Dutch undergraduate psychology students participated in the study and were compensated by pay (€3.50) or partial class credit. The 2011 sample included 151 participants (age $M = 22.06$, range 18–64, 63 men, 81 women, seven missing demographic information) while the 2012 sample included 62 (age $M = 22.81$, range 18–41, 26 men, 36 women).

Materials

We selected video clips from high-stakes games that are likely to be among the most emotional of all the season – the final games of the World Series. The clips were selected from the last two games of the 2011 finals (games 6 and 7) and from the final game of the 2012 finals (game 4). These games determined who would win the Major League Baseball (MLB) championship. TV footage of the games was screened for incidents where the face of the pitcher could clearly be seen right before the pitch[1], as there are many incidents where the camera is focused on the batter or on other elements of the game, and not on the pitcher.[2] In the 2011 finals (games 6 and 7) there were 659 pitches in total, of which 63 met the above mentioned inclusion criterion. In the 2012 finals there were 290 pitches in total, of which 29 met the inclusion criterion.

Once we identified these incidents, we created short clips that lasted only a few seconds, ranging from 1.5 to 3 s (the material is available open request from the corresponding author). These clips were further edited in order to blur all irrelevant information (e.g., team names, the score, players on base, etc.) so that they showed only the pitchers' faces and bodies as they prepared to throw the ball.

Procedure

The short clips were shown in randomized order to participants. Following the clip, participants were asked to indicate on a scale from *1 = not at all* to *10 = very much* the degree to which a number of emotional displays had been visible in the clip. The list of emotions was prepared by the researchers in advance and contained those emotions that were deemed most relevant given the current context. The exact items differed somewhat between the 2011 and 2012 finals (details below). Participants received a notification before each clip was about to start. There was no possibility to rewind and watch a clip more than once.

[1]This included a clear shot of the face of the pitcher right before the pitch, when the pitcher's face was present in the shot for more than 1.5 s, and if the pitch itself was thrown no more than 2 s after the pitcher was depicted. Clips that matched the above mentioned criteria were further screened to ensure that there were clips of every pitcher, with at least two possible outcomes (i.e., swing, ball, foul, or strike). After selecting the pitchers and pitches that were usable for the experiment, videos were included in the study if there were four clips of the same pitcher. This was done to ensure some variance in pitchers' perceived emotional displays and to take into account specific features of a pitcher (not their momentary emotional display) that had an impact on predictions.

[2]We contacted the US Major League Baseball Association with a request for footage from their cameras that were directed at the pitcher. To this day no response was received.

Results

Aggregation Strategy

The aggregation from the individual, per-emotion ratings to clip-level perceived emotion displays proceeded as follows. First, we assessed the reliability of the emotion scales using the average of the per-clip reliabilities, instead of calculating an overall reliability across all observations. (The latter approach would treat multiple observations from the same individual as independent, which would inflate the estimated reliability). Then, we determined the agreement among the raters about the extent to which various emotions were displayed in the video clips (see Data Analysis above for more details) prior to aggregating the perceived emotion ratings to the video level.

2011 Finals Clips

The 63 clips selected from the 2011 World Series finals were rated by the participants. Each participant rated a randomly selected subset of 25 videos on the following emotional displays: happiness, sadness, somberness, confusion, anger, fear, concentration, confidence, excitement, aggression, hope, despair, and stress. Excitement was not considered in the analyses because during data collection, we found that participants interpreted the Dutch translation of excitement (*opgewonden*) in a sexual way, which is not what we intended to measure.

To determine how many emotion clusters would be needed to represent the emotion display ratings, we initially inspected 3-, 4-, and 5-factor solutions for a factor analysis on all 12 emotion ratings (with oblimin rotation) and found that each item loaded substantially (>0.50) on at least one of the factors in a 5-factor solution (which accounted for 64.4% of the total variance). Happiness loaded on a separate factor, without any substantial cross-loadings, and was therefore treated as a single-item scale for happiness. Anger and aggression loaded substantially on another factor, and also had few cross-loadings. They were treated as a two-item scale for anger (mean $r = 0.65$, range 0.37–0.82). The remaining three factors were difficult to interpret, had inter-correlations up to $r = 0.63$, and several items loaded on more than one of these factors. We therefore attempted a second exploratory factor analysis on the remaining items, which revealed no meaningful factor structure when asking for 4, 3, or 2 factors. We therefore constructed a third scale using all items with absolute factor loadings >0.50 on a one-factor solution (confidence [reverse-coded], sadness, somberness, confusion, fear, despair, stress) that we interpreted as worry (mean Cronbach's $\alpha = 0.84$, range 0.78–0.92).

The perceived emotion display ratings showed substantial inter-rater reliability[3]; happiness: ICC(2) = 0.81, 95% CI = [0.73, 0.87]; anger: ICC(2) = 0.88, 95% CI = [0.83, 0.92]; worry: ICC(2) = 0.88, 95% CI = [0.83, 0.92]. We also found moderate

[3]The emotion ratings were not normally distributed. Because we are not aware of a method to correct the ICC for non-normality of the DV, and because simulation studies show that non-normality does not inflate the chance of Type I errors with the *F*-test on which the ICC is based (e.g., Lix et al., 1996), we report ICC values based on parametric tests. Given the high ICC values that we obtained, we consider it unlikely that a non-parametric test would lead to opposite conclusions about the reliability of the ratings.

to strong inter-rater agreement; happiness: mean $r_{WG} = 0.63$, range 0.32–0.88; anger: mean $r_{WG(2)} = 0.65$, range 0.22–0.84; worry: mean $r_{WG(7)} = 0.82$, range 0.67–0.92. Less than moderate agreement ($r_{WG(J)} < 0.51$) was observed on 23 of the 189 ratings (12.2%), and each clip had moderate or better agreement on at least two of the three perceived emotion displays. As explained above, we deemed satisfactory inter-rater reliability (which we observed) more important than high inter-rater agreement because we focused on relative differences between clips, rather than assigning absolute perceived emotion display scores to the clips. Yet, we took inter-rater agreement into account as well by selecting 17 clips that offered a reasonable compromise between inter-rater agreement and variance in terms of perceived emotion displays. The characteristics of the clips we selected are displayed in **Table 1**.

2012 Finals Clips

All 29 clips selected from the 2012 World Series finals were rated by the participants. Because anger, happiness, and worry emerged as the most important emotion clusters in the 2011 finals, we adjusted the selection of rated emotion so that all items were relevant to one of these three emotions. The emotions assessed included: happiness, sadness, irritation, confusion, anger, worry, contentment, relaxed, cheerful, aggression, hope, despair, and stress.

Aggregation of the perceived emotion ratings proceeded in the same way as before. First, we checked the factor structure of the emotion ratings. After dropping hope, which did not clearly load on one of the factors, the expected three-factor solution emerged. Then, participant-level emotion scales were formed based on the individual perceived emotion display ratings. Happiness, contentment, relaxed, and cheerful formed the happiness scale (mean Cronbach's $\alpha = 0.86$, range 0.75–0.93); irritation, anger, and aggression formed the anger scale (mean Cronbach's $\alpha = 0.81$, range 0.68–0.89); and sadness, confusion, worry, despair, and stress formed the worry scale (mean Cronbach's $\alpha = 0.81$, range 0.68–0.88).

Once again, there was substantial inter-rater reliability[4]: happiness: ICC(2) = 0.92, 95% CI = [0.85, 0.95]; anger: ICC(2) = 0.95, 95% CI = [0.90, 0.97]; worry: ICC(2) = 0.91, 95% CI = [0.84, 0.95]. Inter-rater agreement again varied between modest and strong; happiness mean $r_{WG(4)} = 0.82$, range 0.66–0.91; anger mean $r_{WG(3)} = 0.69$, range 0.37–0.90; worry mean $r_{WG(5)} = 0.78$, range 0.63–0.91. We found less than moderate agreement ($r_{WG(J)} < 0.51$) on only 6 of the 87 ratings (6.9%), and all clips showed moderate or better inter-rater agreement on at least two of the perceived emotion display ratings. The anger, happiness, and worry scales were therefore aggregated to the video level by averaging. From this set, we selected 13 clips that offered the best compromise between inter-rater agreement and variance in the perceived emotional displays for the main study. The characteristics of the clips we selected are displayed in **Table 1**.

TABLE 1 | Means and associated ranges of r_{wg} values for each emotion cluster.

Season	Statistic	Happiness	Anger	Worry
2011 ($n = 17$)	*M*	2.39 (1.62–3.50)	3.27 (2.33–5.55)	3.91 (3.19–4.64)
	r_{wg} $\sigma_E = 8.25$	0.68 (0.39–0.88)	0.66 (0.22–0.84)	0.82 (0.72–0.91)
	r_{wg} $\sigma_E = 5.09$	0.47 (0.00–0.80)	0.35 (0.00–0.71)	0.32 (0.00–0.79)
2012 ($n = 13$)	*M*	3.11 (2.10–4.53)	3.11 (2.25–4.60)	3.53 (2.36–4.73)
	r_{wg} $\sigma_E = 8.25$	0.80 (0.66–0.91)	0.74 (0.40–0.90)	0.79 (0.63–0.91)
	r_{wg} $\sigma_E = 5.09$	0.44 (0.00–0.84)	0.44 (0.00–0.82)	0.35 (0.00–0.82)

Ranges for Mean and $r_{WG(J)}$ values are reported in brackets. In addition to the r_{wg} values based on the commonly used uniform null distribution ($\sigma_E = 8.25$) that we report in the text, we also report an alternative set of values for reference purposes, thereby following recommendations by LeBreton and Senter (2008). These alternative $r_{WG(J)}$ are based on a moderately skewed null distribution ($\sigma_E = 5.09$).

DISCUSSION

This pre-study demonstrates that observers show considerable convergence in terms of the emotions they perceived in the facial expressions of pitchers. This is an important step to address our research question, but also indicates that emotional displays can be perceived even in short clips that include movements, where faces are partially covered by a baseball cap, and many times with facial hair as well. Thus, despite those sub-optimal circumstances individuals are able to recognize emotional expressions with considerable levels of inter-observer reliability.

The converging identification of emotions in the clips allowed us to categorize the clips according to the perceived emotions identified in them and to address our main research question concerning what information observers draw from those perceived emotions.

MAIN STUDY

Method

Thirty-four Dutch psychology undergraduate students (5 men, 29 women, age $M = 20.00$, range 19–26) viewed the 30 selected clips in random order. After viewing each clip, they first estimated the pitch speed (in km/h) and then rated the following anticipated outcomes on 7-point Likert scales (*1 = very unlikely*, *7 = very likely*): pitch speed ("The pitch will be fast" and "The pitcher will throw a slow pitch" (reverse-scored); mean $r = 0.82$, range 0.65–0.92); pitch difficulty ("The pitcher will throw a difficult ball" and "The pitcher will throw an easy ball" (reverse-scored); mean $r = 0.80$, range 0.47–0.95); pitch accuracy ("The pitch will be in the strike zone" and "The pitch will not be in the strike zone" (reverse-scored); mean $r = 0.82$, range 0.66–0.97); and batter swinging versus not swinging ("The batter will attempt to hit

[4]The emotion ratings were not normally distributed. See comment for the 2011 series.

the ball" and "The batter will let the ball go" (reverse-scored); mean $r = 0.77$, range 0.53–0.96). The two items for each outcome were averaged. The study was carried out in accordance with APA regulations and approved by the IRB at the University of Amsterdam.

To be able to test whether the identified emotional displays were associated with objective game outcomes as well as to compare the predictions made by our participants with what actually happened during the games, we coded the outcome of each pitch as well as different aspects of the game that could influence the pitch or the decision to swing (or not swing) at the ball. All this information is publicly available from the television footage of the game as well as from several websites that provide statistical information about baseball matches. In addition to the game data, we obtained data regarding the pitchers' and batters' skills as recorded and reported on the MLB website (MLB.com)

The outcomes we coded were (1) the outcome of the pitch (hit/ball/strike/foul), (2) whether the batter swung or not, and (3) the speed of the pitch. We also recorded information about several contextual factors that we thought might impact the pitch or the decision to swing at the ball or not so that we could control for them in the analyses. Specifically, we recorded (a) whether the batter's team was ahead or behind, (b) what inning it was, (c) whether the pitcher had already thrown two strikes or not, (d) whether the pitcher had already thrown three balls or not, (e) whether there were already two outs or not, and (f) the season batting average (taken from mlb.com) of the batter and (g) the pitching average for the pitcher (taken from mlb.com) as a measure of their skill (Appendix 1 contains an explanation of these baseball specific terms).[5]

Results

Our analyses were conducted in three steps. In the first step, we assessed to what extent participants' predictions of pitch outcomes were influenced by the perceived emotional displays in the clip. In the second step, we analyzed the accuracy of these predictions by comparing them to the actual outcomes of the pitch during the game. In the third step, we compared the relationship between the emotions detected to actual specific game outcomes.

Predicted Outcomes

The relation between the pitcher's perceived emotional displays and the participants' predictions was modeled by fitting GLMMs using the lme4 package (Bates et al., 2015) for R (R Core Team, 2015). Modeling started by fitting a full model that included fixed effects for one of the emotion clusters (i.e., happiness, anger, and worry), a random intercept for clip, and both a random intercept and random emotion slope for participants. Thus, three full models were fit for each prediction: one for happiness, one for anger, and one for worry. These models were then simplified to the reported models by dropping non-significant predictors one-by-one. The significance of the final predictors was tested using the "bootMer" method in the lme4 package (10,000 resamples) and reported using 98.3% confidence intervals (based on percentiles) to correct for fitting three models (significance level of $\alpha = 0.05/3 = 0.0167$ – Bonferroni correction).

Pitch speed

Using the GLMM described above, we first regressed estimates of pitch speed in km/h on pitchers' perceived emotional displays. We found that participants expected the pitch to be faster to the degree that the pitcher was perceived as expressing more anger ($\beta = 0.24$; 98.3% CI [0.06, 0.42]). Perceived expressions of happiness ($\beta = -0.00$; 98.3% CI [−0.26, 0.26]) and worry ($\beta = -0.18$; 98.3% CI [−0.38, 0.03]) did not influence estimated pitch speed. Repeating the analyses of the pitch speed prediction on the Likert scales revealed the same pattern. Again, the final models showed that participants expected the pitch to be faster when the pitcher was perceived as expressing more anger ($\beta = 0.21$; 98.3% CI [0.04, 0.39]), while perceived expressions of happiness ($\beta = 0.07$; 98.3% CI [−0.12, 0.27]), and worry ($\beta = -0.16$; 95% CI [−0.37, 0.04]) did not affect pitch speed estimates.

Pitch difficulty

The next set of analyses focused on estimates of pitch difficulty. We found that perceived displays of anger increased estimates of pitch difficulty ($\beta = 0.15$; 98.3% CI [0.03, 0.28]). Perceived happiness ($\beta = 0.05$; 98.3% CI [−0.09, 0.18]) and worry displays ($\beta = -0.11$; 98.3% CI [−0.25, 0.04]) did not influence estimates of pitch difficulty.

Pitch accuracy

Analyses of the predicted pitch accuracy showed that it was increased when the pitcher was perceived as expressing more happiness ($\beta = 0.11$; 98.3% CI [0.04, 0.18]) and decreased when the pitcher was perceived as displaying more worry ($\beta = -0.11$; 98.3% CI [−0.18, −0.03]). Perceived anger displays did not influence pitch accuracy estimates ($\beta = -0.01$; 98.3% CI [−0.10, 0.09]).

Batter swing

The final analyses focused on the prediction of whether the batter would swing or not. The final models indicated that participants were more likely to predict that the batter would swing to the degree that the pitcher was perceived as displaying more happiness ($\beta = 0.10$; 98.3% CI [0.03, 0.17]) or less worry ($\beta = -0.09$; 98.3% CI [−0.16, −0.02]). Perception of anger displays were not found to influence estimates of swinging ($\beta = 0.00$; 98.3% CI [−0.14, 0.13]).

Prediction results overview

Results regarding predictions of pitch quality indicate that (1) when pitchers' were perceived as expressing anger estimated pitch speed and pitch difficulty increased, (2) perceived expressions of happiness increased estimated pitch accuracy, and (3) perceived expressions of worry decreased estimated pitch accuracy. With regard to predictions of the batter's behavior, the batter was predicted to be more likely to swing at the ball to the degree that the pitcher was perceived as happy or less worried, a pattern that is consistent with that observed for pitch accuracy.

[5]We also coded whether third base was occupied or not during the clip, but there were only three clips in total, all from the 2011 finals, in which third base was occupied. There was therefore too little variance to include this as a covariate.

Accuracy of Predictions

Now that we have established that observers may use the perceived emotional expressions of pitchers to inform their predictions regarding pitch quality, the next question we wanted to address is whether perceived emotional expressions also predicted actual outcomes during the games. Since all of the clips were taken from actual matches during which several pitch characteristics were recorded, we could obtain information about the actual outcome of each pitch. We could then compare the predictions made by our participants with what occurred in reality. One aspect that we could not assess using the recorded data on the actual game outcome is pitch difficulty. This subjective information is not recorded. However, one can assume that faster pitches are on average harder to hit, and therefore we tested whether the prediction of pitch difficulty was related to speed. The other aspects that are objective – pitch speed, pitch accuracy (as determined by the umpire – the baseball referee), and swing or not swing were all used in the analysis.

Because the actual pitch outcomes are on the clip level of analysis, we first needed to aggregate participants' predictions of pitch outcomes to the clip level. Three predictions had high inter-rater reliability: pitch speed (in km/h): ICC(2) = 0.89, 95% CI = [0.81, 0.93]; pitch speed (Likert scale): ICC(2) = 0.88, 95% CI = [0.78, 0.92]; and pitch difficulty: ICC(2) = 0.71, 95% CI = [0.48, 0.82]. The inter-rater reliability was not significant for pitch accuracy (ICC(2) = 0.35, 95% CI = [0.00, 0.59]) and swinging versus not swinging (ICC(2) = 0.31, 95% CI = [0.00, 0.56]), as indicated by the confidence intervals that both include 0 (which is the lower bound for ICC(2) values). The proportion of resamples equaling 0 was less than 5% in both cases (3.5 and 4.4%, respectively), which constitutes marginally significant evidence that the differences between these predictions may still be (partially) attributed to differences between clips. We therefore decided to proceed with aggregating all predictions to the clip level by averaging, while noting that the predictions of swinging and accuracy are less reliable than the other two predictions.

Relation Between Predictions and Actual Outcomes

To assess the accuracy of the participants' predictions, we compared these predictions to three actual pitch outcomes that we recorded for each clip (pitch speed, hit/ball/strike/foul, and batter swinging vs. not swinging). Each prediction was separately used to predict these outcomes. In these analyses, we included all coded game factors (batter's team leading or behind, two outs or not, etc.) in order to control for any influence that these game factors may have on the pitcher's and/or batter's behavior. Because including all seven game factors in the analysis substantially reduced the remaining degrees of freedom (based on 30 clips in total), thereby reducing our statistical power, we also repeated each analysis without controlling for game factors. The reported statistics control for game factors, but in cases where these effects approach significance, we also reported the analysis without controlling for game factors to increase statistical power.

Pitch speed

The first set of analyses focused on the actual pitch speed. Actual pitch speed was normally distributed (Shapiro–Wilk's $W = 0.96$, $p = 0.311$). We separately regressed the actual pitch speed on the estimated pitch speed in km/h, estimated pitch speed on the Likert scale, and estimated pitch difficulty. None of these estimates was related to the actual pitch speed: pitch speed in km/h: $\beta = -0.09$, $t = -0.33$, $p = 0.747$; pitch speed on a Likert scale: $\beta = -0.01$, $t = -0.03$, $p = 0.976$; and pitch difficulty: $\beta = -0.24$, $t = -0.98$, $p = 0.337$.

Pitch accuracy

The second set of analyses focused on the accuracy of the pitch. For this purpose, we recoded pitches that resulted in 'ball' as inaccurate pitches ($N = 10$) and the remaining pitches as accurate pitches (for 1 pitch the outcome was unclear, and this pitch was not included in the analysis). A logistic regression was used to account for this dichotomous coding. The relation between estimated pitch accuracy and the actual pitch being in the strike zone did not reach statistical significance when controlling for game factors ($OR = 2.41$, Wald's $z = 1.52$, $p = 0.129$), but was marginally significant when game factors were not controlled for ($OR = 2.14$, Wald's $z = 1.72$, $p = 0.085$). Thus, there was some suggestive evidence that whether the pitch would end up in the strike zone could be predicted with a certain degree of accuracy from viewing a video clip of the pitcher.

Batter swing

In a logistic regression, we regressed actual swinging versus not swinging on the prediction of swinging made by our participants. The initial analysis revealed no relation between predicted and actual swinging ($OR = 2.50$, Wald's $z = 1.32$, $p = 0.188$), but when game factors were not controlled for this relationship became significant, $OR = 2.43$, Wald's $z = 2.03$, $p = 0.042$. Thus, we found evidence that a batter's behavior in terms of swinging or not swinging at a ball can be predicted with a reasonable degree of accuracy based on a short video clip of the pitcher just before his throw.

Relation Between Perceived Emotion Displays and Actual Outcomes

Next we examined whether the perceived emotional displays of the pitchers predicted objective qualities of their pitches. We regressed each of the three actual outcomes (pitch speed, pitch in strike zone [i.e., not 'ball'], and batter swinging vs. not swinging) in the selected clips on the pitchers' perceived emotional displays, as identified in the pre-study. As above, the reported statistics reflect the relation between perceived emotion displays and game outcomes while controlling for all coded game factors.

Pitch speed

A first series of analyses showed that the pitcher's perceived emotion displays were unrelated to the speed of the actual pitch: happiness: $\beta = 0.31$, $t = 1.48$, $p = 0.156$; anger: $\beta = -0.28$, $t = -1.15$, $p = 0.262$; worry: $\beta = 0.05$, $t = 0.22$, $p = 0.831$. Thus, actual pitch speed was neither related to the participants' predictions, nor to the pitchers' perceived emotional displays.

Pitch accuracy

The second series of analyses showed that the actual accuracy of the pitch (i.e., whether it was not a 'ball') was also unrelated to the pitcher's perceived emotional displays happiness: $OR = 1.39$,

Wald's $z = 0.63$, $p = 0.532$; anger: $OR = 0.21$, Wald's $z = -1.23$, $p = 0.218$; worry: $OR = 1.13$, Wald's $z = 0.26$, $p = 0.793$.

Batter swing

Regarding the relation between the pitcher's perceived emotional displays and the batter's swinging, perceived displays of anger ($OR = 0.68$, Wald's $z = -0.59$, $p = 0.558$), worry ($OR = 0.81$, Wald's $z = -0.41$, $p = 0.682$) and happiness ($OR = 2.23$, Wald's $z = 1.37$, $p = 0.172$) did not predict batters' actual swinging.

Pitcher's perceived happiness displays and prediction of actual outcomes

Our final analysis focused on the relation between the pitchers' perceived happiness, predictions about swinging, and actual swinging. The pitcher's perceived displays of happiness were unique in the sense that they influenced predicted swinging, which in turn was related to actual swinging. In addition, the pitcher's displays of happiness had a comparatively stronger relation to actual swinging than the other perceived emotional displays. We therefore wondered whether our participants' predictions regarding the batters' swinging could explain part of the covariance between the pitchers' perceived displays of happiness and the batters' actual swinging behavior. We tested this possibility by conducting a mediation analysis. It should be noted that this was not a mediation analysis in the traditional sense because we were not testing a process (i.e., it is impossible that batters were actually swinging *because* our participants were estimating their swinging based on the perceived pitchers' expressions). We merely tested whether the batter's actual swinging is related to the variance that is shared between perceptions of happy expressions and predictions of swinging.

We determined and bootstrapped (25,000 resamples) the indirect effect of perceived happiness on actual swinging through predicted swinging. Two hundred and thirty resamples (0.9%) that were based on models that could either not be fit (e.g., because of a lack of variance in the DV), or that produced extreme outliers in the distribution of coefficients in the form of very large coefficients (we used 4 as a cutoff value, which translates into an Odds Ratio of over 50) were dropped. Confidence intervals based on the remaining resamples that exclude $OR = 1.000$ indicate significance.

The results indicated that the indirect effect of perceived happiness through predicted swinging on actual swinging was not significant at the conventional $\alpha = 0.05$ level, $OR = 1.44$, 95% percentile-based CI: [0.926, 3.164]. The 90% percentile-based CI [1.003, 2.643] indicated that the effect was significant at the $\alpha = 0.10$ level, which constitutes marginally significant evidence that the batter's actual swinging was indeed related to the variance shared by the perceived pitcher's expressions of happiness and participants' predictions about swinging.

GENERAL DISCUSSION

The idea that displays of emotions provide information to others is well established (e.g., Parkinson, 1996; Keltner and Haidt, 1999; Manstead and Fischer, 2001; Van Kleef, 2009). It is also clear from previous research that emotions can have a pervasive impact on sports performance (e.g., Totterdell, 2000). Building on and extending pervious work, the current research shows that perceived displays of emotion may be used to predict future behavior and actions of players in sports games. Answering a recent call by Friesen et al. (2013), we examined the interpersonal dynamics of emotions in the context of professional competitive sports. Specifically, we used archival data of the MLB finals to investigate (1) whether observers can reliably perceive players' emotional displays, (2) what types of information observers distill from these perceived emotional displays, and (3) whether observers' predictions regarding the players' future behaviors based on their perceived emotional expressions matched actual behaviors exhibited by the players.

The results allow for three broad conclusions. First of all, our data indicate that several emotions can be reliably identified during professional sports games, even when the displays are short (only a few seconds) and often partly obscured by baseball caps, shadows, facial hair, etc. Specifically, we found consistent evidence across two data sets that displays of happiness, anger, and worry were reliably perceived by observers.

Second, we found evidence that observers used pitchers' perceived emotional displays as information when attempting to assess future pitch features and behaviors of batters (swinging vs. not swinging) who were facing the pitcher who displayed the emotion. To the degree that participants perceived a pitcher as displaying more anger, they predicted his future pitch to be faster and more accurate. To the degree that participants perceived a pitcher as displaying more worry, they predicted his future pitch to be slower and less accurate. And to the degree that participants perceived a pitcher as displaying more happiness, they predicted that the future pitch would be more accurate, and that the batter would be more likely to swing at the ball.

Third, across the board, participants' predictions regarding pitch speed, accuracy, and difficulty did not converge well with actual pitch qualities. However, we did find some evidence that participants' predictions regarding the batter's swinging behavior based on the pitcher's expressions of happiness were associated with the batter's actual swinging. Even though this effect was only marginally significant, and although there was only modest inter-rater agreement about the prediction of swinging, we believe that this effect is potentially important and as it pertains to a key aspect of the game – attempting to hit the ball – attests to the interpersonal power of emotions in natural settings.

Theoretical and Practical Implications

Research on the social effects of emotions has thus far mostly used emotional displays that have been manipulated either by a trained confederate (e.g., Barsade, 2002; Cheshin et al., 2011), verbal text messages (e.g., Van Kleef et al., 2004), selected photos or videos (e.g., Tiedens, 2001; Kopelman et al., 2006; Van Doorn et al., 2015b), emotion induction (Sy et al., 2005), instructions to show emotions (e.g., Sinaceur and Tiedens, 2006; Heerdink et al., 2013), or assessment of emotional displays that are required by one's job (e.g., Barger and Grandey, 2006). In contrast, our study examined a setting in which emotions occurred naturally. Although a few earlier studies have investigated the social effects of emotions as they naturally occur in (sports) teams (e.g., Totterdell et al., 1998;

Totterdell, 2000), this research has been limited to the affective reactions that may be triggered by emotional expressions. To the best of our knowledge, the current study is the first to consider the inferences people draw from the perception of others' emotional displays in settings that are not staged and where emotional displays are not prescribed by the job (cf. 'service with a smile' in customer service). Pitchers in baseball are not required to display specific emotions, and if anything they might be trying to disguise their emotions. Our study thus sheds initial light on the inferences observers may draw from naturally occurring perceptions of emotional displays in the context of actual, high-stakes interactions.

It has been suggested that encountering emotional displays of others helps individuals to make sense of ambiguous situations and to predict the behavior of other individuals in the social situation (Van Kleef et al., 2010, 2011). To date, however, most research on the social effects of emotions has tended to focus on concurrent effects. That is, previous work has focused on how people use social-emotional cues to inform their understanding of past or ongoing events (e.g., Knutson, 1996; Van Kleef et al., 2004; Hareli et al., 2009; Van Doorn et al., 2012, 2015a). The current work advances this field of inquiry by showing that perceived emotional displays may also be used to inform predictions about future behavior.

Participants in our study did not receive specific instructions to focus on the emotions displayed by the pitcher or to use them as cues. Yet, it is evident that they did so, because the perception of the pitchers' emotional displays predicted participants' judgments of the pitchers' throw. This finding supports the theoretical notion that when trying to predict other people's behavior, individuals use cues from others' emotional displays to inform their judgments (Van Kleef et al., 2011). Specifically, our findings indicate that individuals use others' perceived emotional displays to make predictions regarding the future behavior of the expressers (in the current study, the pitchers) as well as the future behavior of observers (the batters).

Limitations, Strengths, and Future Directions

Even though our results allow for a number of clear conclusions, some patterns in the data are inconclusive. For instance, the absence of evidence for a relation between perceived emotional expressions and actual pitch outcomes may reflect that these relations are simply not there, but could also indicate that these relations were too inconsistent to detect in the current study. Indeed, it is likely that in a real game, especially such loaded games as the World Series finals, many different factors influence the various pitch outcomes that we analyzed, which may overshadow or limit any emotional influences. One reason why the effects of pitchers' perceived emotional displays on batters' behavior are not stronger might be due to the inherent time pressure and the limited cognitive resources available to the batters. EASI theory holds that the influence of inferential processes in response to emotional expressions is reduced when perceivers' information processing motivation and/or ability are reduced (Van Kleef, 2009), and a growing body of research supports this idea (for reviews, see Van Kleef et al., 2011, 2012). The amount of time batters have between the time they see the emotion of the pitcher and the time that the pitch reaches them and they need to decide how to respond is very short – no more than 3 s. Because of these pressures the amount of information that batters are motivated and able to distil from the perception of the pitchers' emotional displays might be reduced. Future research could investigate this possibility more directly by examining a sports setting that allows for greater variability in the time lag between one player's emotional expression and another player's response (e.g., chess).

During a baseball match, players are confronted with a lot more information than just the facial displays of their counterparts. It is possible, therefore, that players during a match would focus less on the emotions of the pitcher than our participants did. Our findings may therefore represent an overestimation of actual effects as they take place during competitive sports games. Yet, one can argue that players in competitive sports games could potentially glean useful information from their counterpart's emotional expressions if they were to pay close attention to them.

It is important to note that we have investigated the observable, perceived displayed emotion that was communicated (intentionally or not) and not the actual feelings of the players. It is possible that these displays were inauthentic and were purposely displayed as part of one's role (Rafaeli and Sutton, 1987) in order to try and influence the opponent. It is also possible that what observers saw were not displays of emotions at all, but rather physical strain of the players who were engaging in a physically strenuous activity. Regardless of what the displayers were actually feeling, however, these displays could reliably be interpreted as emotional expressions, and did lead to inferences and predictions regarding future actions.

We found that pitchers were assessed as expressing relatively little emotion in the baseball clips we used, and this limited variance may have reduced the magnitude of some of our effects. The highest-intensity perceived emotional displays were around the midpoint of the scale (5.5 out of 10), and many displays were considerably lower in intensity. One reason for the limited amount of emotion displays detected might be the fact that the expressers are professional sports players who perform at the highest level and who are able to control their emotions and might in fact receive training on how to do so (suggested in Friesen et al., 2013). Baseball caps, facial hair and placing the glove in front the face before the pitch are all strategies that might be used on purpose as a means to disguise or blur the emotions the pitcher is feeling or displaying. The relatively low intensity displays identified by our participants might indicate that professional baseball players know that emotions carry information, which may lead them to try and hide or down-regulate their emotions in the same way as professional poker players do. Despite all these confines our participants were able to consistently detect cues of anger, happiness, and worry on pitchers' faces. Thus, even when naturally occurring and relatively mild emotional expressions are not related to objective pitch outcomes, deliberate and more intense emotional expressions of the pitcher could still influence the batter.

Another limitation of the current study is the fact that our participants viewed the pitcher on a computer screen taken from TV footage. This is different from what the actual batters saw, as they viewed the pitcher face-to-face from a distance of about 18 meters. Thus, the size of the face and the body were not in the same proportion between the two types of observers. Our participants viewed larger footage of the pitchers that filled most of the computer screen, whereas the batter had less of a "zoom in" option and the pitcher was smaller in proportion to all the other things in their field of view. Yet, one should take into account the fact that the pitcher communicates with the catcher who stands behind the pitcher (and is therefore even farther away; see **Figure 1**), with the help of his fingers. Accordingly, if a pitcher can clearly see the fingers of the catcher, it is safe to assume that the batter can see the face of the pitcher sufficiently well to notice nuances such as facial displays of emotion, in addition to body movements. Moreover, professional baseball players, as evident by the quote mentioned by Charlie Metro, attest to not only noticing facial expressions of pitchers but also to using them as cues.

As outlined in EASI theory (Van Kleef, 2009), emotional expressions can influence observers' behavior by eliciting inferential processes and/or affective reactions in them (see also Hareli and Rafaeli, 2008). Thus, observing the emotions of the pitcher might influence the batter not only by providing him with information regarding the pitch, but also by influencing his own emotion. These elicited emotions could also influence the batter's actions. Because we have no information regarding the batters' emotional experiences, we cannot rule out the possibility that the batters' emotional responses to the pitchers' perceived emotional displays impacted on their decisions to swing or not swing. Future studies should therefore incorporate both affective and inferential processes so that their relative impact can be disentangled (cf. Van Kleef et al., 2009).

Perhaps the biggest limitation of the study is the fact that we could not use all the possible data points, that is, all the pitches that were thrown. Our data relied on TV footage, which showed the pitcher's face only in about 10% of the cases. In most instances the batter was the one who was being captured on camera, as well as players on bases, the coaches, or the crowd. Even though we have no reason to assume a systematic bias on the part of the producers of the TV footage to show some pitchers and not others, such a bias cannot be ruled out on the basis of the available data.

CONCLUSION

These limitations notwithstanding, the present study attests to the pervasive power of emotional expressions in sports. Our findings indicate that observers use the perceived emotional displays of professional pitchers during baseball games to arrive at predictions regarding objective qualities of the pitch as well as behavioral responses of the batter. This conclusion suggests that professional sports performance is influenced by emotional expressions and implies that performance can potentially be improved by taking this into account. Being able to identify and unravel the information that is conveyed by emotional displays could very well lead to a "home run".

AUTHOR CONTRIBUTIONS

AC and GvK developed the study idea and design, AC and JK conducted the data arrangement and collection, and MH, AC and GvK conducted the analyses. All authors were involved in writing the report and approved the current version.

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Abnormal emotion processing, but intact fairness and intentionality considerations during social decision-making in schizophrenia

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Schizophrenia is a severe mental disorder that is highly characterized by social cognitive impairments. Most studies investigating these impairments focus on one specific social domain such as emotion recognition. However, in daily life, processing complex social situations relies on the combination of several social cognitive and affective processes simultaneously rather than one process alone. A modified version of the economically based Ultimatum Game was used to measure the interplay between fairness, intentionality, and emotion considerations during social decision-making. In this task, participants accept or reject fair and unfair monetary offers proposed intentionally or unintentionally by either angry, happy, neutral, or sad proposers. Behavioral data was collected from a group of schizophrenia patients ($N = 35$) and a group of healthy individuals ($N = 30$). Like healthy participants, schizophrenia patients differentiated between fair and unfair offers by rejecting unfair offers more compared to fair offers. However, overall patients did reject more fair offers, indicating that their construct of fairness operates within different margins. In both groups, intentional unfair offers were rejected more compared to unintentional ones, indicating a normal integration of intentionality considerations in schizophrenia. Importantly, healthy subjects also differentiated between proposers' emotion when rejecting unfair offers (more rejections from proposers depicting angry faces compared to proposers depicting, happy, neutral, or sad faces). Schizophrenia patients' decision behavior on the other hand, was not affected by the proposers' emotions. The current study thus shows that schizophrenia patients have specific problems with processing and integrating emotional information. Importantly, the finding that patients display normal fairness and intentionality considerations emphasizes preservation of central social cognitive processes in schizophrenia.

Keywords: schizophrenia, social decision-making, fairness, intentionality, emotions, emotion processing, Ultimatum Game

Introduction

The last two decennia research in schizophrenia has shifted its focus intensively from positive (e.g., hallucinations, delusions) and negative symptoms (e.g., flattened affect, anhedonia; see Andreasen et al., 1994) to social cognitive deficits. An important reason for this shift of interest relates to findings indicating that these social cognitive deficits are highly predictive for patients' functional outcomes (Brekke et al., 2005). However, most studies investigating social cognitive processes in populations suffering from schizophrenia, rely on basic, relatively quick, and automated cognitive processes as measured in, for example, emotion-recognition tasks. Results on such tasks suggest that schizophrenia patients experience problems in the perception of emotional material, however, the specificity, extent, and nature of the deficits are unclear (Edwards et al., 2002). Yet, in order to cope with different social situations higher-order social cognitive processes such as fairness or intentionality considerations are also essential skills. These higher-order social cognitive processes are often very complex as they rely on combinations of different (social) cognitive and affective abilities (see Pinkham, 2014 for a review on the core social cognitive domains in schizophrenia). For instance, when someone wants to buy something, one addresses his or her *social knowledge* about the context and environment where he or she is in (e.g., buying a souvenir at an exotic holiday spot or buying food at your local market), but also considers the other person's personal inferences (*Theory of Mind*; e.g., is someone selling for personal profit or for charity purposes), and uses basic *emotion-recognition* processes (e.g., is the person you are buying from happy or angry). Together with someone's attitude and personality traits, these social cognitive processes contribute to one's judgments and decisions in many daily life situations, and importantly, also contribute to others' perception of yourself.

During such complex social interactions, requiring reciprocity an trust (Wischniewski and Brüne, 2011), and emotion regulation processes (van der Meer et al., 2009), schizophrenia patients tend to respond differently in comparison to healthy persons. For instance, while testing the appreciation of moral standards, older studies showed that schizophrenia patients less often choose humanitarian responses to moral problems, and instead more often choose authoritarian and self-protective options (Johnson, 1960), or even adjust their moral decisions according to the concepts of power, status, and possessions, rather than equality and reciprocity (Benson, 1980). Unfortunately, this line of research might have contributed to the stigmatization of schizophrenia patients as being immoral beings in a way that during the recent past studies about social norms and moral values in schizophrenia have been disregarded (Wischniewski and Brüne, 2011). Yet, to our knowledge, only one study so far by Wischniewski and Brüne (2011) addressed the possibility that deviating social norms and standards in schizophrenia might also relate to these patients' higher prevalence of being victimized (Hodgins et al., 2009), treated unfairly, or being bullied (Trotta et al., 2013). All factors known for their negative interferences with these patients' functional outcomes (Hodgins et al., 2009).

Recently, higher-order moral judgments in humans have often been investigated by using economic games like the Ultimatum Game (UG) showing that moral judgment is universal and deeply rooted in human nature. During the UG, two players split a certain amount of money. One player plays the role of the proposer, the other player acts as the responder. The proposer decides how the money is split while the responder either accepts or rejects the proposed offer. When the responder accepts the offer, the amount of money is divided accordingly. However, if the responder disagrees with the proposed split and rejects the offer, neither player receives anything. Although the most profitable strategy from an economical perspective would be to accept even the smallest offers, studies show that healthy individuals tend to use different strategies based on fairness and other emotional aspects, rather than rational inferences. Therefore, unfair offers (30% or less from the total amount) are more likely rejected in comparison to fair splits (50%; Nowak et al., 2000).

In schizophrenia, the impairments of certain higher-order social cognitive abilities such as social norms and values (Wischniewski and Brüne, 2011) might be related to these patients' known cognitive (e.g., executive functioning; Nuechterlein et al., 2012) and social cognitive (e.g., emotion processing; Green et al., 2012) dysfunctions. Yet, across several UG studies schizophrenia patients depicted an inconsistent decision pattern. For instance, Agay et al. (2008) was the first to report that schizophrenia patients, when acting as responders, showed no difference in rejection rates compared to healthy controls. However, Wischniewski and Brüne (2011) showed that schizophrenia patients were likely to accept more unfair offers when compared to healthy individuals. The latter finding is in line with a study reporting that unfair offers are also more likely to be accepted by individuals with high schizotypal traits (van't Wout and Sanfey, 2011). Yet, another study reported that schizophrenia patients accepted more unfair offers and rejected more fair offers in comparison with healthy controls (Csukly et al., 2011). Above that, they also found that these patients' acceptance/rejection behavior was not affected by the emotion of the proposer, whilst healthy controls accepted more offers proposed by happy individuals than angry individuals (depicted on a photograph).

While these studies mainly focus on fairness considerations and the reactions toward the direct outcomes of the proposed offers, they do not allow to measure intentional variations of the proposed offers. Yet, as stated before, social decision-making is a complex process requiring the integration of several cognitive and social cognitive abilities working together toward a final decision. Therefore, a modified version of the UG has previously been developed in a way that each proposed offer is contrasted against another possible alternative offer that has not been chosen (Falk et al., 2003; Güroğlu et al., 2010). Using this method, the responder can weigh the proposer's offer against an alternative offer that is either more fair, more unfair, or the same (no alternative). Studies that used this modified version of the UG showed that healthy individuals reject unfair offers more often in the presence of an unselected fair alternative compared to situations where the proposer could only choose between two equally unfair offers (no-alternative; Falk et al., 2003; Güroğlu

et al., 2009, 2010; Radke and de Bruijn, 2012; Radke et al., 2012). This emphasizes that fairness considerations are not only depending on the direct profitable outcomes, but also depend on contextual factors and the intentions they signal (Falk et al., 2008).

In schizophrenia, this method was recently also used in a crossover study directly comparing smoking and non-smoking patients after administration of a placebo, 1 or 2 mg of nicotine (Quisenaerts et al., 2013). Results showed that smoking patients' decisions were affected by the unchosen alternative offer (context) in the expected pattern described above. Non-smoking patients' on the other hand did not dissociate between the different alternatives. They did show, however, a normalized effect of context after administration of 1 mg of nicotine. The authors argued that this normalizing effect in non-smokers might be related to the inverted U shape nature of the cognitive enhancing properties of nicotine. However, intentionality can also be defined by the emotion one expresses. This has been demonstrated by Schreiner et al. (2010) and Csukly et al. (2011) who showed that healthy individuals accepted more offers from happy proposers than from angry proposers.

Crucially, in daily life, these various determinants of social decision-making are combined and have to be processed simultaneously, thus complicating the task tremendously. A recent study aimed at targeting this complexity by combining fairness, contextual, and affective variables into a modified UG (Radke et al., 2013). The results of this study showed that both healthy controls' and depressed patients' rejection rates were highest when the unfair treatment was clearly intentional, so when paired with a fair alternative and when offered with an angry expression. Overall rejection rates were, however, larger in the patient group.

Because of the contradictory findings on social decision-making in schizophrenia research so far, it is important to investigate the involved processes as they occur simultaneously and need to be integrated for adequate decision-making. Following Radke et al. (2013), we therefore used a modified version of the UG that allowed us to disentangle fairness, intentionality, and emotion considerations. Based on the findings of Quisenaerts et al. (2013), we first hypothesize that like healthy individuals, schizophrenia patients' decisions will be affected by intentionality, i.e., the unchosen alternative offer. Second, as reported in the study of Csukly et al. (2011), we expect that schizophrenia patients' decisions are less affected by the proposers' emotions. Third, because of the mixed outcomes regarding acceptance and rejections rates of fair and unfair offers in previous UG studies we also hypothesize that schizophrenia patients will show aberrant behavior when considering fair versus unfair offers by either rejecting more fair offers or accepting more unfair offers than healthy controls. Given the complexity of the study design and the absence of any previous studies investigating context effects such as emotion and intentionality during fairness considerations in schizophrenia patients, we refrained from formulating specific hypotheses about modulatory influences of these contexts on group differences in rejection rates.

Materials and Methods

Participants

The patient group consisted of 37 schizophrenia patients (25 inpatients) recruited from three different Belgian psychiatric centers (PC Sint-Norbertus Duffel: $N = 23$; PC Sint-Amadeus Mortsel: $N = 11$; PC Brother Alexians Boechout: $N = 3$) diagnosed using the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I; First et al., 2002). Patients with current depression or a recent history of substance use disorder (6 months) were excluded. All patients were stable on antipsychotic medication for at least 2 weeks. Fifteen patients received monotherapy with an atypical antipsychotic, one received conventional neuroleptic monotherapy and 21 patients were on polytherapy (14 patients were treated with a combination of atypicals and 9 received a combination of an atypical antipsychotic and a conventional neuroleptic). In order to control for differences in medication, chlorpromazine levels are calculated (cf., Kroken et al., 2009) based on the patients' medication profiles. Besides antipsychotic medication, some patients were treated with mood stabilizers ($N = 8$), antidepressants ($N = 14$), benzodiazepines ($N = 7$), and/or anticholinergics ($N = 4$). Severity of the positive and the negative symptoms were rated during a semi-structured interview using the Scale for the Assessment of Negative Symptoms and the Scale for the Assessment of Positive Symptoms (SANS and SAPS; Andreasen, 1983, 1984).

The control group consisted of 30 healthy individuals that were matched for age and gender with the patient group. The study was approved according to the latest Declaration of Helsinki by all the local ethical committees of the participating centers and all participants gave their written informed consent.

Since high rejection rates of fair offers clearly indicate a lack of understanding the task objective, participants who rejected 75% or more fair offers were excluded from analyses, which resulted in the exclusion of two patients. This left us with a group of 35 schizophrenia patients and 30 healthy controls (see **Table 1** for group characteristics).

TABLE 1 | Clinical and sociodemographic data.

	Controls $N = 30$	Patients $N = 35$	T	X^2	p
Age	29.6 (9.3)	31.2 (8.3)	0,736		0.464
Gender (m/f)	26/4	32/3		−0,613	0.540
Duration of illness (years)		7.6 (7.0)			
SAPS		14.3 (12.0)			
SANS		33.6 (16.4)			
CDS		0.7 (1.5)			
Chlorpromazine equivalent		556 (371)			

SAPS, Scale for the Assessment of Positive Symptoms; SANS, Scale for the Assessment of Negative Symptoms; CDS, Calgary Depression Scale. Values shown are absolute or means with SD between parentheses.

Material and Procedure

Stimuli were presented using E-Prime 2.0 software (Psychology Software Tools Inc, 2012, Pittsburgh, PA, USA) that was programmed with a modified version of the UG (**Figure 1**) in which participants played the role of the responder (cf. Radke et al., 2013). They were told to be playing against the saved data of different proposers who previously participated in this game. On each of the 64 trials, a picture of a different proposer with his or her fictive name was shown in the upper left part of the screen. These pictures were derived from different databases (Lundqvist et al., 1998; Ebner et al., 2010).

Each trial started with a fixation cross (1000 ms), followed by a presentation of two available monetary distributions (1000 ms). Then, the proposer's selected offer was surrounded by a red rectangle (1000 ms). Subsequently, while the selection remained visible, "yes" and "no" buttons were presented as depicted in **Figure 1**. The participants had unlimited time to respond by pressing one of the two assigned keys on a keyboard. Participants' response remained visible for 2000 ms before the next trial started. The position of unfair offers and the proposer's gender were counterbalanced. In contrast with the participants' belief, all choices were computer-generated and randomly presented.

By pressing the "yes" or "no" key, participants either accepted or rejected the proposer's offer. Acceptance resulted in an outcome according to the proposed split while rejection resulted in a complete loss for both. To assure the participants' motivation, they were informed that every trial could influence their financial outcome at the end of the task since several trials were randomly chosen in order to compute their personal profit. Moreover, participants were also instructed about the influence of their decisions on the proposers' profit that would be paid to them after all data of the responders had been collected. In fact, the payoff was set around 2.50 Euro, so that all participants received an equal amount.

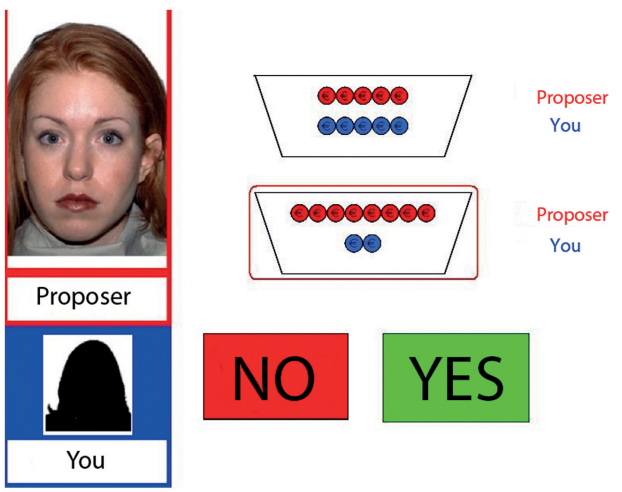

FIGURE 1 | Display of the decision phase in the fair-alternative condition with a neutral proposer. On the left, name and picture of the proposer (here "Proposer") and the name of the participant (here "You") are shown. Red and blue coins specify the two potential distributions. The selected offer is encircled in red. The participant has to decide whether to accept ("YES") or reject ("NO") the offer.

Design and Analyses

The task consisted of 64 trials. On 40 trials the unfair offer (8:2) was selected against (i) a hyperfair (2:8) alternative (8 trials, 2 per emotion), (ii) a fair (5:5) alternative (16 trials, 4 per emotion), or (iii) no alternative (8:2; 16 trials, 4 per emotion). On 16 trials a fair offer was selected against an unfair alternative (4 per emotion) and eight trials consisted of hyperfair offers against an unfair alternative (2 per emotion). The trials including either a hyperfair offer or hyperfair alternative were used to induce more variance in the set of offers and to avoid suspicion from participants being faced with only 5:5 and 8:2 splits on all trials. Therefore, these trials will not be included during analyses (cf. Radke and de Bruijn, 2012).

For analyzing the data, first general rejection behavior was analyzed to investigate the presence of a basic understanding of the task and the concept of fairness. Specifically, rejection rates to fair offers with an unfair alternative and unfair offers with a fair alternative were subjected to a repeated measures ANOVA with fairness (two levels: fair, unfair) and emotion (four levels: angry, happy, neutral, sad) as within-subject factor and group (two levels: schizophrenia patients, healthy controls) as a between-subjects factor.

Second, reactions to unfair offers with the same payoff (8:2) were analyzed against different manipulations of the within-subject factors context and emotion. The factor context refers to the alternative offer that had not been chosen while the factor emotion pertains to the emotional expression of the proposer. The rejection rates were subjected to a repeated measures ANOVA with context (two levels: fair, no alternative) and emotion (four levels: angry, happy, neutral, sad) as within-subject factors and group (two levels: schizophrenia patients, healthy controls) as between subjects-factor.

Separate analyses for possible effects of medication on schizophrenia patients' rejection behavior alone were also assessed including the chlorpromazine equivalent as a covariate. Within-subject effects of all analyses are reported with Huynh–Feldt corrections in cases were the assumption of Sphericity is violated.

Results

Rejection Behavior

The ANOVA repeated measures revealed a significant main effect of fairness [$F_{(1,63)} = 144.92$, $p < 0.001$, $\eta^2 = 0.70$] with higher rejection rates to unfair offers (67%) compared to fair offers (5%). The main effect of emotion was marginally significant [$F_{(1,63)} = 2.61$, $p = 0.057$, $\eta^2 = 0.04$], mainly due to a higher rejection rate of offers from angry proposers (38%) compared to offers from happy proposers (34%; $p = 0.017$). More importantly, the interaction between fairness and group (**Figure 2**) was also significant [$F_{(1,63)} = 4.60$, $p = 0.036$, $\eta^2 = 0.07$]. Follow-up analyses of this interaction showed a significant group difference

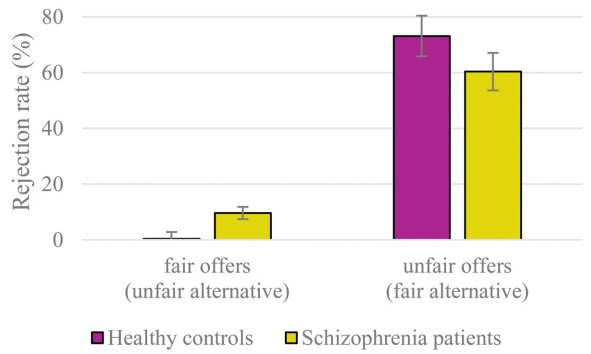

FIGURE 2 | Rejection rates of fair and unfair offers (collapsed over emotions). Overall mean percentage and SE are displayed.

of the rejection rate to fair offers [$F_{(1,63)} = 8.02$, $p = 0.006$, $\eta^2 = 0.11$], indicating that patients rejected more fair offers (10%) compared to healthy controls (0.4%). Regarding the unfair offers, schizophrenia patients' acceptance rate (40%) were higher compared to healthy controls' (27%), however, this difference was only numerical [$F_{(1,63)} = 1.66$, $p = 0.203$, $\eta^2 = 0.03$]. All other main effects and interactions were not significant [All Fs < 1.61, all ps > 0.197, all $\eta^2 < 0.03$].

After separate analyses for the patient group alone including the chlorpromazine equivalent as a covariate, the main effect of fairness remained significant [$F_{(1,33)} = 28.69$, $p < 0.001$, $\eta^2 = 0.47$].

Reactions to Unfairness

The results of the ANOVA depicted in **Figure 3** showed a main effect of context [$F_{(1,63)} = 46.56$, $p < 0.001$, $\eta^2 = 0.43$] and emotion [$F_{(3,189)} = 3.81$, $p = 0.013$, $\eta^2 = 0.06$]. The three-way interaction was marginally significant [$F_{(3,189)} = 2.74$, $p = 0.056$, $\eta^2 = 0.04$]. Separate group follow-up analyses revealed a main effect of context in both groups [controls: $F_{(1,29)} = 22.19$, $p < 0.001$, $\eta^2 = 0.43$; patients: $F_{(1,34)} = 24.24$, $p < 0.001$, $\eta^2 = 0.42$] indicated that both healthy controls and schizophrenia patients rejected more unfair offers when the proposer had a fair alternative (controls: 73%; patients: 60%) compared to rejections of unfair offers with no-alternative (controls: 36%; patients: 28%). Importantly however, controls showed a significant effect of emotion [$F_{(3,87)} = 2.98$, $p = 0.046$, $\eta^2 = 0.09$] that was not apparent in the group of patients [$F_{(3,102)} = 2.13$, $p = 0.109$, $\eta^2 = 0.06$]. *Post hoc* pairwise comparisons showed that healthy controls rejected more unfair offers of angry faces (59%) in comparison to unfair offers of happy faces (52%; $p = 0.016$) and neutral faces (55%; $p = 0.039$). Unfair offers of angry faces were also numerically rejected more compared to unfair offers of sad faces (53%; $p = 0.068$). The remaining pairwise comparisons between happy, neutral, and sad faces were not significant (all ps > 0.160). Interestingly, when analyzing both groups separately, the patient group also showed a marginal significant two-way interaction between context and emotion [$F_{(3,102)} = 2.42$, $p = 0.090$, $\eta^2 = 0.07$] that was not apparent in the control group [$F < 1$]. Subsequent analyses of this interaction per context revealed that schizophrenia patients showed an effect of emotion only when they were offered an intentional unfair split (fair alternative context) [$F_{(3,102)} = 3.83$, $p = 0.019$, $\eta^2 = 0.10$], but not when they were offered an unintentional unfair split (no-alternative context) [$F_{(3,102)} < 1$]. Follow-up pairwise comparisons showed that during these intentional unfair offers, schizophrenia patients rejected more offers from angry (65%) compared to happy (55%; $p = 0.021$) and neutral proposers (59%; $p = 0.048$), and also rejected more unfair offers from sad (63%) compared to happy proposers ($p = 0.019$). All other main effects or interactions of the primary ANOVA were not significant [All Fs < 1.68, all ps > 0.199, all $\eta^2 < 0.03$].

A closer look at **Figure 3** might imply that while schizophrenia patients are affected by the proposers' emotions during unfair offers in the context of a fair alternative, healthy controls are rather affected by emotions during unfair offers in the no-alternative context. Therefore, subsequent analyses per context were also executed. The interaction between emotion and group was not significant during the intentional unfair context [$F_{(3,189)} = 1.46$, $p = 0.228$, $\eta^2 = 0.02$], but showed a trend during the unintentional unfair context [$F_{(3,189)} = 2.36$, $p = 0.073$, $\eta^2 = 0.04$]. Follow-up analyses of the latter interaction, suggested that in contrast to schizophrenia patients [$F_{(3,102)} < 1$], only healthy controls [$F_{(3,87)} = 2.82$, $p = 0.056$, $\eta^2 = 0.09$] were affected by the proposers' emotions during unintentional unfair proposals. More specifically, offers from angry proposers were rejected more (43%) compared to offers from happy (33%; $p = 0.016$), sad (35%; $p = 0.048$), and neutral proposers (35%; $p = 0.059$). This latter result is in line with the previous analyses showing that only healthy controls are affected by emotions, yet particularly when the proposer had no-alternative.

After analyzing the patient group alone including the chlorpromazine equivalents as a covariate, the main effect of context remained significant [$F_{(1,33)} = 13.37$, $p = 0.001$], while there was still no effect of emotion [$F_{(3,99)} = 1.28$, $p = 0.286$].

Discussion

By using a modified version of the UG in combination with emotional faces we aimed to deepen our understanding of higher-order social decision-making processes involving fairness, intentionality, and emotion considerations in schizophrenia patients. Our primary finding showed that schizophrenia patients and healthy controls were similarly affected by the intentionality behind unfair offers as reflected by the context in which offers were proposed, i.e., more rejections of unfair offers with a fair alternative compared to unfair offers with no-alternative. Second, we found that unlike patients, healthy controls' decisions to unfair offers were also affected by the emotional state of the proposers (i.e., more rejections of unfair offers from angry proposers compared to unfair offers from happy or neutral proposers). However, subsequent analyses indicated that schizophrenia patients also might be affected by the proposers' emotions, yet particularly when they were offered an intentional unfair split (i.e., more rejection of intentional unfair offers from angry proposers compared to intentional unfair offers

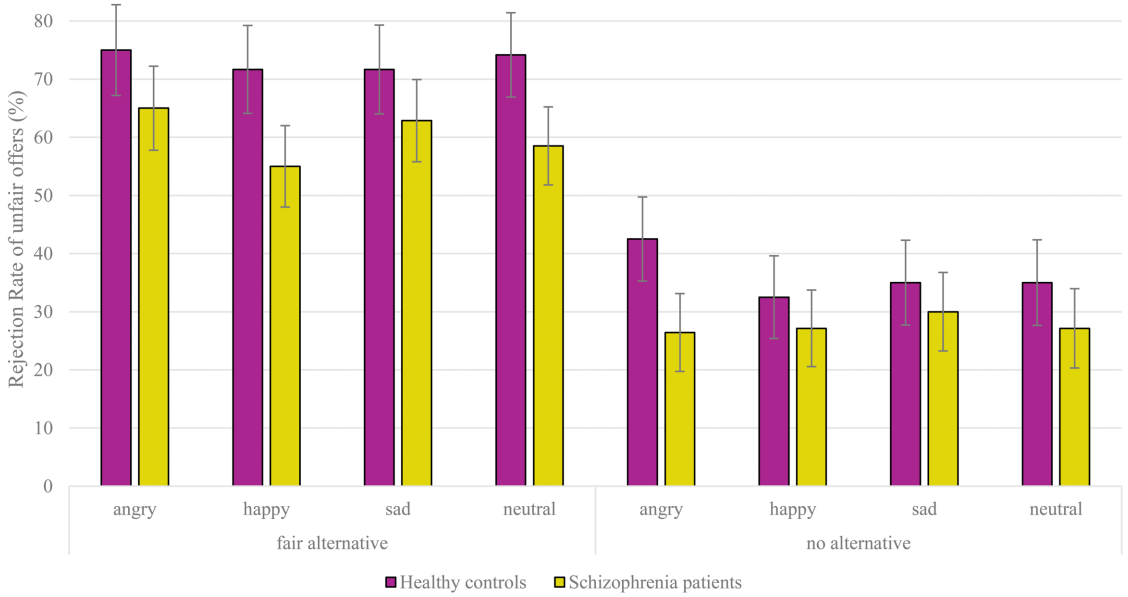

FIGURE 3 | Rejection rates of unfair offers with regard to the facial emotion of the proposer and alternative offers. Overall mean percentage and SE of rejections are displayed for schizophrenia patients and healthy individuals.

from happy proposers and neutral proposers, and also more rejections of intentional unfair offers from sad versus happy proposers). Third, while both groups rejected unfair offers more often compared to fair offers, schizophrenia patients specifically rejected more fair offers in comparison to healthy controls.

The latter finding is in accordance with our hypothesis stating that schizophrenia patients will show aberrant behavior when considering fair versus unfair offers by either rejecting more fair offers or accepting more unfair offers than healthy controls. This finding is also in line with a previous study of Csukly et al. (2011) who reported that, in comparison to healthy controls, schizophrenia patients rejected more fair offers. Besides this, Agay et al. (2008) also reported that regardless the amount of the offer, schizophrenia patients generally rejected more offers. In contrast, however, Wischniewski and Brüne (2011) did not find increased rejections toward fair offers in schizophrenia patients. Yet, in line with Csukly et al. (2011), they did report the reverse effect where schizophrenia patients accepted more unfair offers, a finding that was not present in the current data. Csukly et al. (2011) suggested that: "rather than being rational maximizers, schizophrenia patients seem to be 'inconsistent maximizers,' following a paradox strategy." A possible explanation for this inconsistent behavior was not directly given by the authors, however, one might assume that because of schizophrenia patients' heightened state of social anxiety (Green and Phillips, 2004) and tendency to suppress emotions rather than reappraise them (van der Meer et al., 2009), social avoidant behavior is reinforced (de la Asuncion et al., in revision) resulting in more rejections of fair offers. Alternatively, disturbed reward processing or negative symptomatology such as blunted affect and anhedonia might underlie the increased rejection rate of fair offers. Disturbances in reward processing have been demonstrated before in schizophrenia patients and contribute to reduced goal-directed behavior or pleasure-seeking behavior (Strauss et al., 2014) as currently reflected in increased rejection rates of fair offers.

The finding that schizophrenia patients, like healthy controls, reject unfair offers more often in cases where the proposer had the ability to choose for a fair alternative (intentional unfair) compared to cases were the proposer had no alternative (unintentional unfair), are directly in line with our first hypothesis expecting both groups to be sensitive toward the different contexts. Correspondingly, Quisenaerts et al. (2013) reported the same behavior in a group of smoking schizophrenia patients. However, non-smoking schizophrenia patients only showed this pattern after they were administered 1 mg of nicotine. Although we did not register smoking behavior of our participants, we may assume that more than 80% of our patients were smokers (Keltner and Grant, 2006) resembling the smoking group in Quisenaerts et al. (2013) more likely than the non-smoking group. It might therefore be possible that in the current study, patients benefit from the cognitive enhancing properties of nicotine (Newhouse et al., 2011). However, this is merely speculative and must be studied more specifically. Another study using the same paradigm while comparing a group of healthy controls and individuals suffering from depression, also reported more rejections of unfair offers in the context of a fair alternative compared to no alternative in both groups (Radke et al., 2013). Furthermore, previous research in healthy controls found that people responded in a pattern where acceptance rates declines with higher degrees of unfairness (Fehr and Fischbacher, 2003; Sanfey et al., 2003). This pattern was also found in schizophrenia patients (Csukly et al., 2011; Wischniewski and Brüne, 2011) and is in accordance with our finding of both patients and

healthy controls rejecting intentional unfair offers more likely compared to unintentional unfair offers. This shows that like healthy individuals, schizophrenia patients adequately recognize unfair intentions and have an intact sense of fairness in general.

Regarding the influence of the proposers' emotional state while making an offer, we hypothesized that schizophrenia patients would be less sensitive toward the emotion compared to healthy controls. Our results were in line with this proposition and showed that only healthy controls' behavior was directly influenced by the proposers' emotions. Specifically, healthy controls rejected unfair distributions more often when they were offered by an angry proposer compared to unfair offers proposed by a happy or a neutral proposer. This is also partially in line with the results of Radke et al. (2013) who reported more rejections of unfair offers from proposers with angry faces compared to happy and sad proposers in both healthy controls and patients with depression. Rejection behavior of schizophrenia patients, however, was not affected by the proposers' emotions. A similar result was previously reported by Csukly et al. (2014) using a traditional Ultimatum Game. They found that healthy individuals alone accepted slightly unfair offers (40%) and fair offers (50%) more likely when the proposer was happy compared to angry proposers. In the current study, controls were still affected by the proposer's emotion while they only received an offer of 20% from the total amount. The reason why healthy controls are still likely to accept these highly unfair offers more from happy, neutral, and sad proposers is related to the different contexts, which partially included unintentional unfair offers (no alternative). i.e., since the proposer did not have a real choice when confronted with two equally unfair offers, controls have taken that into account resulting in less rejections of the proposed offer. More importantly, however, is the question why schizophrenia patients were not affected by the proposers' emotions. One explanation is related to schizophrenia patients' abnormal emotion-recognition abilities (Edwards et al., 2002). Since these patients have difficulties to distinguish different emotions and are prone to misinterpret ambiguous (de la Asuncion et al., in revision) and neutral emotions (Pinkham et al., 2011), one might argue that these patients do not differentiate well enough between the different emotions and consider them more alike. However, Csukly et al. (2014) controlled for impaired emotion-recognition abilities and did not find an influence of these impairments on the patients' behavior. Moreover, the currently used task was completely self-paced, providing the participants with ample time to process all the information. A pressure for speed can thus not explain possible integration problems. Therefore, one can also assume that rather than abnormal emotion-recognition abilities in schizophrenia, these patients deviate in the processing of the depicted emotions during this complex task.

This latter assumption is supported by some of the findings during the subsequent analyses we performed. These results showed that healthy controls' reactions to emotions remained the same during the two unfair contexts with generally more rejections of unfair offers from angry proposers compared to happy, neutral, and sad proposers. Schizophrenia patients, however, showed a marginal significant interaction between emotion and context, implying that these patients' decisions were only affected by emotions when offered an intentional unfair offer, but not during unintentional unfair offers. First, this indicates that like healthy controls, schizophrenia patients do process the emotions of others during complex social decision-making situations, yet, when focusing on the specific rejection behaviors toward the different emotions, some group differences appear. Specifically, schizophrenia patients reject more intentional unfair offers from sad compared to happy proposers, while both groups reject more (intentional) unfair offers from angry proposers compared to happy and neutral proposers. Possible group differences in attribution style might be responsible for these different reaction patterns toward sad proposers. While healthy controls, for instance, interpret the sad emotion as a sign of compassion toward the participant because of the negative situation (attribution of negative valence to the situation), schizophrenia patients rather attribute this negative emotion to the proposer because of their personalizing bias (attribution of negative valence to the person; Langdon et al., 2006). Alternatively, schizophrenia patients' impaired Theory of Mind or poor insight of others' mental states (Brune, 2005), might also be an explanation for their aberrant behavior toward sad proposers. Second, the fact that schizophrenia patients are only affected by the proposers' emotion during intentional unfair trials, and not during unintentional unfair trials, suggest that these patients process the emotions differently when the offer can be regarded as a genuine unfair choice from the proposer toward the patient. This is in line with previous findings showing that schizophrenia patients who are primed with a negative affective prime, express an exaggerated negative influence on their social judgment (Hooker et al., 2011). Whether the affective prime in this study can be related to the negative emotion or the intentional unfair offer is unclear. However, the fact that schizophrenia patients do not differentiate between emotions when offered an unintentional unfair split, suggest that these patients first process the intentionality of the offer, and depending on how negative the intentions are, further process other contextual factors such as the proposers' emotions. So when an unfair offer was unintended and the proposer had no real choice, patients seem to feel less affected by it and disregard the proposers' emotion. Yet, these final interpretations are mainly based on marginal significant results. Therefore, we must remain cautious about their validity, however, in the light of future studies, they might have a significant additional value.

One of the shortcomings of this study is that the participants were mostly males. Therefore, possible gender differences in social decision-making cannot be addressed. However, since the prevalence of schizophrenia is much higher in males than in females (Aleman et al., 2003), the gender differences in the current study represent a rather realistic reflection of general patient populations. Also, all participants in the patient group were on antipsychotic treatment, and we were thus unable to rule out possible effects of antipsychotic medication on patients' decision-making process. Yet, *post hoc* analyses including patients' individual chlorpromazine equivalents as a

covariate factor, did not change the previously described effects in this group.

Taken together, it is clear that schizophrenia patients adequately differentiate between fair and unfair offers, suggesting that these patients have a basic understanding of moral reasoning. However, when compared directly with healthy individuals, possible disturbances in schizophrenia patients' reward processing influence their margins of fairness judgments in a way that is disadvantageous for themselves (i.e., higher rejection rates of fair offers). In addition, schizophrenia patients' ability to differentiate between intentional and unintentional offers is still intact. Both outcomes imply that these social cognitive capacities that play a central role in social decision-making are preserved in schizophrenia. On the other hand, these patients do seem to have problems with processing the emotional information of others during this complex social decision-making task, and even seem to process information differently in different contexts. This shows that schizophrenia patients have problems with correctly combining and integrating different pieces of information during higher order cognitive processes such as social decision-making. In social daily life situations, this might for instance translate in to situations wherein these patients misinterpret, disregard or just incorrectly attribute (personalizing bias), someone's emotions during complex social situations consisting of multiple contextual elements that also need to be taken into account. This may easily lead to confusion or inappropriate behavior and conflicts. For this reason, the current results emphasize the need for cognitive remediation trainings in patients suffering from schizophrenia in order to enhance not only specific cognitive abilities, but also to improve the integration of different cognitive and affective constructs. Furthermore, the current study also warrants future research aimed at investigating the effects of (social) cognitive training on higher order cognitive processes such as social decision-making, emotion processing, and emotion regulation processes which have proven to be effective in regulating healthy persons' decisions (van't Wout et al., 2010) and might help these patients process others' and own emotions more accurately.

Author Contributions

Jd and Ed designed the study. Jd and LD wrote the protocol and retrieved all the data. Jd analyzed the data. Jd and Ed wrote the manuscript. LD, MM, and BS contributed to the conception of the work and revised the manuscript critically for important intellectual content. All authors have approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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The strength of a remorseful heart: psychological and neural basis of how apology emolliates reactive aggression and promotes forgiveness

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Apology from the offender facilitates forgiveness and thus has the power to restore a broken relationship. Here we showed that apology from the offender not only reduces the victim's propensity to react aggressively but also alters the victim's implicit attitude and neural responses toward the offender. We adopted an interpersonal competitive game which consisted of two phases. In the first, "passive" phase, participants were punished by high or low pain stimulation chosen by the opponents when losing a trial. During the break, participants received a note from each of the opponents, one apologizing and the other not. The second, "active" phase, involved a change of roles where participants could punish the two opponents after winning. Experiment 1 included an Implicit Association Test (IAT) in between the reception of notes and the second phase. Experiment 2 recorded participants' brain potentials in the second phase. We found that participants reacted less aggressively toward the apologizing opponent than the non-apologizing opponent in the active phase. Moreover, female, but not male, participants responded faster in the IAT when positive and negative words were associated with the apologizing and the non-apologizing opponents, respectively, suggesting that female participants had enhanced implicit attitude toward the apologizing opponent. Furthermore, the late positive potential (LPP), a component in brain potentials associated with affective/motivational reactions, was larger when viewing the portrait of the apologizing than the non-apologizing opponent when participants subsequently selected low punishment. Additionally, the LPP elicited by the apologizing opponents' portrait was larger in the female than in the male participants. These findings confirm the apology's role in reducing reactive aggression and further reveal that this forgiveness process engages, at least in female, an enhancement of the victim's implicit attitude and a prosocial motivational change toward the offender.

Keywords: apology, forgiveness, reactive aggression, Implicit Association Test, ERP, LPP

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INTRODUCTION

Interpersonal conflicts are ubiquitous in our social life. A natural self-defense mechanism in many social species is the desire for revenge, that is, to react aggressively toward the offender. However, reacting in accordance with the "eye-for-an-eye" principle also carries adverse effects and ultimately leads to the breakdown of interpersonal relationships (Carlsmith et al., 2008; Rand et al., 2009; Wu et al., 2009). In fact, humans possess an important virtue, which is the ability to forgive. Social psychologists define forgiveness as a set of changes whereby one feels decreased negative emotions toward the offender, reduced motivation to retaliate or punish, and an increase in will to continue the relationship despite the offender's hurtful actions (McCullough et al., 1997; Worthington, 2006). In other words, forgiveness acts to rebuild the damaged relationship. Yet, in real life, unconditional forgiveness as a pure gift is not easily affordable (Griswold, 2007; Hughes, 2015). The key process to avoid revenge and overcome the negative feelings of resentment in the victim is for the offender to give an apology. The offender must acknowledge his/her responsibility and express remorse (Lazare, 2004), demonstrate that he/she is a trustful person, and that both parties share the same moral values. In these terms, apology meets the conditions required for forgiveness, and constitutes a crucial remedy for interpersonal conflict.

The positive impact of apology on reconciliation and forgiveness is well established in social psychological research (Darby and Schlenker, 1982; McCullough et al., 1997; Exline and Baumeister, 2000; De Cremer et al., 2011). Factors mediating the influence of apology have also been extensively studied, including the severity of the offense and level of responsibility (Schlenker and Darby, 1981; Bennett and Earwaker, 1994), the intention to offend (Struthers et al., 2008), the level of elaboration of apology (Darby and Schlenker, 1982; Kirchhoff et al., 2012) and the time lapse between offense and apology (Frantz and Bennigson, 2005). There is evidence that apology from an offender influences the victim at the affective, cognitive, and behavioral levels. At the cognitive level, apology affects victims' perception of the offender such that they make more positive attributions about the one who apologizes (Darby and Schlenker, 1982; Ohbuchi et al., 1989). At the affective level, apology can help reduce the victim's negative emotions such as anger (Ohbuchi et al., 1989; Kirchhoff et al., 2012) and increase empathy toward the offender (McCullough et al., 1997). At the behavioral level, the recipient of apology is more likely to refrain from retaliatory and aggressive behavior (Gold and Weiner, 2000; Strang et al., 2014).

While much is known about the consequences of apology, little is known about the implicit and neural impact substantiating those outcomes. As far as we know, there is only one recent neuroimaging study investigating the neural correlates of receiving an apology and actively forgiving offense in a two-person interactive game (Strang et al., 2014). In this study, participants were asked if they wanted to forgive another player when the latter made a choice with negative consequences for them. Before the decision to forgive, the participants either received an apology or not from the other player. The authors found that participants forgave more often after an apology message and that receiving an apology yielded activation in empathy-related brain regions. However, several features in their design may have rendered their interpretations ambiguous. First, as the offenses and the decisions not to forgive involved losing money for the participants and/or the offender, other psychological factors such as fairness consideration, strategic thought, and self-interest might have influenced the behavior. Moreover, since the participants were explicitly asked at each trial if they forgave the player or not, they could be forced to abide by the social norm (i.e., forgiving transgressors if they repent) and falsely express their forgiveness of the apologizing offenders. To avoid these potential pitfalls, here we aimed to utilize more implicit measures to examine the victim's reactions to apology that are otherwise not visible in explicit measures and behavior. With a more naturalistic setting, we combined behavioral and electrophysiological (event-related potential, ERP) measures and investigated, at the cognitive, affective, and behavioral levels, the direct, implicit transformations elicited by apology. Note, we used the ERP technique to measure brain responses to forgiveness as its impact unfolds over time, rather than brain regions involved in forgiveness, as Strang et al. (2014) did.

In two experiments, we adopted a modified version of the Taylor Aggression Paradigm (TAP; Taylor, 1967) divided into two phases (**Figure 1**). The first, "passive" phase was designed so that the participant was passively punished (received painful stimulation) by two different opponents each time he/she lost a trial (i.e., responded slower than the opponent) in a reaction-time competition task. In this phase, the aggressiveness of the opponents was predetermined such that they systematically chose more high than low intensity punishment for the participant. After the first phase, one opponent sent an apologizing message and the other a non-apologizing message to the participant. In the second, "active" phase, the roles of the participant and the two opponents were exchanged: the participant became an active partner and had the right to punish the opponents when they lost a trial. Our design allowed us to measure the changes induced by apology at the three distinct levels mentioned above. Compared with existing studies we attempted to measure implicit reactions in addition to participants' explicit self-reports. First, at the behavioral level, as an index of the retaliation/forgiveness behavior we measured the severity of the reactive punishment administrated by the participant to each of the opponents during the second phase (Experiments 1 and 2). Second, at the cognitive level, in order to measure their attitude toward the apologizing and non-apologizing opponent, we administrated an Implicit Association Test (IAT; Greenwald et al., 1998) right after the participant received the apologizing and non-apologizing messages (Experiment 1). Third, at the affective/motivational level, we recorded and analyzed ERPs of the participants (Experiment 2).

We analyzed EEG responses during the decision phase and the outcome phase in Experiment 2. For the decision phase (when participants were deciding the intensity of punishment), we focused on N2 and the late positive potential (LPP). The former component, a negative deflection of brain potential peaking around 200 ms after stimulus, has been associated with aggressiveness in a previous study using TAP (Krämer et al.,

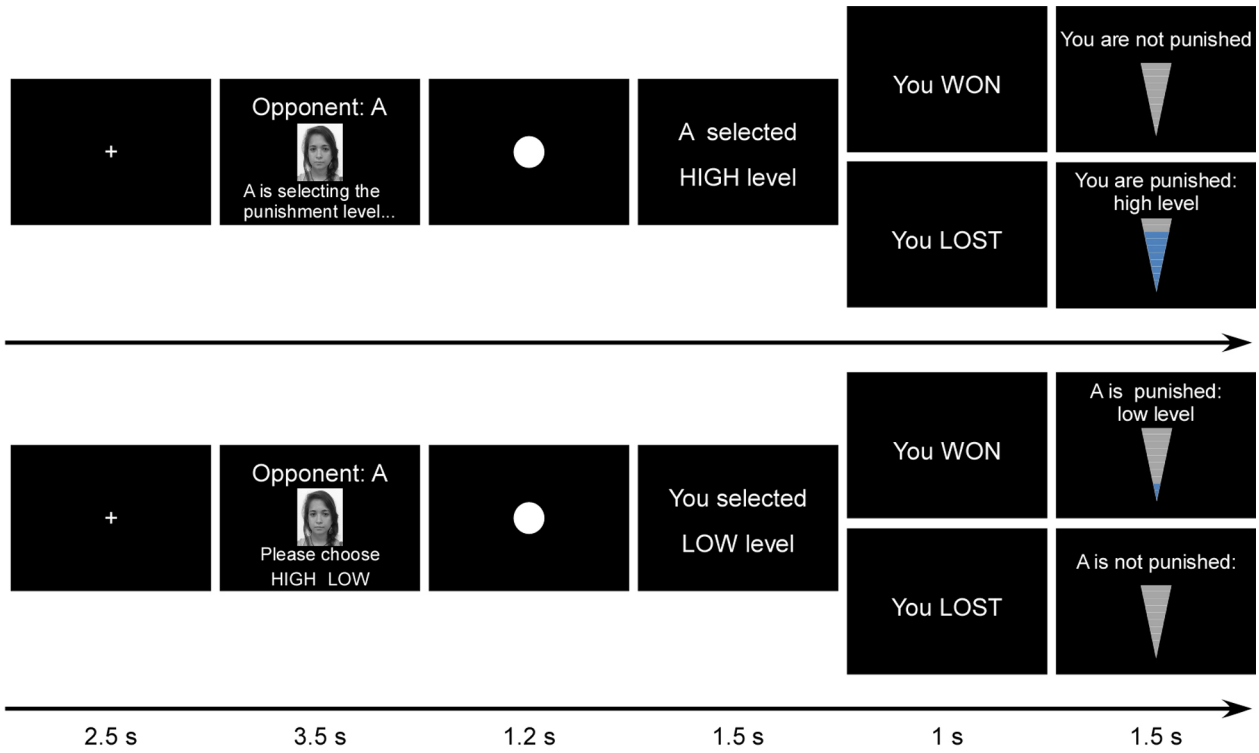

FIGURE 1 | Task display and timing of Experiment 1. Top panel: passive phase. Bottom panel: active phase.

2008). If apology reduces aggressiveness, we hypothesized that N2 should show a larger amplitude for the non-apologizing opponent than for the one who apologized. The LPP is a sustained positive component distributed mainly in the posterior part of the brain, which has been consistently associated with the processing of emotional stimuli, irrespective of the valence of the affective arousal (Schupp et al., 2000; Sabatinelli et al., 2007). The pattern of LPP could help us gain insight into the effect of apology on the affective/motivational reaction underlying the decision to punish the offender. For the outcome stage, where participants learned if they won or lost the trial, we focused on the feedback-related negativity (FRN) and P300. As these components are sensitive to outcome evaluation (e.g., Gehring and Willoughby, 2002; Hajcak et al., 2005), we sought to investigate whether apology influences the affective/motivational reaction to win or loss trials. Given that FRN is usually more pronounced for negative feedbacks, it is possible that, if participants have stronger retaliation motivation toward the non-apologizing opponent, losing a trial against the non-apologizing opponent (i.e., who would then not be punished in that trial) would elicit a larger amplitude than losing a trial against the apologizing opponent. In contrast, the P300 response has been found to be stronger for positive than negative rewards; because apology reduces the motivation to punish, winning against the opponent who did not apologize (which leads to punishment for the opponent) would be felt as more positive and rewarding than winning against the apologizing opponent.

We believe that these different measures are conceptually related and can provide insights from different angles into the psychological processes motivating a victim to forgive. Given that gender plays a significant role in social and affective processes, especially in dealing with aggressive behavior (Bettencourt and Miller, 1996), we were also interested in whether gender could moderate the effect of apology on interpersonal forgiveness.

EXPERIMENT 1: BEHAVIORAL EXPERIMENT

Methods

Participants

Thirty-six graduate and undergraduate students (aged between 19 and 25 years, 17 males; none from psychology or related disciplines) took part in this experiment. All the participants were right handed, with normal or corrected-to-normal vision. None of them had a history of neurological, psychiatric, or cognitive disorders. All the participants were informed of the properties of the pain stimulation in detail during the recruitment and before the experiment began. Informed written consent was obtained from each participant before the test. This study was carried out in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Department of Psychology, Peking University.

Tasks

The modified Taylor Aggression Paradigm

The TAP is a frequently used method to elicit and measure aggressive behavior in a laboratory setting. In TAP, participants are led to believe that they are playing a competitive reaction

time task against one or more opponents. In reality, both the outcome of the reaction time and the opponents' behavior are under control of the experimenter. In the classical TAP, the winner of the task from each trial gets to punish the loser with an aversive stimulus of variable intensity. We modified the classical TAP so that the participant played the game in two phases. During the first (passive) phase, the participant could only be punished (to elicit aggressive retaliation motivation), in the second (active) phase he was the one able to punish the opponents (to measure aggressive reactive behavior). The experimental conditions were manipulated between the first and the second phase, i.e., one opponent wrote an apologizing note, and the other one did not apologize in his note.

The punishment was moderately painful electric stimulations. The use of electric shock has been used in a number of studies investigating social emotions (e.g., Crockett et al., 2014, 2015; Winston et al., 2014). It has the benefits of eliciting more primitive instincts and more intensive emotional arousals than monetary loss (which is widely adopted as a way of interpersonal transgression). It is presumably less vulnerable to inter-individual variations. An intra-epidermal needle electrode was attached to the left wrist of the participant for cutaneous electrical stimulation (Inui et al., 2002). Great care was taken to ensure that no permanent damage could occur. The participants were informed, at the time of recruitment and before the experiment, that the stimulation would not produce any irreversible effect. Two participant-specific pain intensities were calibrated such that the high intensity stimulation was rated as 8 and the low intensity was rated as 3 on a 0–10 scale (0, no sensation; 10, unbearably painful).

The Implicit Association Test

We employed an IAT (Greenwald et al., 1998) to measure the participant's implicit attitude toward the apologizing and non-apologizing opponents. Compared to explicit measures, such as self-report and behavioral punishment, IAT has the strength to assess unconscious and automatic responses to social and affective stimuli, largely unaffected by the influence of reputation, social desirability, and self-image (cf. Phelps et al., 2000). For our study, the participant had to associate belongings from the apologizing and non-apologizing opponents (memorized before the task) with either negative or positive attributive words. This modified version of IAT was used in a number of previous studies (e.g., Huang et al., 2009; Wu et al., 2013). We hypothesized that participants would respond faster to the apologizing opponent with positive attributive words and to the non-apologizing opponent with negative attributive words (congruent trials), and slower for the non-apologizing opponent's belonging with positive attributes and apologizing opponent with negative words (incongruent trials).

Design and Procedure

Upon arrival, each participant was told that he/she would later play an interactive game together with two opponents already in another room, via intranet. We first measured the pain threshold of the participant and determined the two critical pain intensities for each participant. The low intensity corresponded to the participant's self-report of 3 and the high intensity corresponded to 8 on a scale ranging from 0 to 10. Then each participant was told that the experiment was divided into two parts: first a passive phase during which the participant would be passively punished by the two opponents each time he/she lost a trial. Then an active phase where the participant could actively punish the opponents when they lost. The participant was made to believe that the opponents did not know about the role switching until the second phase.

During the whole experiment, the participant did not meet the two opponents (confederates); the identity of the two opponents was given by his/her (facial) portrait and the label A and B through the intranet. The two opponents were of the same sex as the participant and the associations between portraits and apologizing/non-apologizing were counterbalanced over participants.

Phase 1: passive phase

At the beginning of each trial (**Figure 1**, top panel), the computer presented the identity of the opponent (the portrait and the label A or B), indicating against whom the participant was playing for this trial and that this opponent (the active player) was selecting the intensity of the punishment (high or low). Then the reaction time task required the players to press a button ("space key") as fast as possible when a white dot appeared in the center of screen. The punishment intensity chosen by the opponent was subsequently presented on the screen. After that, the outcome of the reaction-time game was displayed. If the opponent won the trial (i.e., responded faster than the participant), the participant would receive the punishment with the intensity chosen by the opponent at the beginning; if the opponent lost the trial, the participant would not be punished. In fact, the outcome of each trial was predetermined by the experimenters.

The participant played as the passive player for a total of 64 trials. For each trial, one of the two opponents (A or B) was randomly selected by the computer to interact with the participant in that trial. A and B opponents were each selected for 32 trials. The probability of winning a trial was 50% for both A and B and the proportion of high intensity punishment chosen by A and B was 75% (24 trials) in total. All the trials were pseudorandomized and the condition with the same punishment intensity would not appear more than three consecutive times.

Apology manipulation during the break time

After the first passive phase, participants and the opponents had a break time during which the participant received one message from each opponent, which was passed on by the experimenter (the participant did not meet the opponent directly throughout the experiment). Specifically, one opponent apologized to the participant while the other did not. The message from the apologizing opponent was: "Sorry, the punishments I gave you were a bit high, I will modify my choices for the next part. Sorry again for the harm I caused to you." The message from the non-apologizing opponent was: "I find this game rather exciting, I guess the electrical stimulation does not hurt that much, so I chose some higher intensity." The opponent labels (A or B) and the apologizing/non-apologizing messages were counterbalanced over participants.

TABLE 1 | Procedure of the Implicit Association Test.

Block	Task (number of trials)	Corresponding key	
		Left key (F)	**Right key (J)**
i	Target stimuli reaction (24)	A belongings	B belongings
ii	Attributive words reaction (24)	Positive words	Negative words
iii	Initial association task (24)	A belongings/positive words	B belongings/negative words
iv	**Initial association task (48)**	**A belongings/positive words**	**B belongings/pegative words**
v	Reversed target stimuli reaction (24)	B belongings	A belongings
vi	Reversed association task (24)	B belongings/positive words	A belongings/negative words
vii	**Reversed association task (48)**	**B belongings/positive words**	**A belongings/negative words**

Blocks in bold are testing blocks.

After the participant read the messages, he/she completed a number of subjective ratings. On a 7-point scale, he/she answered his/her level of unhappiness, anger, willingness to forgive, willingness to punish, willingness to be a friend, and impression for the two opponents respectively. For the "impression" item, 1 means "very bad," and 7 means "very good." For the other items, 1 means "not at all," and 7 means "extremely strong."

Implicit Association Test

Right after the completion of the subjective ratings, the IAT began. Each participant first had to take 2 min to memorize and associate a number of objects/belongings (target stimuli) to their owners (i.e., the opponents, A and B). Then, the participant performed seven IAT blocks (**Table 1**) in which he/she was instructed to respond to target stimuli and/or attributive words as correctly and quickly as possible. The first two blocks were training blocks. In Block 1, the participant pressed one key (F or J on the keyboard) when A's belongings were presented, and the other key for B's belongings. In Block 2, he/she pressed one key for positive words and the other for negative words. In Block 3 and Block 4, the participant pressed one key for A's belongings or positive words, and pressed another key for B's belongings or negative words. Block 3 served as a training block, familiarizing the participant with the key codes, and Block 4 served as a testing block. In Block 5, the key code for the belongings switched and the participant had to respond to belongings only, as in Block 1. It should be noted that the key code for the attributive words remained the same throughout the whole IAT experiment. Block 6 and Block 7 were similar to Block 3 and Block 4, except that the key code for the belongings switched. Given that we hypothesized that the participant has positive attitude toward the apologizing opponent and negative attitude toward the non-apologizing opponent, we defined the congruent block as the testing block in which the apologizing opponent's belongings and positive attributive words shared the same key, and defined the incongruent block as the testing block in which the apologizing opponent's belongings and negative attributive words shared the same key. The order of congruent and incongruent blocks was counterbalanced across participants. A red "X" appeared at the center of the screen after every incorrect response, i.e., when the participant responded with the wrong key.

We analyzed the reaction times for the fourth and seventh blocks (i.e., the testing blocks) in the IAT experiment. Note again, for half of the participants, the fourth block was the congruent block, in which the apologizing opponent's belongings and positive words shared the same response key, and the seventh block was the incongruent block, in which the apologizing opponent's belongings and negative words shared the same response key. For the other half, the fourth block was the incongruent block, and the seventh block was the congruent block. The potential influence of test order was therefore counterbalanced in this procedure.

One group of target stimuli (belongings) contained "figurine," "ruler," and "candy" (in words), and the other group, "chocolate," "cup," and "pen" (in words). Positive attributive words included "sunshine," "luck," "love," "happiness," "joy," "fun," "festival," and "friendship"; negative attributive words included "disease," "death," "murder," "accident," "poison," "war," "tragedy," and "vomit." Inquisit four software was employed to present stimuli in IAT. The two groups of target stimuli were assigned to the opponents A and B, respectively. This assignment was counterbalanced over participants.

Phase 2: active phase

For the second, active phase, the participant and the two opponents exchanged roles. The participant became the active player while the two opponents became the passive players. The participant was told at the beginning of the experiment that only he/she knew that the roles would be exchanged, while the opponents did not learn about this manipulation until the beginning of the second phase. This information was given to eliminate the participant's potential concern about a strategic apology (i.e., giving an apology just to avoid undergoing the revenge of the participant and be punished in the next part). In other words, the participant was made to believe that the opponent apologized sincerely, without knowing that he/she would be punished later. At the beginning of each trial (**Figure 1**, bottom panel), the portrait of the opponent and the corresponding label was presented on the screen and the participant had to choose the pain intensity for this opponent. The participant pressed two buttons to choose from two intensity levels. The key codes were counterbalanced over participants. The rest of the trial sequence was similar to the passive phase: the participant had to press the space key as the white dot appeared on the screen, then the participant was presented with the punishment intensity he selected earlier in the trial, followed by the outcome of the reaction time task. At the end of the trial, the outcome of the reaction-time game was displayed. In contrast to the passive phase, if

TABLE 2 | Subjective ratings for apologizing/non-apologizing opponents in Experiment 1.

	Apologizing opponent (Mean ± SD)	Non-apologizing opponent (Mean ± SD)	*t*-value ($n = 36$)	*p*-value
Unhappy	2.08 ± 1.32	2.39 ± 1.62	−1.43	0.160
Anger	1.71 ± 0.98	1.89 ± 1.27	−1.27	0.213
Forgiveness	5.76 ± 1.64	5.84 ± 1.50	−0.27	0.791
Willingness to punish	4.13 ± 1.30	4.00 ± 1.27	0.68	0.500
Willingness to be friend	5.61 ± 1.29	5.37 ± 1.36	1.10	0.277
Impression	5.74 ± 1.13	5.55 ± 1.29	1.16	0.255

After receiving the opponents' messages but before the active phase, the participant rated on a 7-point scale about the degree to which he/she felt on the above dimensions. For the "impression" item, 1 means "very bad", and 7 means "very good". For the other items, 1 means "not at all," and 7 means "extremely strong".

the participant won the trial, the opponent would receive the punishment with the intensity chosen by the participant at the beginning; if the participant lost the trial, the opponent would not be punished. All trials were pseudorandomized such that the same condition would not appear three or more consecutive times. Similar to the passive phase, the active phase consisted of 64 trials. The two opponents interacted with the participant respectively for 32 trials, whose performance was in fact controlled by our program. The proportion of winning trials was 50% for both opponents. After this second phase, the participants were paid and thanked. No participants expressed suspicion of the experiment manipulation.

Measurements

The intensity of punishments that the participant selected for the two opponents in the second phase of the TAP was used as an index for the retaliation/forgiveness behavior. For the IAT (implicit attitude), we analyzed the reaction times of congruent and incongruent trials. Steps for the analysis followed the procedure implemented in previous research (i.e., Wu et al., 2013). (1) We removed one participant whose error rate was over 20%, leaving 35 participants for further data analysis. (2) We excluded all the error trials from the analysis of reaction time, i.e., when the participant answered with the wrong response key (average error rate: 5.8%). (3) From the remaining trials, those in which participants did not respond within 3 s and trials in which the reaction times exceeded three standard deviations from the mean in each experimental condition were excluded from the data analysis (0.18% of the trials). Thus, in total, less than 6% of the total trials were excluded.

Results

Subjective Ratings

Ratings on the six items after receiving the messages of the two opponents did not show any significant difference between the two opponents (**Table 2**). There was no gender difference either.

IAT Reaction Time

To examine the impact of apology on the implicit attitude of the victim toward the offenders, we used an IAT construct (Greenwald et al., 1998) to reflect the implicit attitude (positive or negative) toward the apologizing or non-apologizing opponent. Shorter response times in the congruent block and longer response times

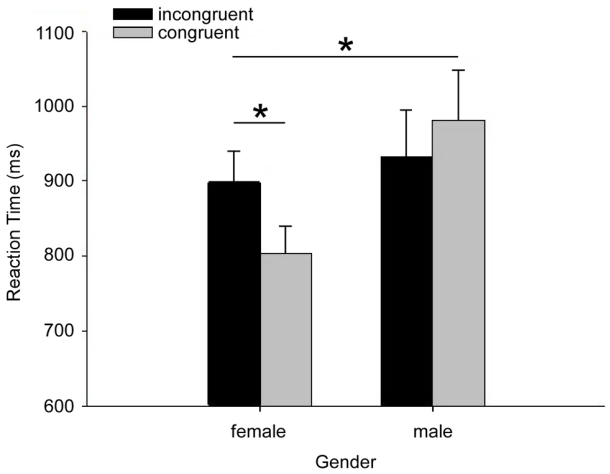

FIGURE 2 | IAT reaction time (Error bars represent standard deviation of the mean value). Congruent: apologizing opponent belongings-positive words/non-apologizing belongings-negative words; incongruent: apologizing opponent belongings-negative words/non-apologizing belongings-positive words). Significance indicators: $^*p < 0.05$.

in the incongruent block indicated stronger association between the apologizing opponent (relative to non-apologizing opponent) and positive concept. The association with positive/negative concept was interpreted as reflecting the participant's implicit attitude toward the target objects. Here, we carried out a two-way ANOVA with congruency as a within-participant factor and gender as a between-participant factor. The interaction was significant, $F(1,33) = 4.76$, $p = 0.036$. Pair-wise comparisons were carried out separately for each gender (**Figure 2**). We found that the reaction times for the female participants in the congruent condition ($M = 786$ ms, SD = 132) were significantly faster than those in the incongruent condition ($M = 885$ ms, SD = 171), $F(1,33) = 5.7$, $p = 0.022$, while there was no significant difference between the two conditions for male participants (congruent: $M = 936$ ms, SD = 299; incongruent: $M = 906$ ms, SD = 221). The main effects of congruency, $F(1,33) = 1.34$, $p = 0.25$, and gender, $F(1,33) = 2.43$, $p = 0.13$, were not significant. For error rate, no significant difference was found between genders, $F(1,30) = 1.16$, $p = 0.29$, or between congruent and incongruent conditions, $F(1,30) = 0.48$, $p = 0.43$. However, the interaction between gender and congruency was significant, $F(1,30) = 4.3$, $p = 0.047$. Specifically, pairwise comparisons

revealed that male participants' error rates were higher in the congruent condition ($M = 4.73$, SD $= 6.47$) than in the incongruent condition ($M = 2.73$, SD $= 2.89$), $F(1,30) = 3.6$, $p = 0.067$; whereas female participants' error rates were higher for the incongruent condition ($M = 2.94$, SD $= 3.51$) than for the congruent condition ($M = 1.94$, SD $= 1.48$), although this effect did not reach statistical significance, $F(1,30) = 1.02$, $p = 0.32$.

Reactive Punishment

To examine the effect of apology on the reactive aggressive behavior, we examined the punishment behavior toward the two types of opponents. For the second, "active" phase, the dependent variable was the proportion of high intensity punishment chosen by the participant. We carried out an ANOVA with opponent (apologizing vs. non-apologizing) as a within-participant factor and gender of the participant as a between-participant factor. The main effect of opponent was significant, $F(1,34) = 5.99$, $p = 0.020$. Participants' choices of high punishments for the apologizing opponents ($M = 0.43$, SD $= 0.18$) were significantly lower than those chosen for the non-apologizing opponents ($M = 0.47$, SD $= 0.18$). The main effect of gender was not significant, $F(1,34) = 0.54$, $p = 0.47$. The interaction between the two factors was not significant either, $F(1,34) = 0.02$, $p = 0.89$. We tested the correlation between the apology effect on behavior (the difference between punishment for non-apologizing and apologizing opponent) and the congruency effect in IAT (the difference between RT in incongruent and congruent trials). The correlation was not significant, $r = 0.165$, $p = 0.34$.

Discussion

In line with the philosophical and psychological definitions of forgiveness, the behavioral data showed that participants reduced the proportion of high intensity punishments for the apologizing opponent relative to the non-apologizing opponent. Moreover, the IAT results, measured before the active phase, revealed that female participants responded significantly faster in the congruent block than in the incongruent block, suggesting that they had a more positive attitude toward the apologizing than the non-apologizing opponent. However, male participants did not show significant difference in implicit attitude toward the two opponents. This null effect will be discussed later on. In general, findings from this experiment suggest that after an interpersonal transgression, the forgiveness process is facilitated by apology. Specifically, apology reduces exterior reactive aggression behavior for both male and female, and induces changes in the implicit attitude toward the apologizing offender, at least for females. Finally, the results indicated no significant correlation between IAT and behavioral punishment.

EXPERIMENT 2: EEG EXPERIMENT

Methods

Participants

We recruited 26 graduate and undergraduate students (10 males, aged between 19 and 24; none from psychology or related disciplines) for this experiment. None of them had participated in Experiment 1.

Tasks

The experiment was similar to Experiment 1: the participant was the passive player for the first phase and then the active player in the second phase. In this Experiment, EEG data were collected during the second phase. Moreover, to avoid potential influences on brain activity, we did not administrate the IAT after the reception of the apologizing and non-apologizing messages.

Procedure

The experimental procedure was essentially the same as in Experiment 1, except that there was no IAT between the two phases.

In the first phase, we increased the number of trials from 64 to 100 and raised the proportion of high intensity punishments selected by the opponents from 75% to 80%. These changes were aimed to enhance the magnitude of the offense and the reactive aggression in the participants.

In between the first and second phases, after the participant read the two messages from opponents, he/she carried out the subjective ratings (the same as in Experiment 1). Then the second phase began with the participant being the active player. In this phase EEG data were collected (**Figure 3**).

For the second phase, the number of trials increased to 160; the participant played 80 trials with each opponent, with the winning trials kept at 50%, similar to the first experiment. The larger number of trials was required by the EEG recording and analysis.

Each trial had a decision phase, during which the (face) portrait and label (A or B) of the opponent were presented, informing the participant that he/she would have to choose the punishment intensity for this opponent. After this decision phase was the reaction time competition task. Then came the outcome (feedback) phase, during which the result of the reaction time game was displayed on the screen (**Figure 3**). We analyzed the neural activity for the decision and the outcome phases, respectively.

At the end of Experiment 2, we administrated a manipulation check: the two opponents' portraits were presented to the participant on a white sheet. The participant had to write the letter (A or B) corresponding to their labels. Then the participant recalled the opponents' messages between the passive and active phases and indicated which one had expressed apology in a forced-choice question ("Who has expressed apology to you, A or B?"). No participants expressed suspicion of the experimental manipulation.

EEG Recording

The EEG data were recorded using a 64-channel Brain Products system (online pass band: 0.061–100 Hz, sampling rate: 1000 Hz), connected to a standard EEG cap according to the international 10–20 system. The electrodes were localized at the frontal area (FP1, FP2, AF7, AF3, AF4, AF8, F7, F5, F3, F1, Fz, F2, F4, F6, and F8), central area (C5, C3, C1, Cz, C2, C4, and C6), parietal area (P7, P5, P3, P1, Pz, P2, P4, P6, and P8), temporal area (FT7, FT8, T7, T8, TP7, and TP8), occipital area (O1, Oz, and O2),

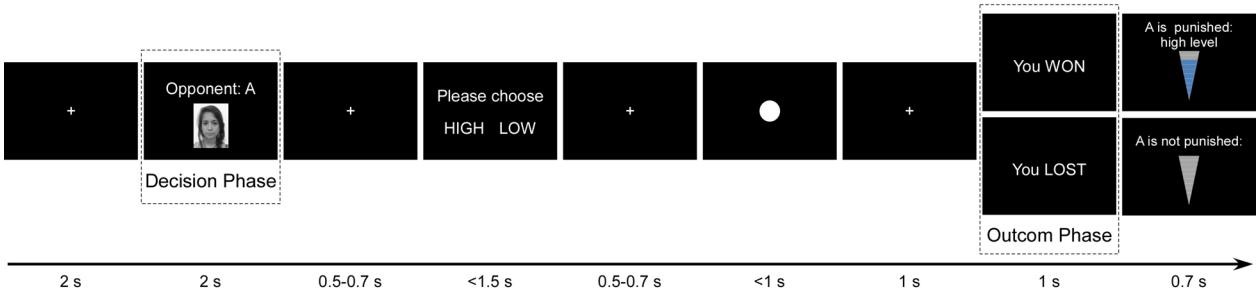

FIGURE 3 | Task display and timing of Experiment 2. Active phase, when the participant selects high level punishment. The critical events for EEG analysis are marked with dash line.

fronto-central area (FC5, FC3, FC1, FCz, FC2, FC4, and FC6), centro-parietal area (CP5, CP3, CP1, CPz, CP2, CP4, and CP6), and parieto-occipital area (PO7, PO5, PO3, POz, PO4, and PO8). The nose was used as online reference channel, and all channels impedances were kept lower than 10 kΩ. To monitor ocular movements and eye blinks, electro-oculographic (EOG) signals were simultaneously recorded from four surface electrodes, one pair placed over the higher and lower eyelid of left eye, the other pair placed lateral to the outer canthus of the each eye.

EEG Data Analysis

Standard procedure for data analysis was employed for the analysis of ERP data (Luck, 2005, Chap. 4). We used Analyzer 2.0 software to analyze the EEG recordings. EEG data were re-referenced offline to the mean of the left and right mastoids. The EEG data contaminated by eye-blinks and movements were corrected using an independent component analysis (ICA) algorithm as implemented in the software. For both the decision phase and the outcome phase, EEG epochs were extracted using a time window of 1000 ms (200 ms pre-stimulus and 800 ms post-stimulus), and baseline corrected using the pre-stimulus time interval. All trials in which EEG voltages exceeded a threshold of ±85 μV during recording were excluded. The EEG data were low-pass filtered below 30 Hz.

Decision phase

From the grand average ERPs across all the participants in the decision phase, N2 and the LPP were analyzed.

N2, a fronto-centrally distributed negativity around 200–300 ms post-onset, was defined as the mean amplitudes in the time window of 200–280 ms. N2 has been associated with aggressiveness in a previous study (Krämer et al., 2008). EEG data from three participants were excluded due to excessive artifact contaminations within this time window (leaving 23 participant for analysis). For these participants, the number of trials for at least one condition was less than 10 trials (about 30% of the total number of trials in that condition) after artifact rejection. For the simplicity of statistical analysis, we focused on the FCz electrode. We performed a three-way ANOVA with opponent (apologizing vs. non-apologizing) and the punishment intensity that the participant subsequent chosen (high vs. low) as the within-participant factors, and participants' gender as the between-participant factor. Effects over the whole scalp are illustrated with the topographic map (**Figure 4**).

Late positive potential, a component strongly modulated by the emotional intensity of a stimulus (Schupp et al., 2000; Sabatinelli et al., 2007), was defined as the mean amplitudes in the time window of 400–800 ms. EEG data from the same three participants were excluded due to excessive artifact contaminations within this time window. From the grand average ERPs across all the participants in the decision phase, we chose five electrodes along the midline (Fz, FCz, Cz, CPz, and Pz) to represent the LPP component. For statistical analysis of the magnitude of LPP, we carried out a four-way ANOVA with opponent (apologizing or non-apologizing), punishment intensity (high and low), and electrode position (five levels: Fz, FCz, Cz, CPz, and Pz) as the within-participant factors and the participant's gender as the between-participant factor. Again, effects over the whole scalp are illustrated with the topographic map (**Figure 5**). The rationale for the selection of the electrodes for N2 and LPP was that the grand average ERPs showed the strongest effects on the corresponding electrodes for these components and that the electrodes are typically reported for these components in the literature (see, for example, Smillie et al., 2011; Moser et al., 2006, for similar methods of electrodes selection). PASW 20 software was used in the statistical analyses. The Greenhouse–Geisser correction for violation of the ANOVA assumption of sphericity was applied where appropriate. Bonferroni correction was used for multiple comparisons.

Outcome phase

We analyzed ERPs during the outcome phase to see if apology had an effect on the affective/motivational evaluation of win or loss trials. For the grand average ERPs over all the participants in the outcome phase, the FRN and P300 were analyzed. EEG data from four participants were excluded due to excessive artifact contaminations within the time windows, leaving 22 participants for data analysis.

Feedback-related negativity is a negative deflection at fronto-central recording sites; we defined it as the mean amplitudes in the time window of 250–300 ms. The number of trials for at least one condition was less than 20 trials (about 50% of the total number of trials in that condition) after artifact rejection. For the simplicity of statistical analysis, we focused on the Fz electrode.

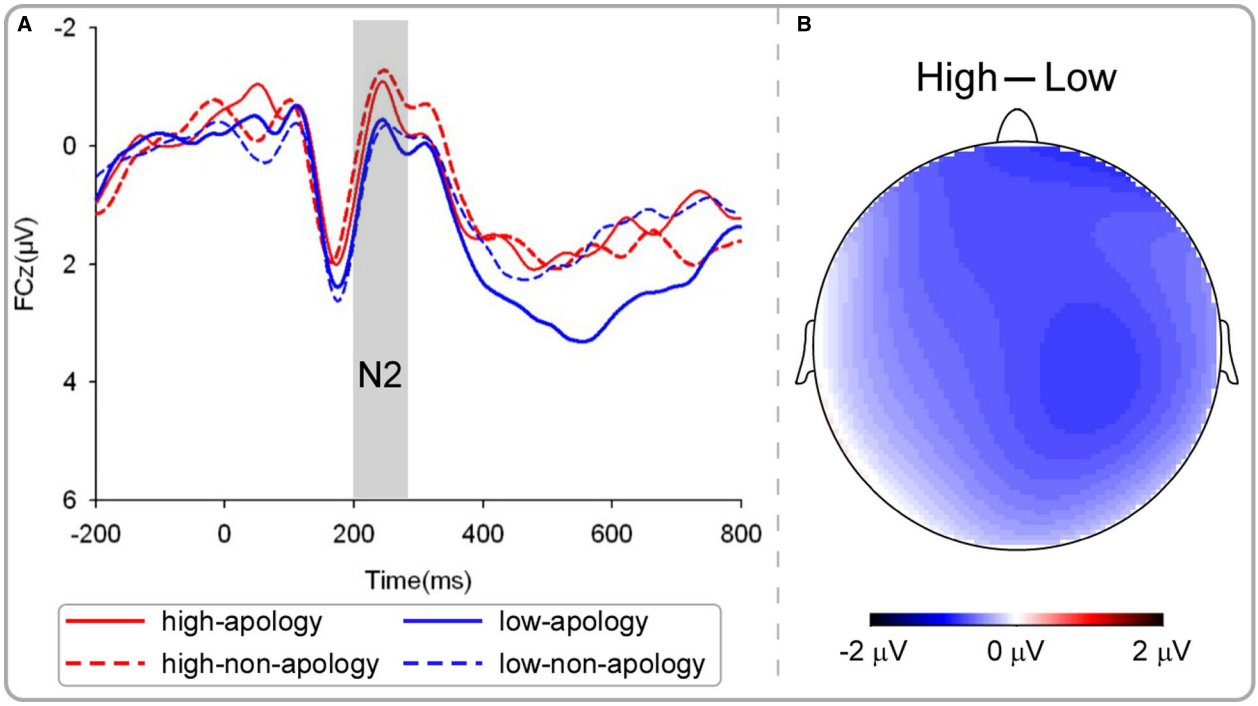

FIGURE 4 | EEG results of the decision phase: N2. (A) Grand average ERP. **(B)** Topography of high—low punishment condition.

We performed a three-way ANOVA with opponent (apologizing vs. non-apologizing) and outcome (win vs. loss) as the within-participant factors, and participants' gender as the between-participant factor. Effects over the whole scalp are illustrated with the topographic map (**Figure 6**).

P300 is the most positive peak between 200 and 600 ms post-onset of feedback; here it was defined as the mean amplitudes in the time window of 350–500 ms. For statistical analysis, we focused on the Pz electrode. We performed a three-way ANOVA with opponent (apologizing vs. non-apologizing) and outcome valence (win vs. loss) as the within-participant factors, and participants' gender as the between-participant factor. Again, effects over the whole scalp are illustrated with the topographic map (**Figure 6**).

Results

Manipulation Checks and Subjective Ratings

In the post-experiment manipulation check, all of our participants correctly assigned the labels to the corresponding opponents and accurately recalled who had apologized. We can thus confirm that our manipulation was successful. For the subjective ratings, we carried out a two-way ANOVA for each item with apology as the within-participant factor and gender as the between-participant factor (**Table 3**). There were no significant gender differences. There was only a significant main effect of the opponent for the willingness to punish, $F(1,24) = 6.25$, $p = 0.02$. Specifically, the willingness to punish was lower for the apologizing opponent ($M = 4.12$, SD $= 0.77$) than the non-apologizing opponent ($M = 4.65$, SD $= 0.85$).

Reactive Punishment

The dependent variable for the active phase was the proportion of high punishment chosen by the participant. We carried out a repeated-measure ANOVA with the opponent (apologizing vs. non-apologizing) as the within-participant factor and the gender of the participants as the between-participant factor. The main effect of opponent was significant, $F(1,24) = 8.052$, $p = 0.009$. The proportion of high punishments chosen for the apologizing opponent ($M = 0.48$, SD $= 0.14$) was significantly lower than for the non-apologizing opponent ($M = 0.56$, SD $= 0.16$). The main effect of gender was not significant, $F(1,24) = 0.34$, $p = 0.56$, nor was the interaction between gender and apology, $F(1,24) = 3.107$, $p = 0.091$.

EEG Results

To further examine the impact of apology on the neural and psychological processes associated with forgiveness, we analyzed the neural response of participants when they were indicating for which opponent they would chose the punishment intensity (the decision phase) and when they were presented with the outcome of the reaction-time frame (outcome phase).

Decision phase

N2. In a previous study using TAP (Krämer et al., 2008), larger N2 amplitudes have been observed in high trait aggressive participants in response to high provocation, relative to low provocation. Given that N2 is interpreted as reflecting the conflict between aggressive impulse and cognitive control, we hypothesized that the amplitude would be larger (more negative)

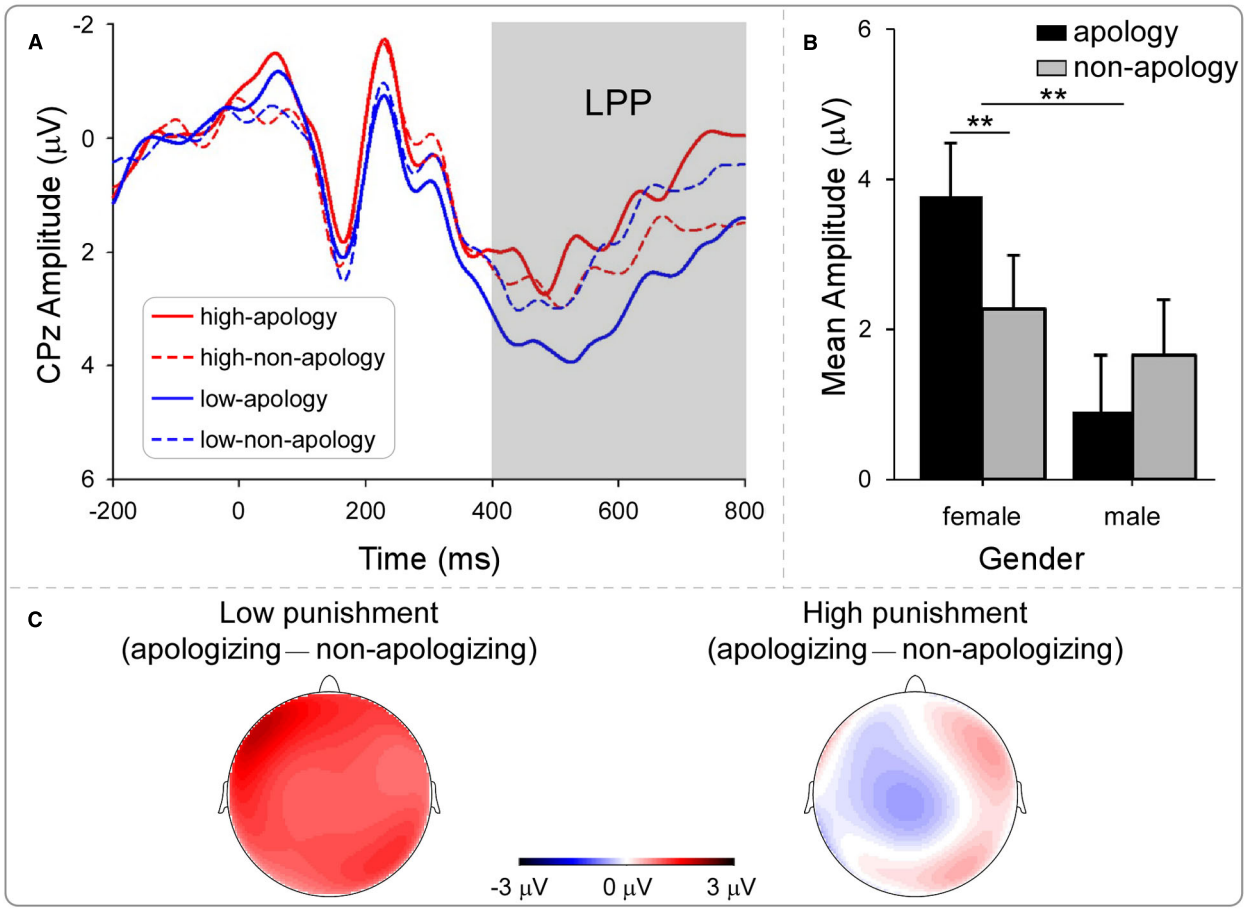

FIGURE 5 | EEG results of the decision phase: LPP. (A) The grand average ERP in the decision phase condition of LPP. **(B)** LPP mean amplitude as a function of opponent and participants' gender. **(C)** Topography of "apologizing—non-apologizing" in high and low punishment. Significance indicators: $^{**}p < 0.001$.

when selecting punishment intensity for the non-apologizing opponent relative to the apologizing opponent. We carried out a three-way ANOVA with opponent (apologizing vs. non-apologizing) and punishment intensity that the participant subsequently chose (high vs. low) as within-participants factors, and gender as a between-participant factor. Inconsistent with our hypothesis, the only significant effect revealed by this analysis was a significant main effect of punishment intensity, $F(1,21) = 8.96$, $p = 0.007$ (**Figure 4**). The mean amplitude of high punishment ($M = -0.57$ μV, SD = 2.52) was significantly more negative than that of low punishment ($M = 0.18$ μV, SD = 2.65).

LPP. Previous studies have shown that increased positive amplitudes reflect enhanced motivated attention to emotional stimuli (Hajcak and Olvet, 2008; Van Hooff et al., 2011). Therefore, if LPP amplitude was stronger for the non-apologizing opponent, this would suggest that the stronger emotional salience of this opponent motivated the participant to inflict higher punishments. If LPP amplitude was larger for the apologizing opponent, it would suggest that the motivation elicited by apology leads the participant to behave more prosocially toward the apologizing opponent rather than behave more aggressively toward the opponent who did not apologize. The grand average LPPs at the CPz electrode are shown in **Figure 5A**. We carried out a four-way repeated-measures ANOVA on the LPP mean amplitudes, with apology (apologizing vs. non-apologizing), punishment intensity (high vs. low), and electrode position (Fz, FCz, Cz, CPz, and Pz) as within-participant factors, and the participant's gender as a between-participant factor. The main effect of electrode position was not significant, $F(4,19) = 1.571$, $p = 0.216$, neither was any interaction involving the electrode. Therefore, we collapsed the five electrodes position and carried out a three-way ANOVA with the three factors left. The three-way interaction was not significant, $F(1,21) = 0.518$, $p = 0.480$, but we found two significant two-way interactions. First, the interaction between punishment intensity and opponent was significant, $F(1,21) = 4.232$, $p = 0.052$ (**Figures 5A,C**). Pair-wise comparison showed that when participants chose low punishment, the amplitude for the apologizing opponent ($M = 3.07$ μV, SD = 3.35) was larger than for the non-apologizing opponent ($M = 1.87$ μV, SD = 2.23), $F(1,22) = 4.27$, $p = 0.051$, consistent with our second hypothesis; whereas for high punishment, there was no difference in the amplitude for the two opponents (**Figures 5A,C**), $F(1,22) = 0.58$, $p = 0.45$.

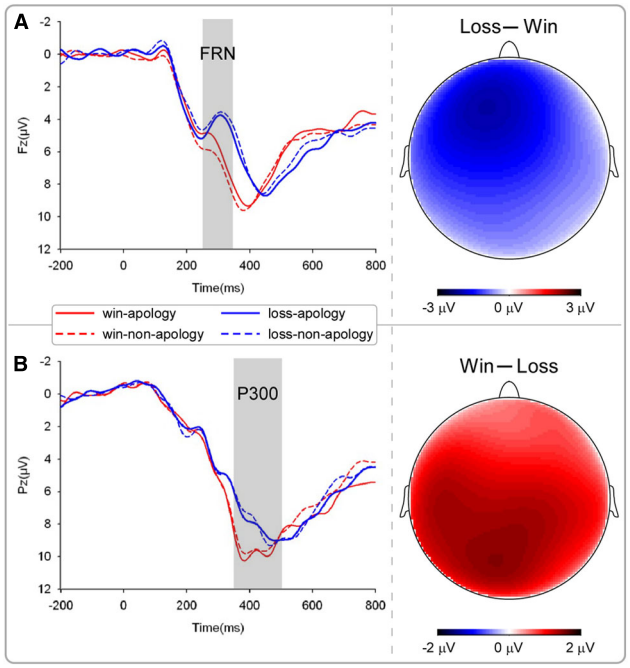

FIGURE 6 | EEG results in the outcome phase. The grand average ERPs of **(A)** FRN and **(B)** P300.

Second, there was a significant interaction between gender and opponent, $F(1,21) = 14.98$, $p = 0.001$ (**Figure 5B**). Pair-wise comparisons showed that the LPP amplitude for the apologizing opponent ($M = 3.77$ μV, SD = 2.91) was significantly larger than for the non-apologizing opponent ($M = 2.27$ μV, SD = 2.81) among female participants, $F(1,21) = 13.9$, $p = 0.001$, whereas for male participants the amplitude did not significantly differ between the apologizing opponent ($M = 0.9$ μV, SD = 2.75) and the non-apologizing opponent ($M = 1.65$ μV, SD = 2.21), $F(1,21) = 3.18$, $p = 0.089$. Additionally, LPP amplitude for the apologizing opponent was significantly larger among female participants ($M = 3.77$ μV, SD = 2.91) than male participants ($M = 0.9$ μV, SD = 2.75), $F(1,21) = 7.7$, $p = 0.011$, whereas female and male participants' amplitudes did not significantly differ for the non-apologizing opponent, $F(1,21) = 0.36$, $p = 0.55$.

We tested the correlation between the apology effect on behavior (the difference between the proportion of high punishment for non-apologizing and apologizing opponent) and the difference between the magnitude of LPP when choosing high intensity punishment for the apologizing opponent and the non-apologizing opponent. The correlation was not significant, $r = 0.041$, $p = 0.85$, consistent with the finding in Experiment 1.

Outcome phase

FRN. FRN (**Figure 6A**) is more pronounced for negative feedback associated with an unfavorable outcome, such as incorrect response or monetary loss (Gehring and Willoughby, 2002). Therefore, if apology influences FRN responses, we would predict a stronger negativity for loss trials against the non-apologizing opponent than the apologizing one. The three-way ANOVA of gender by opponent by outcome valence revealed that the main effect of opponent was not significant, $F(1,21) = 0.367$, $p = 0.55$. However, the main effect of outcome valence was significant, $F(1,21) = 22.91$, $p < 0.001$, with the mean amplitude for the "loss" trials ($M = 4.23$ μV, SD = 3.35) less positive than for the "win" trials ($M = 6.24$ μV, SD = 3.82). The interaction between gender and outcome valence was significant, $F(1,20) = 5.65$, $p = 0.028$. Females had a larger amplitude for winning trials ($M = 7.31$ μV, SD = 3.9) than for losing trials ($M = 4.29$ μV, SD = 3.65), $F(1,20) = 31.37$, $p < 0.001$, whereas the difference between winning ($M = 5.16$ μV, SD = 1.2) and losing trials ($M = 4.15$ μV, SD = 1.1) did not reach significance for males, $F(1,20) = 2.45$, $p = 0.133$.

P300. P300 (**Figure 6B**) has been shown to be sensitive to valence of rewards (Hajcak et al., 2005). Therefore, we expected that the amplitude would be larger in win trials where the non-apologizing opponent would be punished. The main effect of outcome was significant, $F(1,20) = 4.53$, $p = 0.046$. The mean amplitude for "win" trials ($M = 12.95$ μV, SD = 6.05) was significantly larger than that of "loss" trials ($M = 11.97$ μV, SD = 7.02). The main effect of opponent was not significant, $F(1,20) = 0.01$, $p = 0.94$. The main effect of gender was not significant either, $F(1,20) = 3.84$, $p = 0.064$, nor was the interaction between apology and gender, $F(1,20) = 2.216$, $p = 0.15$.

Discussion

The behavioral results of Experiment 2 replicated Experiment 1. Both male and female participants selected significantly lower intensity punishments for the apologizing opponent relative to the non-apologizing opponent.

For the decision phase, when participants were presented with the identity of the opponent for whom they would have to select the punishment, ERP showed that the N2 was not altered by apology. However, the amplitude of N2 was altered by punishment intensity. Specifically, its amplitude was larger when participants chose to inflict high punishment to the opponents than when they chose low punishment. This replicates the results from a previous study using a modified version of the TAP, showing that among the higher trait-aggressive participants, selecting high punishments elicited larger N2 than selecting low punishments (Krämer et al., 2008). Therefore, in line with Krämer et al. (2008), N2 in our experiment might be an indicator of aggressiveness.

As for the LPP amplitude during the decision phase, we found two significant interactions. First, choosing low intensity punishment for the apologizing opponent elicited larger LPP than choosing low punishment for the non-apologizing opponent; but no difference was found between the two types of opponents when high intensity punishments were chosen. Second, we found that gender moderated the LPP amplitude between the apologizing and the non-apologizing opponent. Namely, the apologizing opponent elicited a significantly larger LPP among female than male participants, whereas there was no difference between male and female LPP amplitude for the non-apologizing opponent. Third, we found no significant correlation between LPP responses and behavioral punishment. We defer our discussion of these results to the General Discussion.

TABLE 3 | Subjective ratings for apologizing/non-apologizing opponents in Experiment 2.

	Apologizing opponent (Mean ± SD)	Non-apologizing opponent (Mean ± SD)	*t*-value ($n = 26$)	*p*-value
Unhappy	2.62 ± 1.39	2.73 ± 1.54	−0.36	0.722
Anger	2.12 ± 1.40	2.35 ± 1.29	−0.84	0.407
Forgiveness	5.85 ± 1.35	5.46 ± 1.63	1.10	0.284
Willingness to punish	4.12 ± 0.77	4.65 ± 0.85	−2.67	0.013*
Willingness to be friend	5.19 ± 1.30	4.88 ± 1.56	0.96	0.349
Impression	4.85 ± 1.26	4.65 ± 1.38	0.71	0.486

*After receiving the opponents' messages but before the active phase, the participant rated on a 7-point scale about the degree to which he/she felt on the above dimensions. For the "impression" item, 1 means "very bad," and 7 means "very good." For the other items, 1 means "not at all," and 7 means "extremely strong." *$p < 0.05$.*

During the outcome phase, when the result of the reaction time competition was displayed on the screen, FRN and P300 components were only sensitive to outcome valence (Wu et al., 2012) but were not affected by apology or the participant's punishment choice. Given that no firm conclusion can be drawn from the null effects, these findings will not be discussed further.

GENERAL DISCUSSION

The present study investigated how apology facilitates forgiveness in an interpersonal transgression context. We used an interactive paradigm in which the participant could actively punish two opponents after being passively punished by them. Before he/she had the opportunity to retaliate, the participant received a message from each of the opponents—one apologized for his/her previous behavior and the other one not. Therefore we were able to observe not only the behavioral changes (i.e., the proportion of high punishments selected during retaliation) but also the changes at the cognitive (implicit attitude) and affective/motivational level (ERP) elicited by apology. We discuss the significance of our findings at each of the three levels of analysis and offer a coherent interpretation of such findings, which may help broaden our understandings of the mechanisms of apology and forgiveness.

Apology Changes Female Victims' Implicit Attitude Toward the Offender

In Experiment 1, an IAT administrated after receiving the apology and the non-apology messages revealed that the female participants had a more positive implicit attitude toward the apologizing opponent than to the non-apologizing one, although such an effect was not observed for the male participants (**Figure 2**). The pattern of error rates was consistent with the pattern of the reaction times: for the female participants, responses in the congruent block were both faster and no less accurate than in the incongruent block; for the male participants, responses in the congruent block were both less accurate and no faster than in the incongruent block, indicating that the females had a stronger association between positive concepts and the apologizing opponent.

In accordance with previous studies using only explicit measure of attitude and reactive aggressive behavior, our IAT results confirmed, although only in female, the role of apology in improving victim's impression of their offender (Ohbuchi et al., 1989; Tabak et al., 2012). Tabak et al. (2012) investigated how apology and conciliatory gestures influence forgiveness. They found that the victims' perception of their transgressors' agreeableness mediated the effects of apology and compensation on forgiveness. Importantly, in our paradigm, the participants believed that none of the opponents were aware of the fact that the roles in the game would be switched for the second phase; therefore the apology could not be taken as a strategic move to avoid revenge from the participants. Instead, after being harmed, the expression of remorse and repentance positively changed female participants' perception of the opponent, as the apologizing opponent might have appeared to be a more trustful and considerate person, relative to the non-apologizing opponent.

Nevertheless, the fact that only female, but not male, participants showed a change of implicit attitude after receiving apology seems to be a challenge to our hypothesis. One possibility could be that in the current experimental setting, the manipulation of apology was not sincere and formal enough: the apologizing opponent did not show up and say sorry directly to the participant. According to Lazare (2004), insincere apology may convey to the victim the transgressor's indifference to the victim's loss and suffering, and may amplify the victim's resentment and aggression toward the transgressor. But the extent to which one finds an apology sincere varies across individuals. It has been demonstrated that compared to men, women judge more often that an apology was deserved (Schumann and Ross, 2010). And thus it is conceivable that the majority of the female participants accepted the apology as sincere, while most of the male participants did not. Another possibility is that the female participants in the current study were more affectively offended by their opponents (cf. Schumann and Ross, 2010), and this might leave more room in women than men for apology to take effects. In other words, women do not only have lower threshold for offense but also have lower threshold for changing their attitude by others' affective expressions (e.g., apology); men might demand more concrete "actions" rather than just apologizing "words" before they change their implicit attitude toward the offender.

Neural Substrates of the Effect of Apology on Reactive Aggression

Our electrophysiological results further demonstrate the psychological changes elicited by apology in the victim of

interpersonal transgression. Akin to the findings concerning the implicit attitude, the effect of apology on brain responses to the offender was moderated by the gender of the participants: female participants showed higher LPP magnitude, during the decision phase, toward the apologizing opponent than the non-apologizing one, whereas there was no difference in LPP magnitude between the two opponents in male participants. A widely accepted account of the psychological significance of LPP posits that this component reflects the affective and motivational salience of the perceived event/object (Cacioppo et al., 1996; Schupp et al., 2000; Liu et al., 2012), i.e., the importance of the event/object to the survival and welfare of the organism. Along this argument, we could interpret our finding concerning the gender difference in LPP as reflecting that female participants perceive the apologizing opponent as more important than the non-apologizing opponent, and the male participants may just care less about the verbal apology than the female participants. Although this interpretation is based on a relatively small sample size ($n = 11$ and $n = 12$ after splitting into groups) and should be regarded as provisional, it is in line with our IAT results: the verbal apology did not effectively change the male participants' implicit attitude toward the apologizing opponent.

The LPP magnitude also reflected the differential decision-making processes associated with the apology and the non-apologizing opponents. In this respect, we observed a significant interaction in the magnitude of LPP between apology and the participants' subsequent punishment choice (**Figure 5**): in the trials in which the participants chose low punishment, LPP was larger for the apologizing than the non-apologizing opponent. As we pointed out earlier, the LPP reflects the affective and motivational salience of an event/object; the LPP amplitude can be modified by emotion regulation strategies such as reappraisal (Hajcak and Nieuwenhuis, 2006). Thus we suggest that the larger LPP elicited for low punishments to the apologizing opponent (relative to the non-apologizing) is likely to reflect motivational and arousal relevance induced by apology. Forgiveness is often defined as a prosocial motivational change toward the harm-doer (McCullough et al., 2000). The presentation of the apologizing opponent's portrait at the decision phase might have activated a relatively positive representation encoded in participants' memory (indicated by larger LPP) and in turn motivated a prosocial response instead of revenge. Consequently, although their mind is set to retaliate after a transgression, viewing the apologizing opponent portrait may have triggered the willingness to forgive and choose lower intensity punishments. The presentation of the portrait of the non-apologizing opponent comparatively did not arouse motivation to reduce punishment intensity in this same context.

Finally, forgiveness requires overcoming the negative feelings prompted by the transgression from an offender (Lazare, 2004). This implies that a dynamic emotion regulation process may underlie apology-induced forgiveness: the victim's initial response is to retaliate the offender, only at some point of time such initially vengeful motivation is down-regulated by the previously encountered apology. Accordingly, our findings reveal that a relatively early component, N2 (200–280 ms; **Figure 4**), was not affected by apology during the decision phase. This is consistent with another study using a similar TAP revealed that N2 during the decision phase was related to provocation and indicated aggressiveness (Krämer et al., 2008). Thus, it is possible that apology-induced forgiveness influences later stage processing but not early provocation-related effects. These results lend support to the philosophical notion that reactive aggression, which is a natural tendency, is of greater automaticity and that forgiveness, which is an acquired virtue, is more related to intentionality and continence (Aristotle, 2014).

Apology Reduces Reactive Aggression Toward the Offender

The behavioral data in both Experiments 1 and 2 revealed that apology reduced the victims' reactive aggressive behavior, as reflected by the lower punishments chosen for the apologizing opponent than for the non-apologizing one. These findings are consistent with previous studies (Ohbuchi et al., 1989; Strang et al., 2014), and confirm in the laboratory setting the role of transgressor's apology as a generally effective way to reduce interpersonal revenge and aggression (Lazare, 2004).

However, our experiment distinguishes itself from past research in two main aspects. First, in our experiment, what the participants decided to forgive was an intentional transgressor who had deliberately inflicted harm to them earlier but expressed remorse and apology later on. This feature makes the process of forgiveness in our study closer to the concept of forgiveness in its strictest philosophical sense (cf. Enright and Coyle, 1998). In this regard, our study could make a novel contribution to our understanding of forgiveness beyond the past few previous studies where the object of forgiveness is either unintentional (Young and Saxe, 2009; Yu et al., 2015) or ambiguous offense (Strang et al., 2014). Forgiving an unintentional offense has consistently been associated with the theory-of-mind brain structure (e.g., the temporoparietal junction, TPJ) partly because in that situation counterfactual processing of intention is crucial for forgiveness. In contrast, in our paradigm, apology-based forgiveness relies less on counterfactual processing and more on overcoming anger and adjusting the reactive attitude toward the offender. Second, our major measurements of the impact of apology (i.e., vengeful behavior, ERP, and implicit attitude) did not involve explicit, forced-choice question such as "Do you forgive this opponent?" (e.g., Strang et al., 2014). Instead, we indirectly measured forgiveness by analyzing the proportion of high punishments issued by the participants. This design allowed us to get hold of the psychological processes and neural reactions associated with reception of apology that are closer to real-life situations (Pfeiffer et al., 2013).

How to Reconcile Our Implicit/Neural Findings With the External Behavior?

It is still an open question as to how the implicit processes (such as those measured by the current IAT and ERP) are related

to the explicit behavior. In fact, the exterior behavior, *prima facie*, did not exhibit gender difference: both female and male participants punished the apologizing opponent less than the non-apologizing opponent. For females, this behavioral pattern is consistent with the improvement of implicit attitude (from IAT) and the stronger affective reaction (revealed in ERP) toward the apologizing opponent. The results for male participants, however, did not reveal such a consistent pattern: although they reduced their punishment toward the apologizing opponent, their implicit attitude did not seem to change right after receiving an apology; the latter null effect was also observed on LPP for the apologizing and non-apologizing opponent. Then how could the exterior punishment behavior be reconciled with the implicit measures of attitude and brain activity?

These data from different techniques/modalities might occur at different stages of the psychological processes of forgiveness and probably carry different types of information about such processes. For instance, implicit measures of associations have shown different outcome as compared with explicit measures in past studies and are considered to be more reliable measures of innate, automatic representations and processes (e.g., Phelps et al., 2000). In their seminal work, Phelps et al. (2000) found that racial bias measured by IAT was positively correlated with the strength of amygdala activation to Black-versus-White faces, but not with the direct report of race attitude. This suggests that explicit reports are subjected to controlled inhibition due to external display rules. In a similar vein, in our study male participants behaviorally forgive the apologizing opponent, perhaps due to the demand of social norm or the will for relationship harmony; but they were not actually implicitly/affectively influenced by the apology. Future studies are needed to directly test this hypothesis by, for instance, manipulating the importance/utility of the relationship between the participant and the opponent to the participant (e.g., Nelissen, 2014).

The ERP results seem to support our interpretation. While female participants exhibited larger LPP toward the apologizing opponent, relative to the non-apologizing one, reflecting the salience of apology, male participants did not show such a difference in LPP, indicating that apology did not provoke particular arousal compared to the non-apology. However, similar to female participants, male participants did show a larger LPP when deciding to inflict lower (relative to higher) punishment on the apologizing opponent, while this was not the case for the non-apologizing one. This suggests that although male participants did not care about the informal, verbal apology so much as to allocate more attention to the apologizing than the non-apologizing opponent, they were still pushed in some way to behave more prosocially with the opponent who apologized. In fact, as reported by Bennet and Dewberry (1994), there exist a pronounced pressure to accept apologies even when they are experienced as unsatisfactory (Bennet and Dewberry, 1994).

It is worth noting that the subjective ratings did not show any significant change by apology either in female or male participants (except for the willingness to punish in Experiment 2), in contrast to our behavioral measures (IAT and punishment) and ERP data. This is in line with our argument that forcing participants to express their attitude does not always fit with their actual, implicit attitude or behavior. Thus, our data constitute additional evidence that implicit measures are able to capture psychological reactions that are less/not influenced by social norms, social desirability, or reputation, providing information that are not visible in explicit measures. Clearly, due to the exploratory character of our study, this interpretation stands in a speculative framework. Nevertheless, we believe that our findings open new grounds to a more in-depth understanding of the impact of receiving an apology and forgiveness.

CONCLUSION

Taken together, these results provide a novel insight into the psychological processes underlying forgiveness and reception of apology that are not evident in the explicit measures from past studies. Our findings support the notion that expression of remorse from an offender leads the victim to reduce vengeful behavior, either by changing the victim's implicit attitude toward the offender (particularly for female victims) or by possibly forcing the victim to abide by social norms. We demonstrated that following interpersonal harm, a simple apologizing note from the harm-doer is powerful enough to elicit cognitive, affective, and behavioral changes that underlie the motivation to forgive. Thus, by giving up aggressive and hostile attitude toward a repentant offender, human nature might call for a more harmonious approach of social conflict resolution and, contrary to retaliation mechanisms, apology and forgiveness allow for restoration and maintenance of the relationship.

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Becoming popular: interpersonal emotion regulation predicts relationship formation in real life social networks

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Building relationships is crucial for satisfaction and success, especially when entering new social contexts. In the present paper, we investigate whether attempting to improve others' feelings helps people to make connections in new networks. In Study 1, a social network study following new networks of people for a 12-week period indicated that use of interpersonal emotion regulation (IER) strategies predicted growth in popularity, as indicated by other network members' reports of spending time with the person, in work and non-work interactions. In Study 2, linguistic analysis of the tweets from over 8000 Twitter users from formation of their accounts revealed that use of IER predicted greater popularity in terms of the number of followers gained. However, not all types of IER had positive effects. Behavioral IER strategies (which use behavior to reassure or comfort in order to regulate affect) were associated with greater popularity, while cognitive strategies (which change a person's thoughts about his or her situation or feelings in order to regulate affect) were negatively associated with popularity. Our findings have implications for our understanding of how new relationships are formed, highlighting the important the role played by intentional emotion regulatory processes.

Keywords: interpersonal emotion regulation, emotion regulation, social networks, centrality, popularity, agreeableness, Twitter

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Introduction

When we enter a new social situation, be it starting a new job, beginning a new course of study, moving to a new neighborhood, or even joining an online social network, forming connections with others is paramount to our satisfaction and success. But how can we develop these connections? An emerging body of research provides evidence that attempting to improve other people's feelings may boost the quality of existing relationships (Niven et al., 2012a). The aim of the present paper is to investigate whether engaging in this process of interpersonal emotion regulation (IER) can help people to build *new* relationships during socialization in face-to-face and online networks.

The need to form high-quality relationships with others around us is considered to be a fundamental human motivation (Baumeister and Leary, 1995). Relationships with others can furnish people with many benefits, including practical and emotional support (Argyle, 1992).

Perhaps unsurprisingly then, research in the social network tradition documents various advantages to being popular.

Popularity is typically defined as being well-liked and accepted by one's peer group (Scott and Judge, 2009), and is, therefore, commonly operationalized as having a high number of connections to others in one's social environment (Freeman, 1979). For example, many social network studies examine popularity by measuring *in-degree centrality*, which reflects the extent to which other people report having a connection with a focal person (Czarna et al., 2014). In work organizations, high popularity, as captured by a person's in-degree centrality, is linked to better in-role and extra-role performance, higher well-being, and indicators of career success such as reputation and supervisors' ratings of developmental potential (Sparrowe et al., 2001; Totterdell et al., 2004; Lin and Huang, 2005; Mehra et al., 2006). During socialization in new networks in particular, building informal connections with others can be crucial. In a study of newcomers to an accounting firm, for example, Morrison (2002) reported that the number of connections newcomers had formed during their first 9 months in post-predicted their social integration, learning, and commitment to the organization.

Connecting with others is not just important in face-to-face contexts, but also online. Over the past 10 or so years, use of social networking sites that allow people to establish and maintain connections with others online, such as Facebook and Twitter, has been growing at an incredible rate. In March 2012, such websites attracted audiences of almost 171 million unique visitors via computers and 67 million via mobile phones within France, Germany, Italy, Spain, and the UK (ComScore, 2012). Crucially, making connections on such sites is found to provide similar benefits as making connections in other offline contexts. For example, Ellison et al. (2007) and Steinfield et al. (2008, 2009) have reported that connections through Facebook and internal organizational social networking sites are associated with greater well-being, social integration, and self-esteem.

Given the importance of forming new relationships for satisfaction and success, researchers have begun to explore factors associated with popularity. Typically, popularity has been examined as a function of observable attributes like gender at the neglect of psychological factors (Totterdell et al., 2008). Where psychological factors have been studied, the focus has usually been on stable traits (e.g., extraversion and agreeableness; Klein et al., 2004; Selfhout et al., 2010; Quercia et al., 2012), or similarity in demographic or personality characteristics (McPherson et al., 2001). Thus, to date, research has concentrated on predictors of popularity that people are largely unable to control.

In this paper, we introduce IER as a process that is under volitional control, which we argue might prove a fruitful avenue for investigation with respect to providing guidance about how to boost one's popularity when entering new social contexts. We follow the definition offered by Niven et al. (2009) of IER as the process whereby people intentionally try to influence the way others feel. While others (Zaki and Williams, 2013) have used the term IER more widely, to refer to any form emotion regulation that involves more than one person, our use of the term specifically concerns attempts to regulate others' feelings, rather than attempts to regulate one's own emotions (in line with what Zaki and Williams term 'extrinsic' IER). Taking an example, if you just started work at a company and encountered a new coworker who appeared to be upset, you might offer to make a coffee for the person or make a light joke to try to cheer him or her up. If the same person appeared to be anxious, you might ask if he or she was okay and whether you could do anything to help. IER is used in a range of social contexts, including peer groups, support groups, sports teams, and work organizations (Thoits, 1996; Lively, 2000; Niven et al., 2012b; Friesen et al., 2013). Here, we maintain that IER might play an important role in building new relationships in such contexts.

The reason why IER is expected to play a role in forming new relationships is due to its link with positive affect. IER is most commonly used with the intention of improving others' feelings, and evidence suggests that attempts to improve others' feelings do often boost the intended target's affect (Niven et al., 2007, 2012c), although the effects of offering support more generally may vary according to factors such as responsiveness to targets' needs (Maisel and Gable, 2009). The often positive effects of attempts to improve others' feelings likely transpire due to the social information communicated during IER (Van Kleef, 2009), as attempts to improve others' feelings may convey positive information to the target (e.g., this person likes me and wants me to feel better). Not only do targets of IER experience changes to their affect, so too do those who observe IER (Totterdell et al., 2012). For example, studies of elevation describe the warm or glowing feeling that people experience when they witness acts of kindness or compassion toward others (Haidt, 2002). The effects of IER on observers' affect are also likely to be due to positive inferences, this time on the part of the observer (e.g., about the agent's motives and character, or about humanity more generally). Crucially, both targets and observers of IER attempts to improve others' feelings are likely to attribute any pleasant emotion that results from this kind of interaction to the person who initiated the IER attempt.

The positive affect that may be arise from IER attempts could help to build new relationships in two ways. First, according to Lawler's (2001) affect exchange theory, when pleasant feelings are experienced during an interaction, they trigger cognitive efforts to understand the causes (i.e., an attribution process; Weiner, 1986). Because people strive to reproduce pleasant feelings which are internally rewarding, if an exchange between *person a* and *person b* generates pleasant emotion which *person a* attributes to *person b*, *person a* will want to interact with *person b* again in the future, eventually generating a strong and durable network tie. Second, people may be drawn to others who leave them feeling positive because this enables them to conserve the cognitive resources that are typically associated with engaging in self-regulation of emotion. It is well-established that regulating one's own emotions can be effortful and costly (Niven et al., 2013). Consistent with social baseline theory (Beckes and Coan, 2011) and Fitzsimons and Finkel's (2010) notion of a shared regulatory system for emotions, building relationships with people whose IER is effective and results in pleasant feelings for the target may help to reduce those costs and may thus make an attractive proposition. As such, engaging in IER may help people to build relationships in newly formed social networks. However, to date,

just two studies have reported a link between the use of IER and high-quality relationships, and the focus of those studies was on improving the quality of existing social ties (Niven et al., 2012a, Study 1 and Study 2) rather than on building new relationships.

Alongside the paucity of research regarding the potential role of IER in forming new connections stands the question of which types of IER are most important for building relationships. Building on work in the field of emotion self-regulation, which has distinguished between regulation that involves cognitive vs. behavioral means (Parkinson and Totterdell, 1999), as well research into the strategies that people use to regulate others' feelings, the dominant model of IER proposes that strategies to improve others' emotions can primarily be differentiated according to whether they are cognitive or behavioral (Niven et al., 2009, 2011). In IER terms, cognitive strategies involve trying to change a person's emotions primarily by influencing the person's thoughts about his or her feelings or situation (e.g., giving someone advice), while behavioral strategies involve trying to change a person's emotions primarily by using one's behavior to communicate a message about one's relationship with the target (e.g., doing something nice for someone). Most studies to date on the effects of IER have yet to distinguish these strategy types. Here, we contend that these strategies may have different implications for the formation of new relationships, because of likely differences in how they are appraised by targets.

Cognitive strategies attempt to improve the target's emotion by offering a different perspective, showing the situation in a different (usually positive) light. When it comes to regulating one's own feelings, cognitive strategies, such as reappraisal, are usually considered highly effective (Gross and John, 2003; Webb et al., 2012). For regulating others' emotions, however, such strategies could be seen by the target and by observers as a challenge to the target's existing views. A key difference is that the change to the target's view of the situation occurs by choice in the case of emotion self-regulation, but is enforced—and may not always be welcomed—in the case of IER. Thus, in the short-term at least, cognitive IER has the potential to be interpreted in negative terms, especially in a relationship that is not well established. Accordingly, cognitive IER may not always lead to a positive appraisal of the regulator's motives and so may not make the target want to interact with the regulator in future.

Behavioral strategies, by way of contrast, attempt to change the target's emotion by conveying a positive message about the agent's relationship with the target that functions to express a sense of understanding and sharing of the target's way of viewing the situation. Receipt of support, comfort, and validation are the motives most commonly-cited by people when they share negative emotions with others (Rimé, 2009). Thus, the use of such strategies in a new relationship would be likely to fulfill (and to be seen by observers to fulfill) the target's needs, leading to a likely positive appraisal of the regulator's intentions, and thus a positive relational outcome.

The evidence outlined above suggests that behavioral IER strategies would facilitate the development of new connections with others, whereas cognitive strategies may not always have the same benefits. In line with this proposition, a recent study in which pairs of friends or intimates were instructed to adopt specific listening strategies when discussing an emotional video sequence indicated that socio-affective strategies (which the authors likened to Niven et al.'s, 2009 behavioral strategies), but not reframing strategies (likened to cognitive strategies), led to feelings of emotional proximity and reduced loneliness (Nils and Rimé, 2012). However, to date, no studies have investigated whether spontaneous use of these distinct strategy types in everyday life has a differential impact on people's relationship formation.

The studies presented in this paper present the first test of whether IER can help people to form new relationships, tracking the effects of IER on development of new connections in real social networks from the formation of networks over time. In Study 1, we test the effects of IER in face-to-face social networks. In Study 2, we build on our first study by contrasting the effects of cognitive and behavioral IER strategies, and by exploring the effects of IER in online social networks. Although traditionally it was assumed that the type of computer-mediated communication (CMC) that occurs online was devoid of social cues and, therefore, lacked emotional content, several perspectives challenge this view. For example, Walther's (1992) social information processing theory argues that communicators are driven to develop social relationships, irrespective of their communication medium, and that relationships can, therefore, develop to the same degree via CMC as face-to-face communication. Recent accounts of emotion regulation further highlight that given that online exchanges may be just as emotional as face-to-face interactions, they should be included in contemporary studies of emotion in social contexts (Kappas, 2013).

Study 1

In our first study, we examined whether IER could help people to form new relationships in face-to-face social networks. In particular, we investigated students taking year-long Masters courses, tracking the change in their popularity from the first few weeks of the course to the end of their first semester, and assessing their use of IER toward their coursemates in the interim period. In addition to assessing participants' use of IER, we also measured two stable personality traits that have been found by previous researchers to be important predictors of popularity in social networks, namely extraversion and agreeableness (Selfhout et al., 2010; Quercia et al., 2012). Extraversion reflects individual differences in the extent to which people are outgoing, sociable, assertive, enthusiastic, and energetic, and thus may predispose people toward seeking out new relationships with others (Pollet et al., 2011). Agreeableness is a personality trait that reflects individual differences in sympathy, warmth, and consideration, and is strongly associated with motives to form positive relationships (Jensen-Campbell and Graziano, 2001).

We chose to examine two types of relationships in this context: work-related and non-work-related. In new organizational contexts, both of these relationship types are extremely salient and crucial for people to integrate into their networks and to derive well-being and self-esteem benefits (Morrison, 2002).

Previous research suggests that people choose who they work with in the same way that they choose who they socialize with, based on liking over competence (Casciaro and Lobo, 2005). According to Casciaro and Lobo (2005), the reason for this is that when we like someone we feel that the resources they have are accessible to us and, therefore, that we can benefit from that relationship, whereas competence only implies presence of resources and not accessibility. As such, we expected that the same factors would drive popularity in both work and non-work networks.

Method

Participants

Students from three psychology Masters courses at different UK universities were invited to participate in a study on how relationships develop; participation was not a course requirement. The first course comprised 27 students, 20 of whom provided data on all measurement occasions. The second comprised 18 students, 17 of whom completed all data points. The third course included 33 students, with full data from 31. The overall sample, therefore, comprised 68 participants (42 females and 24 males, $M_{age} = 23.66$ years, $SD = 2.45$), representing a response rate of 87%. Ethical approval for the study was obtained from the Department of Psychology Research Ethics Committee at the University of Sheffield in the UK (the institution where the first author formerly worked).

Design and Procedure

We used a longitudinal social network study design to assess whether use of IER predicted changes in participants' popularity over time. Surveys were distributed during the students' first semester of their courses (approximately a 12-week period). At baseline, 3 weeks into their course, students were given an introduction to the study and an opportunity to ask questions, and consented to take part in the research. They then provided a first measure of their work and non-work ties in their respective networks and completed measures of their demographic characteristics (gender and age) and personality (extraversion and agreeableness) and a scale assessing the extent of their use of IER toward their coursemates over the semester thus far. At the end of the semester, students completed a second measure of their work and non-work network ties.

Measures

Popularity

Participants' popularity in the work and non-work networks was calculated on the basis of responses to two sociometric items, administered using a roster method. Participants were presented with a list of the people on their own Masters course, and asked to rate the extent (from 0 'not at all' to 4 'a great extent') to which they had shared specific types of relations (work and non-work) with each person during a defined time-period. In the Time 1 survey, participants rated the extent to which they had shared ties since they started the course; in the Time 3 survey, they rated the extent to which they had shared ties in the interim period since the first survey. For work ties, we asked participants to "please indicate the extent to which you have worked with each of your coursemates. . . By working together, we mean studying together at a library, collaborating on a course project, asking or giving advice on an academic topic – any university-related work activity." For non-work ties, we asked participants to "please indicate the extent to which you have socialized with each of your coursemates outside of the University. . . By socializing, we mean going for a drink, going out for the night, going to the cinema, spending time in each others' houses – any non-work leisure activity."

Using responses to these items, we calculated participants' *in-degree centrality* within their respective networks. As described earlier, in-degree centrality is a measure in social network analysis that indicates the extent to which others in a network have nominated a given network member (e.g., as someone they have worked or socialized with). It is often used as a measure of popularity in social network studies because the data is not self-reported by the network member in question, making it relatively objective (Sparrowe et al., 2001; Czarna et al., 2014). In this case, we calculated in-degree centrality (i.e., popularity) in the work and non-work networks. Finally, we divided the centrality values by network size, to control for differences between the networks (Scott and Judge, 2009; Czarna et al., 2014).

Interpersonal Emotion Regulation

Use of IER toward others in the networks was assessed using a self-report measure that has previously been validated against behavioral data (Niven et al., 2011). The measure was taken from the emotion regulation of others and self (EROS) scale, a comprehensive measure of emotion regulation that includes four subscales covering use of strategies to (i) improve one's own feelings, (ii) worsen one's own feelings, (iii) improve others' feelings, and (iv) worsen others' feelings. In this study, we used the subscale that assesses use of strategies to improve others' feelings (termed 'extrinsic affect-improving'). This subscale comprises six items ($\alpha = 0.88$), with example items including: "I gave someone advice to try to improve how they felt" and "I made someone laugh to make them feel better". Participants indicated the extent to which they had used these strategies toward their coursemates since the start of the semester (from 1 'not at all' to 5 'a great deal').

Personality Traits

Extraversion and agreeableness were each assessed using items each taken from the short version of the Big Five Inventory (Rammstedt and John, 2007). Participants indicated the extent to which they agreed (from 1 'disagree strongly' to 5 'agree strongly') with two items for extraversion (e.g., "I see myself as someone who is outgoing, sociable"; Spearman–Brown coefficient = 0.75) and two items for agreeableness (e.g., "I see myself as someone who is generally trusting"; Spearman–Brown coefficient = 0.67).

Results

Means, standard deviations, and correlations between the main study variables are shown in **Table 1**. There was a high degree of overlap between popularity in the work and non-work networks: at baseline, $r = 0.73$, $p < 0.01$ (95% CIs 0.64, 0.85); and at end of semester, $r = 0.82$, $p < 0.01$ (95% CIs 0.78, 0.92). Correlations

TABLE 1 | Correlations between main study variables in Study 1.

		Mean	*SD*	1	2	3	4	5	6	7	8
1	Age	23.66	2.45								
2	Gender	0.36	0.49	0.20							
3	Popularity in baseline work network	0.36	0.21	−0.04	−0.35**						
4	Popularity in baseline non-work network	0.39	0.25	−0.22	−0.22	0.73**					
5	Popularity in end of semester work network	0.48	0.32	−0.01	−0.37**	0.69**	0.53**				
6	Popularity in end of semester non-work network	0.48	0.29	−0.11	−0.28*	0.68**	0.75**	0.82**			
7	Interpersonal emotion regulation (IER)	2.22	0.73	−0.31*	−0.24	0.19	0.10	0.40**	0.29*		
8	Extraversion	3.37	1.00	0.04	−0.25*	0.23	0.23	0.18	0.22	0.01	
9	Agreeableness	3.80	0.74	−0.13	−0.31*	0.12	0.09	0.25*	0.13	0.30**	<0.01

*N = 68; Gender was coded 0 for females, 1 for males. *p < 0.05, **p < 0.01.*

suggested that the use IER was significantly related to popularity at the end of the semester: in the work network, $r = 0.40$, $p < 0.01$ (95% CIs 0.14, 0.56); and in the non-work network, $r = 0.29$, $p < 0.05$ (95% CIs −0.01, 0.52). However, IER was not related to baseline popularity in the work, $r = 0.19$, $p = 0.13$ (95% CIs −0.09, 0.40) and non-work, $r = 0.10$, $p = 0.40$ (95% CIs −0.15, 0.36) networks, suggesting a lack of reverse causal relationship (i.e., that popularity is not associated with later use of IER).

Regression analyses were conducted to investigate whether the use of IER predicted a change in popularity across the semester. In these analyses, popularity at baseline, age, gender, extraversion, and agreeableness were controlled for. The results, shown in **Table 2**, indicate that IER strategies had a unique effect over personality in predicting change in popularity across the course of the semester, in both the work, $\beta = 0.25$, $p < 0.01$ (95% CIs 0.03, 0.19), and non-work, $\beta = 0.21$, $p < 0.05$ (95% CIs 0.01, 0.15), networks. The findings of this study, therefore, provide initial evidence that using IER toward others may be associated with relationship formation, in this case in face-to-face work and non-work networks.

Study 2

In our second study, we wanted to determine whether the observed effects of IER on popularity could be replicated in online social networks. In other words, would the same psychological factors would be important in driving relationship formation online as face-to-face? We tested our central proposition using a dataset of Twitter users. Founded in 2006, Twitter is the world's fastest growing online social networking site (ComScore, 2012), with 255 million monthly active users. Twitter allows users to post updates and messages, referred to as *tweets*, and to elect to subscribe to receive tweets from other users by *following* them. The number of followers a user has is, therefore, an indicator of a user's popularity. The aim of the present study was to establish

TABLE 2 | Regression analyses predicting change in social network popularity in Study 1.

	Centrality in work network at end of semester			Centrality in non-work network at end of semester		
	β	*t*	ΔR^2	β	*t*	ΔR^2
Step 1						
Age	−0.02	−0.17		0.05	0.59	
Gender	−0.02	−0.22		−0.04	−0.40	
Centrality in work network at baseline	0.69	6.86**				
Centrality in non-work network at baseline				0.77	8.48**	
Extraversion	0.04	0.44		0.03	0.33	
Agreeableness	0.12	1.23	0.55**	0.04	0.46	0.61**
Step 2						
Age	0.04	0.45		0.10	1.15	
Gender	<0.01	−0.02		−0.02	−0.18	
Centrality in work network at baseline	0.68	7.06**				
Centrality in non-work network at baseline				0.77	8.78**	
Extraversion	0.05	0.54		0.03	0.39	
Agreeableness	0.06	0.62		−0.01	−0.10	
IER	0.25	2.68**	0.05**	0.21	2.36*	0.04*
Total R^2			0.60			0.65

*N = 68; Gender was coded 0 for females, 1 for males. *p < 0.05, **p < 0.01.*

whether Twitter users' engagement in IER via their tweets would predict their popularity. Drawing on data from a sample of over 8000 Twitter users from English-speaking countries, we used a linguistic tool to detect instances of IER in people's *tweets* and tracked the activity of these users from the formation of their accounts.

A second aim of this study was to extend the findings reported in Study 1 by exploring whether cognitive and behavioral IER strategies would have different effects on popularity in this context. As discussed earlier, while behavioral IER ought to fulfill targets' needs and so help to develop new relationships, cognitive IER could potentially be seen as a challenge to targets' views and thus be taken as an offense. In online contexts, a difference between cognitive and behavioral IER may be particularly likely to be apparent, as written words that challenge a person may appear more abrasive due to the lack of non-verbal cues (Culnan and Markus, 1987).

Method

Participants

Participants in the study were drawn from a dataset produced from a full sample of Twitter activity in 2013 that covers a large amount of Twitter users in different countries (Abisheva et al., 2013). Among these users, the participants selected for the present study were those from four English-speaking countries—USA, Canada, Australia, and the UK—who had at least one follower and at least one tweet mentioning another user by the designated point of analysis, and for whom we had access to almost all (over 95%) of the tweets they had generated. These criteria were important because we analyzed the content of tweets in English, were interested in interpersonal processes and so needed users who engaged at least somewhat with other members of Twitter, and wanted comprehensive documentation of users' Twitter activity. The final sample comprised the 8605 Twitter users from the dataset who fulfilled these criteria, with up to 3200 tweets per user.

Although Twitter profiles do not have explicit information about demographics of users, meaning that we do not have demographic characteristics for the present sample, previous work has assessed the distributions of age, occupation, and gender of Twitter users. Twitter users in the US are somewhat more likely to be male, with 64% of users reported as male in 2013 (Garcia et al., 2014). The age distribution of Twitter users is clearly biased toward younger populations, but without very striking differences in occupation (Sloan et al., 2015).

Our analysis involved data voluntarily selected by participants to be publicly shared on Twitter. This public sharing explicitly includes third parties and thus provides clear consent to data access. In contrast with user interface manipulations that require careful ethical considerations, the present study does not control or manipulate the user interface and the analyses are performed over aggregations of users. Thus, following the principle of numerous previous studies on publicly available Twitter data (Golder and Macy, 2011; Mislove et al., 2011; Sloan et al., 2015), and consistent with principles of e-research ethics (Parker, 2010), no formal institutional ethics approval is required for this type of research.

Design and Procedure

We used a correlational study design in which we tracked each user from the database from the creation of their Twitter accounts starting with no followers to the point of analysis. This allowed us to determine whether the IER that users engaged in during their tweets predicted the development of new connections. The tweets used in the analysis were filtered, such that only tweets including an *@-mention* were selected. An @-mention in a tweet indicates that the person tweeting is communicating directly with another Twitter user. This is important because many tweets are not direct acts of communication with specific others (e.g., people may tweet general messages about a meal they just ate, or a place they have been to). In addition, we filtered out *re-tweets*, in which a user copies the content of another user, so that only original tweets were included in the analyses. Out of the total 10,170,651 tweets, our final pool included 4,250,112 tweets from the participants. We then coded each participant's tweets to identify whether or not they represented an instance of IER (as described below).

Measures

Popularity

Popularity was measured as the number of followers users had gained since creating their accounts. Because people elect whether or not to follow a user, this is considered a suitable method of assessing popularity that is analogous to in-degree centrality. We applied a logarithmic transformation to the number of followers for our analysis. This type of transformation is commonly applied for data that are positively skewed (Quercia et al., 2012; Abisheva et al., 2013) and that follow power-law distributions (Clauset et al., 2009). In the present case, the skewness of the variable (pre-transformation) was 31.85. In our analyses on popularity, we also controlled for the age of the Twitter account, in recognition of the fact that people would have more time to gain followers with older accounts.

Cognitive and behavioral IER

Participants' use of IER in their Twitter activity was inferred based on their use of particular terms in their tweets. Specifically, we coded all eligible tweets from participants using the dictionaries of the Linguistic Inquiry and Word Count (LIWC) tool (Pennebaker et al., 2007). LIWC is a software program that analyzes text for instances of particular words and terms to determine the extent to which different categories are used in that text.

We first coded all tweets for the presence of emotional terms, using the 'affect' category of the LIWC (which contains terms pertaining to positive and negative emotions). We then coded the tweets for presence of terms relating to the two main types of strategies to improve others' emotions proposed in the dominant model of IER: (i) cognitive strategies, which involve trying to influence a person's thoughts about his or her feelings or situation, e.g., giving someone advice; and (ii) behavioral strategies, which involve using behavior to change a person's feelings, e.g., doing something nice for someone (Niven et al., 2009). To capture cognitive strategies, we coded the tweets for terms from the cognitive mechanisms category

of the LIWC, which includes terms relating to logic, insight, causality, re-evaluation, thinking, and understanding. Such terms reflect the cognitive strategies included in Niven et al. (2009) classification of strategy types. Example tweets identified using this analysis as cognitive IER include "@XXX Since you have no control over your thoughts please don't feel guilty about them...acting on them is a different matter" and "@XXX good plan. keep your head down and don't answer any questions you're asked. you should feel fine :)". To capture behavioral IER, we coded for terms related to social processes in the LIWC. The expression of social process terms serves as a signal of social support (Tausczik and Pennebaker, 2010), including terms such as confiding, encouraging, flattering, giving, helping, and listening, which match well to the behavioral strategies in Niven et al. (2009) model. Example tweet identified as behavioral IER are "@XXX I'm sorry to hear that, Amy. Sending lots of hugs your way. Xo" and "@XXX most definitely. Can someone bring you a book and some distractions, perhaps? Would you like some cat sites I can send?"

Using this linguistic analysis, we then expressed each variable as a ratio, representing the number of tweets in which both cognitive and affect terms were used (for cognitive IER) or in which both social and affect terms were used (for behavioral IER) as a proportion of the total number of tweets sent by the user that fulfilled the filtering criteria outlined above (i.e., original tweets that included an @-mention). The resulting variables, therefore, represented the extent to which the user engaged in each type of IER in their Twitter activity.

Results and Discussion

Descriptive statistics of the main study variables are shown in **Table 3**. The Twitter users produced an average of 111.39 tweets containing terms pertaining to cognitive IER (SD = 130.02), and an average of 127.19 tweets containing terms pertaining to behavioral IER (SD = 145.58), representing 22 and 26%, respectively, of all original interpersonal Twitter activity. There was a strong correlation between presence of terms connoting cognitive and behavioral IER in tweets, $r = 0.76$, $p < 0.01$ (95% CIs 0.75, 0.77). This overlap appeared to be due to the presence of emotion terms in both types of tweets, as additional analyses revealed that there was only a small correlation between presence of cognitive and behavioral terms in the tweets when emotion terms were held constant, $r = 0.05$, $p < 0.01$ (95% CIs 0.03, 0.07). Further analysis of the data revealed that 6% of tweets included in this study contained only cognitive IER (i.e., they did not also contain behavioral terms), while 9% of tweets contained only behavioral IER (i.e., they did not also contain cognitive terms).

Despite the overlap between cognitive and behavioral IER, both appeared to have distinct relations with popularity. The use of tweets connoting cognitive IER had a small negative relationship with users' popularity, $r = -0.02$, $p < 0.05$ (95% CIs −0.04, −0.001), whereas use of behavioral IER in tweets was positively related to popularity, $r = 0.12$, $p < 0.01$ (95% CIs 0.10, 0.14). Among the tweets that included only cognitive or only behavioral IER, there were stronger correlations with popularity in the same direction as those reported above (cognitive IER, $r = -0.18$, $p < 0.01$; behavioral IER, $r = 0.16$, $p < 0.01$).

A regression analysis was then conducted, in which the age of the Twitter account and the total number of tweets users had sent out were controlled for in Step 1 (to account for differences in time to gain followers and usage of Twitter), and both types of IER were entered as predictors in Step 2 (**Table 4**). The results at Step 2 indicated that use of behavioral IER in one's tweets was positively related to network popularity, $\beta = 0.49$, $p < 0.01$ (95% CIs 0.45, 0.53), while cognitive IER was negatively related to popularity, $\beta = -0.44$, $p < 0.01$ (95% CIs −0.48, −0.39). At Step 3 the interaction between cognitive and behavioral IER was added to the model to determine whether presence of both cognitive and behavioral terms in tweets would have additional predictive value in terms of popularity. The interaction was not significant, $\beta < 0.01$, ns (95% CIs −0.01, 0.02). The findings of this study, therefore, replicate the first study in suggesting that IER may be associated with the development of new connections with others, but present a more

TABLE 3 | Correlations between main study variables in Study 2.

	Mean	*SD*	1	2	3	4
1. Age of the account (days)	842.69	523.11				
2. Number of tweets	493.91	497.80	0.10**			
3. Number of followers	463.82	3751.05	0.20**	0.21**		
4. Use of cognitive IER terms in tweets	0.22	0.10	0.04**	0.06**	-0.02*	
5. Use of behavioral IER terms in tweets	0.26	0.13	0.03**	−0.04**	0.12**	0.76**

*N = 8605; Number of followers is analyzed in raw form for mean and SD, and as a logarithmic transform for correlations *p < 0.05, **p <0.01.*

TABLE 4 | Regression analysis predicting Twitter popularity in Study 2.

	Number of followers		
	β	*t*	ΔR^2
Step 1			
Age of the account (days)	0.17	11.43**	
Number of tweets	0.55	36.26**	0.17**
Step 2			
Age of the account (days)	0.18	11.94**	
Number of tweets	0.56	37.42**	
Use of cognitive IER terms in tweets	−0.44	−19.68**	
Use of behavioral IER terms in tweets	0.49	22.06**	0.05**
Step 3			
Age of the account (days)	0.18	11.95**	
Number of tweets	0.56	37.34**	
Use of cognitive IER terms in tweets	−0.44	−19.22**	
Use of behavioral IER terms in tweets	0.49	22.05**	
Interaction: cognitive × behavioral IER	<0.01	0.51	<0.01
Total R^2			0.21

*N = 8605; *p < 0.05, **p < 0.01.*

nuanced picture, at least for online connections, in suggesting that only behavioral strategies may be positively related to popularity.

General Discussion

How do we make connections when we enter a new social situation? The present research suggests that making attempts to improve others' emotions may facilitate the formation of new relationships. Across two studies, we found that use of IER was associated with attraction of new network connections, in face-to-face and online contexts, and in work and non-work relationships. IER may, therefore, have an important role to play in helping people to become popular.

Our research suggested that the effects of IER may not always be positive when it comes to popularity, however. In our second study, we contrasted two types of strategies for IER. We found that while use of terms relating to behavioral IER in tweets was associated with higher popularity in terms of Twitter followers gained, use of terms relating to cognitive IER was associated with lower popularity. The negative associations between cognitive IER and popularity observed in the present research stand in contrast to research on emotion self-regulation, in which cognitive strategies, such as reappraisal, are generally found to have positive consequences for both affect and social relations (Gross and John, 2003). A possible issue with cognitive strategies when it comes to regulating others' emotions is that even though they are used with the intention of improving the target's affect, they could be construed as a challenge to the target's views and thus taken as an offense (e.g., a person who is upset about criticism from his manager could find a colleague's suggestion that the manager is only trying to improve his performance insensitive to his feelings or as taking the manager's side). Although this unintended impact may not always transpire, it may be especially likely during CMCs where the lack of non-verbal cues may mean that any confusion over someone's intentions is difficult to resolve and offense may be taken more quickly (Culnan and Markus, 1987). Thus, consistent with research suggesting that attempts to provide social support that are not perceived to be responsive to the intended target's needs may backfire (Maisel and Gable, 2009), cognitive IER may also fail to achieve relational benefits, at least in online communications. An alternative explanation for the negative association between cognitive IER and popularity found in our second study; however, is that there may have been issues with the coding of cognitive strategies (discussed later in more detail), such that tweets that did not include cognitive IER may have been included in the analysis.

The present research makes three key contributions to the literature. First, it makes a broad contribution to the field of the social nature of emotions. Research on emotion regulation has paralleled that in the field of emotion, in that the *social nature* of this process has been recognized more widely in recent years. For example, studies have reported that people's regulation of their emotions is often engaged during or in anticipation of social interactions (Erber et al., 1996) and that people can recruit the aid of others in regulating their feelings (Fitzsimons and Finkel, 2010). One of the most important advances in this area is the recognition that as well as regulating their own emotions, people can also intentionally try to shape the way others feel (i.e., they can engage in IER), yet to date empirical research on this process has been somewhat sparse. In the present paper, we not only demonstrate the everyday use of this social process of IER in both face-to-face and online relationships, but we also explicitly connect it to its social consequences, by showing that it can have implications for relationship formation.

Second, the research makes a more specific contribution toward our understanding of the differential effects of distinct types of IER. Despite two main types of strategies to improve others' affect being proposed in the dominant model of IER (Niven et al., 2009), to-date most studies have only contrasted strategies to improve and to worsen affect. The present research theorizes that each type of strategy may have differential effects due to the way in which the strategy is likely to be appraised and presents the first clear evidence that cognitive and behavioral strategies have different effects when used in real relationships. Behavioral strategies communicate support, comfort, and validation, and so are likely to be positively appraised and facilitate the formation of new relationships over time. In contrast, cognitive strategies may be perceived as a challenge to the target's way of viewing a situation, and so may not always aid in building new relationships. Our findings in this respect are in line with earlier work on different listening styles (Nils and Rimé, 2012), but extend this work by studying the spontaneous use of IER strategies in the naturalistic context of newly developing relationships. However, it should of course be noted that we only tested and observed differences between cognitive and behavioral IER within online relationships. Future studies should, therefore, compare the effects of these strategy types in face-to-face social networks.

Third, our research contributes by extending the theoretical understanding of how social networks develop over time. The importance of building informal network ties, especially for newcomers (e.g., in work organizations) is well-established (Morrison, 2002), yet there has been a relative dearth of research examining psychological factors—especially those that are within a person's control—that predict formation of new ties (Totterdell et al., 2008). The present research suggests that IER may potentially be an important process in facilitating popularity in new networks, even when personality traits that have previously been thought to be important determinants of popularity (i.e., extraversion and agreeableness) are taken into account. Our research, therefore, highlights the central nature of pleasant feelings to relationship formation. Specifically, because IER can elicit positive affect (Niven et al., 2007), people may wish to repeat exchanges with IER users in order to experience more of these rewarding feelings (Lawler, 2001) or to share the effort involved in emotion regulation with the interaction partner (Beckes and Coan, 2011). On a practical level, our findings offer a key set of strategies that people may be able to engage in to facilitate the

formation of relationships when entering a new social context. They further highlight that similar types of strategies can help to develop online and face-to-face relations, and work and non-work relations (consistent with previous research on factors driving work partner choices; Casciaro and Lobo, 2005).

The present research has several strengths, notably: the use of relatively objective indices of popularity; the study of real emerging relationships over time; and that we explored the effects of IER on the formation of three different types of relationships. However, certain limitations of the research must be acknowledged. In particular, an issue across both studies is that we used aggregate measures to assess popularity. Although this provides the most accurate way of capturing the views of a whole network of people, a potential problem is that our findings only tell us about networks on average, and not about the fate of particular relationships. As such, while using IER might help people to form more relationships overall, it could still, in theory, cause some relationships to be cut off. In addition, the correlational design of our studies also means that evidence for causality is not unequivocal. By studying networks from their formation with measures separated temporally across a 3-month period (Study 1), and studying Twitter users from the point at which they started their accounts (Study 2), we overcame some of the typical issues associated with correlational study design. Moreover, while it is still possible based on our study design that popularity might cause the use of IER as well as the reverse, the findings of Study 1 suggest this was unlikely to be the case, given that baseline popularity did not predict later use of IER. Nevertheless, the use of experimental study designs to establish causality more directly will be important to complement the findings we have observed here.

A final limitation specifically in reference to Study 2 concerns the indirect nature of our measures of IER. In this study, we were only able to infer the use of IER by using linguistic analysis of people's tweets to other users. Analyzing the content of online communication for social sharing of emotions (Garas et al., 2012) and emotion-related processes (e.g., empathy; Pfeil and Zaphiris, 2007) is an established means of studying relationship formation, and the tool we applied is widely used and robust (Garcia et al., 2012). However, IER is defined in terms of the intention of the regulator to affect a change in someone else's feelings (Niven et al., 2009), and intentionality cannot be fully captured without directly questioning the regulator. Moreover, there are possible instances of IER that may not have been picked up using our coding system (e.g., if someone were to use IER without explicitly referring to an emotion term) as well as possible instances where tweets could have been coded as IER erroneously. Likewise, there could be potential for miscoding of cognitive strategies as behavioral and vice versa, due to the overlap in terms likely to relate to each strategy type (e.g., the term 'understanding' was featured in the category used to code for cognitive IER, even though the notion of behavioral IER concerns communication of understanding to the target). Future research examining use of IER in online communications should, therefore, consider cross-validating coding, for example, by correlating IER as inferred from online social network messages with self-reported use of IER as indicated on an established measure, such as the EROS scale (Niven et al., 2011).

Future research should also explore whether our findings translate to other social contexts. The fact that we found similar patterns of results regarding different types of relationships, and that in Study 1 we included three different networks of people (i.e., three Masters courses) and found the same patterns of results within each (exploratory moderation analyses examining differences between the networks in Study 1 revealed no significant variations), is encouraging. However, additional research conducted with other samples of people entering new social contexts (e.g., people starting new jobs, moving to new neighborhoods, or joining new leisure clubs) would provide further confidence in the generalizability of our findings.

Another direction for future research will be to consider situations under which IER does not lead to expected gains in popularity. One possible factor to consider here will be motives for IER. Recent research has highlighted that people do not always have others' interests in mind when engaging in IER. Specifically, across a series of studies, Netzer et al. (2015) demonstrated that people may regulate others' emotions in order to pursue personal instrumental goals. While in the present research, we have reported evidence that trying to improve others' emotions is associated with formation of new relationships; future research could study whether people's motivations for using IER (or others' perceptions of their motives) will influence how successful IER is in boosting popularity.

Author Contributions

KN led the design, data collection, and analysis of Study 1, contributed to the design of Study 2, and produced the first and revised drafts of the paper. DG led the design and analysis of Study 2 and helped to revise the paper. IL, DH, and WM contributed to the design and data collection of Study 1 and helped to revise the paper. All authors are accountable for the accuracy or integrity of the work.

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Sub-optimal presentation of painful facial expressions enhances readiness for action and pain perception following electrocutaneous stimulation

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Observation of others' painful facial expressions has been shown to facilitate behavioral response tendencies and to increase pain perception in the observer. However, in previous studies, expressions were clearly visible to the observer and none of those studies investigated the effect of presence of peripheral stimulation on response tendencies. This study focuses on the effect of sub-optimal presentation of painful facial expressions in the presence and absence of an electrocutaneous stimulus. Twenty-two healthy individuals categorized arrow targets which were preceded by a sub-optimally presented facial expression (painful, happy, or neutral in different blocks). On half of the trials, aversive electrocutaneous stimulation was delivered to the wrist of the non-dominant hand between the presentation of facial expression and target (an arrow directing to right or left). Participants' task was to indicate direction of the arrow as soon as it appears on the screen by pressing the corresponding key on the keyboard and to rate their pain at the end of block. Analysis showed that responses were faster to targets preceded by aversive stimulation than to targets not preceded by stimulation, especially following painful expressions. Painfulness ratings were higher following painful expressions than following happy expressions. These findings suggest that sub-optimally presented painful expressions can enhance readiness to act to neutral, non-pain-related targets after aversive stimulation and can increase pain perception.

Keywords: painful facial expressions, observation of pain, sub-optimal processing, action readiness, pain perception

Introduction

Facial expressions of pain are salient social signals of potential physical threat (Williams, 2002). It has been recently re-emphasized that the consequences of pain expressions could potentially be profound, not only for the sufferer, but also for the observer (Hadjistavropoulos et al., 2011). For example, observation of pain in others may elicit empathy and fear responses in the observer,

associated with hypervigilance to threat, increased urge for avoidance of pain/threat-related signals, and elevated perception of pain in the observer (Goubert et al., 2005; Khatibi et al., 2014).

Indeed, there are some indications that the observation of others' painful facial expressions has an effect on responses to pain among healthy individuals. The observation of pain in the faces of other people increases the observer's nociceptive flexion reflex (NFR) in response to a painful electrocutaneous stimulus, which has been taken to reflect an elevated readiness for taking (avoidance) action (Vachon-Presseau et al., 2011; Mailhot et al., 2012; Khatibi et al., 2014). In addition, the observation of others' painful facial expressions has been shown to have an effect on pain perception in healthy individuals. More specifically, observing painful facial expressions increased perceived unpleasantness of an electrocutaneous stimulus but had no effect on perceived intensity (Vachon-Presseau et al., 2011; Mailhot et al., 2012; Khatibi et al., 2014). Observing painful facial expressions, as compared to observing neutral, joyful, or fearful expressions, also increased perception of thermally induced pain (Reicherts et al., 2013).

In all aforementioned studies on the impact of the observation of painful facial expressions on readiness for action or pain perception so far, expressions were presented in optimal visual conditions, and were therefore clearly visible to the observer. They draw the attention to the capacity for the understanding of the affective state of others and its contribution to the preparation of appropriate reaction (Jackson et al., 2005). On the other hand, there are studies suggesting that conscious processing of emotions is not necessary and the neural system's response to the emotional expression of others does not rely on the explicit processing of expressions and is reflective in nature (Davis and Whalen, 2001). Considering pain as an emotional experience, it is unknown whether conscious processing of facial expressions is necessary for the facilitation of responses, or whether semantic, non-social processing of emotion in the expression alone can influence readiness for action. In the present study, we aimed to investigate the effect of *sub-optimal* presentation of painful facial expressions on readiness for action in healthy individuals. Previous studies have shown that sub-optimally presented stimuli can be processed semantically and can influence our behavior (Van den Bussche et al., 2009; Schrooten et al., 2011). So it can be expected that also sub-optimally presented painful facial expressions could prime behavioral responses.

Few previous studies investigated the interaction between stimuli from two modalities and its effect on the preparation of actions. For example, Mulckhuyse and Crombez (2014) have shown that congruent presentation of spatial cues (visual) and peripheral cues (electrocutaneous stimulation) can result in stronger action preparation and faster responses to a target. They suggested that electrical stimulation decreased reaction time (RT) by improving action preparation and stronger congruency effect is due to the response priming effect. However, they did not take the effect of emotional factors into account. In the current study, we were interested to see whether sub-optimally presented painful expressions that are followed by painful electrocutaneous stimulation can increase readiness for taking an action in comparison with the situation in which there is no electrocutaneous stimulation. We expect that participants show an increased readiness for action (indicated by faster responses on a non-pain-related task) on trials with electrocutaneous stimulation as compared to trials without stimulation, and that this facilitation is stronger after sub-optimally presented painful expressions, as compared to sub-optimally presented happy or neutral expressions. Furthermore, along with findings of previous studies, which suggested that processing of pain in facial expression of other people under optimal condition improves the observer's perceived pain (Vachon-Presseau et al., 2011; Mailhot et al., 2012; Khatibi et al., 2014), we hypothesize that processing of painful facial expressions under sub-optimal condition will lead to increased pain ratings of an electrocutaneous stimulus compared to the happy or neutral expressions.

Materials and Methods

Participants

Twenty-two healthy volunteers (six males), with a mean age of 25.6 years (SD = 3.8, range 22–35) participated in the study. Exclusion criteria were current pain complaints, pregnancy, and electronic implants. All participants had Dutch as mother tongue. All had normal (or corrected to normal) vision. The study was approved by the Medical Ethics Committee of the Vrije Universiteit Brussel (reference 2011/197).

Questionnaires

Pain Catastrophizing Scale

The Pain Catastrophizing Scale (PCS; Dutch version: Van Damme et al., 2000, 2002a,b) consists of 13 items which describe different thoughts and feelings that may be associated with pain. Participants indicate the degree to which they experience each of those thoughts and feelings when they feel pain on a 5-point Likert scale (0 = not at all; 4 = all the time). Higher PCS total scores reflect higher levels of trait catastrophizing about pain. The PCS has three subscales with items referring to thoughts or feelings associated with magnification, rumination, or helplessness. The PCS has demonstrated good psychometric properties, also for healthy Dutch speaking populations (Van Damme et al., 2000, 2002a).

Fear of Pain Questionnaire

The Fear of Pain Questionnaire [FPQ-III; (McNeil and Rainwater, 1998) Dutch version: (Roelofs et al., 2005)] consists of 30 items that describe pain-arousing experiences. Participants indicate their fear for those experiences on a 5-point Likert scale (1 = not at all; 5 = extreme). Higher FPQ-III total scores reflect higher levels of trait fear of pain. The FPQ-III has three subscales with items referring to experiences of severe pain, minor pain, or medical pain. The FPQ-III has demonstrated good psychometric properties, also for healthy Dutch speaking populations (Roelofs et al., 2005).

Task Material

Electrocutaneous Stimuli

The electrocutaneous stimulus (2-ms duration, rectangular waveform, Frequency = 65 Hz) was delivered by a constant current stimulator (DS7A, Digitimer, Welwyn Garden City, England) using surface sensormedics electrodes (8 mm) filled with K–Y gel attached to the back of *non-dominant* hand (Meulders and Vlaeyen, 2013). Stimulus intensity was individually set using a work-up procedure (Meulders and Vlaeyen, 2013). A series of stepwise increasing intensities of electrocutaneous stimuli (2 mA increase per step) was delivered once. Participants were asked to rate the painfulness of each stimulus upon stimulus delivery on an 11-point Likert scale (0 = "not painful at all", 10 = "Extremely painful"). Intensities were increased to a level that was reported as painful but just tolerable as reported by the participant. The highest intensity presented during this procedure was used during the priming task. Mean painfulness rating of the selected stimuli was 6.7 (SD = 0.8; range: 6–8).

Facial Expressions

Grayscale photographs (width 6 cm, height 4.5 cm) of three types of facial expressions were used: four painful expressions, four happy expressions, and four neutral expressions. The expressions were from four different actors (two females, two males) with the three types of expressions for each actor. The expressions were snapshots of dynamic facial expressions (1-sec movies) and were selected from an existing database (Simon et al., 2008). Selection of expressions was based on intensity ratings acquired from authors of a previously published study (Vachon-Presseau et al., 2011). On all photographs, head and eye-gaze were directed forward and the head filled most of the picture. See supplementary material for the photographs included in the current study.

Tasks

Priming Task

Figure 1 presents a typical trial configuration which was based on previous masked priming studies (e.g., Dell'Acqua and Grainger, 1999; Van den Bussche et al., 2009). Throughout the task, all stimuli appeared at central fixation on a gray background (RGB: 150, 150, 150). All stimulus presentations were synchronized with the vertical refresh cycle of the screen (13.3 ms). Each trial started with a small (1 mm*1 mm) black fixation cross for 400 ms. Then, a masked photograph of a facial expression (i.e., the *prime*) was presented (cf. Delord, 1998; Van den Bussche et al., 2009). More specifically, the fixation cross was first replaced by a series of four different masks (random black-and-white dot patterns; width = 9 cm, Height = 6.5 cm), each presented for 13.3 ms. Immediately after the offset of the fourth mask, a facial expression was presented for 13.3 ms, after which a blank was presented for 27 ms. Then, a series of four masks was presented again. At the onset of the second mask in this series the electrocutaneous stimulus was delivered on half of the trials (randomly determined); during the other half of the trials no electrocutaneous stimulus was delivered. Immediately after the offset of the last mask, a blank was presented for 200 ms. Finally, the *target*, a black arrow, was presented (width = 8 cm, Height = 5.5 cm). On half of the trials (for both trials with and without electrocutaneous stimulation) the arrow pointed to the right; on the other half of the trials the arrow pointed to the left. Participants were instructed to classify the arrow as fast as possible by pressing the corresponding arrow keys on the bottom right of an AZERTY keyboard with their dominant hand, while avoiding mistakes. The arrow was presented until one of the response keys was pressed or for a maximum of 3000 ms. The arrow was followed by an inter-trial interval that randomly varied between 1000 and 1200 ms (could be either 1000, 1100, or 1200 ms) and during which the screen was blank.

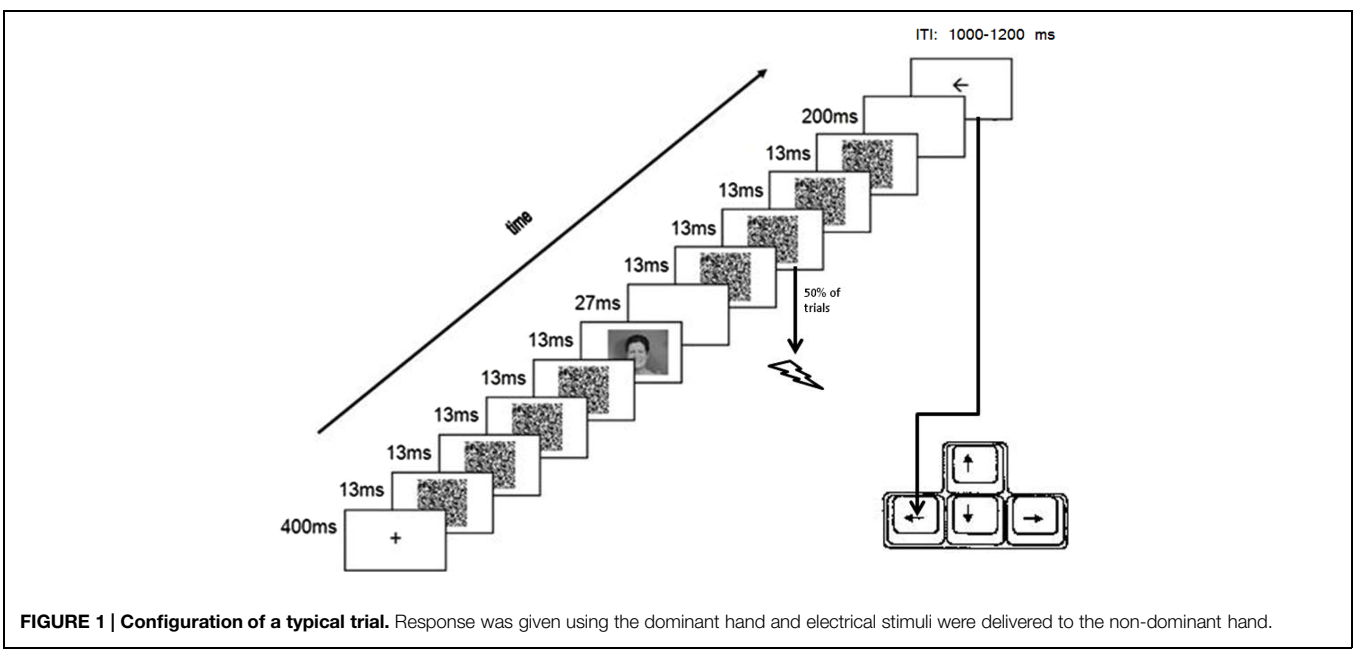

FIGURE 1 | Configuration of a typical trial. Response was given using the dominant hand and electrical stimuli were delivered to the non-dominant hand.

Participants were not informed about the presence or the type of the facial expressions. The three facial expression types were presented in three separate blocks. Each block contained 48 trials with each of the four faces presented 12 times in each block (six trials with electrocutaneous stimuli and six times without). Block order was counterbalanced between participants. After each block, participants were asked to rate the average intensity, unpleasantness, and painfulness of the electrocutaneous stimulation experienced during the previous block on three separate 100 mm visual analog scales with the end points labeled '0 = not intense/unpleasant/painful at all' and '10 = extremely intense/unpleasant/painful.' Breaks between blocks were self-paced.

Prime Awareness Check

To determine participants' objective awareness of the sub-optimally presented facial expressions (i.e., the primes), a forced-choice prime awareness task was administered after the priming task (Van den Bussche et al., 2009). In this task a fixation cross appeared on the screen (400 ms) and replaced by four consecutive masks (13.3 ms each). Then a facial expression was presented for 27 ms and replaced by a blank screen (13.3 ms) which was followed by a series of four masks (13.3 ms each). After the last mask three Dutch words appeared on the screen (Font 28 Arial, in Black, First letter capitalized, 5 cm below the fixation cross and interspaced by 5 cm). These words were "painful" ("pijnlijk"), "happy" ("blij"), and "neutral" ("neutraal"). Participants were explicitly informed that a sub-optimal facial expression was presented on each trial and they were asked to classify that by mouse-clicking the corresponding word. Words were presented until a response was given and after each trial the position of the cursor was returned to the center of the screen. Participants were instructed to guess if they could not see the facial expression. The three facial expression types were presented in a randomized manner (each expression was presented four times, so the task had total of 48 trials). If participants were unaware of the primes, this was indicated by performance at chance level (i.e., 33%) on this prime awareness task.

Apparatus

Electrocutaneous stimulus delivery, task presentations, and logging of button presses were controlled by a Dell Optiplex 755 computer (OS: windows XP; 2 GB RAM; Intel Core2 Duo processor at 2.33 GHz; ATI Radeon 2400 graphics card with 256 MB of video RAM), running Affect 4.0 software (Spruyt et al., 2010) and connected to a 19" CRT DELL monitor (75 Hz vertical refresh rate; refresh duration: 13.3 ms/frame), an AZERTY keyboard, a mouse, and a constant current stimulator (see above).

Procedure

All participants were tested individually in a dimly lit testing room. They were video-monitored and could communicate via an intercom with the experimenter who was located in a separate room. Upon arrival at the testing room, they received an information sheet describing the experimental procedure. More specifically, it was explained that the study focused on the factors involved in the perception of pain. Participants were informed that they would perform a simple categorization task while receiving painful electrocutaneous stimuli. Then they signed the informed consent and completed demographic questions and a battery of Dutch questionnaires including the PCS and the FPQ. After questionnaire completion, electrodes were attached and painful electrocutaneous stimulus intensity was individually set. Then participants performed the priming task followed by the objective prime awareness check. Finally, the electrodes were detached and participants were debriefed and informed about the purpose of the experiment.

Results

Participant Characteristics

Table 1 presents an overview of participants' scores on the questionnaires. The PCS and FPQ ratings of the present sample are comparable to PCS and FPQ ratings of similar samples in previously published studies (Van Damme et al., 2000; Roelofs et al., 2005; Engelen et al., 2006).

Priming Task Performance

This section focuses on RT analyses[1] Incorrect responses ($M = 2.5\%$, SD = 2.1) and responses slower than 1000 ms (less than 1% of the trials) were removed prior to RT analyses. In addition, we noticed that due to a software failure, during 20.8% of trials the presentation time for at least one stimulus (a mask,

[1]There was not enough variability in the error rates to allow for parametric analyses (see Supplementary Table S1 in supplementary materials).

TABLE 1 | Participants' mean scores on the questionnaires ($N = 22$).

Questionnaires	Total score/Subscale	Mean	Median	SD	Minimum	Maximum
Pain Catastrophizing Scale (PCS)	Total	14.64	13.50	10.03	0	30
	Rumination	6.86	8.00	4.70	0	13
	Magnification	3.18	2.00	2.48	0	9
	Helplessness	4.59	4.00	4.01	0	12
Fear of Pain Questionnaire (FPQ)	Total	68.77	65.50	13.47	46	96
	Severe pain	32.77	33.00	5.99	20	42
	Minor Pain	15.36	15.50	4.52	10	29
	Medical Pain	20.64	18.50	5.83	13	36

the prime, or the blank presented after the prime) was zero instead of 13 ms, so these trials were removed from the analyses as well. After removing these trials, there were at least 14 ($M = 18.8$, SD = 0.7, range: 14–23 trials) trials for each subject during each block and each condition which was sufficient for the purpose of analyses. The reported analyses were performed on mean RTs.

Mean RTs were subjected to a repeated-measures ANOVA with electrocutaneous stimulation (two levels: aversive electrocutaneous stimulation vs. no electrocutaneous stimulation) and facial expression type (three levels: painful vs. happy vs. neutral) as within subjects factors. Mean RTs (SD) as a function of electrocutaneous stimulation and facial expression type are presented in **Table 2**.

There was a significant main effect of electrocutaneous stimulation [$F(1,21) = 15.90$, $p = 0.001$, $\eta_p^2 = 0.43$] with faster RTs to targets preceded by aversive electrocutaneous stimulation ($M = 334.7$ ms, SD = 29.4) than to targets preceded by no electrocutaneous stimulation ($M = 345.0$ ms, SD = 30.8). There was no main effect of facial expression type [$F(2,42) = 0.20$, $p = 0.90$, $\eta_p^2 = 0.001$]. However, a significant interaction between electrocutaneous stimulation and facial expression type emerged [$F(2,42) = 4.57$, $p = 0.02$, $\eta_p^2 = 0.18$].

In order to address this significant interaction, an index of response facilitation was computed by subtracting mean RT to targets preceded by aversive electrocutaneous stimulation from RTs to targets preceded by no electrocutaneous stimulation. A *post hoc t*-test, comparing this index against zero (i.e., no response facilitation) indicated response facilitation for targets preceded by electrocutaneous stimulation following painful expressions [$M = 21.4$, SD = 24.2, $t(21) = 4.12$, $p < 0.001$, *Cohen's d* = 0.98]. However, following happy [$M = 8.1$, SD = 20.5, $t(21) = 1.81$, $p = 0.08$, *Cohen's d* = 0.40] and neutral expressions [$M = 1.2$, SD = 20.8, $t(21) = 0.28$, $p = 0.78$, *Cohen's d* = 0.06] no significant response facilitation emerged (**Figure 2**).

The observed facilitation of responses in trials with painful expressions was significantly different from trials with neutral expression [$t(21) = 2.76$, $p = 0.01$, *Cohen's d* = 0.59]. There was no such a difference between trials with happy expressions and neutral expressions [$t(21) = 1.31$, $p = 0.21$, *Cohen's d* = 0.28], nor between painful expressions and happy expressions [$t(21) = 1.75$, $p = 0.09$, *Cohen's d* = 0.37].

Inclusion of PCS or FPQ as centered covariate into the ANOVA described above did not change the reported pattern of results and did not reveal any new main effect or interaction.

Pain Rating

Table 3 provides an overview of mean (SD) ratings of painfulness, intensity and unpleasantness separately for each facial expression type.

Ratings of painfulness, intensity, and unpleasantness were subjected to three separate repeated measures ANOVAs with facial expression type (three levels: painful, happy, neutral) as within-subjects factor.

For painfulness ratings, the main effect of facial expression type shows a trend toward significance [$F(2,42) = 2.81$, $p = 0.07$, $\eta_p^2 = 0.12$). Mean painfulness ratings were higher following painful expressions ($M = 5.81$, SD = 1.9) than following happy expressions ($M = 5.18$, SD = 2.4) [$t(21) = 2.08$, $p = 0.05$, *Cohen's d* = 0.44]. There were no significant differences between painfulness ratings following neutral expressions ($M = 5.55$, SD = 1.9) and either happy [$t(21) = 1.40$, $p = 0.18$, *Cohen's d* = 0.30] or painful expressions [$t(21) = 1.14$, $p = 0.27$, *Cohen's d* = 0.24].

For intensity ratings, the effect of facial expression type did not reach statistical significance [although it showed a trend: $F(2,42) = 2.69$, $p = 0.09$, $\eta_p^2 = 0.11$]. Mean intensity ratings were higher following painful expressions ($M = 5.68$, SD = 2.0) than following happy expressions ($M = 5.23$, SD = 2.3) [$t(21) = 2.08$, $p = 0.06$, *Cohen's d* = 0.43], though this comparison also did not reach significance. There were no differences between intensity ratings following neutral expressions ($M = 5.45$, SD = 2.1) and either happy [$t(21) = 1.31$, $p = 0.2$, *Cohen's d* = 0.28] or painful expressions [$t(21) = 1.23$, $p = 0.2$, *Cohen's d* = 0.26].

For unpleasantness ratings, there was no significant main effect of facial expression type [$F(2,42) = 1.66$, $p = 0.26$, $\eta_p^2 = 0.13$].

Prime Awareness Check

Overall prime awareness was 37% which was not significantly higher than chance level (i.e., 33%), [$t(21) = 1.54$, $p = 0.14$, *Cohen's d* = 0.36], suggesting that on average participants were not aware of whether a painful, happy, or neutral expression was presented and that facial expressions were presented sub-optimally.

Discussion

In the current study, we aimed to investigate the effect of sub-optimally presented pictures of painful, happy and neutral facial

TABLE 2 | Reaction times in function of prime type (happy, neutral, or painful) and electrocutaneous stimulus presence (Yes or No).

		Reaction times				
Electrocutaneous stimulus present	**Prime type**	**Mean**	**Median**	**SD**	**Minimum**	**Maximum**
Yes	Happy	335.39	328.17	28.82	291.81	404.15
	Neutral	338.99	337.55	30.60	275.43	409.47
	Painful	329.78	325.95	29.54	273.43	401.52
No	Happy	343.54	346.80	26.32	305.05	404.11
	Neutral	340.25	341.15	25.73	282.30	394.94
	Painful	351.15	346.66	39.04	277.33	443.05

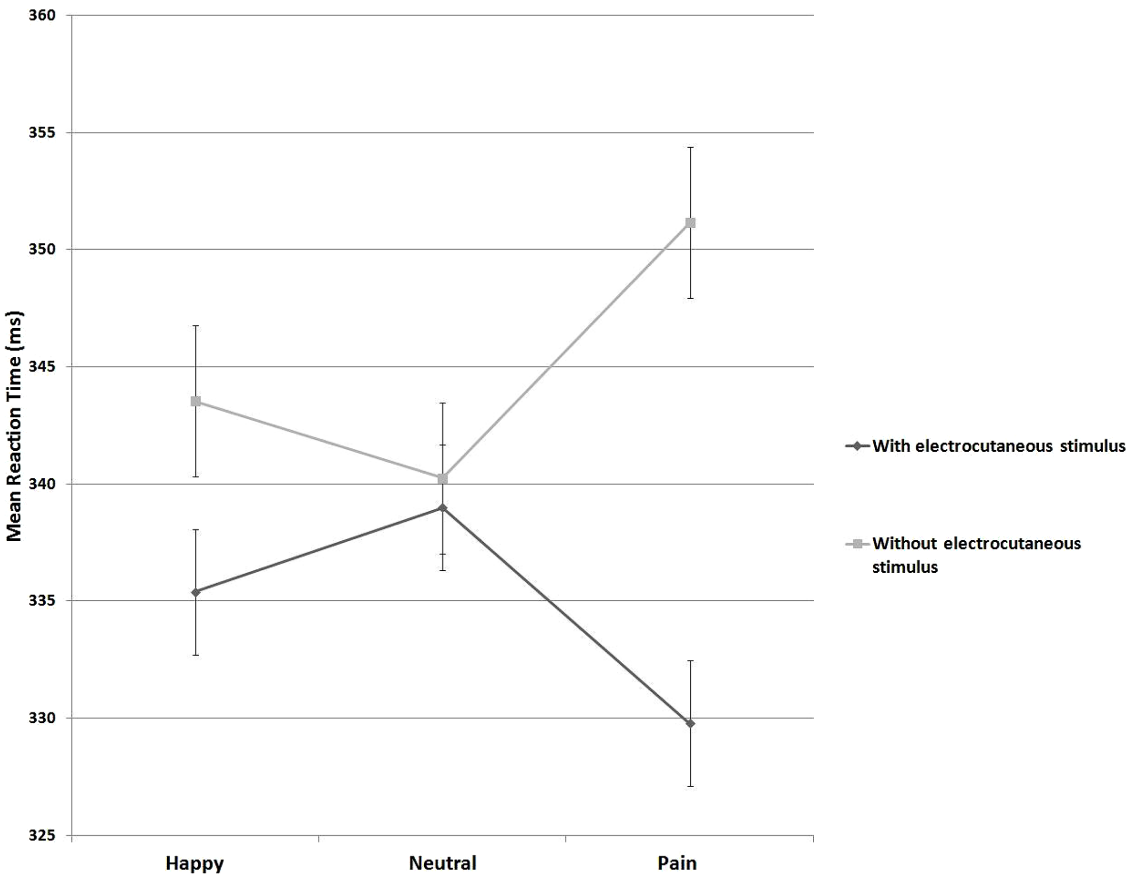

FIGURE 2 | Mean reaction times (RTs) on trials with and without electrocutaneous stimulus in three blocks with different primes (Happy, Neutral, Painful).

TABLE 3 | Participants mean ratings (*M* ± SD) of electrocutaneous stimulus after each block of the priming task (*N* = 22).

	Pain rating	Electrocutaneous stimulus intensity	Electrocutaneous stimulus unpleasantness
Prime type			
Painful	5.82 ± 1.94	5.68 ± 2.01	6.18 ± 1.82
Happy	5.18 ± 2.36	5.23 ± 2.31	5.72 ± 2.03
Neutral	5.55 ± 1.87	5.45 ± 2.06	6.00 ± 1.83

expressions on action readiness and ratings of painfulness, intensity, and unpleasantness of the electrocutaneous stimulation.

The results can be readily summarized. First, responses to non-pain-related targets were faster following electrocutaneous stimulation than when no stimulation was delivered, indicating enhanced readiness for action. Second, this response facilitation was greater when the electrocutaneous stimulus was preceded by a sub-optimally presented painful expression compared to happy or neutral expressions. Third, painfulness ratings were higher following painful expressions than following happy expressions.

Faster responses to targets preceded by aversive electrocutaneous stimulation than to targets not preceded by stimulation were taken to reflect improved action readiness following aversive tactile stimulation (cf. van Loon et al., 2010). This is in line with findings of a previous study which provided evidence in support of a hypothesis on a higher cortico-spinal excitability when observing unpleasant compared to pleasant or neutral stimuli, and no difference in the excitability when observing neutral compared to pleasant stimuli (van Loon et al., 2010). To our knowledge, our study is the first study investigating the effect of aversive electrocutaneous stimulation in combination with sub-optimal processing of painful and non-painful facial expressions on the observer's readiness for taking an action in an unrelated behavioral task. The observation of enhanced action readiness following aversive tactile stimulation is in line with the cognitive motivational priming hypothesis which predicts that when we encounter threat, a defensive system automatically increases our readiness to reduce the consequences of such an encounter (Lang, 1995). In a similar vein, it has been suggested that activation of low-level self-defensive mechanisms by perceived threat from electrocutaneous stimulation can activate brain areas responsible for preparation of an action (e.g., premotor cortex) through a projection from the brain areas involved in the affective evaluation of perceived stimuli (Buchel et al., 1998) which might lead to faster responses.

The present data revealed enhanced action readiness following the sub-optimal presentation of painful expressions. This finding might have implications for research on human empathy, suggesting that observation of pain in the facial expression of another person results in increased readiness in the observer for taking action. The facilitation in the responses is corroborated by the finding that empathic responses to painful facial expressions are primarily influenced by the threat value of pain, and that perceived threat encourages faster reactions (Yamada and Decety, 2009). Although previous studies have demonstrated the enhancing impact of clearly visible optimally presented painful facial expressions on action readiness (Vachon-Presseau et al., 2011, 2012; Mailhot et al., 2012; Khatibi et al., 2014), the present study is the first demonstration of the impact of sub-optimally presented painful facial expressions on action readiness. We used a masking paradigm to prevent the expressions from being fully consciously processed by the observer. Previous researches have shown that masked primes can be processed up to a semantic level (Van den Bussche and Reynvoet, 2007; Van den Bussche et al., 2009). In addition, it has been shown that processing of emotion in expressions is a rapid and automatic process which starts at the early stages of processing (Batty and Taylor, 2003; Ibanez et al., 2011). These authors also suggested that differentiation of different emotions in the expressions starts at those early stages of processing and is not limited to the processing at the strategic level.

Complementary to the literature and comparing findings of this study with previous studies which used emotional priming by presentation of emotional facial expressions at optimal processing condition may suggest that conscious processing of emotional (here painful and happy) facial expressions is not necessary for the semantic processing of those expressions. Accordingly, we can assume that the presentation of painful facial expressions under a condition of restricted awareness in our study did not interfere with the processing of the threatening value of these expressions by observers, although the subjects were not able to consciously report or identify them. In line with the literature our observation suggests that the processing of (threat in) painful facial expressions does not need to be performed at a fully conscious level to influence the observer's subsequent actions and that even sub-optimally presented facial stimuli can improve the readiness for an action in the observer.

It should be noted that RTs on trials with painful expressions and electrocutaneous stimulation were faster than on trials with painful expressions but without electrocutaneous stimulation (this difference for the other two types of expressions did not reach significance). The observed interaction between the effect of processing of pain in others and processing of an electrocutaneous painful stimulus can be further explained in the light of theories on the empathy. These theories hypothesize that one of the functions of empathy in human is toward the preparation of the person for coping with potential demands of the situation (Preston and de Waal, 2002). It has been shown that the processing of visual cues which signal the presence of an impending threat can activate defensive mechanisms which prime motor responses (Mulckhuyse and Crombez, 2014). Previous studies also suggested that observation of pain in facial expressions of others can be seen as a signal for an impending threat (Williams, 2002). In addition, a congruent presentation of a visual cue, which signals threat, with a somatosensory cue (electrocutaneous stimulation) improves subjects' readiness for taking an action (Mulckhuyse and Crombez, 2014). One possible but still speculative explanation about the observed interaction is that painful facial expressions increased readiness for taking an action and when it is paired with aversive electrocutaneous stimulation resulted in increased excitability and thus faster responses through the congruency between visual cue and sensory cue (Mulckhuyse and Crombez, 2014). On the other hand, the absence of aversive electrocutaneous stimulation after painful facial expressions makes this condition an incongruent condition. This means that the readiness state activated by observation of pain in others needs to be suppressed because anticipation for electrocutaneous stimulation following the processing of the expression was not validated. This would inhibit the activated excitation to bring the response system back to its pre-activation level, resulting in slower responses.

Our results showed that participants' painfulness ratings were slightly higher following painful expressions than following happy expressions. This finding is in line with previous studies demonstrating that pain perception can be influenced by observation of pain in others (Vachon-Presseau et al., 2011; Mailhot et al., 2012; Reicherts et al., 2013; Khatibi et al., 2014). It is suggested that activation of the brain during the observation of pain in others is similar to the brain's response to the first hand experience of pain (Botvinick et al., 2005; Saarela et al., 2007). It has been suggested that activation in brain areas in response to the observation of pain in others may facilitate processing of pain in the observer which can result in higher pain perception in the observer (Vachon-Presseau et al., 2011; Mailhot et al., 2012). However, this explanation is based on findings of behavioral and neuropsychological studies and none of previous studies directly tested this hypothesis. Future brain imaging studies may help us to test this in a more direct manner.

Some study limitations and suggestions for future research should be noted. First, our participants rated the electrocutaneous stimuli retrospectively following each block of trials. Retrospective ratings are more prone to be influenced by memory bias than online ratings upon stimulation (Redelmeier and Kahneman, 1996). Second, our sample mainly composed of female participants. A larger and more (gender) balanced sample would be helpful to explore the generalizability of our results. Third, although problems related to the physical and psychological health (such as chronic pain problems or history of mental disorders) were considered as exclusion criteria, we did not include specific measures to test them in our subjects. Future studies may benefit from these measures to have a more homogenous sample. Fourth, in the current experiment we only included emotional expressions related to pain and not to other negatively valenced stimuli. Although some previous studies have shown that observation of other negative emotions (such as sad faces) can increase pain perception (Bayet et al., 2014), but it is not investigated whether they can influence action

readiness or not. This is something that needs to be investigated in future research to test the specificity of the effect we observed in the current study. Finally, action readiness was assessed for simple classification responses. This task does not represent an approach or avoidance oriented action. The literature of research on the empathy has widely discussed the importance of observation of emotion in others and selection of approach oriented action (altruistic behavior) or avoidance oriented action (defensive behavior; Preston and de Waal, 2002). Activation of any of these two mechanisms is dependent upon a number of other factors (e.g., the relationship between the observed person and the observer, contextual factor, and etc). Future studies should use more complex tasks to investigate the effect of the observation of painful facial expressions on the performance in more cognitive demanding situations and to differentiate its effect on the activation of approach or avoidance oriented actions.

Conclusion

Sub-optimal presentation of painful facial expressions facilitated observers' responses on a non-pain-related behavioral task when these expressions were followed by electrocutaneous stimulation. Furthermore, the painful expressions increased participants' perception of painfulness of the electrocutaneous stimulation. This is in accordance with literature on the vicarious facilitation of responses and shows that this facilitation can also occur under sub-optimal observation conditions.

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Supplementary Material

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/article/10.3389/fpsyg.2015.00913

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An experimental examination of catastrophizing-related interpretation bias for ambiguous facial expressions of pain using an incidental learning task

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Individuals with pain-related concerns are likely to interpret ambiguous pain-related information in a threatening manner. It is unknown whether this interpretation bias also occurs for ambiguous pain-related facial expressions. This study examined whether individuals who habitually attach a catastrophic meaning to pain are characterized by negative interpretation bias for ambiguous pain-related facial expressions. Sixty-four female undergraduates completed an incidental learning task during which pictures of faces were presented, each followed by a visual target at one of two locations. Participants indicated target location by pressing one of two response keys. During the learning phase, happy and painful facial expressions predicted target location. During two test phases, morphed facial expressions of pain and happiness were added, equally often followed by a target at either location. Faster responses following morphs to targets at the location predicted by painful expressions compared to targets at the location predicted by happy expressions were taken to reflect pain-related interpretation bias. During one test phase, faces were preceded by either a safe or threatening context cue. High, but not low, pain-catastrophizers responded faster following morphs to targets at the location predicted by painful expressions than to targets at the other location (when participants were aware of the contingency between expression type and target location). When context cues were presented, there was no indication of interpretation bias. Participants were also asked to directly classify the facial expressions that were presented during the incidental learning task. Participants classified morphs more often as happy than as painful, independent of their level of pain catastrophizing. This observation is discussed in terms of differences between indirect and direct measures of interpretation bias.

Keywords: painful facial expressions, interpretation bias, indirect measures, incidental learning task, direct measures, pain catastrophizing

INTRODUCTION

Pain-related behaviors, such as facial expressions, provide information about one's current feelings and situation to others (Williams, 2002). However, pain behavior can be ambiguous, not always providing a clear signal of pain or somatic threat (Pincus and Morley, 2001). Interpreting ambiguous pain signals in a threatening manner might be adaptive, as it reflects early threat detection and facilitates fast action when needed (Ohman and Mineka, 2001). However, in some conditions, such negative interpretation bias might lose its functional value (Vancleef et al., 2009). Especially relevant to pain and maladaptive pain responding is whether negative interpretation bias of ambiguous pain behavior depends on the meaning attached to pain. It has been suggested that individuals who habitually attach a catastrophic meaning to pain perceive others' pain as more intense, and feel more distress when observing others in pain than individuals who catastrophize less about pain (Sullivan et al., 2006; Goubert et al., 2011). Biased interpretation of ambiguous pain-related information, such as words related to pain and somatic threat, has found to be associated with individuals' levels of pain-related anxiety, pain catastrophizing, and pain-related fear in healthy individuals (Pincus and Morley, 2001; Keogh and Cochrane, 2002; McKellar et al., 2003; Vancleef et al., 2009). In the current study, we investigated biased interpretation of ambiguous pain-related facial expressions (i.e., morphed facial expressions of pain and happiness) in healthy volunteers, taking individual differences in level of pain catastrophizing into account.

Besides the observer's level of pain catastrophizing, interpretation bias regarding others' pain behavior might also depend on available context information. It has been shown that the processing of facial expressions is influenced by emotional context information (De Gelder et al., 2006). Furthermore, healthy individuals' tendency to classify ambiguous pain-related facial expressions as painful has shown to be especially enhanced when these expressions are preceded by negative priming words (Yamada and Decety, 2009). Therefore, a second aim of the current study

was to examine the influence of physically threatening contextual information on interpretation bias for ambiguous facial expressions.

Direct measures of interpretation bias, such as direct classification tasks, have frequently been used in the study of cognitive biases related to pain and threat (e.g., Richards et al., 2002; Liossi et al., 2012), but also have been criticized. One of the problems with the direct measures is their susceptibility to self-presentation biases (Nisbett and Wilson, 1977; Hirsch and Mathews, 1997). Indirect measures of interpretation bias avoid this problem by inferring interpretations from behavioral response patterns. Therefore, we applied an indirect task, and more specifically an incidental learning paradigm (cf. Yoon and Zinbarg, 2008) in addition to a direct classification task, to examine interpretation bias for pain-related ambiguous facial expressions. This is the first published study that uses the incidental learning task to examine pain-related interpretation bias.

In sum, we hypothesized that healthy individuals, and especially high pain catastrophizers, interpret morphed facial expressions of pain and happiness in a negative, pain-related manner. We further hypothesized that this bias will be enhanced when morphs are presented in a threatening context.

METHODS

PARTICIPANTS

Sixty-four Dutch-speaking female undergraduates from the University of Leuven took part in this study. Exclusion criteria were history of chronic pain, presence of acute pain, and uncorrected visual problems. Three participants were excluded from further analyzes because their dataset was incomplete due to technical problems. The final sample consisted of 61 participants (mean age = 18.37 years, $SD = 0.7$).

Groups representing high ($n = 29$) and low ($n = 32$) pain catastrophizers were formed based on the final sample's median score (17) on the Pain Catastrophizing Scale (see Sections Pain Catastrophizing Scale and Apparatus). The high pain catastrophizers' mean PCS score (25.9; $SD = 6.3$) was in the 9th decile of norm scores for female, Belgian, Dutch-speaking undergraduate students; the low catastrophizers' mean PCS score (11.4; $SD = 5.0$) was in the 3rd decile of these norm scores (Van Damme et al., 2000).

The experiment was approved by the ethical committee of the faculty of psychology, University of Leuven, Belgium. All participants took part based on informed consent, in exchange for a course credit or money (7€).

PAIN CATASTROPHIZING SCALE

Participants completed the Dutch version of the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995; Van Damme et al., 2000). The PCS consists of 13 items describing different thoughts and feelings that may be associated with pain. Participants indicate the degree to which they have each of those feelings or thoughts on a 5-point Likert scale (0 = not at all; 4 = all the time). We calculated a total PCS score with a range of 0-52 by summing the 13 item scores. Higher total scores reflect higher levels of pain catastrophizing. In our final sample PCS total scores ranged between 0-42 (mean = 18.1, $SD = 6.3$). The psychometric properties of the Dutch version of the PCS have been approved for different populations (reported Cronbach's Alpha in Dutch-speaking population >0.85, Van Damme et al., 2000).

STIMULUS MATERIALS

Pictorial face stimuli

Pictorial face stimuli were presented during the incidental learning task (see Section Incidental Learning Task) and the direct classification task (see Section Direct Classification Task). Colored photographs (height 6 cm × width 4.5 cm) of happy and painful facial expressions from 54 actors (30 male; young Caucasian adults and racially congruent to the participants) were obtained from two databases (Roy et al., 2007; Langner et al., 2010). On all photographs, head and eye-gaze were directed forward and the head filled most of the picture. All images had the same size and the relative size of head was the same for all images. Non-facial features were removed and replaced with a uniform gray background, because this information might distract from expression processing (Nusseck et al., 2008).

A pilot study with 20 female undergraduates (mean PCS = 17.7, $SD = 5.9$; mean age = 18.4, $SD = 0.6$) from the same population as the experimental sample (but who did not take part in the actual experiment) was conducted to select the face stimuli. During this pilot study, participants rated 180 face stimuli on four different scales (Simon et al., 2008): the intensity of *happiness* in the expression on a 6-point Likert scale (0 = not happy at all; 5 = extremely happy), the intensity of *pain* in the expression on a 6-point Likert scale (0 = not painful at all; 5 = extremely painful), the extent of *pleasantness* of the expression on a 9-point Likert scale (−4 = extremely unpleasant; 4 = extremely pleasant), and the extent of *arousal* of the expression on a 9-point Likert scale (−4 = completely calm; 4 = extremely aroused). Based on these ratings (data provided in Table S1, online only), 16 painful and 16 happy expressions from 32 actors (16 females; eight male and eight female actors expressed pain; the other half of the actors expressed happiness) were selected to be presented as prototype (unmorphed) expressions during the actual experiment. Sixteen morphed expressions were created by morphing the pictures of 16 painful and 16 happy expressions from 16 other actors (all white Caucasians; eight females), using Fanta-Morph software (Delux, 3.4.2[1]). More specifically, for each actor, a painful expression was paired with a happy expression. For each of the resulting 16 pairs, the software produced 60 frames (transition from painful to happy expression) from which five different frames were selected, each consisting of a similar amount (percentage) of painful and happy expression. In the process of creating and selecting the morphs 10 experts in the coding of facial expressions (FACS coding) were asked for their independent opinion and expert view. They were asked to select for each of the 16 pairs the most ambiguous morph out of the five created morphs and to rate its perceptual quality on a 5-point Likert scale (0 = Very poor, 4 = Very good). The morphs selected by at least half of the experts, as being the most ambiguous morph for that specific pair, and

[1] http://www.fantamorph.com

with sufficient quality (mean rating = 3.66, $SD = 0.35$) were selected for the present study. Examples of the selected stimulus materials are presented as Supplementary Materials (Figure S1; online only).

Finally, all participants of the actual experiment rated at the end of the experimental lab session the ambiguity of all facial stimuli that were presented during the interpretation bias tasks (see Section Procedure) on a 100 mm VAS (1 = "minimum level of ambiguity" anchored on the left, 10 = "maximum level of ambiguity" anchored on the right). Morphs were rated as more ambiguous (mean = 6.15, $SD = 1.9$) than happy expressions [mean = 1.34, $SD = 0.6$, $t_{(60)} = 20.55$, $p < 0.001$] and painful expressions [mean = 1.57, $SD = 0.7$, $t_{(60)} = 18.86$, $p < 0.001$]. There was no significant difference between high and low pain catastrophizers' rating of ambiguity in morphed expressions [High PCS: mean = 6.18, $SD = 1.9$; Low PCS: mean = 6.11, $SD = 1.8$; $t_{(59)} = 0.13$, $p = 0.9$]; happy expressions [High PCS: mean = 1.43, $SD = 0.7$; Low PCS: mean = 1.26, $SD = 0.4$; $t_{(59)} = 1.18$, $p = 0.2$] and painful expressions [High PCS: mean = 1.46, $SD = 0.7$; Low PCS: mean = 1.66, $SD = 0.8$; $t_{(59)} = 1.05$, $p = 0.3$].

Context cues

Context cues were presented during the incidental learning task (see Section Incidental Learning Task). Context cues were 16 colored photographs (height 4 cm × width 6 cm) of which eight of them depict a hand in a physically threatening situation, and eight a hand in a nonthreatening situation as obtained from a database developed by Jackson et al. (2005). Threatening and non-threatening context cues were matched in terms of positioning and background. This selection was based on threat ratings on a 10-point Likert scale as provided with the original database (by Jackson et al., 2005). For the threat-related photos, threat ratings were between 5.6 and 7.5 (mean = 6.22, $SD = 0.67$) and for non-threatening photos less than 0.18 (mean = 0.06, $SD = 0.04$). Examples of contextual cues are presented as Supplementary Materials (Figure S2; online only 2).

INTERPRETATION BIAS TASKS

Incidental learning task

General. The incidental learning task (cf. Yoon and Zinbarg, 2008) consisted of three phases: a learning phase and two testing phases (**Figure 1**). During the learning phase, unmorphed painful and happy expressions were presented one by one, followed by a target at one of two predefined locations. Expression type predicted the target's location and participants were expected to learn this association. During the testing phases, morphed facial expressions were presented in addition the unambiguous happy and painful expressions. The rationale behind the incidental learning task is that following the presentation of a morphed facial expression, participants respond faster to targets at the location predicted by painful expressions if they interpreted the expression as painful. On the other hand, they are expected to respond faster to targets at the location predicted by happy expressions if they interpreted the morphed expression as happy. So, faster reactions following morphed expressions to targets at the location predicted by painful expressions in comparison with the location predicted by happy expressions were taken as indicative of pain-directed interpretation of morphed facial expressions.

Learning phase (Figure 1; left panel). During the learning phase, each trial started with a black central fixation cross on a gray background and two square position markers (black frames, 1 × 1 cm), one at the left and one at the right of the fixation cross. The inner edge of the target position-marker distanced 12 cm (horizontal axis) from the fixation cross. The fixation cross was presented for 500 ms and then replaced by an unambiguous happy or painful facial expression. This expression was presented for 675 ms and was immediately followed by a target letter "H" (0.85 × 0.85 cm). For half of the participants, (1) happy expressions were followed by a target at the left side of the fixation cross in 80% of the trials (i.e., *location predicted by happy expressions*) and at the right side in 20% of the trials (i.e., *location predicted by painful expressions*) and (2) painful expressions were followed by a target at the right of the fixation cross in 80% of the trials (i.e., *location predicted by painful expressions*) and at the left side in 20% of the trials (i.e., *location predicted by happy expressions*). For the other participants, right target location was predicted by happy expressions and left target location by painful expressions. Participants' task was to indicate on each trial the target's position as quickly and accurately as possible, by pressing the corresponding key on the response box (i.e., left key to left target; right key to right target). So, for half of the participants the left key was associated with responses to targets at the location predicted by happy expressions and the right key with responses to targets at the location predicted by painful expressions; for the other participants this mapping was reversed. As soon as a response was given, or after 3000 ms, the screen was refreshed and the next trial was started. The learning phase consisted of two blocks, each consisting of 32 trials (16 happy and 16 painful expressions). Each individual expression was presented twice, once during each trial block. Trials were presented in a different random order for each participant.

Test phase without context cues (Figure 1; middle panel). The test phase without context cues was similar to the learning phase, except that 16 morphed expressions were presented, equally often followed by a target at the left or the right side of the screen—together with eight happy expressions, always followed by a target a the location predicted by happy expressions during the learning phase, and with eight painful expressions, always followed by a target a the location predicted by painful expressions during the learning phase. These painful and happy expressions were randomly chosen from the 32 expressions that were presented during the learning phase and were the same for all participants. The trials with painful and happy expressions served as additional learning/retention trials. The test phase without context cues consisted of one block with 32 trials (16 morphs, eight happy, eight painful). Each individual expression was presented once. Trials were presented in a different random order for each participant.

Test phase with context cues (Figure 1; right panel). The test phase with context cues only differs from the one without context cues in that after 500 ms, the fixation cross was first replaced by a

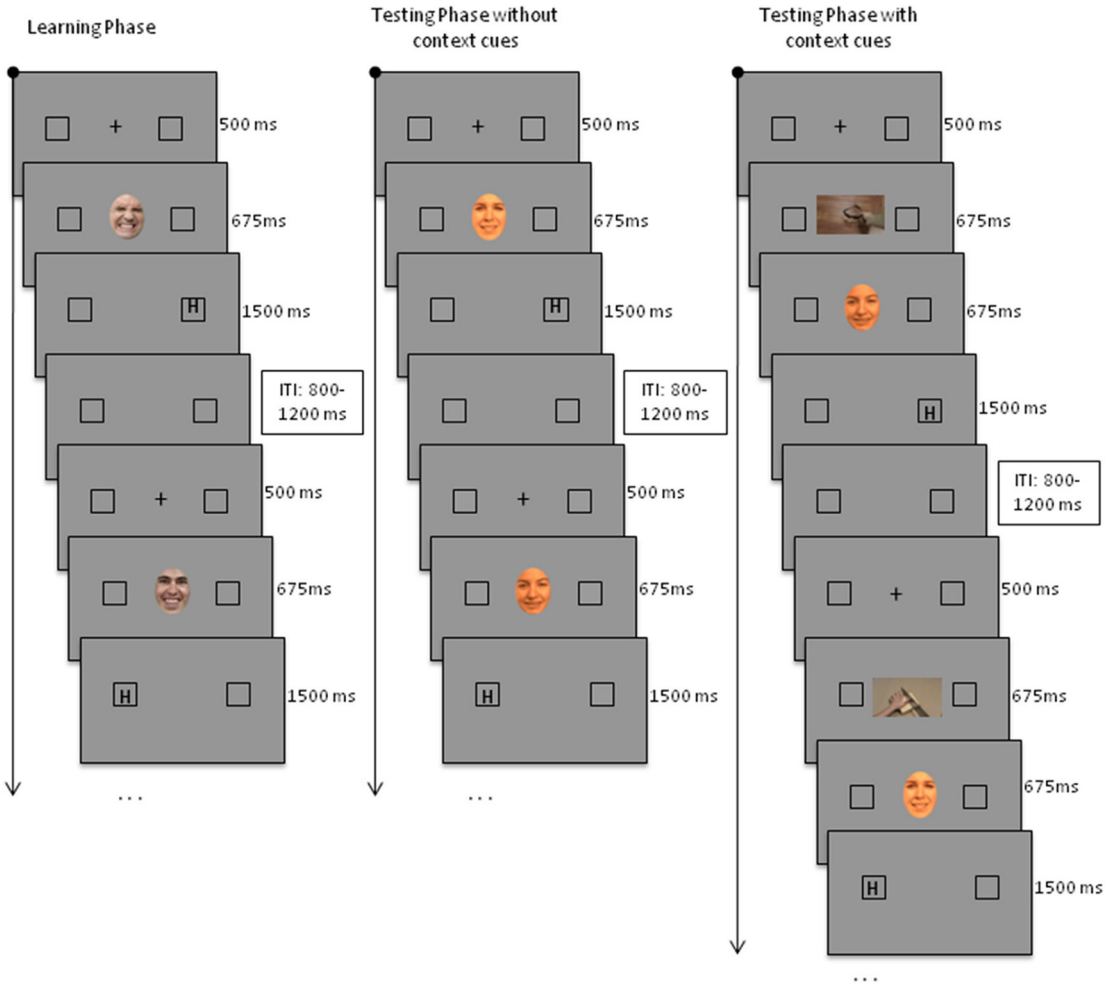

FIGURE 1 | Typical trial configuration for the learning and testing phases of the incidental learning task.

context cue (i.e., picture of hand in either a threatening or non-threatening situation). After 675 ms, the context cue was replaced by the facial expression. The rest of the trial was the same as for trials during the test phase without context cues. The test phase with context cues consisted of two blocks, each consisting of 32 trials (16 morphs, eight happy, eight painful). Each individual expression was presented twice, once preceded by a threatening cue and once by a non-threatening cue. Trials were presented in a different random order for each participant.

Direct classification task

Each trial of the direct classification task (Liossi et al., 2012) started with a fixation cross at the center of the computer screen. The cross was presented for 500 ms and then replaced by a happy, painful, or morphed facial expression. Each facial picture was presented for 675 ms and then replaced by two Dutch words, one besides the other, representing the two choice alternatives ("Painful" and "Happy"). All 32 photos that were presented during the testing phases of the incidental learning task were presented once, in a different random order for each participant. Participants' task was to indicate whether the facial expression was a happy or a painful one, by pressing the spatially corresponding response key on the response box. The position of the choice alternatives on the screen, and so the assignment of the response keys, was counterbalanced between participants. A higher number of morphs classified as painful than as happy is considered to reflect a negative interpretation bias.

APPARATUS

Task presentations, and logging of button presses were controlled by a Dell Optiplex 755 computer (OS: windows XP; 2 GB RAM; Intel Core2 Duo processor at 2.33 GHz; ATI Radeon 2400 graphics card with 256 MB of video RAM), running Affect 4.0 software (Spruyt et al., 2010) and connected to a 19" CRT DELL monitor (75 Hz vertical refresh rate; refresh duration: 13.3 ms/frame, image resolution 1280 × 1024), and a two button response box (via parallel port).

PROCEDURE

Participants were individually tested in a dimly lit testing room. They were informed that the experiment targeted the relationship between concentration and performance and signed the

informed consent form. They were seated in front of the computer screen (viewing distance ≈ 60 cm). So the visual angle of the facial expressions to be presented on the computer screen was ∼5.7° (vertically) and ∼4.3° (horizontally), and of the context cues ∼3.8° (vertically) and ∼5.7° (horizontally). Participants positioned their hands on the response box, with their right index finger on the right response key and the left index finger on the left response key.

Then instructions for the incidental learning task were given. Participants were not informed about the to-be-learned associations. They were informed that the task would be followed by questions regarding the faces presented during the experiment. If all instructions were clear, the incidental learning task was started, with the learning phase followed by the two test phases (one without and one with context cues). The order of the test phases was counterbalanced between subjects. After each block of trials there was a short break during which participants were given the opportunity to relax and close their eyes for a minute.

After completion of the incidental learning task, the following questions were presented one by one: (1) *What different facial expressions did you see?* (2) *During the previous task you saw pictures of hands in different situations. Those situations can be divided into two or more general categories. To what different categories did the observed situations belong?* (3) *When a HAPPY face was presented, did the letter "H" more often appear on the right, more often on the left, or as often on either location?* and (4) *When a PAINFUL face was presented, did the letter "H" more often appear on the right, more often on the left, or as often on either location?* Whether participants were aware of the to-be-learned contingency between cue type (expression) and target location was derived from their answers to the third and fourth question.

After this assessment, all participants performed the direct classification task. Since performing the direct classification task could influence learning during the incidental learning task, the order of incidental learning task and direct classification task was not counterbalanced.

Finally, participants were asked to rate the ambiguity of the facial stimuli used in both interpretation bias tasks. See also Section Pictorial Face Stimuli.

Two days after the lab session, participants were invited by Email to complete as soon as possible but within 2 days via a secure online survey system a battery of questionnaires (EFS online survey), including demographical questions (e.g., age) and the Dutch version of the PCS. As soon as they had completed the questionnaires, participants received their compensations. When the data of all participants were collected, participants were informed about the experimental details and the aims of the study.

RESULTS

INCIDENTAL LEARNING TASK

Data preparation

Trials with incorrect responses were excluded from final analyzes. Trials with correct responses deviating more than 2.5 SDs from the individual's mean correct RT (per phase) were considered RT outliers and were also excluded. Percentages of excluded responses (% incorrect responses based on all responses; % RT outliers based on all correct responses) are reported at the beginning of each section, for each phase separately. The reported analyzes are on mean correct RTs after exclusion of outlier responses.

Learning phase

During the learning phase, 4.2% of the responses were excluded (1.7% incorrect responses; 2.5% RT outliers). Mean RTs (**Table 1**, top rows) were subjected to an ANOVA with expression type (2: painful vs. happy) and target location (2: location predicted by painful expressions vs. location predicted by happy expressions) as within-subjects factors and PCS group (2: high vs. low) as between-subjects factor. As expected, there was a significant expression type × target location interaction, $F_{(1,\ 59)} = 18.0$, $p < 0.001$, $\eta_p^2 = 0.23$, suggesting that participants learned the association between expression type and target location. Following painful expressions, RTs were significantly faster to targets at the location predicted by painful expressions than to targets at the location predicted by happy expressions, $t_{(60)} = 4.1$, $p < 0.001$, *Cohen's* $d = 0.8$. Following happy expressions, RTs were somewhat faster to targets at the location predicted by happy expressions than to targets at the location predicted by painful expressions, though non-significantly so, $t_{(60)} = 1.0$, $p = 0.3$, *Cohen's* $d = 0.01$. There was no other significant effect, indicating that the learning effect did not depend on participants' level of catastrophizing.

Since a number of learning theorists emphasize the importance of contingency awareness (e.g., Mitchell et al., 2009), we decided to include contingency awareness as a between subjects factor in the analyzes. This enables us to test whether learning the association between target location and type of facial expressions is influenced by the awareness of the contingencies between both stimuli. Forty-three participants of the final sample answered both the third and fourth awareness check question (see Section Procedure) correctly and were categorized as contingency aware (24 low-PCS; 19 high-PCS). The other participants answered both questions incorrectly and were categorized as contingency-unaware (8 low-PCS; 10 high-PCS)[2]. Adding awareness (2: cue-target contingency aware vs. unaware) as a between-subjects factor to the ANOVA with expression type, target location, and PCS group as factors revealed a significant interaction between expression type and target location, $F_{(1,\ 59)} = 15.6$, $p < 0.001$, $\eta_p^2 = 0.21$, that was no further modified by level of pain catastrophizing and/or awareness. Although the three-way interaction between expression type, target location, and awareness did not reach significance, $F_{(1,\ 57)} < 0.02$, $p = 0.96$, $\eta_p^2 < 0.001$, the interactions between awareness and expression type and between awareness and target location did, $F_{(1,\ 57)} = 5.0$, $p = 0.02$, $\eta_p^2 = 0.08$ and $F_{(1,\ 57)} = 8.3$, $p = 0.005$, $\eta_p^2 = 0.13$, respectively.

Therefore, we conducted the above mentioned ANOVA per contingency-awareness group. Contingency-*aware* participants

[2]Contingency aware and unaware participants did not significantly differ in pain catastrophizing, as suggested by a univariate ANOVA with PCS group (2: high vs. low PCS) and awareness (2: cue-target contingency-aware vs. contingency-unaware) as between-group factors and PCS total score as dependent variable [main effect awareness: $F < 1$; PCS group × awareness: $F < 1$; main effect of PCS group $F(1,\ 57) = 89.2$, $p < 0.001$, $\eta_p^2 = 0.61$].

Table 1 | Mean reaction times (ms; mean ± s.e.m.)[a] for each phase of the incidental learning task, separately for those scoring low and high on the Pain Catastrophizing Scale (PCS) and separately for those who were aware and unaware about the to-be learned contingency between expression and target location.

Phase	Context cue	Expression	Target location	Groups			
				Contingency aware		Contingency unaware	
				Low PCS	High PCS	Low PCS	High PCS
				n = 24	*n* =19	*n* = 8	*n* = 10
Learning	n/a	Painful	Location predicted by painful faces, not by happy faces	345.6 ± 12.3	353.8 ± 13.9	315.3 ± 21.4	349.7 ± 19.1
			Location predicted by happy faces, not by painful faces	364.4 ± 14.4	368.8 ± 16.2	370.6 ± 24.9	392.0 ± 22.3
	n/a	Happy	Location predicted by painful faces, not by happy faces	364.0 ± 14.1	373.2 ± 15.8	316.6 ± 24.4	344.5 ± 21.8
			Location predicted by happy faces, not by painful faces	351.5 ± 12.6	353.8 ± 14.2	323.1 ± 21.9	365.7 ± 19.6
Test without Context Cues	n/a	Morph	Location predicted by painful faces, not by happy faces	329.4 ± 8.7	320.1 ± 12.9	293.9 ± 17.3	330.9 ± 15.4
			Location predicted by happy faces, not by painful faces	322.1 ± 15.1	347.9 ± 17.0	306.8 ± 18.6	323.8 ± 16.7
Test with Context Cues	Non-threatening cues	Morph	Location predicted by painful faces, not by happy faces	343.7 ± 11.2	340.9 ± 12.5	328.0 ± 17.9	357.6 ± 16.0
			Location predicted by happy faces, not by painful faces	353.4 ± 14.8	342.7 ± 16.7	329.7 ± 17.3	365.1 ± 15.3
	Threatening cues		Location predicted by painful faces, not by happy faces	344.6 ± 12.1	335.1 ± 13.6	324.2 ± 18.7	347.9 ± 16.7
			Location predicted by happy faces, not by painful faces	341.7 ± 12.6	330.2 ± 14.2	317.3 ± 14.9	348.2 ± 13.3

[a] *Only correct RTs after exclusion of outlier responses were included.*

showed the expected interaction between expression type and target location $F_{(1,\ 42)} = 13.5$, $p = 0.001$, $\eta_p^2 = 0.24$, indicating that they learned the association between expression type and target location. Following painful expressions, they were significantly faster to targets at the location predicted by painful expressions than the other location $t_{(42)} = 2.6$, $p = 0.01$, *Cohen's* $d = 0.4$. Following happy expressions, they were significantly faster to targets at the location predicted by happy expressions than the other location, $t_{(42)} = 2.0$, $p = 0.05$, *Cohen's* $d = 0.3$. There was no other significant interaction or main effect $Fs < 1$, $ps > 0.5$.

Contingency *unaware* participants also showed an interaction between expression type and target location, $F_{(1,\ 17)} = 4.8$, $p < 0.04$, $\eta_p^2 = 0.22$ [superseding a main effect of target location, $F_{(1,17)} = 12.6$, $p = 0.002$, $\eta_p^2 = 0.43$]. Following painful expressions, they were faster to targets at the location predicted by painful expressions than the other location, $t_{(17)} = 3.48$, $p = 0.003$, *Cohen's* $d = 0.8$. Following happy expressions, they seemed to be faster to targets at the location predicted by happy expressions than the other location. However, this difference did not reach statistical significance, $t_{(17)} = 1.63$, $p = 0.12$, *Cohen's* $d = 0.4$.

In sum, these analyzes suggest a clear learning of the predictive value of expressions type, at least in contingency aware participants. The results suggest a less pronounced learning of the predictive value of expressions in contingency unaware participants.

Test phase without context cues

During the test phase without context cues, 2.2% of the responses were excluded (0.3% incorrect responses; 1.9% RT outliers). Mean RTs (**Table 1**, middle-rows) to targets following morphed expressions were subjected to an ANOVA with target location (2: location predicted by painful expressions vs. location predicted by happy expressions) as within-subjects factor and PCS group (2: high vs. low) as between-subjects factor. This analysis revealed no significant effects, $Fs_{(1,\ 59)} < 3.3$, $ps > 0.7$, $\eta_p^2 s < 0.05$. There was no significant correlation between interpretation bias score (i.e.,

mean RT to targets at the location predicted by happy expressions minus mean RT to targets at the location predicted by painful expressions) and total PCS score, $r_{(61)} = 0.14$, $p = 0.27$.

Adding awareness (2: cue-target contingency-aware vs. unaware) as between-subjects factor to the ANOVA with target location and PCS group as factors revealed a significant 3-way interaction between target location, PCS group, and awareness, $F_{(1, 57)} = 6.9$, $p = 0.01$, $\eta_p^2 = 0.09$. There was no other significant interaction or main effect $Fs < 1.6$, $ps > 0.2$.

For each awareness group separately, mean RTs to targets following morphed expressions were subjected to an ANOVA with target location and PCS group. For participants who were *contingency aware*, there was a significant interaction between target location and PCS group, $F_{(1, 41)} = 7.9$, $p = 0.007$, $\eta_p^2 = 0.16$ [main effects: target location $F_{(1, 41)} = 2.7$, $p = 0.11$, $\eta_p^2 = 0.06$; PCS group $F_{(1, 41)} < 1$]. In line with this finding, in contingency aware participants there was also a significant positive correlation between interpretation bias score and total PCS score, $r_{(43)} = 0.34$, $p = 0.02$, suggesting that higher levels of pain catastrophizing are associated with a more negative interpretation of ambiguous pain-related facial expressions.

As can be seen in **Figure 2**, among contingency aware participants, high pain-catastrophizers responded faster to targets at the location predicted by painful expressions as compared to targets at the location predicted by happy expressions, $t_{(18)} = 2.36$, $p = 0.03$, *Cohen's* $d = 0.34$, suggesting biased interpretation toward painful expressions. Low pain-catastrophizers showed no such a difference in their responses $t_{(23)} = 1.21$, $p = 0.24$, *Cohen's* $d = 0.15$. **Figure 2** also suggests that among contingency aware participants, high catastrophizers, as compared to low catastrophizers, were especially slow to targets at the location predicted by happy expressions (*Cohen's* $d = 0.35$) and that there was no such group difference in responses to targets at the location predicted by painful expressions (*Cohen's* $d = 0.17$). However, for neither target location, the group difference reached statistical significance [painful faces: $t_{(41)} = 0.54$, $p = 0.59$; happy faces: $t_{(23.6)} = 1.04$, $p = 0.31$, equality of variances not assumed]. For participants who were *unaware* of the contingency, the ANOVA with target location and PCS group revealed no significant effects, $F_{(1,16)}s < 2.6$, $ps > 0.13$, $\eta_p^2 s > 0.14$. This group showed also no significant correlation between interpretation bias score and PCS score, $r_{(18)} = 0.2$, $p = 0.15$.

Test phase with context cues

During the test phase with context cues, 2.8% of the responses were excluded from analysis (0.3% incorrect responses; 2.5% RT outliers). Mean RTs (**Table 1**, lower rows) to targets following morphed expressions were subjected to an ANOVA with target-location (2: location predicted by happy expressions vs. location predicted by painful expressions) and context cue (2: threatening vs. non-threatening) as within-subjects factors and PCS group (2: high vs. low) as between-subjects factor. Overall, responses were slower following non-threatening cues than following threatening cues, $F_{(1, 59)} = 6.0$, $p = 0.017$, $\eta_p^2 = 0.09$. There were no other significant effects: $Fs_{(1, 59)} < 2.5$, $ps > 0.1$, $\eta_p^2 s < 0.04$. Including awareness as additional factor revealed no further significant effects.

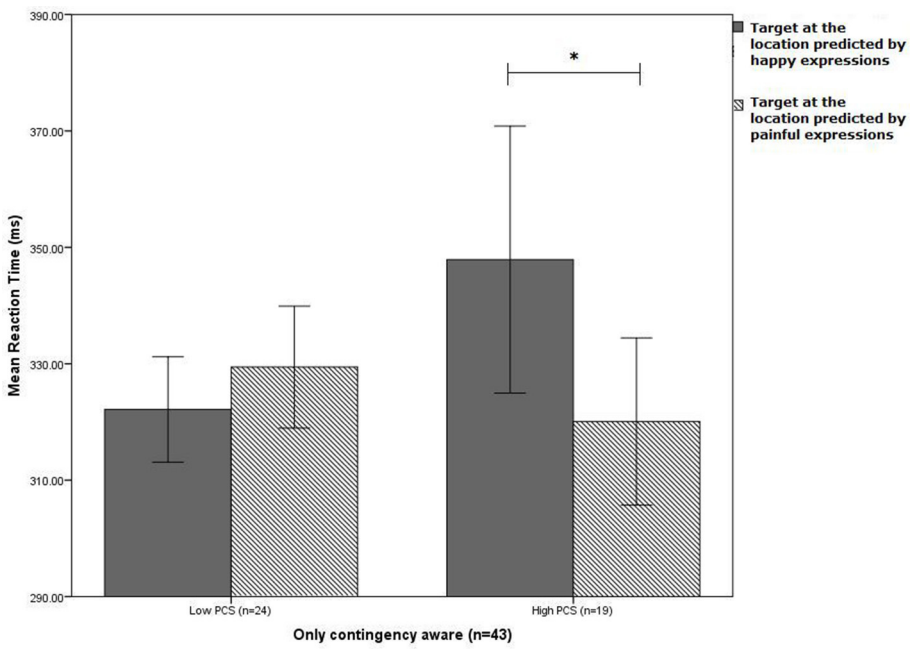

FIGURE 2 | Mean reaction time of participants scoring relatively low and high on the Pain Catastrophizing Scale (PCS) to targets following morphed expressions at the location predicted by painful and happy expressions (*$p < 0.05$, there was no trend or other significant difference) (error bars represent s.e.m.).

DIRECT CLASSIFICATION TASK

The prototype happy and painful faces were 100% correctly categorized. The number of morphs classified as painful or happy were subjected to an ANOVA with classification (2: classified as painful vs. happy) as within-subject factor and PCS group (2: high vs. low) as between-subjects factors. This analysis revealed a significant main effect of classification, $F_{(1, 59)} = 41.5$, $p < 0.001$, $\eta_p^2 = 0.4$, but no effect of PCS group [main effect PCS group: $F_{(1, 59)} < 1$; PCS group × classification: $F_{(1, 59)} < 1$]. As can be seen in **Table 2**, morphs were categorized nearly twice as often as happy than as painful, irrespective of pain catastrophizing level. There was no significant correlation between the percentage of morphed expressions classified as painful (vs. happy) and total PCS score, $r_{(61)} = 0.1$, $p = 0.5$. There was also no significant correlation between interpretation bias scores on the incidental learning task and percentage of morphed expressions classified as painful on the direct classification task, neither overall $r_{(61)} = -0.04$, $p = 0.8$, nor per PCS group or contingency awareness group $rs < 0.1$, $ps > 0.6$.

DISCUSSION

The primary objective of this study was to investigate whether healthy individuals, especially those with higher levels of pain catastrophizing, show a negative interpretation bias for ambiguous pain-related facial expressions. Secondly, the effect of threatening contextual information on individuals' interpretation of ambiguous expressions was evaluated. Interpretation bias was assessed using an indirect as well as a direct measure.

The results can be summarized as follows. *First*, following morphed expressions during the incidental learning task, and only among contingency-aware subjects, individuals with relatively high levels of pain catastrophizing responded faster to targets appearing at the location predicted by painful expressions than to targets at the location predicted by happy expressions, while this was not the case for the low pain catastrophizers. High pain catastrophizers were also slower in reacting to targets at the location predicted by happy expressions and slightly faster to targets at the location predicted by painful expressions, although neither of these two differences reached standard levels of statistical significance. *Second*, when contextual cues were included in the incidental learning task, there was no indication of interpretation bias. Overall responses were slower following presentation of non-threatening contextual cues than threatening contextual cues. *Third*, independent of their level of catastrophizing, participants classified the morphed facial expressions more often as happy than as painful.

Table 2 | Classifications of the 16 morphed expressions during the direct classification task separately for those scoring low and high on the Pain Catastrophizing Scale (PCS).

	Low PCS	High PCS
	***n* = 32**	***n* = 29**
Mean number of expressions classified as painful (±*SD*)	5.5 ± 2.9	5.4 ± 3.1
Mean number of expressions classified as happy (±*SD*)	10.2 ± 2.8	10.4 ± 3.2

The response pattern as shown by high catastrophizers during the incidental learning task can be taken to reflect a threat-related interpretation bias toward pain. This finding is in line with previous research showing that negative interpretation of bodily sensations is associated with higher levels of catastrophizing in healthy individuals (Vancleef and Peters, 2008). It is suggested that negative interpretation bias plays a role in the development of pain-related problems as seen in individuals with high levels of pain-related catastrophizing (Pincus and Morley, 2001).

It is noteworthy that in our study, the interpretation bias effect was observed only among participants with relatively high levels of pain catastrophizing who also reported awareness of the association between expression type and target location. Modern accounts of associative learning (Mitchell et al., 2009) and evaluative conditioning (Kattner, 2012), assume that contingency awareness is a prerequisite for learning to occur, and our findings are in line with this assumption. However, further studies are needed to further evaluate the effect and importance of contingency-awareness during incidental learning paradigms.

Our study extends previous research in at least two ways. *First*, it shows catastrophizing-related differences in interpretation of morphed painful expressions. Previous studies on pain-related interpretation bias primarily focused on the biased processing of ambiguous words related to pain and somatic threat (Edwards and Pearce, 1994; Pincus et al., 1994). The few studies on biased interpretation of ambiguous pain-related expressions (Yamada and Decety, 2009; Liossi et al., 2012) did not take into account the individual differences in the interpretation of ambiguous expressions in a pain-free population, and used only direct measures of interpretation.

Second, this study is to our knowledge the first in applying both an indirect and a direct measure to examine pain-related interpretation bias for the same stimulus material, in the same sample, and during the same session. Interestingly, those indirect and direct measures seemed to reveal different outcomes. During the direct classification task, participants classified morphed expressions more often as happy, suggesting a biased interpretation toward happy expressions independent of pain catastrophizing. This finding is in line with some previous observations, for example of mothers directly classifying ambiguous painful-happy expressions more often as happy than as painful (Liossi et al., 2012). In the incidental learning task, interpretation bias depended on subjects' level of catastrophizing (more negative interpretation of ambiguity among high catastrophizers and neutral interpretation among low catastrophizers). Structural differences between the direct classification task and the indirect incidental learning task might help to explain differences in results. Differences might for example be due to the participant's level of control on the outcome of the to-be-measured bias. The outcome of direct measures are directly based on participants' response, while in the indirect measures the responses will be derived from performance behavior (De Houwer and Moors, 2010). In experiments with direct measures it is easier for participants to be aware of the goal of research, as compared to

those with indirect measures. Being aware of crucial stimuli during direct measures does more likely change the subjects' attribute which might influence the performance during the task. Further research is needed to systematically study structural differences between direct and indirect measures of interpretation bias, the precise mechanisms that underlie them, and the characteristics of the interpretation biases that are captured.

When contextual cues preceded the expressions in the incidental learning task, there was no indication of expression-related and/or catastrophizing-related differences between responses to targets following morphed expressions at all. This observation corroborates to a certain extent a previous finding showing that healthy individuals' sensitivity to the presence of pain in ambiguous facial expressions is independent from the affective value of a prime (Yamada and Decety, 2009). However, the results of this previous study also showed that, in contrast to the present findings, the tendency to actually classify ambiguous pain-related facial expressions as painful is especially enhanced when these expressions are preceded by negative priming words. One possible but speculative explanation is that in the current study incidental learning effects were overridden by masking/priming effects by the contextual cues. Note that including contextual cues resulted in overall slower reaction times to targets and increased variance (**Table 1**). Finally, perceived direction of threat may have an influence on the priming of expressions by contextual cues. This is an interesting avenue for future studies to consider the effect of different pain reference frames (self vs. other) between contextual cues and ambiguous pain stimuli on interpretation bias.

A number of limitations should be acknowledged when interpreting the current findings. *First*, the present sample was female. Previous studies showed that there is a relationship between negative interpretation bias and measures of pain-related anxiety only among females and not males (Keogh et al., 2004). In this first study on catastrophizing-related interpretation bias for ambiguous pain-related facial expressions, with the incidental learning task, we wanted to avoid any influence of gender and therefore chose for a female-only sample. However, we also recognize that using a relatively homogeneous, female-only student sample limits the generalizability of results. It would therefore be valuable for further research to also consider samples of balanced gender and different age groups to strengthen the external validity of the findings. Replication of a similar experimental approach in a clinical sample would help us to understand the role of interpretation bias in chronic pain and dysfunctional pain behavior. *Second*, to test the main hypothesis of this study we only included painful-happy morphs. In order to study the content-specificity of the observed effects, other emotionally ambiguous expressions, such as morphs between happy expressions and expressions of negative emotions (e.g., anger, sadness) might be included. *Third,* pictorial face stimuli were carefully chosen and created based on ratings as delivered with the original databases, ratings by an independent group of participants drawn from the same population as the current sample, and ratings by experts in facial coding. The created morphs were also rated as ambiguous by the participants of the actual experiment (see Section Pictorial Face Stimuli). Future studies might prefer to use stimuli that are selected based on ratings in a bigger and more diverse sample, also taking individual differences among raters into account. It would also be valuable for future studies to have participants themselves rate intensity of emotions in the facial expressions and to also take into account other facial cues (e.g., age, race, sex). As an alternative approach, in order to avoid pre-selection of ambiguous stimuli based on subjective ratings, one might present morphs with different intensities of expressions and use a signal detection approach (as in Liossi et al., 2012) or derive psychophysical functions to examine the relationship between negative interpretation bias in ambiguous pain-related expressions and pain catastrophizing.

Taken together, to our knowledge this study is the first study that used an incidental learning task (in addition to a direct classification task) to investigate pain-related interpretation bias, and more specifically interpretation bias for ambiguous facial expressions in catastrophizing. The observed biased interpretation of ambiguous pain-related expressions is relevant in the context of observational learning and its presumed role in the development of pain problems. It has for example been suggested that a pain-related interpretation of ambiguous pain signals, as for example expressed by the behavior of others, is associated with the acquisition of pain-related fear in response to that painful expression (Goubert et al., 2011). Recent research shows that pain-free participants who observe others immersing their hand in assumed cold water, before performing the same immersion task themselves, express more pain-related fear and expect more unpleasant and intense pain when the color of the water is associated with painful rather than with neutral facial expressions (Helsen et al., 2012). This acquisition process is likely to be mediated by the interpretation of the model's expression. Further research is warranted to test these presumed causal mechanisms systematically.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://www.frontiersin.org/journal/10.3389/fpsyg.2014.01002/abstract

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Feel like you belong: on the bidirectional link between emotional fit and group identification in task groups

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Three studies investigated the association between members' group identification and the emotional fit with their group. In the first study, a cross-sectional study in a large organization, we replicated earlier research by showing that group identification and emotional fit are positively associated, using a broader range of emotions and using profile correlations to measure group members' emotional fit. In addition, in two longitudinal studies, where groups of students were followed at several time points during their collaboration on a project, we tested the directionality of the relationship between group identification and emotional fit. The results showed a bidirectional, positive link between group identification and emotional fit, such that group identification and emotional fit either mutually reinforce or mutually dampen each other over time. We discuss how these findings increase insights in group functioning and how they may be used to change group processes for better or worse.

Keywords: emotions, emotional fit, group identification, small group dynamics, longitudinal, structural equation modeling, multilevel models, path analysis

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Introduction

Partners of couples and other dyads who spend time together, and members of small groups, such as work and sport teams show higher emotional similarity than what would be expected by chance (George, 1990; Totterdell et al., 1998; Bartel and Saavedra, 2000; Totterdell, 2000; Barsade, 2002; Anderson et al., 2003; Gonzaga et al., 2007; Ilies et al., 2007; Tanghe et al., 2010). This similarity, or "emotional fit," may point to a shared perspective: emotions are appraisals of the (social) context, and emotional fit points to some sharing of appraisal (e.g., Parkinson, 1996; Fischer and Manstead, 2008; Mesquita et al., 2012; Elfenbein, 2014). For instance, anger signals that a person is unhappy with a situation, for which someone else is held responsible; in expressing anger, a person feels powerful and in control of the situation (Frijda et al., 1989; Kuppens et al., 2003). When two colleagues are angry because another colleague showed up late for a meeting, they interpret the situation similarly. Therefore, emotional fit stands for an alignment of interaction partners.

Individuals who are invested in their relationships and groups appear to have higher emotional fit. Indeed, in small group research, high identifiers' emotions were more related to the group average than were the emotions of low identifiers (Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010). One possible explanation is that high identifiers are more receptive to other group members' take on reality, and thus more readily adopt their emotions. This has been the most common interpretation of the link between group identification and emotional fit with the group; it suggests directionality *from*

group identification *to* emotional fit. However, most of the evidence merely establishes a correlation between group identification and emotional fit, without showing directionality of the process.

An alternative view would be that group identification is an outcome of emotional fit. In this case, experiencing emotions that are typical of the group would be the very reason to feel belonging. If emotions reflect people's position in the (social) world, then it would make sense that emotional similarity is an important ground for association with a group. For instance, feeling identified with Democrats may be largely based on feeling like a Democrat (Smith et al., 2007). It is plausible that individuals whose emotions resemble those of the majority of a group (In the 2008 elections, the Democrats were "hopeful," "energized," and "spirited," among others; Dance et al., 2009) may become attracted to this group, and attach greater importance to it; over time, this would lead to stronger connections with the other group members. Although previous research did establish the *association* between emotional fit and group identification, there is no research to date that documents how group identification *follows* emotional fit. In the current research, we go beyond the association between group identification and emotional fit, and investigate their mutual influence over time.

From Group Identification to Emotional Fit

Several researchers have suggested that group identification precedes emotional fit (Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010). There are two putative pathways (Haslam, 2004; Haslam et al., 2011). First, high identifiers pay more attention to other group members, because the group is very central to their identity. Therefore, high identifiers more readily pick up on (emotional) cues sent by other group members, and more readily adjust. Second, high identifiers who embody the group's values, goals, and possibly emotions, serve as models to the other group members. In this case, other members adjust their emotions to fit those of the high identifiers. Regardless of the pathway, the result would be that members' group identification predicts their emotional fit.

Evidence from correlational studies is consistent with this prediction, but does not address the direction of the link. For instance, in research with teams of nurses, accountants, or cricket players, commitment to the team predicted stronger emotional fit (Totterdell et al., 1998; Totterdell, 2000). Similarly, in teams of service employees, the emotions of high team identifiers were more closely linked to the emotions of their team than the emotions of low team identifiers (Tanghe et al., 2010). Furthermore, among self-identified Republicans and Democrats in the US, the emotions of those who were highly identified resembled the average emotional profile more than the emotions of those who were less identified (Smith et al., 2007).

To our knowledge, the only study that tested the direction of the link between group identification and emotional fit was done by Tanghe et al. (2010; Study 2). In this study, the authors manipulated both group identification and the group's emotions at the same time, and found that high identifiers adjusted their emotions more toward the emotions of the group than low identifiers. Although this study demonstrated a causal link from group identification to emotional fit, it suffered from limitations. First, group membership was only imaginary: the participants imagined being part of a team. Second, the manipulation of identification rather than identification *per se* may have introduced emotional fit: as part of the identification-manipulation, participants had to imagine that "they fit well with the team" (Tanghe et al., 2010, p. 349) and that "there was a good match between themselves and the other team members" (p. 349).

In sum, despite its theoretical appeal, evidence that group identification promotes emotional fit is limited. In the current research, we investigate the causal link from group identification to emotional fit longitudinally.

From Emotional Fit to Group Identification

Emotions may also be "the glue that sticks group members together" (Barsade and Gibson, 1998). Emotional fit itself may strengthen an individual's felt connection to the group, thus amounting to higher group identification. In this case, group identification would be an outcome rather than a precursor of emotional fit. Consistent with this idea, one study found that ingroup identification increased after individuals were either made happy about the ingroup or angry toward an outgroup (Kessler and Hollbach, 2005). Similarly, one's perceived fit with the emotions of other ingroup members led to stronger identification with the ingroup (Livingstone et al., 2011). These results suggest that group identification may be the result of emotional similarity between ingroup members, rather than merely its antecedent.

The findings on emotional fit are corroborated by a larger body of research showing that fit in other domains contributes to group members' identification. For instance, a meta-analysis on person-organization fit and work attitudes showed that employees' objective fit with the values, goals and personality characteristics that were central to their organization predicted their commitment to the organization (Verquer et al., 2003). Similarly, members' value fit predicted their identification with the group several weeks later (Meeussen et al., 2014). Finally, when members of minimal groups communicated their ideas about a subsequent negotiation, inducing shared cognition among group members, their group identification had increased at the end of the negotiation (Swaab et al., 2007). It is possible, therefore, that the relationship between emotional fit and group identification goes in the other direction, with fit leading to increased group identification. The current research investigates the causal link from emotional fit to group identification longitudinally.

The Current Research

In three field studies, we aimed to replicate and extend existing research on the association between group identification and emotional fit. The first study was meant to replicate the results from earlier cross-sectional research, using improved methods. The next two studies followed the direction of the relationship between group identification and emotional fit longitudinally, and tested whether either link is stronger than the other.

Study 1

The aim of the first study, a cross-sectional study with different teams of a large organization, was to replicate the positive association between group identification and emotional fit with the group found by earlier research (Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010) with stronger measures of emotions and emotional fit.

Method

Participants

Participants were 789 employees of a large, semi-governmental Belgian organization who were members of 85 teams, each consisting of 4–33 members ($M = 9.28$, SD = 4.91). Of the 789 participants, 491 were men (62%)[1]. Participants were on average 43.5 years old (SD = 9.73). They had been employed by the same organization for an average of 18 years (SD = 11.67), and had joined their current team for an average of 9.8 years (SD = 8.88). Since participants included both French-speaking and Dutch-speaking Belgians, the questionnaires were administered in French and Dutch respectively[2]. Participants completed the questionnaire in the language of their choice: 46% of the participants chose the French version ($n = 362$), and 54% the Dutch ($n = 427$).

Procedure

The current study was part of a larger research on "Diversity at the workplace" that took place in the organization. After the director of the organization had given his consent, we selected teams to be included in our study. Out of a list of all available teams, we selected the 122 that consisted of 25 employees or less[3], because we assumed that the employees of these teams would interact with each other. Team leaders of all 122 potential teams were contacted by phone; after several attempts, 15% of the team leaders ($n = 18$) could not be reached, and 2% ($n = 2$) declined. Of the remaining teams ($n = 102$), 84% ($n = 85$) participated in the study.

The team leaders received the number of French and Dutch questionnaires needed for their teams, and distributed them among the members. Employees who consented to partake in the study, completed the questionnaire individually during work hours; filling out the questionnaire took approximately 30 min. After completing the questionnaire, employees returned their completed questionnaires in a sealed envelope to their team leader. The team leaders collected the envelopes from all team members, and mailed them back to the researchers.

[1]One participant was dropped from the analyses because we had reasons to believe he faked his answers: (a) he reported to be sleeping at work, (b) he reported to have no colleagues, yet he also claimed responsibility for 80 employees, (c) he only used the extreme ends of the scales.

[2]The questionnaire was translated and back-translated from Dutch into French by a bilingual translator and checked by two researchers speaking both languages.

[3]Two of the teams in our final sample consisted of more than 25 team members, because they had grown since the team list was made.

Measures

Team identification

Team identification was measured by a seven item-scale (Cronbach's alpha = 0.73): four items were taken from the identification-scale by Ellemers et al. (1999) (e.g., "I identify with the other members of my team"), and three items from the identification-scale by Roccas et al. (2008) (e.g., "Other teams can learn a lot from our team."). Participants rated their agreement with each of the items on 5-point Likert scales ranging from 1 = *Totally disagree* to 5 = *Totally agree*. The mean rating of team identification across participants was 3.54 (SD = 0.65).

Emotional fit

Participants rated to what extent they experienced each of 24 emotions during the last month, when they worked together with the other members of their team. We expanded the commonly used list of affect items (e.g., nervous, enthusiastic; eight items; e.g., Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010), and added 16 emotion items to more fully reflect the emotion domain (Barrett et al., 2007; e.g., respect for my colleagues, ashamed of my group). Participants rated all emotion items on 5-point Likert scales ranging from 1 = *Very weak* to 5 = *Very strong*.

To measure participants' emotional fit with their team, we used profile correlations (cf. De Leersnyder et al., 2011). Profile correlations measure the co-occurrence of a range of emotions. They provide an objective measure of fit, since the patterns of individual group members and their group are based on different sources (Kristof-Brown et al., 2005). To calculate profile correlations, we correlated participants' own emotional pattern (across 24 emotions) with the average emotional pattern of their team, excluding their own values from this team average. Profile correlations have the advantage over difference measures that (a) they take into account information from a whole range of emotions, rather than averaging across these emotions, and (b) they take into account individual differences in scale use. The correlations ranged between −1 and 1, indicating the emotional fit with the team. Participants' emotional fit was calculated if they responded to at least 19 out of 24 emotions. Because the measure of emotional fit was skewed (more data points when getting closer to 1), we transformed the correlations into Fisher's z scores before conducting the remaining analyses (Fisher, 1921). The mean emotional fit across participants (Fisher's z score) was 1.05 (SD = 0.56).

Analyses

We specified a two-level random intercept model, reflecting the nested nature of the data (employees within teams; Hox, 2002). Our main independent variable, team identification, and most control variables (gender, age, team tenure, leadership, and language) were situated at the individual level; the control variable team size was a team-level variable.

Results

As expected, we found a positive relationship between team identification and emotional fit with the team: team identification

TABLE 1 | Team identification predicts emotional fit in Study 1.

	Emotional fit			
	Regression weight	**Standard error**	***t*-test (df)**	***p*-value**
Intercept	**0.874**	**0.066**	**13.22 (94.66)**	**<0.001**
Gender	0.029	0.041	0.70 (694.12)	0.487
Age	0.000	0.002	0.07 (694.95)	0.941
Team tenure	−0.003	0.002	−1.27 (691.15)	0.201
Leadership	**0.091**	**0.041**	**2.21 (651.09)**	**0.027**
Language	−0.036	0.042	−0.85 (521.56)	0.394
Team size	**0.013**	**0.005**	**2.42 (53.29)**	**0.019**
Group identification	**0.400**	**0.027**	**14.68 (687.96)**	**<0.001**

Bold numbers represent significant effects.

predicted fit to the average emotional pattern of the team ($\beta = 0.40$, SE $= 0.03$, $p < 0.001$)[4] (see **Table 1**).

With regard to the control variables, there was a main effect for leadership ($\beta = 0.09$, SE $= 0.04$, $p = 0.03$): leaders showed more emotional fit with their team than the other employees. Furthermore, team size emerged as a significant predictor ($\beta = 0.01$, SE $= 0.005$, $p = 0.02$): employees of larger teams showed relatively more emotional fit.

Discussion

Earlier research showed that compared to less identified team members, the affective state of strongly identified team members is more closely linked to the average affect in the team (Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010). In our research, we similarly found that members' team identification was positively associated with their emotional fit to the team. Team members reported on emotions they had experienced during the last month, when spending time with the team. The emotion scales were selected to cover the full emotion domain, and are more representative of the experiences of team members than measures of positive or negative affect only. Moreover, the correlational measure of emotional fit used in this research does not suffer from the same disadvantages that are associated with the difference measures used in previous research.

The results held true when controlling for gender, age, team tenure, leadership, language, and team size. The control variable leadership itself showed an interesting and intuitive relationship with emotional fit, and suggests that indeed group leaders' emotions shape the emotions of their followers (e.g., Sy et al., 2005; Haslam et al., 2011). Team size too predicted emotional fit, but this may have been a methodological artifact: the average group pattern in larger teams is based on more observations and is thus less likely to be "extreme."

[4]We also conducted the analyses for the two subscales of group identification separately. The results replicated the results with the combined identification-scale. In addition, the subscales were less reliable than the combined scale [Cronbach's alphas of 0.58 for the scale by Ellemers et al. (1999) and 0.64 for the scale by Roccas et al. (2008)]. Therefore, we only report the results for the combined scale.

Study 2

The aim of the second study was to establish the link between group identification and emotional fit longitudinally and to test the directionality of this effect. More specifically, we tested if members' group identification at one point in time predicts their emotional fit with the group at the next, controlling for their emotional fit with the group at the previous point in time. We also tested if members' emotional fit at one point in time strengthens their group identification at the next, when controlling for their group identification at the previous point in time.

Method

Participants

We followed 68 task groups, each consisting of four to six second-year psychology students ($M = 4.93$, SD $= 0.31$) at a Dutch-speaking university in Belgium, throughout their collaboration on a joint project. Participants received an online questionnaire (in Dutch) at four different times; all students ($N = 295$) completed the questionnaire at least once during this collaboration. Attrition rates were low: 83% of the participants completed all questionnaires, and the rate of participation ranged from 98% in the first wave to 88% in the fourth. Because there were no differences between participants who did and did not complete all questionnaires, we included all participants in the analyses [Little's (1988) Missing Completely at Random-test, $\chi^2(168) = 158.90$, *ns*].

The majority of the participants were female (88%); on average, participants were 20.39 years old (SD $= 1.20$). Demographics reflect the population characteristics of the student body (i.e., second-year psychology students). Participants received 10€ when they completed all four questionnaires, and 3€ when they completed any number lower than four.

Procedure

The study was approved by the Ethics Board of the University of Leuven, and participants signed an informed consent to agree to participate in the study. We recruited all students from a sophomore methods course for psychology majors. The course took a full semester (13 weeks), in which students conducted research. Measurement points marked the end of different steps in the research process: (1) completion of a literature review (week 2), (2) formulating hypotheses (week 4), (3) collecting and analyzing data (week 10), and (4) writing a research report (week 13).

The collaborative project was personally important for the students, because it was worth a full semester credit. Students reported working on the project for an average of 4.36 h per week (SD $= 2.37$); about one third of this time, they collaborated with the whole group on the project ($M = 1.45$ h, SD $= 1.25$). Good collaboration paid off, since 90% of the final course grade was based on the group's performance.

Measures

Group identification

Group identification was measured with six of the seven items used in Study 1; the item "I feel strongly connected to the members

TABLE 2 | Means, standard deviations and reliabilities for group identification and emotional fit with the group (Study 2).

	Week 2	Week 4	Week 10	Week 13
	M (SD) Cronbach's alpha			
Group identification	3.59 (0.60) 0.77	3.56 (0.62) 0.78	3.51 (0.74) 0.86	3.40 (0.77) 0.85
Emotional fit (Fisher z-transformed)	1.10 (0.63)	1.11 (0.64)	1.00 (0.58)	1.11 (0.63)

of my team" was accidentally omitted from this scale. Participants rated their agreement with each of the items on 5-point Likert scales ranging from 1 = *Totally disagree* to 5 = *Totally agree*.

Emotional fit

Participants rated to what extent they had felt each of 14 emotions (e.g., pride about the group, angry at the other group members) when working together with the other members of their group in the time since the last measurement. To limit the burden on participants (who were asked to fill out the questionnaire at four different times), we reduced the number of emotions in this study as compared to Study 1. Participants rated the emotion items on 5-point Likert scales ranging from 1 = *Very weak* to 5 = *Very strong*. Emotional fit was calculated using the procedure as described for Study 1.

Table 2 summarizes the means, standard deviations and Cronbach's alphas for group identification and emotional fit at each of the four waves.

Analyses

To investigate the interplay between group identification and emotional fit, we used multilevel structural equation modeling. More specifically, we estimated a fully cross-lagged path model. We were particularly interested in the cross-lagged paths because they estimate the effect of one variable at one time point on another variable at the next time point, controlling for the other variable at the previous time point as well as controlling for within-time associations. Hence, we were able to estimate the effect of group identification on emotional fit as well as the effect of emotional fit on group identification over time. We estimated all within-time correlations and autoregressive paths to control for their effects. Since individual group members were nested within task groups, we specified multilevel models to take into account that observations were not independent (Hox, 2002).

Model specifications

In structural equation modeling, model selection takes place by comparing the respective fit of different models. More restricted (= more simple) models are compared against less restricted (= more complex) models. The more restricted model is chosen over the less restricted model when model restrictions do not result in significant decreases of the model fit.

In our data, we first tested an unrestricted model with all parameters freely estimated. Next, we compared this model with two restricted models. First, we did not predict that the links between emotional fit and group identification in whichever direction would differ across time. Therefore, we restricted the cross-lagged paths to be equal over time and compared the restricted model to the unrestricted model. If the model fit does not significantly decrease by equating these paths, the effects can be considered to be equal over time.

Second, we also did not have any *a priori* ideas about the direction of the link between group identification and emotional fit. To test whether the effect of emotional fit on group identification was stronger than the effect of group identification on emotional fit, or *vice versa*, we restricted the model by equating the links in both directions, and comparing this restricted model to the previous restricted model. If the model fit significantly decreases by equating these paths, one of the effects can be considered stronger than the other; if the model fit does not significantly decrease by equating these paths, the effects can be considered equally strong in both directions.

Each tested model's fit was evaluated using two common indices to evaluate model fit: a model with an RMSEA-value than 0.10, and preferably 0.06, and a CFI-value higher than 0.90, and preferably 0.95 indicate adequate to excellent model fit (Hu and Bentler, 1999; Kline, 2005). The same indices are also used to evaluate change in model fit when testing a more restricted model against a less restricted model. When the change in RMSEA is smaller than 0.015 and the change in CFI is smaller than −0.01, the more restricted model is chosen over the less restricted model (Vandenberg and Lance, 2000; Cheung and Rensvold, 2002).

Results

The selected model (see **Figure 1**) shows a mutual, positive relationship between members' group identification and their emotional fit over time. Equating the cross-temporal paths from group identification to emotional fit as well as from emotional fit to group identification, did not result in a significant decrease of the model fit (ΔRMSEA = −0.015, ΔCFI = 0.004), suggesting similar effects over time. More specifically, members' group identification at one point in time predicted their emotional fit with the group at the next, controlling for their group identification at the previous time. Conversely, members' emotional fit with their group at one time predicted their group identification at the next, controlling for their own emotional fit at the previous time. Thus, the higher (lower) group members' identification at one point in time, the higher (lower) their emotional fit at the next, and *vice versa*.

Moreover, it was possible to equate the path from group identification to emotional fit to the path from emotional fit to group identification (ΔRMSEA = −0.004, ΔCFI = 0.001), indicating that the effect was equally strong in both directions. These effects were found, both when controlling for within-time correlations between group identification and emotional fit, and when controlling for the autoregressive effects of group identification and emotional fit; all within-time correlations and autoregressive effects were significant.

In sum, our results document a bidirectional effect that was equally strong in both directions: not only did members' group identification predict their emotional fit with the group, but

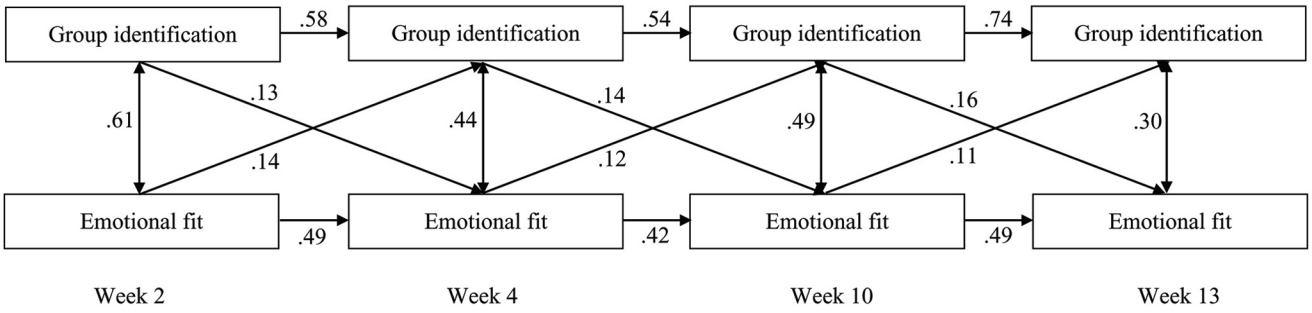

FIGURE 1 | Fully cross-lagged multilevel model outlining the relation between group identification and emotional fit over time (Study 2). The numbers in the figure represent the standardized betas. Model fit was excellent: CFI = 0.99, RMSEA = 0.05. The results converged with and without controls (age, gender and number of friends at the start of the project), as well as with the full identification scale, and the identification subscales (Ellemers et al., 1999 vs. Roccas et al., 2008). The presented model is the model without controls and with the full identification scale. All *p*'s < 0.001.

members' emotional fit with the group also predicted their group identification.

Discussion

In Study 2, we extended the results of Study 1 by testing the directionality of the link between members' group identification and their emotional fit to the group. A multilevel cross-lagged path analysis showed that group identification and emotional fit with the group mutually influenced each other over time. Moreover, these effects were equally strong in both directions. To our knowledge, our study is the first study that provides evidence for a bidirectional link between group identification and emotional fit using a longitudinal design.

Study 3

The third study aimed to replicate the results of Study 2, using sociometric data to measure members' identification to their group. Sociometric data provide an implicit measure of group identification. They allow to infer a person's strength of their connection to the group from their connections with every individual group member. Convergence of the results based on this implicit measure of identification with those based on the explicit measures of group identification used in the previous studies would inspire confidence in the conclusions.

We followed student work groups over time, and measured group identification by examining the strength of the connections between different group members. Whereas the student work groups in Study 2 consisted of white and primarily female psychology students, the work groups in Study 3 consisted of ethnically diverse and primarily male engineering students. As in Study 2, we investigated the mutual influence between group identification and emotional fit with the group over time.

Method

Participants

We followed 33 task groups throughout their collaboration on a project; each task group consisted of five to seven group members plus one group leader (group size: $M = 7.24$, SD = 0.66). The group members were first-year engineering students and the group leaders were fourth-year engineering students at a French-speaking university in Belgium. All students ($N = 239$) completed a paper-and-pencil questionnaire (in French; see text footnote 2) at least once during their collaboration. Attrition rates were somewhat higher than in Study 2, but still 72% of the participants completed all three waves. The participation rate was 90% in wave 1, 79% in wave 2, and 92% in wave 3. We included all participants in the analyses, since participants with and without missing data did not significantly differ from each other on the variables of interest [Little's (1988) Missing Completely at Random-test, $\chi^2(85) = 93.69$, *ns*].

On average, group members were 18.5 years old (SD = 1.12) and group leaders were 22 years old (SD = 1.98); 79% of the group members were men and 70% of the group leaders were men. Demographics reflect the population characteristics of the student body (i.e., first- and fourth-year engineering students). All participants took part in the study voluntarily. Students of two participating groups received cinema tickets via a lottery after the study was completed.

Procedure

The study was approved by the Ethics Board of the University of Leuven, and participants signed an informed consent to agree to participate in the study. We recruited participants during the launch session of an engineering course. For this course, students worked together on a group project for 6 months. During this period, they designed and built a technical device that could heat water by means of physical activity (e.g., pedaling or rowing); the group leader guided the process. At the end of the project, students handed in a written report on their group project and presented their prototype to an external jury. The group project was significant, both in terms of its place in the curriculum and in terms of time spent on it. On average, the students reported working on the project on average 4.73 h a week with the whole group (SD = 3.96) and 4.67 h by themselves (SD = 4.18). At three times during the project, students completed the questionnaire: in week 7, week 21 (with six weeks of holiday and exams in between)

TABLE 3 | Means, standard deviations and reliabilities for group identification and emotional fit with the group (Study 3).

	M (SD) Cronbach's alpha		
	Week 7	**Week 21**	**Week 24**
Group identification	3.68 (0.54) 0.84	3.71 (0.53) 0.92	3.85 (0.55) 0.92
Emotional fit (Fisher z-transformed)	1.10 (0.44)	1.10 (0.48)	1.20 (0.48)

and in week 24 (after presenting their prototype to an external jury).[5]

Measures

Group identification

In the current study, we measured group identification by sociometric data rather than by a self-reported summary statement. Group identification was the average strength of the ties of an individual group member to all the other group members. Ties were measured as the extent of (1) liking, (2) getting along with, and (3) being attuned to a particular group member. To obtain a group member's identification, we first averaged an individual participant's ratings (of all the other group members) per item; we then averaged across the three items. Averaging across items was justified, as factor analyses yielded one single factor at each point in time, and the reliabilities of the resulting three-item scales were excellent (see **Table 3**).

Emotional fit

Emotional fit was measured in the same way as in Studies 1 and 2. In this study, the emotional concordance score was based on 27 emotions (e.g., respect toward other group members, enthusiastic, irritation toward other group members, nervous). Participants' emotional fit was calculated if they responded to at least 22 out of 27 emotions.

Table 3 summarizes the means, standard deviations and Cronbach's alphas for group identification and emotional fit.

Analyses

The analytic strategy in this study is the same as in Study 2. To investigate the relationship between group identification and emotional fit with the group, we estimated multilevel cross-lagged models using structural equation modeling techniques.

Results

Figure 2 shows support for a bidirectional link between group identification and emotional fit. As expected, we found a mutual, positive relationship between members' group identification and their emotional fit over time. Given that the decrease in model fit was not significant, we equated the paths from group identification to emotional fit and from emotional fit to group identification over time (ΔRMSEA $= -0.002$, ΔCFI $= -0.007$), such that their effects were equal over time. More specifically, members' group identification at one point in time predicted their emotional fit with the group at the next, controlling for their group identification at the previous time. Similarly, members' emotional fit with their group at one time predicted their group identification at the next, controlling for their own emotional fit at the previous time.

Moreover, the model fit did not deteriorate significantly when the paths from group identification to emotional fit and from emotional fit to group identification were set equal to each other (ΔRMSEA $= -0.004$, ΔCFI $= -0.002$). Thus, the link is bidirectional and equally strong in both directions. As in Study 2, the results were true when controlling for within-time correlations between group identification and emotional fit as well as when controlling for the autoregressive effects of both group identification and emotional fit; all of these effects were also significant.

Discussion

In Study 3, we replicated the results of Study 2: we found evidence for a bidirectional link between group identification and emotional fit over time. The results of Study 2 and 3 converged despite important differences between the two studies. A first difference concerns the measurement of group identification: In study 2, we measured self-reported connectedness with the group, and in Study 3, we used sociometric data. Second, sample characteristics differed: Groups in Study 2 consisted of White and majority female students, whereas the groups in Study 3 were ethnically diverse, and predominantly male. Moreover, the participants of Study 2 were psychology students, whereas the participants of Study 3 were engineering students. Finally, the questionnaires in Study 2 were administered in Dutch, whereas the questionnaires in Study 3 were administered in French. In sum, two longitudinal studies with naturally occurring student work groups yielded converging evidence for a bidirectional link between group identification and emotional fit with the group.

General Discussion

Across three studies, following "real" interactive task groups working on tasks that were meaningful and important to them, we found that group identification predicts members' emotional fit, a link that had been suggested by previous research (Totterdell et al., 1998; Totterdell, 2000; Tanghe et al., 2010). We replicated this relationship, using different measures of group identification and considering a broader range of emotions than had been included by these previous studies. Moreover, we used profile correlations to measure emotional fit instead of difference measures. Emotional fit in terms of profile correlations points to an alignment of group members' perspective on the situation, and this alignment may be initialized by a strong connection with the group. In addition, we also found evidence for the reverse

[5]We did not succeed in our aim to make the intervals between measurement times similar. The timing of the different waves (at 7, 21, and 24 weeks) was primarily motivated by pragmatic considerations. After 7 weeks, the group leaders had the opportunity to distribute the questionnaire to their group members for the first time. The large gap between the first wave (week 7) and the second (week 21) was due to a 6-weeks semester break. Finally, the last questionnaire was distributed to the group members immediately after they presented their work to an external jury (week 24), and therefore right before the group's dissolution.

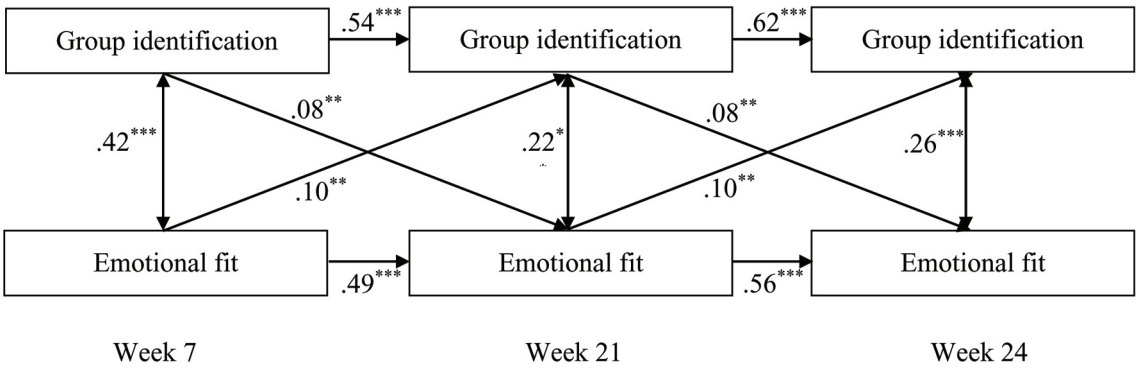

FIGURE 2 | Fully cross-lagged multilevel model outlining the relation between group identification and emotional fit over time (Study 3). The numbers in the figure represent the standardized betas. Model fit was good: CFI = 0.97, RMSEA = 0.07. The results converged with and without controls (age, gender and leadership). The presented model is the model without controls. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

effect: emotional fit also predicts group identification. When group members' emotions are aligned, and thus their perspectives on the situation as well, they start feeling more connected with their group.

Our two longitudinal studies established a bidirectional relationship between group identification and emotional fit. Furthermore, the effects were equally strong in both directions: there were feedback loops between group identification and emotional fit, such that group identification and emotional fit either mutually reinforce or mutually dampen each other. In the context of small, interactive task groups, both group identification and emotional fit are thus dynamic rather than stable over time.

Relevance for Group Outcomes

The dynamic interplay between group identification and emotional fit suggests that a change in the one variable, brings about a change in the other. This may set in motion a positive or negative spiral, affecting members' well-being, motivation and performance in the group. Indeed, higher levels of emotional fit and group identification have both been associated with positive outcomes.

On the one hand, many studies have shown that emotional fit benefits relationship outcomes. For instance, emotional fit in dyadic relationships predicts satisfaction with the relationship (Locke and Horowitz, 1990; Anderson et al., 2003; Gonzaga et al., 2007; Verhofstadt et al., 2008; Townsend et al., 2014). Similarly, emotional fit with one's culture is positively associated with relational well-being (De Leersnyder et al., 2014). Finally, in top management teams, members' affective fit with the team is positively related to their satisfaction with the interpersonal relationships in the team (Barsade et al., 2000).

On the other hand, group identification has been found to motivate members to contribute to the group's goals. Members who are highly identified with the group are thus more motivated to work on the group's tasks as well as to perform better on these tasks (Worchel et al., 1998; Ellemers et al., 2004; Meeussen et al., 2014).

Practical Implications

Team members who are aware of the dynamic interplay between group identification and emotional fit, will be able to break a negative spiral or promote a positive spiral. Similarly, group interventions leveling at improving either group identification or emotional fit may promote positive outcomes for the group (e.g., Anderson et al., 2003; Ellemers et al., 2004). Team building activities provide a good framework to attain these goals.

On the one hand, team building activities may strengthen group identification. Previous research has shown that group members identify more strongly with their group after personally contributing to their group's identity (Swaab et al., 2008; Jans et al., 2012; Meeussen et al., 2014). An intervention including all group members, aiming at jointly building a group identity (cf. "an inductive route to social identity formation," Jans et al., 2012) would be one way to increase members' group identification.

On the other hand, team building activities may be used to increase emotional fit by encouraging discussion about the meaning of events. For instance, we think of a framework like the one provided by Clark and Wilkes-Gibbs (1986), in which interaction partners took turns communicating about ambiguous stimuli until they reached a common understanding of the stimuli. During this process, and throughout different interaction turns, partners increasingly reached agreement on the meaning of stimuli. Similarly, exercises where group members discuss emotional scenarios with the aim of reaching a common understanding of the situation may improve the process of emotional appraisal, thus increasing emotional fit.

Limitations and Future Directions

Although we have established the bidirectional link between group identification and emotional fit longitudinally, the processes underlying this link have yet to be explored. As discussed in the introduction, there are two different processes that may bring about high identifiers' stronger emotional fit to the group. High identifiers may either more readily align their emotions with those of other group members, or they may set an example to the other group members (Haslam, 2004;

Haslam et al., 2011). Future studies should examine the conditions under which each of these pathways occur.

Another limitation, at least for the longitudinal studies, is that they focused on newly formed groups. The studies thus pertain to identification and emotional fit of group members who have just started to collaborate. Future research may study whether the bidirectional link remains over time, or only exists during group formation. Longitudinal research on teams that have been in existence for some time (such as the teams included in the first study) should be expected to shed light on this issue.

Furthermore, the current research describes general processes of identification and fit across group members. Future research may disentangle the trajectories of different types of group members: individuals with either high or low group identification, or either high or low emotional fit. To establish different trajectories, and thus monitor fluctuations over time, research might benefit from measuring group identification and emotional fit at shorter intervals.

Another direction for future research is to study how different mean patterns of emotional experience influence the outcomes associated with emotional fit. Emotional fit may not always be functional or advantageous. For instance, fit to a pattern that is characterized by high levels of anger may be less beneficial than fit to a pattern that is characterized by high levels of group pride. Similarly, fit to a pattern that is characterized by intense anger and low levels of other emotions may be less beneficial than fit to a pattern that is characterized by equally intense anger that is accompanied with high levels of respect and sympathy. The former in each comparison may lead to worse group outcomes, whereas the latter may benefit group outcomes.

Conclusion

To conclude, three studies with real-life, interactive task groups yield a bidirectional link between group identification and emotional fit with the group. Over time, group identification predicted emotional fit, but the reverse link was found as well. Interventions that improve either one may thus affect both processes. This may lead to better group relationships and better group performance. Conversely, a decrease in either group identification or emotional fit may lead to deteriorations in both, and thus negatively affect group outcomes.

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Intragroup Emotions: Physiological Linkage and Social Presence

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We investigated how technologically mediating two different components of emotion—communicative expression and physiological state—to group members affects physiological linkage and self-reported feelings in a small group during video viewing. In different conditions the availability of second screen text chat (communicative expression) and visualization of group level physiological heart rates and their dyadic linkage (physiology) was varied. Within this four person group two participants formed a physically co-located dyad and the other two were individually situated in two separate rooms. We found that text chat always increased heart rate synchrony but HR visualization only with non-co-located dyads. We also found that physiological linkage was strongly connected to self-reported social presence. The results encourage further exploration of the possibilities of sharing group member's physiological components of emotion by technological means to enhance mediated communication and strengthen social presence.

Keywords: psychophysiology, physiological linkage, emotions, social presence, emotional contagion

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INTRODUCTION

Emotional contagion—the tendency for emotions between two or more people to converge—is a well-established phenomenon (Barsade, 2002). Not only emotions displayed during face-to-face interaction but also mediated (text-based) emotional cues have been found to elicit similar emotions in others (Salminen et al., 2013). Physiological linkage—the synchronization of physiological activity across individuals—has been suggested as being one underlying mechanism of emotional contagion (Hatfield et al., 1993; Bruder et al., 2012). Bruder et al. (2012) suggested that in addition to physiological linkage, a social appraisal process exists, which also leads to emotional convergence within dyads. While the exact nature of emotions is still an open research question, it is widely agreed that emotions are complex constructs with several subcomponents: feelings, expressions and physiological states—and synchrony can occur on all these different levels. In the present study we investigated how technologically mediating two different components of emotion—expression and physiological state—to group members affects physiological linkage and various self-reports in a small group during video viewing. In different conditions the availability text chat (communicative expression) and visualization of group level physiological heart rates and their dyadic linkage (physiology) was varied.

Physiological Linkage

Psychophysiological measurements can provide real time data on the physiological states of participants that are directly related to their emotional states (Cacioppo et al., 2000) which in turn are affected by reactions to media (Ravaja, 2004). In a social group setting these methods can also be utilized in studying the effects of social dynamics on media experience. Physiological linkage refers to the extent to which physiological signals of two or more people are associated with each other, such as a mutual increase in heart rate (HR) during a shared experience. Physiological signals in general, but also linkage indices specifically, can provide information on the emotional and cognitive state of the user or a group of users that would normally remain unobservable.

The physiological linkage can occur through various processes. In addition to pure chance, the most common cause for joint changes in physiology within dyads in a given situation is simply the shared external stimulus to which they are both reacting in similar manner, e.g., the movie clip itself in a shared viewing situation. This type of physiological linkage is not the type of linkage we are currently interested in as it does not reveal anything about the connection of physiological linkage and social presence, or emotional contagion. Consequently this source of linkage should mostly be controlled in an experimental setup when studying other causes of linkage, as the causes cannot be distinguished from one another if they are all present. Bruder et al. (2012) distinguishes two other paths for emotional convergence that lead to physiological linkage: contagion-based and appraisal-based.

The mirror neuron system (Rizzolatti et al., 1996; Rizzolatti and Craighero, 2004) involved in imitating the perceived movements of other people, is a plausible neurophysiological mechanism underlying contagion-based physiological linkage. According to the embodied cognition theory (see Niedenthal et al., 2005; Barsalou, 2008; Mahon and Caramazza, 2008), in order to understand for example the facial expressions of others, the same brain areas of the observer must be activated that are used in producing them (Niedenthal et al., 2001). Mimicry of facial expressions as such is well-known phenomenon (e.g., Dimberg and Öhman, 1996; Korb et al., 2014), and within embodied cognition framework the basis of this phenomenon is that the perception of a smile causes similar brain activation as when the person would be smiling herself. This in essence means that the perception and mimicry of other person's emotional expressions leads to convergence of emotional states in the observer (Hatfield et al., 1993; Rizzolatti and Craighero, 2004). This in turn leads to the phenomenon of emotional contagion where emotional states are transferred from one person to another (Hatfield et al., 1993; Barsade, 2002; Bruder et al., 2012).

Appraisal-based emotional convergence occurs through social appraisal processes (Bruder et al., 2012) where individuals assess other people's emotional expressions in a given situation and based on them cognitively form a more shared understanding of the emotional situation, that then leads to emotional convergence, and the linkage of the physiological component of emotion. Appraisal-based path to emotional convergence assumably is less strongly connected to physiological linkage than contagion-based convergence, as it is not directly caused by physiological mimicry but is a result of higher social appraisal functions.

According to Emotions as Social Information (EASI) model, the social role of emotions is emphasized in ambiguous situations where the amount of more explicit social information is limited (Van Kleef, 2009, 2010; Van Kleef et al., 2010). Indeed, the amount of utilizable information is technologically mediated interaction is typically limited, and previous studies have found it to hinder the perception and mimicry of the other person's emotional states (Garcia et al., 1999). Often mediated interaction and communication takes place when participants are in physically separate locations, which naturally limits the channels of information, and the impact of merely being physically present with someone in the same space is cut off. Studies suggest however that even when physically separated, the social context and motives have an impact on emotional expressions and feelings (Hess et al., 1995; Jakobs et al., 1999a,b; Bruder et al., 2012). In such situations appraisal-based paths of convergence are arguably emphasized over contagion-based. Therefore, providing additional social information, such as expressive communicative social signals (e.g., text chat) and information on emotions through signal visualizations of physiological states (e.g., heart rates), may provide usable social information to an ambiguous situation and facilitate mimicry and emotional contagion between the participants.

Physiological linkage was first used in analysis of marital interactions, where several linkage indices were associated with conflict conversations (Levenson and Gottman, 1983). Later studies have shown that physiological linkage is also related to e.g., empathy (Levenson and Ruef, 1992, 1997) and performance (Henning et al., 2001). These studies highlight the fact that linkage is not associated only with negative interactions. A more recent suggestion is that linkage captures the intensity of social interactions that is elevated in, but not specific to, interpersonal conflicts (Chanel et al., 2012). Similarly, sense of social presence (Biocca and Harms, 2002)—a sense of dyadic interconnectedness or being together with other people in a given context—is linked to physiological linkage (Ekman et al., 2012; Järvelä et al., 2013).

Present Study

In the present investigation, we studied how providing socially utilizable information on two different components of emotion (expression and physiology) affected the emotional and social experiences of the participants, e.g., social presence, and especially physiological linkage between dyads during movie watching in small groups. Specifically, two different types of socially utilizable information and methods of mediating and presenting it through technological means were chosen for the experiment: (1) text chat on a second screen provided an expressive social information channel which was shared to all participants and only displayed information they contributed voluntarily, and (2) heart rate visualization displayed socially utilizable information on physiological state of the participants and their dyadic linkage continuously to the participants. Ordinarily physiological linkage between persons is not directly

observable, but here a visualization of synchrony index that was measured continuously in real time was shown to the participants (see Methods for details). In a sense this enables social appraisal of a complex physiological state and appraisal-based emotional convergence. Such visualization enables the examination of whether the conscious acknowledgment of linkage has an effect on feelings of social presence and could increase emotional contagion within the group.

It has been found that although engaging in text chat during movie watching requires additional attention, it also increases liking and feeling of closeness within the group (Weisz et al., 2007). One of the key characteristics of text chat is asynchronous production where the actual writing of the message is not in synchrony with the actual interactive discussion; that is, the message is written first, sent later, and possibly read and replied by others sometime afterwards. This combined with the possibility for each contributor to write messages at the same time often splits chats into threads where replies to messages do not instantly follow but older messages can be replied to O'Neill and Martin (2003). This asynchronous nature of text chat makes it an activity that does not cause physiological linkage in group members just by providing rhythmic synchronous activity or stimulus—if chat increases physiological linkage it is because of its social aspects and the information it is used to communicate, that is, it is social appraisal-based.

Heart rate is one of the most common and arguably one of the most well-known measures in psychophysiology. Depending on the context, heart rate changes have been used to index increased attention, emotional arousal, and cognitive effort (Ravaja, 2004; Cacioppo et al., 2007). The synchronization of heart beats between two persons is a phenomenon which has been studied for example between patients and therapists, and between mothers and children (see Levenson and Ruef, 1997 for a review). Unlike most other neurophysiological measures, such as electroencephalography EEG or electrodermal activity etc., heart rate measures (e.g., beats per minute, BPM) are rather intuitive to understand and people commonly have a preliminary grasp on what they imply (e.g., arousal) (Janssen et al., 2013). This intuitiveness is essential when visualizing biosignals in an attempt to provide meaningful information to participants concerning their own physiological state. Intuitiveness allows using rather straightforward visualizations (e.g., beating heart icons for heart rate) whereas less intuitive ones would require more elaborated metaphorical visualizations (e.g., clock's hands moving at different speed representing different bands of EEG activity). Although heart rate visualization itself is probably not necessarily enough to cause heart beat synchronization by itself, it can mediate heart rate information to others and increase physiological linkage between two or more people through higher-order social processes. One possible channel for how biosignal visualizations would support physiological linkage is by increasing interoceptive awareness (Craig, 2002)—the awareness of your own bodily state—of all participants, and bringing their attention to the group process of linkage. It can be seen either as making contagion-based convergence easier by boosting interoceptive awareness, or by transforming physiological information into a form that can be utilized in social appraisals. Increased interoceptive awareness has also been found to amplify the experience itself (Dunn et al., 2010).

It would be expected that text chat evokes a sense of human connection and provides emotional cues and information regarding other people (e.g., their feelings toward the movie, opinions, and interests), thereby potentially leading to an increased similarity between the emotional states of the participants. This increased interconnectedness is assumed to manifest as higher reported social presence and physiological linkage. In accordance with previous studies (e.g., Wagner et al., 2015) we expect participants to report increased pleasantness and arousal when chatting as the possibility share emotions and to interact with group members is presumed to be positive experience by default, but HR visualization is not expected to produce such an effect by itself. However, heart rate visualization is expected to increase both physiological linkage and social presence as it provides socially utilizable information on emotional states of the participants. In accordance with the EASI model of emotion (Van Kleef, 2009, 2010; Van Kleef et al., 2010) which states that the social role of emotions is emphasized in ambiguous situations, a pronounced effect is expected in regard to both chat and heart rate visualization when the participants are not physically co-located and where the amount of other socially utilizable information is lower. When spatially separated, some information channels are not in use and the whole situation is more ambiguous and this heightens the importance of the social and emotional cues provided by either chat or heart rate visualization.

The results of this study provide insight on how intragroup emotions are influenced by sharing different emotion components between group members by technological means. It also explores if a visualization of a physiological signal is sufficient emotional information to increase dyadic physiological linkage. In addition, on a more applied level the results contribute to how shared media experience can be enhanced by providing features that strengthen the social presence between group members during media enjoyment. Media is increasingly often enjoyed in situations where the group members are physically in separate locations and they are interacting through technical means. As the second screen phenomenon where e.g., television viewers use tablets to enhance their media experience through various means (Courtois and D'heer, 2012), is quickly spreading, the technical solutions through which these features can be implemented are opening up.

METHODS

Participants

Participants were 62 (21 males and 41 females) Finnish university students whose age ranged from 19 to 35 years ($M = 24.2$ years). All participants provided informed consent prior to the beginning of the experiment. Due to some participants not arriving at the experiment and data lost due to technical reasons, the number of subjects in different analyses varied from 52 to 57.

Stimuli

The stimuli shown in the present study consisted of four video clips, whose duration ranged from 5 min 59 s to 6 min 16 s. The video clips contained no spoken narrative and they were selected to elicit varying emotional valence (unpleasant to pleasant) and arousal (calmness to excitement) levels. Themes consisted of religion (pleasant low-arousal), parkour (pleasant high-arousal), poverty (unpleasant low-arousal), and climbing (unpleasant high-arousal). Religion and poverty clips were selected from the movie "Baraka" (Magidson Films 1992; directed by Ron Fricke), and the parkour and climbing clips were obtained from YouTube Internet service (http://www.youtube.com).

Procedure

Participants arrived to the experiment in 16 four-participant groups. Two of the four participants formed one dyad at the beginning of the experiment so that one dyad was physically located in the same room, and the other two participants were located in two separate rooms. This setup of one co-located dyad and two separated individual participants aimed at comparing the effects of physical (co-located) and mediated (non-co-located) presence while they all were interacting together as a group (**Figure 1**).

Due to participant cancellations, three of the groups had only three participants. In one of these groups two participants were assigned to the same room (co-located condition), and in two groups two participants were assigned to different rooms (non-co-located condition). The remaining third subject took part in the experiment but was not included in the analysis. After instructions and a demonstration of the stimulus presentation system, baseline physiological measurements were recorded during a 5-min rest period. The participants were sitting in a chair facing the television screen (co-located dyad were sitting side by side) where video stimuli was presented in each room, and mobile devices were used for providing textual feedback from the participants. Participants listened to the video clip soundtracks via headphones, so that the co-located participants were not able to hear each other. The co-located dyad could see each other, but were mainly facing the television screen, and the individual participants in separate rooms did not have visual contact to other participants during the experiment.

For each group, the four video stimuli were assigned randomly to four display conditions defined by the inclusion of chat and heart rate (HR) displays (both off, only chat display on, only HR display on, and both on). The presentation order of conditions was randomized for all groups. During chat display, all the participants were able to read and write messages online (**Figure 2B**). During HR display, the heart rates of all participants, as well as the linkage between participant pairs, were displayed (**Figure 2A**). Linkage was defined as the correlation between a pair's HR signals, calculated on-the-fly within a 30-s moving time window. A 30-s time window was adopted in order to continuously visualize relatively recent changes in HR synchrony while allowing enough data points (typically, 20–60 heart beats) for calculating the correlation. The extent of HR correlation between each pair of participants was visualized with line thickness and color coding (gray for positive and blue for negative correlation; see **Figure 2A**).

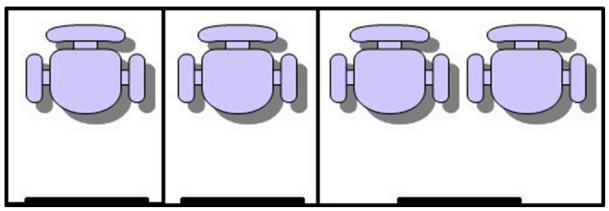

FIGURE 1 | The experimental setup.

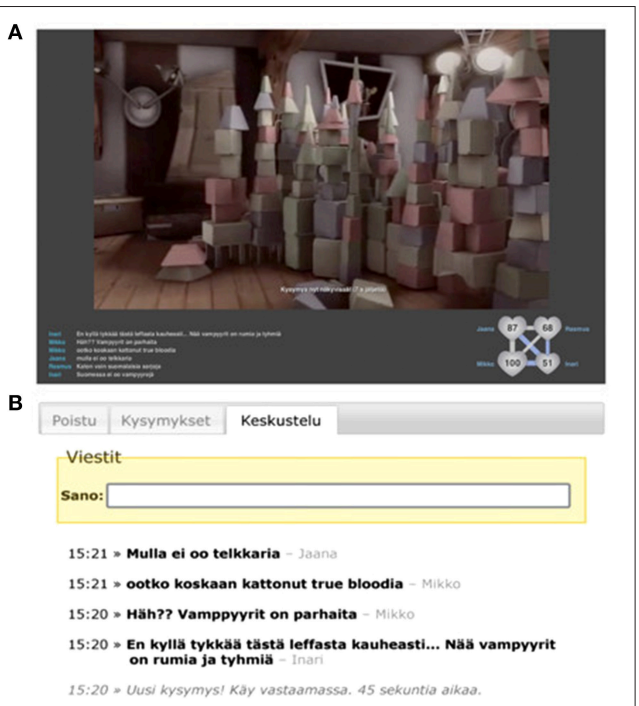

FIGURE 2 | The presentation view on the large screen when both chat and heart rate visualization are on (A) and the chat display on the mobile device (B).

To facilitate social interaction within the participant groups during stimulus presentation, questions related to the contents of each presented video clip (e.g., "Why do many religions encourage women to wear veils?") were presented every 2 min (a total of three questions per video clip), participants were given a restricted amount of time (1 min 30 s) for providing their answers, and all answers were then displayed on the large screen until the beginning of next question (i.e., for 30 s). The facilitation was implemented to ensure at least a minimum amount of social interaction between the participants on a group level as the Finnish culture is not particularly extroverted.

After each video clip session, the participants filled a series of self-report questionnaires (see section Self-reports). After the questionnaires were filled by all participants, the next video was shown.

Heart Rate Measurement and Technical Setup

The heart rates of all participants were measured with prototypical Polar Band heart rate monitors (Polar Electro; http://www.polar.fi). Videos were displayed on 40″ plasma TV screens, approximately 150–200 cm in front of the participants. Nokia N900 mobile devices (Nokia Corporation; http://www.nokia.com) operating on Maemo software platform (http://www.maemo.org) were used for presenting questions related to the video clips, providing answers to these questions, as well as for writing textual messages to other participants during chat display (see Section Procedure).

Stimulus presentation, HR and chat displays, and data collection were controlled with a specialized presentation system PRESEMO (see **Figure 2**; Kuikkaniemi et al., 2010), which has been developed for presenting various multimedia material (e.g., videos, text, and graphs) while allowing the audience to interact with the presentation and with each other via mobile devices. All data from Nokia N900 mobile devices and Polar Band monitors were transferred wirelessly over a Bluetooth connection to a centralized PRESEMO server (for further technical details, see ibid).

Self-reports

Emotional Evaluations

Participants rated their own emotional reactions to the video viewing sessions in terms of valence, arousal, and dominance on 9-step graphical scales. These scales were similar to Lang's (1980) Self-Assessment Manikin (SAM).

Interpersonal Evaluations

The participants were asked to evaluate a series of 17 items measuring social presence (Biocca and Harms, unpublished)—that is, the degree to which they felt they were sharing a common experience—with their assigned (co-located or non-co-located) pair during video viewing. The following facets of social presence were measured: co-presence (e.g., "I often felt as if my partner and I were together in the same room"), attentional engagement (e.g., "I paid close attention to my partner"), emotional contagion (e.g., "I was sometimes influenced by my partner's moods"), comprehension (e.g., "I was able to communicate my intentions clearly to my partner"), and behavioral interdependence (e.g., "My actions were often dependent on my partner's actions"). For each 17 items they evaluated on 7 point scale (1 = I strongly disagree, 7 = I strongly agree). Participants also answered a series of eight questions measuring physical presence (e.g., "When the broadcast ended, I felt like I came back to the "real world" after a journey") (Kim and Biocca, 1997). In contrast to social presence which refers explicitly to socially shared experiences, physical presence refers to the feeling of being physically present in the depicted virtual environment (Lee, 2004). To evaluate the sense of attraction with their pairs, participants were additionally asked to answer 13 questions on a 5-point scale, e.g., boring vs. interesting, cold vs. warm (Moreland and Beach, 1992). All of these scales have been shown to exhibit sufficient reliability (Moreland and Beach, 1992; Kim and Biocca, 1997; Harms and Biocca, 2004).

Data Pre-processing and Analysis

A fundamental difference between the experimental HR visualization and the post-experimental HR data analysis was that the former was updated continuously on-the-fly, whereas the latter was done retrospectively for all the recorded data. HR measurements obtained from Polar Band devices were pre-processed in Matlab (version 7.10.0). HR data was first resampled to 32 Hz. Unrealistic values (3 standard deviations from mean, considering only values between 45 and 145 bpm) were replaced by interpolation. Cubic splines were used for both interpolation and resampling. Frequencies below 0.04 Hz were filtered out by removing a moving average cubic polynomial component from each individual data series. Resultant data series were smoothed with cubic polynomial in a 500 ms time window, and series mean was removed from each participant's data. When quantifying the HR linkage between the two members of each dyad, to allow some temporal lag between the physiological reactions, a ± 5-s temporal window was used in calculating the cross correlations (between the dyad members) for each HR sample (we assumed that the co-occurrence of physiological reactions with a longer temporal lag than 5 s is unlikely to be related to social processes). The highest cross-correlation value within this window was selected for the analysis. Mean cross-correlation coefficients were calculated separately for each film. Finally, Fisher transformation was applied to normalize the distribution of resultant values.

Conventional statistical methods such as analysis of variance (ANOVA) would not have been appropriate for the present data, which were hierarchical such that participants were nested within participant dyads, which were further nested within groups of two dyads. Instead, we adopted a multilevel modeling procedure that is a generalization of the more restricted ANOVA method (Quené and van den Bergh, 2004; Hoffman and Rovine, 2007; see (Hayes, 2006) for an excellent introduction on multilevel models), and which is particularly useful for the analysis of dyadic data (Kenny et al., 2006). Specifically, the data were analyzed by the Linear Mixed Models procedure in SPSS (version 18) with maximum likelihood estimation. With HR data, cross-correlations had been calculated for movie conditions that were presented repeatedly to subject pairs. Respectively, subject pair identifiers were specified as the subject variable and movie (four different movies) as the repeated variable. Unstructured variance-covariance structure (UN) was selected for the residuals based on best fit to the data (estimated with -2 log likelihood function). To account for the hierarchy of pairs within groups, a random intercept was specified with groups as the subject variable. A fixed-effects model was specified with main effects for movie (four levels), location (two levels: co-located and non-co-located), chat display (two levels: on, off), and HR display (two levels: on, off); as well as two 2-way interactions "location × chat display" and "location × HR display."

Self-reports were available from all participants. Therefore, when analysing questionnaire data, participant identifiers were specified as the subject variable, and an additional random intercept was defined for subject pairs to account for the hierarchy between participants and pairs. The analysis remained otherwise identical to that of the HR data. When examining

the association of self-reported social presence with HR cross-correlations, social presence scores were first averaged over both members in each pair and grand-mean centered. The HR data analysis was then repeated with a fixed-effects model that included only a main effect for this continuous covariate.

RESULTS

Results from LMM analyses for emotional and interpersonal evaluations are shown in **Tables 1**, **2**, respectively.

Manipulation Checks

Videos exerted significantly different effects on emotional valence and arousal ratings (**Table 1**). Pairwise *post-hoc* comparisons with Bonferroni correction confirmed that *a priori* pleasant videos (religion: $M = 6.3$; parkour: $M = 6.2$) elicited higher valence ratings than *a priori* unpleasant videos (poverty: $M = 4.2$; climbing: $M = 5.5$; $SE = 0.2$ for all videos). In contrast, *a priori* high-arousal videos (parkour: $M = 4.6$, $SE = 0.2$; climbing: $M = 4.8$, $SE = 0.3$) failed to elicit significantly higher arousal ratings than *a priori* low-arousal videos (religion: $M = 4.1$, $SE = 0.2$; poverty: $M = 5.1$, $SE = 0.2$). To control for any confounds caused by the different videos, the main effect of video was retained in all analyses. Significant video effects emerged for some variables (**Table 2**). *Post-hoc* comparisons showed that the poverty video elicited higher attraction ratings than climbing and parkour videos (Ms = 3.5, 3.3, and 3.3), higher physical presence than parkour video (Ms = 2.8 and 2.4), and higher perceived

TABLE 1 | Linear mixed model analyses for emotional evaluations.

Variable	*df*	*F*	*p*
VALENCE			
Chat display	1, 151.46	27.26	< 0.001***
HR display	1, 149.06	0.03	0.864
Location	1, 13.24	0.23	0.639
Location × Chat	1, 148.88	0.83	0.365
Location × HR	1, 144.10	0.96	0.328
Video	3, 54.80	28.15	< 0.001***
AROUSAL			
Chat display	1, 146.21	10.53	0.001**
HR display	1, 118.18	0.16	0.687
Location	1, 27.07	0.66	0.423
Location × Chat	1, 145.35	0.03	0.854
Location × HR	1, 117.76	2.29	0.133
Video	3, 54.58	3.78	0.015*
DOMINANCE			
Chat display	1, 156.24	19.30	< 0.001***
HR display	1, 139.26	1.55	0.215
Location	1, 13.33	0.02	0.899
Location × Chat	1, 155.83	0.81	0.369
Location × HR	1, 138.19	0.24	0.625
Video	3, 54.83	0.69	0.565

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 2 | Linear mixed model analyses for interpersonal evaluations.

Variable	*df*	*F*	*p*
ATTRACTION			
Chat display	1, 151.39	44.62	< 0.001***
HR display	1, 123.36	1.87	0.174
Location	1, 27.60	2.48	0.127
Location × Chat	1, 150.15	2.23	0.137
Location × HR	1, 122.84	0.07	0.790
Video	3, 55.85	4.58	0.006**
PHYSICAL PRESENCE			
Chat display	1, 151.84	14.76	< 0.001***
HR display	1, 152.97	1.213	0.272
Location	1, 56.93	0.00	0.969
Location × Chat	1, 152.45	4.59	0.034*
Location × HR	1, 152.63	1.24	0.268
Video	3, 52.81	3.34	0.026*
CO-PRESENCE			
Chat display	1, 160.06	63.51	< 0.001***
HR display	1, 133.51	0.02	0.895
Location	1, 45.49	5.36	0.025*
Location × Chat	1, 158.27	27.38	< 0.001***
Location × HR	1, 130.28	1.01	0.316
Video	3, 54.28	0.49	0.688
PERCEIVED ATTENTIONAL ENGAGEMENT			
Chat display	1, 150.87	21.04	< 0.001***
HR display	1, 148.08	0.08	0.775
Location	1, 9.88	0.92	0.360
Location × Chat	1, 151.47	2.01	0.158
Location × HR	1, 147.64	1.45	0.231
Video	3, 55.95	0.70	0.558
PERCEIVED EMOTIONAL CONTAGION			
Chat display	1, 150.18	72.43	< 0.001***
HR display	1, 122.82	1.34	0.249
Location	1, 57.10	6.98	0.011*
Location × Chat	1, 149.49	3.26	0.073
Location × HR	1, 122.33	0.28	0.595
Video	3, 55.56	0.86	0.469
PERCEIVED COMPREHENSION			
Chat display	1, 144.52	549.55	< 0.001***
HR display	1, 119.99	0.06	0.809
Location	1, 25.12	10.95	0.003**
Location × Chat	1, 144.55	0.99	0.322
Location × HR	1, 119.47	0.23	0.633
Video	3, 54.75	2.11	0.110
PERCEIVED BEHAVIORAL INTERDEPENDENCE			
Chat display	1, 154.29	181.93	< 0.001***
HR display	1, 145.31	0.05	0.824
Location	1, 26.06	0.49	0.489
Location × Chat	1, 153.99	1.50	0.223
Location × HR	1, 144.41	0.09	0.769
Video	3, 56.24	4.01	0.012*

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

behavioral interdependence ratings than parkour video (Ms = 2.2 and 1.8, $SE = 0.1$ for all effects). Preliminary analyses showed that interactions between the video condition and chat display, HR display, and location conditions were non-significant for all dependent variables ($ps > 0.05$).

Emotional Evaluations

Chat display exerted significant effects on all emotional evaluations (**Table 1**). Mean evaluations for emotional evaluations in chat and HR display conditions can be seen in **Figure 3A**. The participants reported feeling more aroused, in control of the situation, and more pleasant, when chat was available. In contrast, the HR visualization did not have a similar effect on these components. The location of pairs did not interact significantly with the chat or HR (see **Figure 4A** and **Table 1**) display conditions.

Interpersonal Evaluations

Social presence subscales all showed sufficient reliability (co-presence, Cronbach's α = 0.77, 4 items; Perceived Emotional Contagion, α = 0.90, 4 items; Perceived Comprehension, α = 0.92, 3 items; and Perceived behavioral interdependence, α = 0.89, 3 items) except for the 3 item Perceived Attentional Engagement subscale, that had Cronbach'sα = 0.57. Despite relatively low reliability, scores for Perceived Attentional Engagement are still reported here as they showed very similar results to other social presence subscales. Physical Presence (α = 0.87, 8 items) and Attraction (α = 0.87, 13 items) scales showed high reliability.

Chat display exerted significant effects for all interpersonal evaluations, whereas the effects of HR display were all non-significant (**Table 2**). As can be seen in **Figures 3B,C**, chat display elicited greater attraction, physical presence, and social presence (as measured by all of the five social presence subscales) ratings.

A significant interaction between location and chat display (**Table 2**) demonstrated that the effect of chat display on co-presence evaluation was more pronounced with the non-co-located pairs (**Figure 4C**). In contrast, there were no significant interactions between location and HR display (see **Table 2**). Contrary to expectations, chat display increased evaluated physical presence more with co-located rather than with non-co-located pairs (**Table 2** and **Figure 4B**), but this is possibly because increased social presence also emphasized the physical presence of being in the same room. Unexpectedly, non-co-located pairs reported significantly greater social presence as measured with emotional contagion and comprehension subscales (**Table 2** and **Figure 4C**). However, for emotional contagion there was also a non-significant trend ($p < 0.10$) toward a greater chat

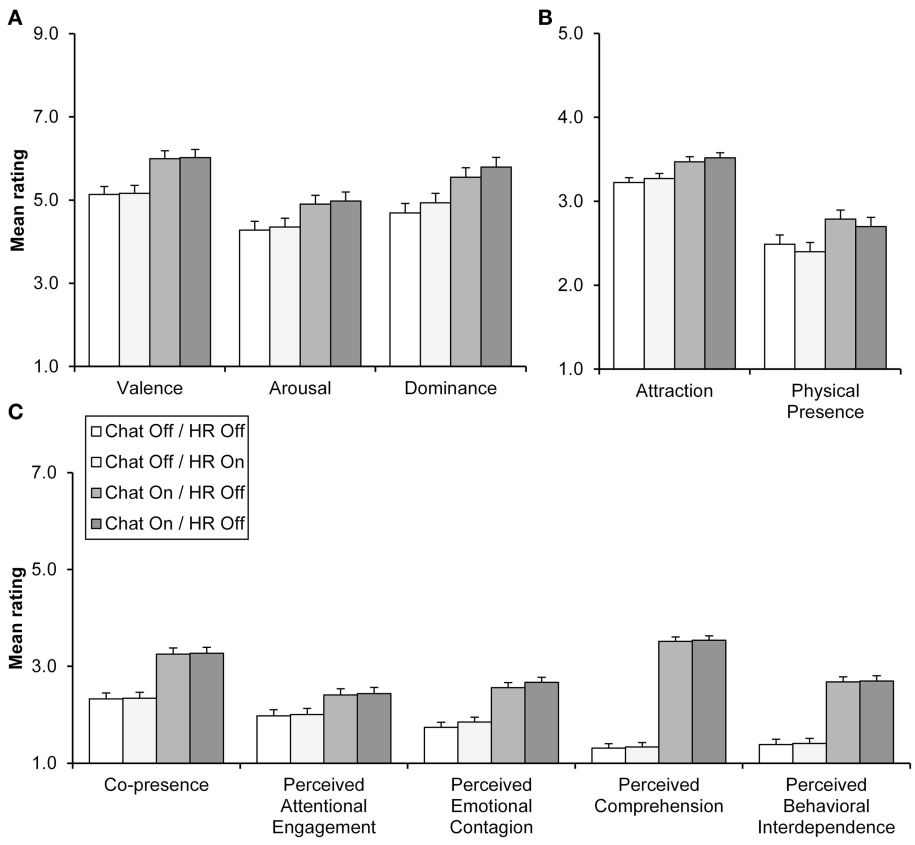

FIGURE 3 | Mean evaluations for emotional (A) and interpersonal evaluations (B,C) by chat and HR display conditions. Interpersonal evaluations are shown separately for variables measured on 5-step **(B)** and 7-step scales **(C)**. Error bars refer to standard errors of the mean.

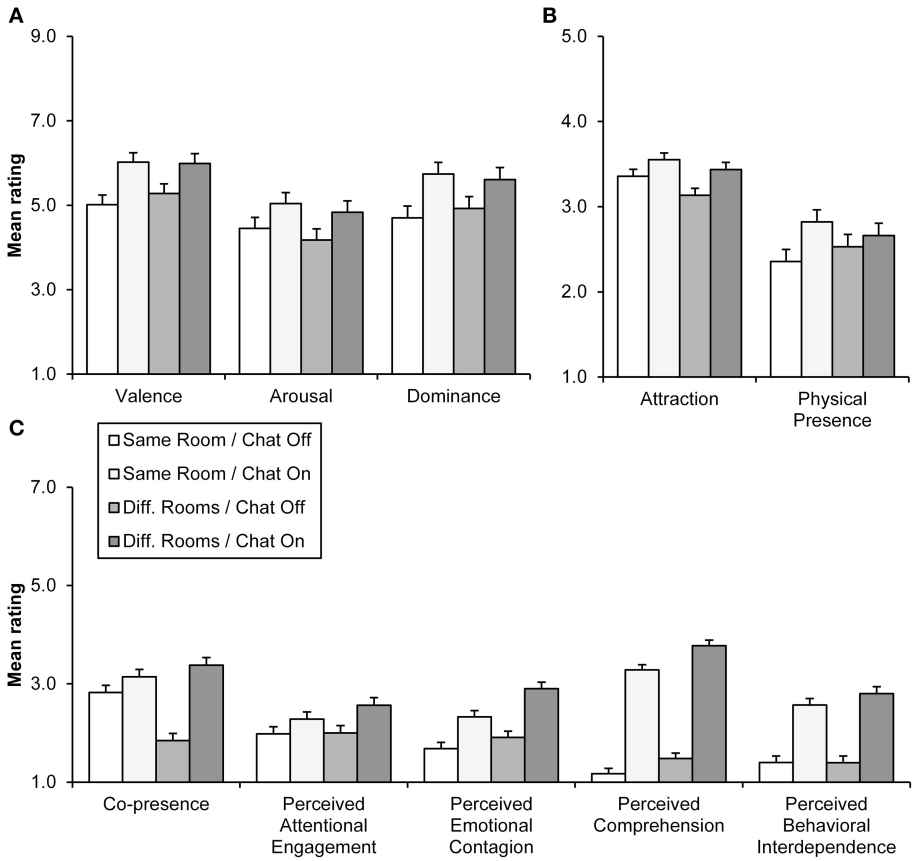

FIGURE 4 | Mean evaluations for emotional (A) and interpersonal evaluations (B,C) by location and chat display conditions. Interpersonal evaluations are shown separately for variables measured on 5-step **(B)** and 7-step scales **(C)**. Error bars refer to standard errors of the mean.

display effect for non-co-located pairs. Given that this effect was similar to that of co-presence, it is possible that these location main effects may have stemmed from interaction effects between location and chat display.

Physiological Linkage

Mean HR cross-correlations between subject pairs for chat and HR display conditions are presented in **Figure 5**. The main effect of chat display, as well as the interaction effects between location and chat display and location and HR display were significant (**Table 3**). In general, HR cross-correlations were higher when the chat display was enabled but were not affected by the HR display. Importantly, however, both the effects of chat and HR displays were more pronounced for the non-co-located pairs (**Figure 5**). Simple effect analyses for non-co-located pairs indicated significant chat display, $F_{(1,\ 53.20)} = 17.26$, $p < 0.001$, and HR display effects, $F_{(1,\ 58.41)} = 4.32$, $p = 0.04$. With co-located pairs, non-significant effects were observed for both chat, $F_{(1,\ 60.23)}$, = 0.02, and HR displays, $F_{(1,\ 62.22)} = 1.41$. **Table 4** displays statistical tests for the associations between HR cross-correlations and the social presence evaluations. The results demonstrated that the HR synchrony between participant pairs showed a significant positive correlation with all evaluated social presence scales, which emphasizes how social presence and physiological linkage are connected.

DISCUSSION

In our experiment we set out to examine how providing more socially utilizable emotional information to participants in a group media consumption situation would affect their experience. The text chat option provided sporadic voluntary communicative emotional expressions to the group while heart rate visualization showed continuous involuntary information on group member's physiological state and their dyadic linkage to other group members.

In this setting, text chat was clearly an effective method of affecting the experience. The subjects reported higher feelings of valence, arousal, attraction, social, and physical presence. The HR visualization by itself did not have such an effect. Simple biosignal visualization of group members' physiological state was not enough to significantly affect self-reported feelings. However, HR visualization and text chat both increased physiological linkage (heart rate cross-correlation) when the participants were physically non-co-located. The idea of physiological linkage as a measure of social presence was supported as they were positively

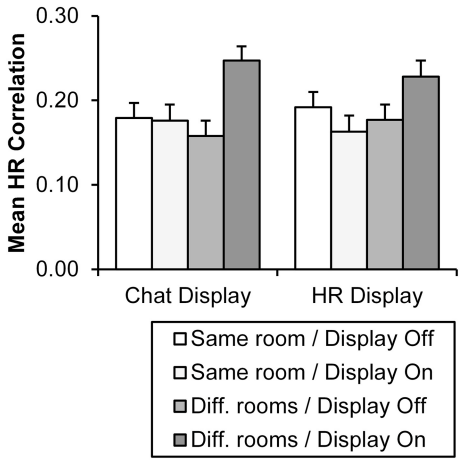

FIGURE 5 | Mean HR cross-correlation values by location and display conditions. Display conditions are shown separately for chat and HR displays. Error bars refer to standard errors of the mean.

TABLE 3 | Linear mixed model analyses for heart rate cross-correlations.

Variable	*df*	*F*	*p*
HR display	1, 49.86	0.38	0.538
Chat display	1, 43.41	7.32	0.010*
Location	1, 5.77	2.45	0.170
Location × HR	1, 60.24	5.38	0.024*
Location × Chat	1, 60.29	8.54	0.005**
Video	3, 21.56	0.27	0.845

*$p < 0.05$; **$p < 0.01$.

TABLE 4 | Linear mixed model analyses for the associations between HR cross-correlations and social presence evaluations.

Variable	*df*	*F*	*p*	Parameter estimate	*SE*
Co-presence	92.04	5.13	0.026*	0.03	0.01
Attentional engagement	91.48	5.73	0.019*	0.04	0.02
Emotional contagion	83.63	4.73	0.032*	0.03	0.01
Comprehension	83.05	7.85	0.006**	0.02	0.01
Behavioral interdependence	86.26	5.30	0.024*	0.03	0.01

*$p < 0.05$; **$p < 0.01$.

correlated with every subscale of self-reported social presence. These results are in accordance with our initial hypotheses, except that HR visualization had weaker effects throughout than expected. When physically co-located, the effects were weaker, especially with HR visualization, which did not have noticeable effect. Our interpretation for this is that it was because the visualization of a physiological component of emotion is harder to interpret and of lesser information value than expressive social signals such as text chat. A possible interpretation for the lack of effect for HR visualization in co-located condition is that contagion-based emotional convergence is a more natural path to utilize the information on physiological state, but that path was already fully in operation when the participants were physically co-located, thus the visualization did not provide anything more by converting the physiological state into form that social appraisal processes can utilize. Another possibility is that in non-co-located condition when the amount and type of social information is lesser, those that are available are emphasized, and consequently the HR visualization is more effective when other forms of information are not available. This would also explain why HR synchrony was higher in non-co-located situations and not just close to co-located situation. It can be concluded that the availability of socially utilizable information, whether it was text chat or HR visualization, increased physiological linkage and associated social presence when the amount of socially utilizable regular information was low, e.g., when communication between subjects was only by technological means. This finding supports the EASI model of emotion, which states that the social role of emotions is emphasized in ambiguous situations. The solid connection between physiological linkage and self-reported social presence supports the idea that social presence could, at least partly, be the subjective feeling component of physiological linkage—however this hypothesis naturally requires further research into the topic.

There were some challenges during the process, mainly with the data quality of the consumer grade heart rate monitor, which is why the data had to be processed rather heavily before the analysis. With a higher quality data, more advanced HR indices could have been calculated and a shorter time window used for linkage calculations. In general, the quality of the non-filtered heart signals might explain the absence of effects of the HR visualization. However, the data quality was sufficient for the results presented here Optimally, the number or participants should have been larger to compensate for the small effect sizes. Now some of the results lack statistical power, and perhaps even more solid results would have been acquired with a larger sample size. Also, as the two information types (text chat and HR visualization) varied in more ways than one (e.g., voluntary vs. involuntary, real-time vs. delay, sporadic vs. continuous) exact interpretations for the results are difficult. Also, the HR visualization provided information not only on the heart rates of group members but also the dyadic linkage between them, and it is impossible to separate the effects from each other. In addition, in a sense linkage scores were used both as dependent and independent variables in the setup. We might not be able to precisely say what caused the difference between chat and HR visualization, but examining those two still provides us with an overview of how a typical mediated communication affects social and emotional states and also how it can be still enhanced with less common biosignal visualizations providing usable emotional and social information.

The positive results acquired in this experiment raise several questions for future studies. For example would a different type of heart rate visualization or a different biosignal altogether produce different effects? Or does the type of emotion (e.g., positive or negative valence, different discrete emotions) experienced affect how physiological synchrony is associated with feelings of social

presence? How would the manipulation of the social context (e.g., cooperation vs. competition) affect physiological linkage? Can different paths of convergence be experimentally separated, e.g., do they require different time scales to operate?

Overall, our interpretation is that technological augmentation provides emotional cues and socially utilizable information, and affects intragroup emotions especially when regular communication is somehow limited. For example, text chat is effective when talking is prohibited or considered disturbing (like during movie watching), and sharing indices of group's shared physiological synchrony is effective when the group members are physically separated from each other. In a sense, these technical solutions compensate for the lack of emotional cues and information that exist in typical face-to-face communication. Their promising potential for augmenting various group situations should be further studied and experimented with. In addition to providing practical solutions for modern technologically mediated communication, this line of research will reveal more fundamental dynamics how group-level emotional expressions and their sharing affects group emotions, and how they manifest in physiological responses and their synchrony.

AUTHOR CONTRIBUTIONS

GC designed the study and performed the experiment, PH pre-processed the data and calculated synchrony indices, JK analyzed the data and wrote the manuscript with SJ and NR.

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Emotional reactions to deviance in groups: the relation between number of angry reactions, felt rejection, and conformity

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How many members of a group need to express their anger in order to influence a deviant group member's behavior? In two studies, we examine whether an increase in number of angry group members affects the extent to which a deviant individual feels rejected, and we investigate downstream effects on conformity. We show that each additional angry reaction linearly increases the extent to which a deviant individual feels rejected, and that this relation is independent of the total number of majority members (Study 1). This felt rejection is then shown to lead to anti-conformity unless two conditions are met: (1) the deviant is motivated to seek reacceptance in the group, and (2) conformity is instrumental in gaining reacceptance because it is observable by the majority (Study 2). These findings show that angry reactions are likely to trigger anti-conformity in a deviant, but they are also consistent with a motivational account of conformity, in which conformity is strategic behavior aimed at gaining reacceptance from the group.

Keywords: emotion, social influence, conformity, social exclusion, group processes, deviance

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Introduction

Accumulating research illustrates that people are greatly influenced by other people's emotional expressions (Van Kleef et al., 2011). Most of this work has examined how a single person's emotional displays affect the perceptions, feelings, and behaviors of another person in dyadic interactions (e.g., Hatfield et al., 1994; Clark et al., 1996; Knutson, 1996; Hess et al., 2000; Van Kleef et al., 2004). However, people spend much of their social life in groups, for instance in work teams, in groups of friends, in school classes, and in sports teams. Compared to dyadic interactions, the potential number of emotional expressions is greater in groups, and such expressions might jointly influence individual group member's cognitions, emotions, and behavior (Heerdink et al., 2013).

Groups are seldom unanimous, however, which implies that an increased number of emoters allows for greater variability of displayed emotions. In the present paper, we examine how multiple emotional expressions jointly influence a focal group member's behavior. More specifically, we focus on the number of individuals that express anger. Is a single angry group member sufficient to influence a focal individual or should more group members express anger? To answer this question, we build on work on majority size and social influence in groups (e.g., Latané, 1981; Bond, 2005). We predict that the more group members react with anger to a focal individual, (1) the more this

individual will feel rejected and (2) the greater the social influence, as reflected in conformity to the majority's position. We tested these predictions in two experiments in which we employed a simulated majority influence paradigm.

Expressions of Anger as Tools of Social Influence

People feel angry when they blame another person for an event that is incongruent with their goals (Lazarus, 1991). Anger is typically expressed when people intend to change the other person's behavior to resolve this incongruence (Averill, 1982; Fridlund, 1994). Thus, expressing anger is functional (at least, from the expresser's point of view) to the extent that it leads to behavioral change in the observer (Fischer and Roseman, 2007; Van Kleef, 2009). For instance, it has been shown that expressions of anger can help to extract concessions from negotiation partners (Van Kleef et al., 2004), that a teacher's angry expressions can increase a student's learning performance (Van Doorn et al., 2014), and that leaders' displays of anger can enhance follower motivation and performance (Damen et al., 2008; Van Kleef et al., 2010).

Within a group context, angry expressions can be seen as cues of imminent exclusion, because the expression of anger and other types of hostility typically precedes the exclusion of deviants (Schachter, 1951). Anger may further signal rejection because it draws attention to the unacceptability of an individual's deviant behavior, and by extension, of the individual him- or herself (Heerdink et al., 2013, 2015). Supporting this reasoning, Heerdink et al. (2013) demonstrated that when multiple group members unanimously expressed anger about a deviant person's behavior, the deviant individual felt rejected by the group.

Maintaining a sense of belonging is a fundamental human need (Baumeister and Leary, 1995). Feeling rejected therefore potentially triggers behavior aimed at restoring the connection with other people (e.g., Williams et al., 2000; Romero-Canyas et al., 2010; DeWall and Richman, 2011). Because conformity signals good group membership (Hollander, 1960) and facilitates collective goal pursuit by restoring group cohesion (Festinger, 1950; Jetten and Hornsey, 2014), conformity is an effective way for deviants to seek reacceptance when they feel rejected as a consequence of other group members' angry reactions. Congruent with this idea, Heerdink et al. (2013) found that participants who felt rejected by their (unanimously) angry fellow group members were likely to conform to the group norm, provided that their conformity could facilitate their reconnection with the group. What is unclear, however, is how many angry group members it takes to enforce such social influence.

Number of Angry Expressions, Feelings of Rejection, and Conformity

Insights about the relation between the number of angry reactions and the degree to which the deviant will conform can be gleaned from more general theories about the cumulative influence of multiple influence sources. For instance, Social Impact Theory (SIT; Latané, 1981) describes the mathematical relation between the number of influencer sources and their influence on an individual person. The theory predicts that social influence increases as the number of influencers increases. Additionally, SIT proposes that the relation between the number of influencers and their social impact (everything else being equal) follows a power law, which implies that each additional influence source is expected to add to the total social influence, but the increase is smaller than for the previous influence source.

The consequences of varying numbers of social influence sources have primarily been investigated in the context of majority and minority influence (e.g., Latané and Wolf, 1981; Bond, 2005). For instance, a meta-analysis of 115 conformity studies shows that the number of influencers is indeed positively (albeit not very strongly) associated with the degree of social influence that is engendered (Bond, 2005). Furthermore, Bond (2005) found that, despite showing a slightly better fit to the data, SIT's power function did not yield a significantly improved prediction over a linear model when majority sizes of 1 were excluded, indicating that the relationship between number of influencers and social impact is most parsimoniously represented as a linear function.

Some research has found that social exclusion is similarly dependent on the number of excluders, but the evidence shows that the direction of this effect may additionally depend on the type of exclusion (active versus passive). With regard to passive exclusion (e.g., ignoring), a recent meta-analysis of 98 Cyberball studies (Hartgerink et al., 2015) found that the ostracism effect in Cyberball is slightly smaller with three other players than with two other players, although the authors note that no studies directly comparing these two settings have been conducted, and the evidence for this difference was generally quite weak. Focusing on more active exclusion, DeWall et al. (2010) tested the relation between the number of group members who did not join in the social exclusion of a participant (e.g., by indicating their willingness to work with the participant) and the extent to which participants felt rejected. They found that felt rejection decreased as the number of accepting group members increased. Thus, social exclusion may decrease with the number of passive excluders, and increase with the number of active excluders.

Because angry reactions constitute an active type of rejection, we hypothesize that deviant group members feel more rejected the more fellow group members express anger about their deviance (H1). Given that feeling rejected motivates a desire to seek reacceptance, we predict that deviants conform more to the extent that they receive more angry reactions (H2), and that this relationship is mediated by felt rejection (H3). We conducted two experiments to test these hypotheses. In both studies, a simulated group interaction was set up in which the participants' opinion was opposite to their fellow group members' opinions. Thus, the situation represented a majority influence situation, in which the participant had a deviant position. The majority then responded emotionally to the participants' deviance. We used neutral to mildly happy reactions as the non-angry reactions in our studies. Previous research suggests that expressing some happiness is the 'default' in positive social interaction (e.g., Fridlund, 1991; Hinsz

and Tomhave, 1991; Jakobs et al., 2001), and we reasoned that it would therefore the most 'normal' reaction in such a group setting.

Study 1

In Study 1, we systematically varied two factors: the size of the majority (i.e., the total group size minus the deviating participant) and the number of angry reactions from majority members to test whether the number of angry reactions uniquely affects felt rejection, or whether this depends on the total number of majority members. Varying the number of angry reactions to deviance within a group means that the number of non-angry reactions also varies. If, as we hypothesized, felt rejection and subsequent conformity increase with the number of angry reactions, this relation should be found independently of the number of non-angry reactions. Thus, majority size should not moderate the effect of angry reactions on felt rejection or conformity. To separate the effects of majority size from those of the emotional reactions, the experiment was set up in such a way that, independent of their emotional reactions, all majority members disagreed with the participant and agreed with each other with regard to their position in the debate.

For the sake of brevity, we use the notation M|A to refer to experimental conditions. M denotes majority size, and A refers to the number of angry reactions. The number of non-angry reactions may be calculated as M – A. Thus, a participant in condition 4|1 was confronted with a majority of four, received one angry reaction, and three (i.e., 4 – 1) mildly happy reactions. Finally, the letters M or A are used when referring to all levels of a manipulation: 3|A refers to all Majority size 3 conditions (3|0, 3|1, 3|2, and 3|3), and M|1 to all conditions with one angry reaction (2|1, 3|1, and 4|1).

Method

Participants and Design

Three-hundred and seventy first-year Psychology students participated in the study as part of an obligatory, 2-h mass testing session that took place at the beginning of the academic year. Participants in the current study were part of two groups of around 225 students each, who were simultaneously seated in front of a computer (separated with dividers) in a large room. Thus, the setting rendered it plausible that the participant would interact with other participants during the study. The majority of tasks preceding the current study were personality questionnaires (and all unrelated to the current study), but there were slight differences in the number (six and eight) and content of the tasks between the two groups. Details may be obtained from the first author.

Of the 370 participants, 56 participants were excluded because their open-ended responses indicated that they doubted the veracity of the simulated interaction[1]. Expression of doubts was not predicted by the manipulations. An additional 34 participants were excluded because they misremembered the number of group members they interacted with, suggesting that they had not paid sufficient attention to the instructions. Misremembering the number of fellow group members was more likely as the number of fellow group members increased ($OR = 3.53$, Wald's $z = 3.85$, $p < 0.001$)[2]. The final sample thus consisted of 280 participants (75 male, $M_{age} = 19.70$, range 18–28). Participants were randomly assigned to a condition of the Majority Size (2, 3, or 4) × Angry Reactions (0, 1, 2, 3, or 4) design (logically impossible conditions in which the number of angry reactions exceeded the majority size were, of course, omitted); the distribution over conditions is displayed in **Table 1**. The study was carried out in accordance with APA regulations and approved by the IRB at the University of Amsterdam.

Materials and Procedure

The experiment was introduced as having two goals: to investigate the opinions of students on a number of study-related issues, and to determine the efficiency of a newly developed discussion technique called the 'one-shot discussion,' which was defined as a discussion in which every participant gets one chance to make a statement.

Initial opinion

Participants first provided their opinion about nine student-related issues. Among these was the issue that would be used later in the group discussion (the focal issue): the percentage of the study materials in the first and second years of the Bachelor's program that should consist of journal articles relative to books. Responses could be made using a slider that ranged from 30 to 70% so as to anchor responses around 50%, which was used as a reference point to determine the group norm (see 'Deviance Manipulation' below). Alternatively, participants could enter a whole number between 0 and 100 in a separate box.

Majority size manipulation

Participants then learned that they would be participating in a one-shot discussion on one of the student-related issues. The program simulated connecting to a number of fellow participants in the mass testing session. Depending on the majority size condition, the connection routine 'discovered' two to four other participants before proceeding to the next stage. Thus, total

[1] Participants were assumed to doubt the veracity of the procedure if they used one or more of the following words to comment on the situation in their response to the final open-ended question (see 'Manipulation Checks'): 'fake' [*nep*], 'not real' [*geen echte*], 'doubt' [*twijfel*], 'don't believe' or similar [*ongeloofwaardig*, *geloof niet*, *geloof niks*], or 'programmed' [*geprogrammeerd*] ($N = 34$). All remaining open-ended responses were read by the first author. Participants were excluded if (a) they directly (e.g., "I think I haven't really discussed with other people.") or indirectly (e.g., "Real people don't type correct sentences") stated that they thought their peer's statements were not coming from real participants ($N = 17$), or (b) correctly guessed the purpose or hypothesis of the study ($N = 2$). Two more participants were excluded because they wrote "The fact that in this room, no four people are participating in the same discussion, makes this quite a strange story" and "I think it's quite a coincidence that all opinion differed from mine, and that I get questions about how excluded I feel." One participant was excluded for writing "blabla" when asked to comment on his/her opinion in the group discussion, suggesting that this participant did not take the situation seriously.

[2] In all analyses, majority size and angry reactions were entered as unstandardized predictors. As a result, the reported βs and ORs indicate the change (in SD, and in odds, respectively) in the dependent variable that is expected when one member is added to the majority, or when there is one more angry reaction. All other predictors were standardized prior to modeling, and the associated βs and ORs have their regular interpretation.

TABLE 1 | Number of participants conforming and total number of participants in each condition (Study 1).

		Number of angry reactions				
		0	1	2	3	4
Number of majority members	2	5/27 (18.5%)	9/23 (39.1%)	14/26 (53.8%)		
	3	8/24 (33.3%)	14/29 (48.3%)	7/21 (33.3%)	13/27 (48.1%)	
	4	5/21 (23.8%)	11/23 (47.8%)	10/19 (52.6%)	10/23 (43.5%)	8/17 (47.1%)

Conditions are based on majority size and the number of angry reactions received by the participant. Cell sizes vary due to random assignment to conditions. Three cells are empty because there cannot be more angry reactions than there are members of the majority.

group sizes for the group discussion (including the participant) varied from three (in the 2|A conditions) to five (in the 4|A conditions).

Deviance manipulation

The next screen indicated that the 'articles vs. books' issue had been selected, and participants were presented with information that indicated that their opinion deviated from the group norm. The group norm was manipulated by showing the answers that the fellow group members had supposedly given, and were drawn from one of two sequences. For the 206 participants (73.6%) whose initial answer fell below 50%, the majority's answers were shown to have been 68, 90, 75, and 85 ('many articles' group norm); for the remaining participants, who had originally answered more than 50%, the corresponding majority answers were 32, 10, 25, and 15 ('few articles' group norm). The number of answers shown corresponded with the Majority size condition. For instance, participants in the 2|A conditions who preferred less than 50% of the study materials to consist of journal articles learned that their first fellow group member had answered 68%, and the second 90%. (No more answers were shown, because there were no more group members in this condition).

Angry reactions manipulation

The next phase was the group discussion, which contained the manipulation of the group's angry reactions. In the group discussion, the group members would each send a successive statement about their opinion to the others. The participant learned that s/he would be the last to state their opinion to the others.

The statements contained arguments and were framed in either a mildly happy or angry way. Four arguments were used for each of the two possible group norms (more articles or more books). The emotional tone of the statements was manipulated by means of emotional words such as 'annoys me'/'makes me angry'; words with strong emotional overtones such as 'ridiculous'; and happy versus angry emoticons, that is, :) or >:(. To avoid a confound between majority size and the number of presented arguments, the statements were written in such a way that all participants read all four arguments. Thus, one of the majority members in the 3|A conditions, and both majority members in the 2|A conditions used two arguments in their statements. Example statements can be found in **Table 2**.

After having received all the simulated group members' statements, participants were asked to write a statement

TABLE 2 | Example statements sent by the simulated group members during the simulated group interaction (Study 1).

Norm: many articles		Group norm: few articles	
Mild happy	**Angry**	**Mild happy**	**Angry**
Later in our study, we'll have to read those articles anyway, so I think it's better to get used to that style as soon as possible..	It's ridiculous that we have books for absolutely everything! We'll be reading those articles later in our study anyway, so doesn't it make sense to get used to that style as soon as possible?	I often don't see the connections between articles and other research, so I prefer a book.. :)	In articles it's often totally unclear how it connects to other research, so having so many articles won't help us in any way!
For my part, we'll just do almost everything using journal articles, it's much cheaper!:)	For my part, we'll just do almost everything using journal articles, it's much cheaper! Not everyone can afford those books so easily!!! >:(	For my part, we'll just do almost everything using books, I find it handy to have a good reference on the bookshelf!	For my part, we'll just do almost everything using books, it really annoys me that some people think it's a good idea to first print everything and then throw it away, rather than investing in something durable >:(
Journals are much more up-to-date than books, right? Seems better to me to get an idea of what's happening in psychology directly from the start!	Journals are much more up-to-date than books, right? I find it really stupid to waste our time by learning about obsolete theories..	I'd rather have one book that just contains everything instead of having to look for an article again and again..	Ridiculous idea, it's often impossible to even find an article.. please give me a book that just contains everything!
Everything has already been said really, but isn't it just better to read the original instead of what someone else thinks about that?	Indeed, don't you just want to read the original instead of how some book writer interprets that??	I'm also against articles, they've been written only so that it suits the author, I think a book is much more objective!	I'm also against articles, theres no point in reading only that which happens to suit the author?! A book is much more objective..

These statements were used in the conditions with four majority members. Depending on the group norm (which was manipulated to be opposite to the participant's initial opinion) and the assigned number of angry reactions, one statement from each row was sent to the participant.

themselves. These statements were not analyzed; rather, we used them to estimate whether participants doubted the reality of the situation (see 'Participants and Design' above). After writing and sending their statement, participants were given 30 s to read and study all the statements that had been made in the discussion.

Conformity measure

Next, the participants read that a student body had developed a proposal related to the focal issue. This proposal was manipulated to be consistent with the group norm (and therefore opposed to the participant's position): The student body proposed to increase the percentage of journal articles to a minimum of 75% when the group norm was 'many articles,' or to reduce the percentage to a maximum 25% when the group norm was 'few articles.' Then, participants were asked to vote. Because the framing of the proposal was consistent with the group norm, a higher proportion of votes for the proposal reflected more conformity.

Acceptance/rejection scale

Following four filler items that asked about the extent to which the discussion had been satisfactory, felt acceptance/rejection was measured using the four-item 7-point bipolar scale used by Heerdink et al. (2013), e.g., "I feel rejected by the group" (1 = *not at all*, 7 = *very much*; $\alpha = 0.64$).

Manipulation checks

Two items checked whether participants perceived the group norm accurately (e.g., "My fellow group members prefer books rather than journal articles," $r = -0.82$, $p < 0.001$). These items were embedded in a questionnaire that checked participants' impressions of the discussion (e.g., the extent to which they thought the others agreed with each other).

To check the manipulation of majority size, participants were then asked to indicate with how many people they had interacted (0–4). Thirty-four participants misremembered majority size, and they were excluded from the analyses.

Three questions were used to check the manipulation of angry reactions. A first question asked whether or not the other group members had expressed anger during the interaction (yes or no). A second question asked how many of their fellow group members had expressed anger (0–5). A third question asked how much anger their fellow group members had expressed (1 = *not at all*, 7 = *very much*).

Finally, participants were asked the open-ended question, "Did you notice anything abnormal, strange, or that the experimenters should know about (e.g., apparatus failure)?"

Debriefing

At the end of the computerized mass-testing session, participants received a booklet that contained the debriefing for all experiments included in the session. The debriefing contained a description of the purpose of the study, explained the aspects of the experiment that had been simulated, and provided an e-mail address where more information could be obtained.

Results

Analytic Strategy

Unless otherwise stated, analysis of each dependent variable began by fitting a full (linear regression) model with the Majority Size × Angry Reactions interaction and main effects as linear predictors[3]. Because less immediate influence sources are less able to engender social impact (Latané, 1981), we controlled for the immediacy of the other group members as a source of social influence by including a measure of social distance as a covariate. It was calculated as the numerical distance between a participant's initial opinion and the group norm (the average of the fellow group members' answers), and reflects the extent to which the participant occupied a deviant position in the group. We refer to this variable as *level of deviance*.

After fitting the full model, this model was simplified using standard model simplification procedures: Non-significant predictors were eliminated step-by-step, starting with the more complex terms (i.e., interactions before main effects). The predictive power of the simplified model was re-assessed after each elimination. The reported, final models are the simplest models (i.e., fewest predictors) that do not sacrifice predictive power relative to the full model. That is, a model comparison yields a non-significant ($p >= 0.050$) difference between the full and the final model.

Manipulation Checks

Analysis of the group norm manipulation check indicated that participants accurately remembered the group norm in their group. Participants perceived their fellow group members to be more in favor of articles when the group norm had been 'many articles' compared to 'few articles,' $\beta = 2.03$, $t = 33.78$, $p < 0.001$. No other effects were retained in the final model, $R^2 = 80.4\%$, $F(1,278) = 1141.22$, $p < 0.001$. The group norms were also perceived as close to the relevant extremes of the 7-point scale (1 = *more books*, 7 = *more articles*) in both the 'many articles' groups ($M = 6.07$, SD = 0.89) and the 'few articles' groups ($M = 2.05$, SD = 0.85). Thus, the group norms were clear to the participants.

The three angry reactions manipulation checks converged in showing that the angry reactions manipulation had been successful. First, a logistic regression indicated that the likelihood of reporting that fellow group members had expressed anger increased as the number of angry reactions increased, $OR = 2.77$, Wald's $z = 7.61$, $p < 0.001$. Second, the reported number of angry reactions increased linearly as the manipulated number of angry reactions increased, $\beta = 0.47$, $t = 11.77$, $p < 0.001$ [$R^2 = 33.3\%$, $F(1,278) = 138.64$, $p < 0.001$]. Third, we found that with every extra angry reaction, participants reported that their fellow group members had expressed more anger, $\beta = 0.47$, $t = 11.59$, $p < 0.001$ [$R^2 = 32.6\%$, $F(1,278) = 134.37$, $p < 0.001$]. No other effects were retained in any of the three final models.

[3]We also fitted the power functions predicted by SIT, but found that this only improved the prediction of the angry reactions manipulation checks. Following Bond (2005) and our own prediction (H1), we therefore focus on the simpler, linear models in the remainder of the paper. We return to this issue in the Section "General Discussion."

Together, these strong and positive effects indicate that the angry reactions manipulation was successful.

Acceptance/Rejection

We found a small but reliable effect of angry reactions on felt rejection, indicating that participants felt more rejected as the number of angry reactions increased, $\beta = 0.15$, $t = 3.22$, $p = 0.001$. Moreover, the covariate was significantly related to felt rejection: participants felt more rejected as they were more deviant, $\beta = 0.14$, $t = 2.33$, $p = 0.020$. No other predictors were retained in the final model [$R^2 = 5.4\%$, $F(2,277) = 7.91$, $p < 0.001$]. The results thus support H1: Felt rejection increased as the number of angry reactions increased, independent of the size of the majority.

Conformity

Logistic regression on participants' votes (coded so that positive regression coefficients indicate an increase in the likelihood of conformity; see **Table 1** for the exact number of participants conforming in each condition) found a small effect of the number of angry reactions, indicating that conformity increased with the number of angry reactions, $OR = 1.32$, Wald's $z = 2.55$, $p = 0.011$. The covariate was also significant, indicating that conformity was less likely to the extent that the participant initially disagreed more with the group, $OR = 0.41$, Wald's $z = -5.58$, $p < 0.001$. Thus, the data support H2 that deviant individuals are more likely to conform when more of their fellow group members respond with anger to their deviance.

Mediation Analysis

To test whether the effect of angry reactions on conformity could be explained by participants' feelings of rejection, we conducted a mediation analysis. Using logistic regression, the participants' decision was regressed on level of deviance (covariate), angry reactions, and the interaction between majority size and felt rejection. Model simplification dropped the majority size manipulation from the model. As before, we found that conformity was less likely to the extent that participants were more deviant, $OR = 0.41$, Wald's $z = -5.41$, $p < 0.001$. Unexpectedly, and contrary to H3 that feeling rejected would explain the positive effect of angry reactions on conformity, we found marginally significant evidence that the likelihood of conformity was *reduced* to the degree that participants had felt rejected, $OR = 0.78$, Wald's $z = -1.77$, $p = 0.077$. Additionally, the number of angry reactions remained a significant and positive predictor of conformity, $OR = 1.37$, Wald's $z = 2.81$, $p = 0.005$.

When the coefficients obtained from the mediation analysis are compared to those from the analysis of conformity above, a small increase in the regression coefficient for the number of angry reactions may be observed (from $OR = 1.32$ to $OR = 1.37$). This indicates a potential suppressor effect (MacKinnon et al., 2000), which means that angry reactions may have had two simultaneous effects: a direct effect of angry reactions that increased conformity; and an indirect effect of angry reactions, through felt rejection, which reduced conformity (cf. Hayes, 2009). To test this possibility, the strength of the indirect effect of angry reactions on conformity through felt rejection was estimated using bootstrapping ($R = 50{,}000$ resamples). There was indeed some evidence for an indirect, conformity-reducing path, $OR = 0.963$, 95% bias-corrected and accelerated confidence interval (95% BC_a CI): [0.904, 0.999], uncorrected two-tailed $p = 0.069$. Although this indirect effect was quite small, it suggests that the likelihood of conformity was simultaneously increased by more angry reactions, and decreased by the felt rejection that was caused by these angry reactions.

Discussion

Study 1 showed that deviant individuals felt more rejected, and conformed more, the more their fellow group members responded with anger to their deviant position, supporting H1 and H2, respectively. Moreover, as expected, these relations were not moderated by the size of the majority. However, the effect of angry reactions on conformity was not mediated by felt rejection. In fact, contrary to H3, the indirect effect of angry reactions on conformity was negative, suggesting that angry reactions reduced conformity through felt rejection. This unexpected result led us to consider more closely what might be driving the relationship between felt rejection and conformity. Previous work suggests that responses to exclusion depend on the prospect of being reaccepted (DeWall and Richman, 2011). Thus, whether people conform after feeling rejected by others may depend on two conditions (see also Matschke and Sassenberg, 2010; Romero-Canyas et al., 2010; Heerdink et al., 2013). First, the rejectee should be motivated to be reaccepted. Second, there should be an actual possibility of reacceptance by the group through conformity (Heerdink et al., 2013). That is, deviants should be more likely to conform when changing their position toward the group norm is instrumental in eliciting (re-)acceptance.

With regard to the first condition, the data of Study 1 showed that conformity was less likely to the extent that participants disagreed more with the majority of their group. This is consistent with classic work showing that people are more influenced by similar others (Festinger, 1950; Latané, 1981). Because similarity increases interpersonal attraction (Montoya et al., 2008), less deviant participants may have felt more attracted to their groups than more deviant individuals. As a result, they may have been more motivated to seek reacceptance, which helps explain why conformity was higher among less deviant participants.

The finding that feeling rejected was associated with decreased conformity may indicate that conformity was not perceived as instrumental to gaining reacceptance in Study 1. Indeed, it has been argued that social exclusion is likely to trigger anti-social behavior if there is no real prospect of reacceptance (DeWall and Richman, 2011). It is possible that the operationalization of conformity in terms of voting behavior may have inspired a sense of anonymity among participants, because votes are often anonymous. Thus, participants may have inferred that the majority would not observe their conformity and therefore would not reaccept them, even if they conformed. This implies that we may find a different effect if the majority can observe the deviant's conformity. We examined this possibility in Study 2.

Study 2

In Study 2, we investigated whether the effect of majority anger on a deviant individual's conformity depends on the deviant's sense of anonymity. For this purpose, we included a manipulation of whether the participants' final decisions were private (as in Study 1) or public. We hypothesized that there would be a more positive association between felt rejection and conformity if the decision was public rather than private (H4).

We further explored whether the initial level of deviance of the participant served as an additional moderator, such that the anonymous or public nature of the final decision would only have an effect on those participants who are not too far removed from the group norm (i.e., those who are relatively less deviant). Participants who are very deviant from the group should be less attracted to their groups (Montoya et al., 2008), which may lower the motivation to seek reacceptance. Thus, we explored whether our data fit the idea that feeling rejected increases conformity only when two criteria are met: (1) the level of deviance is relatively small, and (2) conformity is visible to the group (i.e., under public, but not under private voting).

Method

Participants and Design

Two-hundred and forty-seven first-year Psychology students participated in the study, which was part of a similar mass testing session as Study 1. Again, participants came from two different groups that differed in the number (nine and eight) and content of the preceding tasks (which were, again, primarily personality questionnaires and unrelated to the current study). Details about these tasks may be obtained from the first author. Participants whose responses to the open questions suggested doubt about the reality of the simulated interaction or computer problems ($n = 11$)[4], and participants who misremembered the number of group members they had interacted with ($n = 19$) were excluded, resulting in a sample of 217 participants (64 male, $M_{age} = 19.43$, range 18–27). Failing these checks was not predicted by the manipulations. All participants interacted with a majority of three[5], and they were randomly assigned to one of the conditions of the Angry Reactions (0, 1, 2, or 3) × Decision Context (public or private) design. The distribution over conditions is displayed in **Table 3**. The study was carried out in accordance with APA regulations and approved by the IRB at the University of Amsterdam.

Materials and Procedure

Study 2 was similar to Study 1, and revolved around the same issue (the percentage of journal articles versus books). In addition to the procedural changes described below, we made two minor changes. First, the statements sent by the simulated participants were slightly edited to be more consistent in terms of wording and length (**Table 4**). Second, one of the angry reactions manipulation checks (the question "How many of your fellow group members had expressed anger?") was dropped for reasons of economy.

Deviance manipulation

The initial opinion measure was modified so that the slider ranged from 10 to 70%, and the group norm was now determined using the critical value of 40%. Participants whose initial opinion was less than 40% interacted with a group that endorsed the 'many articles' group norm, and the remaining participants with a group in which 'few articles' was the group norm. The fellow group members' opinions (which constituted the deviance manipulation) were also adjusted so that both group norms were equally far away from the critical value of 40%. The sequences were 52–69–60 for the 'many articles' group norm, and 28–11–20 for the 'few articles' group norms. The percentage of participants interacting with a group with the 'many articles' group norm (73.3%) was comparable to that in Study 1 (73.6%).

Decision context manipulation

For participants in the private decision condition, the procedure was identical to that in Study 1. For participants in the public decision condition, the procedure differed in several ways. First, participants learned that they would have to explain their final decision to their fellow group members[6]. Second, after completing the discussion, a new instruction screen alerted

[4]The same procedure was used as in Study 1. Participants were excluded if they used any of the words listed in Footnote 1 to describe the study ($N = 3$). The first author then read all remaining open-ended responses. Excerpts from the statements that were coded as indicating doubt about the veracity of the procedure ($N = 7$) are: "appears to be a fake-study"; "don't really think I was talking to real people"; "'something went wrong' in the decision round"; "the discussion didn't continue, which was probably intentional"; "I wouldn't be surprised if this was a set-up"; "it didn't feel as if these were really fellow students"; and "the 'other participants' answers' were childish and not very convincing." One more participant was excluded because this participant commented that the slider, which was used as the initial opinion measure, was not working.

[5]The study originally had a Majority Size (2 vs. 3) × Angry Reactions (0–3) × Decision Context (Private vs. Public) between-subjects design. Due to a programming error in the conditions with a majority size of two (2|A), the simulated group members disagreed with each other in these conditions when the norm was 'more books' (i.e., one group member argued for more books; the other for more journals). Thus, these conditions did not represent the intended majority influence situation, and were therefore dropped from the design.

[6]An anonymous reviewer alerted us that research with similar manipulations has shown that it may also trigger a motive for accuracy. Although our dependent

TABLE 3 | Number of participants conforming and total number of participants in each condition (Study 2).

		Number of angry reactions			
		0	1	2	3
Reponse context	Public	18/27 (66.7%)	16/25 (64.0%)	15/28 (53.6%)	12/24 (50.0%)
	Private	13/27 (48.1%)	14/30 (46.7%)	17/30 (56.7%)	11/26 (42.3%)

Conditions are based on response context and the number of angry reactions received by the participant. Cell sizes vary due to random assignment to conditions.

TABLE 4 | Statements sent by the simulated group members during the simulated group interaction (Study 2).

Norm: many articles		Group norm: few articles	
Mild happy	**Angry**	**Mild happy**	**Angry**
Later in our study, we'll have to read those articles anyway, so I think it's convenient to get used to that style as soon as possible..	We'll be reading those articles later in our study anyway, so we should get used to that style as soon as possible, right? It's ridiculous that we have to use books first!	In articles, the connections to other research are not as clear as in books so I'd prefer books..	In articles it's often totally unclear how it even connects to other research, so it's ridiculous to do away with books for that
For my part, we'll just do almost everything using journal articles, it's much cheaper!:)	For my part, we'll just do almost everything using journal articles, it's much cheaper! Not everyone can afford those books so easily!!! >:(	Printing articles costs a lot of paper and ink, and you throw them away anyway, so books are much better for the environment. Much more sustainable:)	Using articles instead of books is nothing but pollution!! Do you know how much ink and paper that takes? And we throw them away anyway, so they're just worthless >:(
Journals are much more up-to-date than books, right? If we use journal articles we get an idea of what's happening in psychology directly from the start!	Journals are much more up-to-date than books, right? it really irritates me to have to learn about all kinds of obsolete theories first	I'd rather have one book that just contains everything instead of having to look for individual articles on the internet..	It's often completely impossible to find an article with these half-broken search engines, so I would find it really super irritating to have to read so many articles..

participants that their decision would be visible to their fellow group members, and that they would need to write an explanation for their decision that would be sent to their fellow group members. The decisions would again be taken one-by-one, in the reverse order in which the statements had been written. Because the participants had always written the last statement, they would always be the first to take and explain their decision. This ensured that the participant would not be influenced by anything but the statements they had read during the discussion.

After participants had made their decisions, the program simulated a connection failure, and subsequently the connection timed out. The purpose of this procedure was to avoid having to present any simulated decisions/explanations to the participant, which could potentially alter the participants' responses in the questionnaire.

Decision context manipulation check

To check whether the decision context manipulation (public vs. private) was had been successful, participants were asked to indicate their agreement with the statement "I could take my decision anonymously" on a 7-point scale (1 = *not at all*, 7 = *very much*). This item was added to the questionnaire that also contained the items that checked the perception of the group norm.

Results

Analytic Strategy

We analyzed the data using the same general strategy as in Study 1. In this case, the full model contained the Angry Reactions × Decision Context interaction and main effects as linear predictors, and level of deviance was again included as a covariate. Once again, the reported final model is the simplest model that does not sacrifice predictive power compared to the full model.

measure (a vote on the preferred percentage of research articles in the study materials) did not include an objectively accurate answer, and this motive is therefore unlikely to have produced our results, it is important to be aware of this explanation in future research.

Manipulation Checks

Analysis of the group norm manipulation check indicated that participants had perceived the group norm correctly. Participants perceived the norm to be much closer to the 'journals' end of the scale (from 1 = *more books* to 7 = *more journals*) when the group norm was 'many articles' ($M = 6.10$, SD = 0.80) rather than 'few articles' ($M = 1.86$, SD = 0.86), $\beta = 2.07$, $t = 33.90$, $p < 0.001$. No other predictors were retained in the final model, $R^2 = 84.2\%$, $F(1,215) = 1149.13$, $p < 0.001$. This strong effect shows that the group norms were clear.

The manipulation check for decision context was influenced by whether the decision was private or public. The decision context effect was small and showed that, as intended, participants in the private decision condition ($M = 5.89$, SD = 1.25) reported that they could take their decision more anonymously than participants in the public decision condition ($M = 5.39$, SD = 1.52), $\beta = 0.36$, $t = 2.65$, $p = 0.009$. The final model contained no other predictors, $R^2 = 3.2\%$, $F(1,215) = 7.03$, $p = 0.009$.

Analysis of the manipulation checks for angry reactions showed that this manipulation also worked as intended. First, a logistic regression analysis on the question of whether the other group members had expressed anger indicated that more angry reactions increased the likelihood of answering this question affirmatively, $OR = 2.64$, Wald's $z = 6.18$, $p < 0.001$. Second, the other group members were perceived to be more angry as the number of angry reactions increased, $\beta = 0.44$, $t = 8.06$, $p < 0.001$ [$R^2 = 23.2\%$, $F(1,215) = 64.89$, $p < 0.001$]. No other effects were retained in the final models. These strong effects show that the angry reactions manipulation was successful.

Acceptance/Rejection

We predicted that participants would feel more rejected as they received more angry reactions. The final model supported this prediction, $R^2 = 6.4\%$, $F(2,214) = 7.35$, $p = 0.001$. The effect of the number of angry reactions was small and shows that as the number of angry reactions increased, participants felt more rejected, $\beta = 0.15$, $t = 2.52$, $p = 0.012$. In addition, as in Study

1, participants felt more rejected when they were more deviant, $\beta = 0.18$, $t = 2.65$, $p = 0.009$. No other effects were retained in the final model.

Conformity

Logistic regression on the decisions made by participants (see **Table 3** for the exact number of participants conforming in each condition) revealed that the predicted interaction between angry reactions and decision context could be dropped from the model without losing predictive power [$\Delta\chi^2(1) = 0.17$, $p = 0.681$]. Thus, H4 that felt rejection would increase conformity in a public decision context was not supported. Further simplification of the model showed that the manipulations were all dropped from the model. However, replicating Study 1, the results did show that the participant's level of deviance moderately predicted conformity: being more deviant decreased the likelihood of conformity, $OR = 0.45$, Wald's $z = -4.99$, $p < 0.001$.

Interestingly, subsequent exploratory analyses provided support for the idea that the relationship between felt rejection and conformity is contingent upon the decision context as well as the amount of initial deviance of the participant. In these analyses, we increased our statistical power by using the anonymity manipulation check as a predictor instead of the decision context manipulation. A model that included the three-way Felt Rejection × Anonymity × Level of Deviance interaction significantly improved the prediction of conformity, relative to the model that contained only felt rejection and level of deviance as predictors [$\Delta\chi^2(5) = 12.17$, $p = 0.033$]. A plot of this three-way interaction ($OR = 1.63$, Wald's $z = 2.43$, $p = 0.015$; see **Figure 1**) indicates that the relation between felt rejection and conformity was generally negative. Only for relatively less deviant participants who did not feel anonymous, the relation between felt rejection and conformity was more positive.

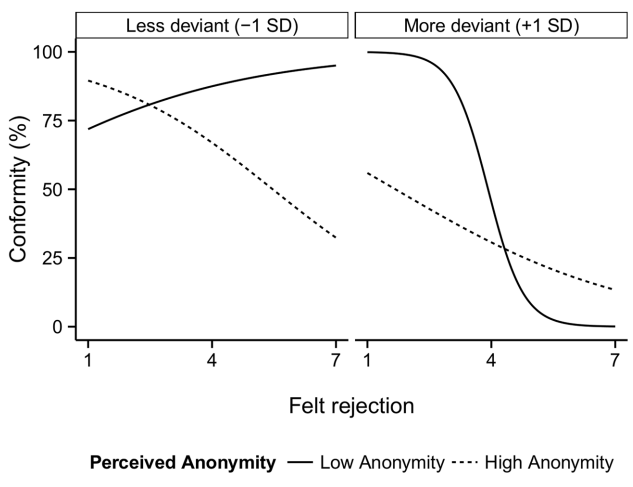

FIGURE 1 | Plot of the predicted values from the three-way Felt Rejection × Anonymity × Level of Deviance interaction on conformity. The panels show the differences between relatively less deviant and relatively more deviant group members. The line types are based on the anonymity manipulation check, and show the different relation between felt rejection and conformity depending on the subjective anonymity of the decision (low and high anonymity, or 2 and 6 on the 7-point scale, respectively).

Indirect Effect

Study 1 indicated that angry reactions produced two competing effects: one direct, that increased conformity; and one through felt rejection, that decreased conformity. Not finding a relation between angry reactions and conformity may thus simply indicate that the positive and negative effects of angry reactions were canceling each other out (cf. Hayes, 2009). Thus, even in the absence of a main (total) effect, it is recommended to test for an indirect effect (Hayes, 2009).

We tested this indirect effect as in Study 1. First, we tested the relation between felt rejection and conformity, and whether this relation depended on decision context. Consistent with the existence of an indirect path, conformity was less likely to the extent participants felt more rejected, $OR = 0.68$, Wald's $z = -2.52$, $p = 0.012$. In addition, as before, conformity was less likely to the extent participants were more deviant, $OR = 0.48$, Wald's $z = -4.61$, $p < 0.001$. No main effects or interactions involving decision type were retained in the final model. Using bootstrapping ($R = 50{,}000$ resamples), we then directly tested the indirect path from angry reactions, through felt rejection, to conformity. The analysis supported the existence of this indirect effect: $OR = 0.943$, 95% BC_a CI: [0.854, 0.992], uncorrected two-tailed $p = 0.024$. No direct, conformity-increasing effect of angry reactions was found. Thus, the small, indirect, conformity-reducing effect from Study 1 was indeed replicated.

Discussion

Study 2 replicated the finding that the more their fellow group members respond with anger to their behavior, the more deviant individuals feel rejected, and that this increased felt rejection subsequently decreases conformity. We hypothesized that in a public decision context, this felt rejection would be associated with increased conformity. Our results, however, show that the relation between felt rejection and conformity not only depends on the decision context, but also on one's level of deviance: for relatively less deviant individuals who felt their decision would be public, we found evidence that the negative relation between felt rejection and conformity can reverse. The findings of Study 2 thus replicate and extend those of Study 1, and are consistent with the idea that conforming to the group requires both visibility of conformity, as well as a relatively lower level of deviance.

General Discussion

Starting from the perspective that emotions are functional in regulating intragroup processes (e.g., Keltner and Haidt, 1999), and the observation that anger is expressed in order to change other people's behavior (e.g., Fischer and Roseman, 2007), we raised the question of whether the number of angry reactions to a deviant group member influences felt rejection and conformity. In two studies, we found evidence for our prediction that deviant group members would feel increasingly rejected as the number of angry reactions from the majority increases, and we found this

relation to be independent of the total size of the group (Study 1). Furthermore, we found that the felt rejection caused by these angry reactions led to anti-conformity, unless two criteria were met: the initial extent of deviance was relatively small (Studies 1 and 2), and conformity could be instrumental in gaining reacceptance (Study 2).

These studies not only provide insight into the dynamics of emotional influence within groups where multiple and different emotional expressions may occur, but they also illustrate the usefulness of studying the role of discrete emotional episodes in shaping intragroup processes. Existing research that focused on how affective phenomena impacts group outcomes (e.g., Barsade, 2002; Van Kleef et al., 2010) has primarily invoked the notion of emotional contagion, where one group member's affective experiences infuse, or trigger similar affective experiences in another group member (Barsade, 2002). We complement this perspective by offering insight into how discrete emotional expressions (or episodes) affect group dynamics. Studying affective processes in this more fine-grained manner helps us to understand the circumstances under which emotional reactions to deviance may ignite, sustain, or help resolve intragroup conflict (e.g., Jehn, 1997).

Although we set out to demonstrate that more angry reactions may increase conformity, our findings generally show the opposite. As such, they speak to the recent increase in attention to conditions under which people resist pressures to conform and choose dissent instead (e.g., Packer, 2007; Packer and Chasteen, 2009; Jetten and Hornsey, 2014). Dissent is considered as an important factor in stimulating group creativity and avoiding group think (e.g., De Dreu and West, 2001; Nemeth et al., 2001). Jetten and Hornsey (2014) describe a number of motivations that may underlie dissent, including a desire to express individual difference [e.g., a desire for personal freedom of choice (e.g., Miron and Brehm, 2006) or seeking uniqueness (Hornsey and Jetten, 2004)], pro-social motivations (e.g., concern for the group when norms are perceived as harmful; Packer, 2007), and anti-social or destructive motivations that aim to harm the group (Jetten and Hornsey, 2014). How should anti-conformity in our studies be understood?

Given that felt rejection mediated the effect of increasing numbers of angry reactions on increased anti-conformity, interpretations in terms of a pro-social motivation fit the data less well than interpretations in terms of seeking individual difference, or anti-social motivations. With regard to the former, it is difficult to see why more rejected participants would be more concerned about the group's well-being given that they are also more likely to leave the group when given the opportunity (Heerdink et al., 2013). Hence, the anti-conformity triggered by angry reactions is more easily interpreted as either an attempt to restore the freedom of choice (i.e., reactance; e.g., Miron and Brehm, 2006), or a more anti-social motivation to harm the group. An interpretation in terms of anti-social motivation is especially likely because rejection experiences have often been associated with antisocial behavior more generally (for a review, see Leary et al., 2006). For instance, in the previously discussed study by DeWall et al. (2010), participants who had been socially excluded by their peers allocated more hot sauce and administered longer blasts of loud noise to their rejecters. Furthermore, there is evidence that people who feel rejected are less inclined to cooperate with their groups (Twenge et al., 2007). Given that anti-conformity breaks the group's consensus, which hinders coordinated goal pursuit (Festinger, 1950), the anti-conformity triggered by angry reactions may reflect an attempt to retaliate against the rejecters. The finding that angry reactions decreased conformity may thus reflect the joint impact of a desire for freedom of choice and anti-social motivations following rejection. The most important observation following this analysis, however, is that neither a motivation to restore the freedom of choice, nor anti-social motivation may be expected to result in the authentic type of dissent that has been found to be conducive to group functioning (Nemeth et al., 2001).

In addition to demonstrating a link between angry reactions and anti-conformity, we have found some evidence that the tendency for anti-conformity may be reduced if contextual factors both promote the motivation to remain a member of the group (e.g., under relatively less deviance, because similarity increases attraction; Montoya et al., 2008) and allow conformity to be instrumental in gaining reacceptance (e.g., when decisions are public). Previous work has indeed shown that in similar situations, angry reactions may actually elicit conformity from a deviant (Heerdink et al., 2013). The fact that we primarily observed anti-conformity may therefore reflect that the contextual factors that would promote conformity were simply not clear or strong enough in the current studies. Because we conducted the experiments with first year students, it is not unlikely that our participants' overall degree of identification with their peers was quite low. Thus, their motivation to remain a member of their groups may have been simply insufficient (even when they were relatively less deviant) to completely reverse the relation between rejection and conformity, and show that a majority can indeed pressure a deviant individual into conforming by reacting with anger.

An interesting inconsistency between our findings and those from earlier majority influence research is that the size of the majority played no role in determining conformity (Study 1), despite the fact that majority size is often considered a determinant of conformity in the majority influence literature (e.g., Asch, 1956; Latané and Wolf, 1981; Bond, 2005). This may point to a similarity between the emotional influence process studied here and processes implicated in normative influence (Deutsch and Gerard, 1955). Normative influence stems from the power of the group to include or exclude individuals, and occurs when people change their opinion for fear of losing group membership (Deutsch and Gerard, 1955). By affecting one's sense of acceptance versus rejection, angry reactions are likely to invoke the same motivations as underlying normative influence. Our finding that majority size did not influence conformity may thus indicate that majority size only plays a role when it is ambiguous to what extent deviance will lead to rejection. In this case, people may infer that they may be rejected if they stay deviant, which leads them to conform. In the current set of studies, information about contingent rejection was provided in the form of angry reactions, which may have disambiguated the situation. This explanation remains to be tested, however.

The direct and positive effect of angry reactions on conformity in Study 1 suggests that angry reactions may enhance informational influence as well. Informational influence occurs because the majority, due to its greater size, has a greater claim to objective reality than a single individual (Deutsch and Gerard, 1955). Informational influence thus occurs when a majority persuades an individual that a certain opinion or behavior is objectively correct. Angry overtones may increase the persuasiveness of arguments, for instance because anger is associated with certainty (Lerner and Keltner, 2001), which often increases persuasion (Karmarkar and Tormala, 2010). There is indeed some evidence that a source's angry expressions can influence the attitudes of a target (Van Kleef et al., 2014). However, it should also be noted that this direct conformity-increasing effect was not replicated in Study 2, where the effect of anger expressions on conformity depended on both the initial level of deviance and the potential instrumentality of conformity in securing acceptance. Future studies may examine these issues into more detail.

Although we used linear modeling to test our hypothesis, it is interesting to consider to what extent the power function predicted by SIT (Latané, 1981) may provide a better description of our data. Additional analyses (not reported) revealed that SIT's power curve only significantly improved the model fit for the angry reactions manipulation checks in both studies. Thus, consistent with the results from the previously described meta-analysis by Bond (2005), the added complexity of SIT's power curve was not needed to describe the data. This may be due to the relatively small effect sizes observed here, which yielded insufficient resolution to fit the SIT curve. More realistic settings, where the effects of emotional expressions are undoubtedly stronger than in the simulated interactions studied here, may thus yield different conclusions. Alternatively, the range of angry reactions (0–4) may have been too narrow to show the gradually smaller effects of subsequent angry reactions. Awaiting further research into this direction, we provisionally conclude that the positive relation between angry reactions and felt rejection is best described as linear.

Finally, although using a simulated interaction paradigm affords the high experimental control that is needed to carefully study the relation between the number of angry reactions, rejection, and conformity, the substantial number of participants who doubted the veracity of the simulated interactions also shows that such a paradigm is prone to arouse suspicion in participants. This is an important limitation because it implies that some participants who did not spontaneously express such doubts in the open-ended questions, and were therefore left in the sample, may actually still have had some suspicion. These participants are unlikely to have perceived the situation as social, which may have led them to simply discount the reactions from the other 'participants,' thereby reducing the impact of our manipulations. Having some suspicious participants in the sample would therefore render our tests conservative, which means that it is likely that the effects of angry reactions on rejection and conformity that we found here are stronger in a more realistic setting.

In sum, we have shown that deviant individuals feel increasingly rejected as more people react with anger to their deviance, and we have shown that this felt rejection generally undermines conformity. Motivated by a desire to restore the individual freedom of choice, or anti-social tendencies triggered by feeling rejection, this anti-conformity may undermine group functioning. Yet, our analysis also illustrates that this anti-conformity following angry reactions and felt rejection may be overcome depending on two critical contextual factors: the initial level of deviance and the potential instrumentality of conformity for gaining acceptance. In showing these relations, we have demonstrated the harmful effects of reacting with anger to deviance, but also shed some light on the conditions under which angry reactions may be effective in resolving the threat to group functioning posed by deviance. Thus, echoing Van Kleef et al. (2011) observation of emotional influence more generally, these findings show that angry reactions to deviance are a tool to handle with care.

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"Put your Hands up in the Air"? The interpersonal effects of pride and shame expressions on opponents and teammates

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The aim of the present research was to investigate the interpersonal effects of pride and shame expressions amongst opponents and teammates in a soccer penalty scenario. Across a series of experiments using the point-light method, pride and shame expressions exerted strong effects upon observers' anticipated emotions, associated cognitions, and performance expectations. Using the Implicit Association Test (IAT) in two pilot studies we demonstrated that the created pride and shame point-light stimuli were implicitly associated with status and performance related attributes. In Experiment 1, observing pride expressions caused opponents to anticipate more negative emotions, cognitions, and lower performance expectancies toward their next performance in comparison with neutral expressions. In contrast, pride expressions led teammates to anticipate more positive emotions (i.e., pride and happiness), cognitions, and performance expectations toward their next performance than neutral expressions (Experiments 2–4). The results are discussed within the emotions as social information (*EASI*, Van Kleef, 2009) framework by arguing that the social context has to be taken into account when investigating the interpersonal effects of emotion expressions. In conclusion, the present research highlights the potential interpersonal influence of the nonverbal expressions of pride and shame in soccer penalty shootouts.

Keywords: emotion expression, pride, shame, interpersonal effects, nonverbal behavior, point-light

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Introduction

Hardly any other sporting event is characterized by such intense emotional displays in close succession as penalty shootouts in soccer. From one moment to the other excessive celebration, not only of players but of whole nations, might be replaced by excessive tears and misery as ultimate success and failure lie very closely together in these situations. Two important emotions in this respect are pride and shame that recently have received increased research attention in the psychological literature. An important question regarding these emotions is whether the expression of these emotions can merely be regarded an outcome as highlighted by previous research (Tracy and Matsumoto, 2008) or whether these emotional expressions also influence competitive (opponents) and cooperative others (team-members) as indicated by a recent study by Moll et al. (2010).

According to Van Kleef (2009) the psychological study of emotions has primarily focused on intrapersonal effects of emotions and neglected the interpersonal effects. Van Kleef

proposed the e*motions as social information model (EASI-model)* to better understand how distinct emotions (expressions) may exert interpersonal effects via communicating specific social information. This model originates from a social-functional perspective to emotion (Parkinson, 1996; Keltner and Haidt, 1999; Shariff and Tracy, 2011) suggesting that emotions not only evolved to prepare individuals to respond adaptively to recurring stimuli but are fundamental in communicating critical social information to coordinate social interactions and relationships. Of particular importance for the present research, several theorists have proposed that emotional expressions can both deliberately and unintentionally be used to influence others (Van Kleef et al., 2011, p. 154): "Emotion is not just a feeling. Emotion is for influence." In the present paper we follow the call of Van Kleef et al. (2011) of exploring the EASI model in the context of sport performance by investigating the interpersonal effects of the post-performance expressions of pride and shame on competitive (opponents) and cooperative others (team-members) in the soccer penalty shootout situation.

When individuals feel emotions they usually express emotions (there are some exceptions to this statement, e.g., anger might be inhibited if it is not appropriate in a given social context), and these emotion expressions can be observed by others. Pride is elicited after living up to a certain social standard—success, whilst shame is elicited after failing to live up to a certain social standard—failure (Tracy and Robins, 2007b; Tracy and Matsumoto, 2008). Evidence suggests that both pride and shame displays can be reliably recognized (see Martens et al., 2012 for a recent review).

Pride has a distinct and universally recognized expression consisting of an expanded and upright posture, the head tilted slightly upward, a small smile, and arms raised above the head with hands in fists or the hands on the hips (Tracy et al., 2009). This pride expression is argued to promote high status for the expresser. By displaying pride after success, individuals signal their success to others, thereby boosting status and acceptance (Tracy and Robins, 2007a). Further, the experience and display of pride has been associated with dominance, control, expertise, and power (Williams and DeSteno, 2009; Birch et al., 2010; Fischer et al., 2011), activated feelings of confidence (Huang et al., 2010), and making one feel good, particularly about oneself (Martens et al., 2012). More direct evidence comes from IAT studies showing that pride expressions were implicitly linked with high status (e.g., Shariff and Tracy, 2009).

The shame expression consists of the head tilted downward, a lowered eye gaze, and a slumped posture (Keltner, 1995; Tracy and Matsumoto, 2008; Tracy et al., 2009). Experiencing shame has been associated with feeling smaller and inferior to others (Tangney, 1993). Despite these negative feelings, displaying shame may benefit expressers by functioning to appease onlookers after a social transgression (Keltner and Buswell, 1997). That is, by showing shame individuals inform others that they are aware of their failure, and take responsibility for it to maintain respect and to avoid rejection (Gilbert, 2007).

Of particular relevance for the present research is the increasing body of evidence demonstrating that emotions do not only affect those who experience and express them, but also those who perceive those expressions shaping their feelings, thoughts, and actions (Elfenbein, 2007; Hareli and Rafaeli, 2008; Van Kleef, 2009). Strikingly, Moll et al. (2010) demonstrated that 80 per cent of soccer players who celebrated a successful penalty by showing pride (in comparison to the ones who did not show pride after a successful penalty) during penalty shootouts in the European and World Championships between 1972 and 2008 ended up winning the shootout. Similarly, a trend was evident indicating that players who showed nonverbal signs that are typical of a shame display (i.e., gazing down) were less likely to win the shootout. The main rationale of the present research is therefore to investigate if this effect might have been caused (or partly caused) by the fact that the pride and shame displays influenced opponents and team-mates as speculated by Moll and colleagues.

The EASI model suggests two specific mechanisms via which pride and shame expressions influence observers: inferential processes and/or affective reactions. Inferential processes describe how an observer of emotional expressions is able to infer certain information about the internal states (e.g., feelings, attitudes, relational orientations) of other people. Observers use this information to better understand the situation and it helps them to decide on an adaptive response. For example, when one is observing a pride display, one may conclude that this individual has achieved something important (inference), and should be treated in accordance with this achievement (e.g., Parkinson, 1996). In addition, the observed expressions can elicit affective reactions within the observer. One type of affective reaction occurs via the process of emotional contagion whereby individuals catch the expresser's emotions through their facial expressions, bodily movements and postures, or vocalizations (Hatfield et al., 1993).

Figure 1 displays the combined guiding model for the present research exemplified in a soccer penalty shootout. Depending on the outcome of an important soccer penalty kick, a penalty taker will experience a certain emotion (e.g., pride after a successful attempt and shame after an unsuccessful attempt) which in many cases leads to the nonverbal expression of the respective emotion (Moll et al., 2010). According to evolutionary accounts, the pride and shame expressions signal certain social information which can be reliably recognized by both team-mates and opponents.

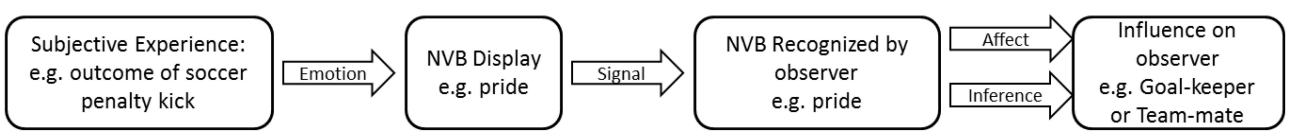

FIGURE 1 | Hypothesized model based on Van Kleef (2009) on the display of emotional nonverbal expressions in a sports situation.

The EASI model predicts that this influences observer's behavior via the described inferential and affective processes.

Importantly the EASI model further predicts that the relative influence of inferential and affective processes depends on social-contextual factors (Van Kleef, 2009; Van Kleef et al., 2010). Whilst the basic information of distinct emotions generalizes across situations, observers may respond differently to emotional displays depending on the nature of the situation—competitive or cooperative. In competitive situations, the effects of emotion expressions upon observers are driven more by inferential processes and less by affective reactions (Van Kleef et al., 2010). Studies have shown that strategic inferences become more prominent with signs of appeasement leading to less concessions in negotiations (see for a review, Van Kleef et al., 2010). In the case of shame, Tracy and Matsumoto (2008) have argued that displayed shame signals that one places oneself beneath the opponent or aggressor recognizing his/her power and superiority. If so, observers perceiving the display of shame in opponents may infer weakness, which, in turn, may result in opposing thoughts, feelings, and attitudes (e.g., increased confidence, Parkinson, 1996; Van Kleef, 2009). This is not to say that emotional contagion will not occur, but it is less prevalent.

In contrast, when individual's goals are linked in a cooperative manner (e.g., as a team winning the penalty shootout), emotion expressions are more likely to influence observers in a more automatic way through affective reactions (Van Kleef et al., 2010) and less by inferential processes. Indeed, researchers have found that in cooperative situations, observers caught the emotions of the expresser through the process of emotional contagion to, in turn, influence their judgments, decisions, and behaviors (Barsade, 2002; Visser et al., 2013). As alluded to by Moll et al. (2010) displayed pride may induce similar feelings in teammates causing them to experience associated thoughts (e.g., activate feelings of confidence) benefiting subsequent performance. That said, inferential processing may occur as observers can still distill strategic information from the expressions depending on their information processing ability (i.e., low time pressure).

Moll et al. (2010) provided first evidence that post-performance pride expressions had a positive effect on team-mates and a negative effect on opponents when retrospectively analyzing penalty shootouts in soccer. Based on the pattern of results they speculated that pride expressions "(a) caused teammates to feel more confident in taking their own penalty kick; (b) helped to enhance expectancy levels of winning the penalty shootout in teammates; or (c) generally resulted in a more positive approach toward the shootout" (p. 988). In addition, an opponent had over double the chances of missing the next penalty after observing a pride expression by an opponent player in comparison to when a player did not celebrate his success. Although, Moll et al. (2010) reasoned that their findings might be explained via the process of emotional contagion, there is currently no evidence supporting this notion. Further, the fact that pride expressions had a negative impact on opponents seems hard to explain via the proposed emotional contagion mechanism and might be more readily explained via inferential processing (Van Kleef et al., 2010). Hence, we aimed at furthering the understanding of the interpersonal effects of pride and shame expressions on both opponents and team-mates in soccer penalty shootouts We investigated the interpersonal effects of pride and shame expressions in both competitive (Experiment 1) and cooperative social situations (Experiments 2–4). The context of penalty shootouts seems well suited in this endeavor since the emotional expressions in question are displayed frequently (Moll et al., 2010) and easily observable in this situation as the penalty takers are in the center of attention of both opponents and team-mates. Prior to this series of experiments, we used the Implicit Association Test (IAT) to investigate whether pride and shame expressions are implicitly associated with status (Pilot Study 1) and performance (Pilot Study 2) related attributes.

We created video footage of penalty takers (**Figure 2**) using the point-light technique (Johansson, 1973). We chose this method to remove appearance characteristics such as clothing from the display and, more importantly, to examine whether the biological motion information relating to the pride and shame expressions reported in Moll et al. (2010) is sufficient for influencing others. It has been suggested that the accurate inferences drawn from biological motion information may have evolved for fitness reasons in social animals in order to efficiently communicate emotional information with one another (Burgoon, 1996; Blakemore and Decety, 2001; Blake and Shiffrar, 2007; Bente et al., 2010). In support of this, Atkinson et al. (2004) demonstrated that observers could reliably detect emotional states from point-light videos and therefore this approach can be considered a suitable methodology for investigating the interpersonal effects of pride and shame expressions during penalty shootouts. Further, this approach has successfully been employed in previous research investigating nonverbal behaviors (NVB) during the penalty preparation related to dominance and submissiveness (Furley and Dicks, 2012; Furley et al., 2012a) and anxiety (Furley et al., 2012b). If the effects reported by Moll et al. (2010) were indeed due to the interpersonal effects of pride and shame—being automatically related to high and low status (Shariff and Tracy, 2009)—then the scarce biological motion information should be sufficient in influencing soccer players in the penalty shootout situation.

To test this idea we used the created point-light stimulus material in a pilot study to replicate the findings of Shariff and Tracy (2009) who demonstrated that pride expressions serve the distinct evolutionary function of communicating high status, instead of merely positive valence. In addition, we aimed to extend this finding in Pilot study 2 by investigating whether pride and shame expressions are further implicitly linked to performance related attributes. The rationale for using implicit methodologies was to test whether the created point-light stimuli of the pride and shame expressions send automatically perceived social signals that go beyond general positivity and negativity.

Pilot Study 1: Implicit Associations between Pride and Shame Expressions and Status

Shariff and Tracy (2009) demonstrated that pride expressions serve the distinct evolutionary function of communicating high status, instead of merely positive valence. In this respect, we attempted to use the IAT—which has been successfully used

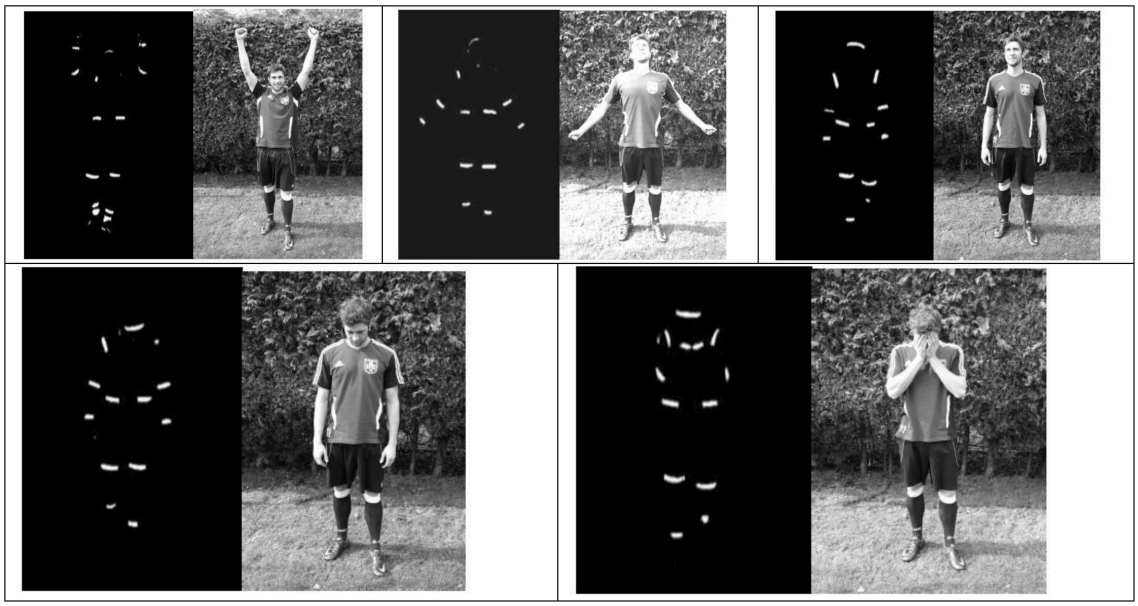

FIGURE 2 | Single frames of a sample pointlight stimuli used in the study on the left and a picture of the acted behavior on the right. Top: from the left to right: both fists above head, full pride expression, neutral expression; **Bottom**: from left to right: hands in front of face; head down.

in previous research on NVB and person perception in sports (Furley and Dicks, 2014; Furley and Memmert, 2015)—to replicate their main finding that pride expressions are implicitly linked to high status.

Methods

Participants

Another group of university students ($N = 21$; $M_{age} = 21.61$ years; $SD = 3.8$ years; 10 female), participated in the study. Neither age, nor gender moderated the pattern of results. The study was carried out in full accordance with the Helsinki Declaration of 1975 and written informed consent was obtained from all participants. The study was approved by the local universities ethic committee.

Materials, Stimuli, and Procedure

In order to investigate whether a soccer player displaying pride is implicitly associated with status, we paired the *target-concept* of nonverbal display of pride vs. shame with the *attribute dimension* of high vs. low status, as is standard procedure when using the IAT. For the initial *target concept discrimination*, we selected five images from point-light videos displaying a soccer player displaying pride and five images of a soccer player displaying shame. For the *associated attribute discrimination*, we used the same status related attributes as in Shariff and Tracy (2009): the list contained 5 attributes characteristic (German translation in square parentheses) of a high status individual (commanding [beherrschend]; dominant [dominant]; important [wichtig]; powerful [mächtig]; prestigious [angesehen]) and 5 of a low status individual (humble [demütig]; minor [untergeordnet]; submissive [unterwürfig]; unimportant [unwichtig]; weak [schwach]).

Procedure

All participants were seated individually in front of a standard 15 inch notebook computer and provided all their responses via a computer keyboard. Participants were informed that the experiment involved a simple response time test. They were asked to classify images and words as quickly and as accurately as possible and were blind to the actual purpose of the experiment. The procedure used was similar to Greenwald et al. (1998) and consisted of five blocks of trials. The first experimental block (block 3) combined the stimuli from the concept category (proud player/shameful player) with the attribute category (high status/low status), whilst the second experimental block (block 5) reversed this combination. Blocks 1, 2, and 4 were practice blocks for participants to learn the associations between the different stimuli and the respective keys. Depending on the experimental condition, the first experimental block was either congruent concerning our hypothesis (i.e., proud player images paired with high status attributes; and shameful player images paired with low status attributes) and the second experimental block incongruent (i.e., proud player images paired with low status attributes; and shameful player images paired with high status attributes), whereas in the other experimental condition we switched this order to exclude potential order effects. In the congruent condition player images and attributes were randomly presented one by one in the middle of the screen and participants had to press the "q" key for proud player images and good penalty taker attributes, whereas they had to press the "p" key for shameful player images and bad penalty taker attributes. In the incongruent condition participants had to press the "q" key for shameful player images and high status attributes, whereas they had to press the "p" key for proud player images and low status attributes. In addition, the order of blocks 2 and 4 were changed

according to the experimental condition to match the attribute categorization of the subsequent experimental blocks 3 and 5.

If the target categories of penalty takers' NVB are differentially associated with the attribute dimension (high vs. low status) as hypothesized, then participants will respond faster to the congruent block in comparison with the incongruent block. After completing the IAT test, participants filled out a questionnaire gathering biographic data.

Data analysis

We ran a mixed design ANOVA on the response times of participants with repeated measures on the within subject factors congruency (*congruent* vs. *incongruent*, stimulus material (*player image* vs. *player attributes*), and the between subject factors sequence order (*congruent* before *incongruent* vs. *incongruent* before *congruent*) and type of sport (baseball vs. soccer). We followed up the omnibus ANOVA with a series of dependent t-tests to illuminate the origin of the effects. For the main analysis regarding the comparisons of response time latencies we further report effect size estimates and their precision in form of 95% confidence intervals.

Results

Figure 3 (right panel) displays the mean latencies and the 95% confidence intervals between the congruent block of the IAT (i.e., proud images paired with high status attributes and shameful images paired with low status attributes) and the incongruent block for the status IAT (i.e., proud images paired with low status attributes and shameful images paired with high status attributes). Response time latencies differed substantially between congruent and incongruent trials ($M_{difference}$ = 844.67 ms [606.4, 1083.0], $d = 1.96$ [1.15, 2.75]) with participants responding almost a second faster on congruent trials compared to incongruent trials.

The mixed design ANOVA on the response times of participants revealed a significant main effect for congruency [$F_{(1, 19)} = 127.775$, $p < 0.001$, $\eta_p^2 = 0.871$], sequence order [$F_{(1, 19)} = 29.222$, $p < 0.001$, $\eta_p^2 = 0.606$], and stimulus material [$F_{(1, 19)} = 9.816$, $p = 0.005$, $\eta_p^2 = 0.341$]. Further the interaction between congruency and sequence order was significant [$F_{(1, 19)} = 25.860$, $p < 0.001$, $\eta_p^2 = 0.576$]. No other interactions reached significance (all $p > 0.26$).

The IAT effect was evident for both penalty taker attributes (congruent: $M = 811.00$ ms; $SD = 142.00$ ms vs. incongruent: $M = 1616.37$ ms; $SD = 586.03$ ms) and player images (congruent: $M = 659.26$ ms; $SD = 80.39$ ms vs. incongruent: $M = 1543.22$ ms; $SD = 650.80$ ms). These results suggest that participants show strong implicit associations between a penalty takers post-performance NVB and attributes related to status. Follow-up dependent *t*-tests revealed significant differences between the congruent and the incongruent conditions for both the player image stimuli ($t_{(20)} = -6.839$, $p < 0.001$, two-tailed, $d = 1.91$ [1.01, 2.70]) and the status attribute stimuli ($t_{(20)} = -7.401$, $p < 0.001$, two-tailed, $d = 1.89$ [1.11, 2.65]).

Discussion

Results of Pilot Study 1 replicated the findings of Shariff and Tracy (2009) and showed that the pride and shame point-light stimuli were implicitly associated with status-related attributes. Specifically, we found substantially faster reaction times when pride expressions were paired with high status words and shame expressions were paired with low status words compared to

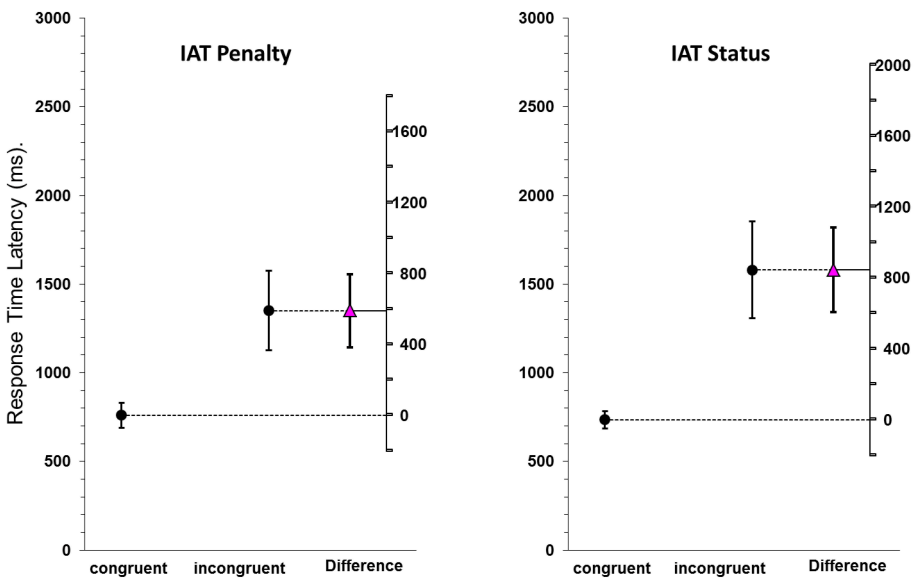

FIGURE 3 | Mean latency results and 95% confidence intervals for the congruent trials (proud player + good penalty taker; shameful player - bad penalty taker) vs. the incongruent trials (proud player + bad penalty taker; shameful player - good penalty taker) of penalty IAT (left panel) the status IAT (right panel). The difference between the group means, with its 95% confidence interval, is shown on a floating difference axis at the right in each panel.

when pride expressions were paired with low status words and shame expressions with high status words (**Figure 3**, right). As participants were equally motivated to respond as quickly as possible on every trial (Shariff and Tracy, 2009), this finding suggests that the stimulus material was differentially associated to status implicitly.

To investigate whether pride and shame expressions might not only be implicitly associated with status related attributes, but further associated with performance related attributes in soccer, we created an additional IAT in Pilot Study 2.

Pilot Study 2: Implicit Associations between Pride and Shame Expressions and Penalty Performance

Methods

Participants

A group of soccer players ($N = 21$; $M_{age} = 22.0$ years; $SD = 2.5$ years; 9 female), who had an average of 13.6 years ($SD = 4.3$) of playing experience, participated in the study. Neither age, gender, nor experience moderated the pattern of results. The study was carried out in full accordance with the Helsinki Declaration of 1975 and written informed consent was obtained from all participants.

Materials, Stimuli, and Procedure

In order to investigate whether a soccer player displaying pride is implicitly associated with attributes characterizing a "good penalty taker," we paired the *target-concept* of nonverbal display of pride vs. shame with the *attribute dimension* of good vs. bad penalty taker, as is standard procedure when using the IAT. We used the same pride and shame displays as in the previous IAT. For the *associated attribute discrimination*, we initially asked a soccer expert, teaching coaching courses in soccer at the local university, to create a lists consisting of 10 attributes being either associated with a good penalty taker and 10 attributes with a bad penalty taker. In a second step, two different soccer experts (in possession of a high coaching license) rated this list of attributes as being either characteristic of a good penalty taker or of a bad penalty taker on a Likert scale ranging from 1 "very characteristic of a bad penalty taker" to 7 "very characteristic of a good penalty taker." Following the expert ratings, we produced a list of 5 attributes (German translation in square parentheses) that were rated highest as being characteristic of a good penalty taker (good finishing [abschlussstark]; confident [selbstbewusst]; focused [konzentriert]; composed [gefasst]; assertive [durchsetzungsfähig]) as being rated highest for a bad penalty taker (poor finishing [abschlussschwach]; not confident [nicht selbstbewusst]; distracted [abgelenkt]; on edge [gestresst]; insecure [unsicher]). If the target categories of penalty takers' NVB are differentially associated with the attribute dimension (good vs. bad penalty taker) as hypothesized, then participants will respond faster to the congruent block in comparison with the incongruent block. After completing the IAT test, participants filled out a questionnaire gathering biographic data. Otherwise the procedure was identical to the previous IAT.

Results

Figure 3 (left panel) displays the mean latencies and the 95% confidence intervals between the congruent block (i.e., proud images paired with positive performance related attributes and shameful images paired with negative performance related attributes) of the IAT and the incongruent block for penalty IAT (i.e., proud images paired with negative performance related attributes and shameful images paired with positive performance related attributes). Response time latencies differed substantially between congruent and incongruent trials ($M_{difference} = 589.88$ ms [383.6, 796.2], $d = 1.62$ [0.88, 2.34]) with participants responding over half a second faster on congruent trials compared to incongruent trials.

The mixed design ANOVA on the response times of participants revealed a significant main effect for congruency [$F_{(1, 19)} = 34.375$, $p < 0.001$, $\eta_p^2 = 0.644$] and stimulus material [$F_{(1, 19)} = 28.249$, $p < 0.001$, $\eta_p^2 = 0.598$]. Further the interaction between congruency and stimulus material was significant [$F_{(1, 19)} = 7.003$, $p = 0.016$, $\eta_p^2 = 0.269$]. The main effect for sequence order ($p = 0.70$, $\eta_p^2 = 0.008$), nor any of the other interactions reached significance (all $p > 0.53$). The IAT effect was evident for both penalty taker attributes (congruent: $M = 847.89$ ms; $SD = 190.15$ ms vs. incongruent: $M = 1525.28$ ms; $SD = 599.21$ ms) and player images (congruent: $M = 672.05$ ms; $SD = 131.53$ ms vs. incongruent: $M = 1174.41$ ms; $SD = 435.08$ ms).

Follow-up dependent t-tests revealed significant differences between the congruent and the incongruent conditions for both the player image stimuli ($t_{(20)} = -5.623$, $p < 0.001$, two-tailed, $d = 1.56$ [0.83, 2.28]) and the player attribute stimuli ($t_{(20)} = -5.777$, $p < 0.001$, two-tailed, $d = 1.52$ [0.8, 2.21]).

Discussion

The results of Pilot Study 2 suggest that participants further show strong implicit associations between a penalty takers pride and shame displays and attributes related to their penalty taking performance. In tandem with the findings from Pilot Study 1 and the findings from Shariff and Tracy (2009), it therefore seems plausible that pride and shame expressions in a penalty situation have distinct communicative effects by being implicitly related to both status and performance. After validating these distinct implicit associations of pride and shame expressions, we move on to investigating the interpersonal effects of pride and shame expressions on both competitive (Experiment 1) and cooperative observers (Experiments 2–4) in penalty shootouts.

Experiment 1: The Effect of Nonverbal Pride and Shame Expressions on Opponents

In Experiment 1, we examined the effects of observing post-performance shame and pride expressions among a group of goal-keepers using a within-subject design similar to previous

research on nonverbal expressions in sports (Greenlees et al., 2005, 2008; Furley and Dicks, 2012; Furley et al., 2012a,b). Based upon the suggestions of Moll et al. (2010), we hypothesized that pride and shame expressions could be distinguished based on biological motion information from neutral expressions; that pride expressions would lead to more negative anticipated emotions and cognitions compared to a neutral expression; and shame expressions would lead to more positive anticipated emotions and cognitions compared to a neutral expression amongst opposing goal-keepers.

Methods

Participants

Fifteen experienced male goalkeepers (M_{age} = 27.1; SD = 8.1) took part in the study, who had on average 15 years (SD = 7.1) of amateur to semiprofessional playing experience. Neither age nor playing experience significantly moderated the pattern of results. Informed consent was obtained from every participant before commencing the experiment. The study was carried out in accordance with the Helsinki Declaration of 1975.

Materials and Stimuli

The filming took place in a dark room where almost all ambient light was blocked. The point-light footage was recorded using a Canon HG21 digital video camera mounted on a tripod at a height of 1.85 m, 11 m from a penalty spot resembling the perspective goalkeepers have on the penalty taker. Two halogen spotlights were positioned in front of the camera directed at the actor executing the penalty kick. Four actors were recruited to create the stimulus material. They all received the same instructions on how to execute the penalty kick and how to behave after the kick when being filmed. In Experiment 1 every actor first pretended to execute a penalty kick and then take two steps toward the camera while acting various post-performance expressions detailed below. The actors wore black tight fitting clothes and headwear. The reflective tape was placed on the clothes (**Figure 2**) following the procedures outlined by Atkinson et al. (2004).

Post-performance NVB manipulation

NVBs expressing pride and shame were created based both on the coding system adopted by Tracy and Matsumoto (2008) and on the coding system used by Moll et al. (2010) to make them more representative of the emotional expression during penalty shootouts. Based on Moll et al. (2010) we created six different post-performance NVBs associated with pride, shame, and one neutral NVB expression (cf. **Figure 2**). The first NVB expression of pride involved the player (i) tilting the head back; (ii) extending both arms above the head with hands in fists; and (iii) expanding the chest (cf. left most image of the top panel of **Figure 2**). The second one involved the actor (i) tilting the head back, (ii) expanding the chest, (iii) turning the shoulders outward with the hands facing the camera, and (iv) the arms slightly extended from the body (cf. middle image of the top panel of **Figure 2**). The neutral condition involved the actor neutrally taking two steps toward the goalkeeper after the penalty execution (cf. right most image of the top panel of **Figure 2**). In the neutral condition we asked participants to (i) adopt a relaxed stance with the feet shoulder-wide apart and the shoulders casually hanging; (ii) neither collapse the limbs inwards nor outwards; (iii) not to deliberately hold the head up and the chin slightly pointed toward the ground. The leftmost image of the bottom panel of **Figure 2** shows the first shame expression which simply involved the actor to (i) gaze down with (ii) the shoulders slumped. The rightmost image of the bottom panel of **Figure 2** shows the second shame expression that involved a (i) slumped posture and (ii) moving the hands in front of the face to cover it. We implemented two versions of this shame expression one involving gazing down and the other tilting the head back as these were differentiated in Moll et al. (2010). However, as these were literally perceived as identical on all ratings we did not differentiate between these in the data analysis and pooled them as one expression of shame.

Stimuli selection

Each actor was filmed in the 6 different emotional expression conditions three times, before one video from each condition was selected by the experimenters that was—except for the experimental manipulation—most similar to one another. Hence, the final experiment contained 24 point-light videos of approximately 4 s length—4 actors in the 6 experimental conditions which we reduced to five in the data analysis as the two shame conditions that involved hiding the face behind the hands while either facing down or up were rated identically and therefore were pooled to one condition.

Measures

After every video, participants rated the observed player on several computer-generated 11-point digital semantic differential scales. The measures were partially derived from previous person perception research in sports (cf. Furley et al., 2012a,b), from previous research on pride (Williams and DeSteno, 2008), whereas others were included in an exploratory manner. In order to give their ratings, participants had to move a mouse cursor from the middle of the scale toward either end of the scale and provide their rating by clicking the left mouse button. The E-prime software transformed the ratings into a value (with 3 decimals) between 0 reflecting the left end of the scale and 1 reflecting the right end of the scale.

Perception of target player

The first seven measures provided data on the perceived impressions of the observed penalty taker and served as a manipulation check. The dimensions were: (i) not confident–confident; (ii) on edge–composed; (iii) stressed–relaxed; (iv) unhappy–happy; (v) calm–excited; (vi) not ashamed–ashamed; and (vii) not proud–proud.

Expected feelings/cognitions items

Participants rated their anticipated feelings/cognitions after viewing the emotion expression on the following items: First, participants rated their anticipated feelings of pride, shame, and happiness toward the next penalty with the following three items: (i) not proud–proud; (ii) ashamed–not ashamed; (iii) unhappy–happy. To assess how stressful participants anticipated

feeling toward the next penalty, they rated the following items: (iv) on edge–composed; (v) stressed–relaxed; (vi) excited—calm; and (vii) worried–content. Participants rated their anticipated thoughts toward the next penalty on the following items: (viii) not confident–confident; (ix) not in control–in control; (x) not focused–focused; (xi) uncomfortable–comfortable.

Expected quality of next penalty and performance toward shootout

Participants rated their expectancy of the power of the penalty kick along the dimensions very weak—very powerful with low scores reflecting weak penalties. Further they rated the expected accuracy of the penalty kick along the dimensions very inaccurate—very accurate with low scores reflecting inaccurate penalties.

The next three items assessed the extent to which participants expected to: (i) perform to the best of their ability; (ii) to save the next penalty; and (iii) to win the shootout. Participants had to give their ratings along the dimensions not sure at all and very sure.

Procedure

E-prime 2.0 professional (Psychological Software Tools, 2007) was used to present the stimuli and collect the judgments on a 17-inch computer screen placed 60 cm away from the subjects. Every participant viewed the 24 experimental videos in a random order. Participants were instructed that they had to assume the role of the opposing goal-keeper in a penalty shootout situation and that point-light video clips would be presented of different penalty takers performing penalty kicks. Subsequently they were informed that they would have to answer questions about the penalty taker, the next penalty in line, and the entire shootout based solely on the penalty footage that was presented to them in the point-light displays. Before commencing the experiment, participants filled out a questionnaire gathering demographic data. Every participant was tested individually. Participants first viewed a point-light video to familiarize themselves with the procedure prior to the 24 experimental clips that were presented in random order. After completing the Experiment, participants were informed about the purpose of the study.

Data Analysis

We calculated a series of within subject ANOVAs with repeated measures on the within subject independent variable post-performance NVB (fists above head; chest expanded; neutral; head down; and hands in front of face) on the seven perception of target player items, on the eleven feelings/cognitions toward next penalty items, the two expected penalty quality items, and the three expected performance items. Further, we conducted a series of planned contrasts testing the respective pride and shame expressions against the neutral expression for every dependent variable. Where, the assumption of sphericity was violated, the *p*-values were computed using the conservative Greenhouse-Geisser method with corrected degrees of freedom.

Results

Perception of Target Player and Manipulation Check

The univariate analysis and descriptive statistics of the seven perception of target player scales that served as a manipulation check are displayed in **Table 1**. The results revealed that the manipulated post-performance pride and shame expressions were recognized by the observers. Especially the large effect sizes for the proud and shame scales highlight the successful manipulation of the displayed NVB in question. However, it should be noted that the effect sizes for happiness were similarly high. A point we will return to in the general discussion section. Planned contrasts revealed that the fist above head expression significantly differed (except marginally nonsignificant for the calm-excited measure; $p = 0.055$; $\eta_p^2 = 0.24$) from the neutral condition on all the dependent measures (all $\eta_p^2 > 0.80$). Similarly, the chest expanded condition significantly differed from the neutral condition on all measures except marginally not for calm-excited ($p = 0.063$; $\eta_p^2 = 0.24$) and not ashamed-ashamed ($p = 0.083$; $\eta_p^2 = 0.20$). Target players were rated as more confident, more composed, more relaxed, happier, and as less ashamed when displaying pride as compared to the neutral expression. Both shame expressions differed significantly on all the dependent measures from the neutral condition (all $\eta_p^2 > 0.40$), except on the calm-excited measure between neutral and head-down ($p = 0.095$; $\eta_p^2 = 0.19$). Target players were rated as less confident, less happy, more on edge, more stressed,

TABLE 1 | Univariate analysis of Experiment 1 (opponent goal-keepers) for the main effects of post-performance NVB on the perception of the target player.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2p	*p*
Not confident–confident	0.95(0.06)	0.76(0.07)	0.54(0.08)	0.14(0.08)	0.07(0.08)	4, 56	346.5	0.96	<0.001
On edge–composed	0.93(0.05)	0.81(0.07)	0.74(0.11)	0.53(0.30)	0.17(0.13)	1.9, 25.9	56.4	0.80	<0.001
Stressed–relaxed	0.92(0.07)	0.80(0.08)	0.73(0.10)	0.51(0.30)	0.15(0.12)	1.8, 24.9	57.2	0.80	<0.001
Unhappy–happy	0.97(0.03)	0.76(0.06)	0.49(0.07)	0.12(0.07)	0.06(0.04)	4, 56	624.2	0.98	<0.001
Calm–excited	0.44(0.35)	0.33(0.14)	0.25(0.09)	0.38(0.28)	0.78(0.16)	1.6, 22.7	11.0	0.44	<0.001
Not ashamed–ashamed	0.02(0.02)	0.21(0.08)	0.27(0.18)	0.88(0.11)	0.93(0.07)	1.7, 24.3	307.7	0.96	<0.001
Not proud–proud	0.99(0.02)	0.81(0.06)	0.51(0.06)	0.10(0.08)	0.03(0.02)	2.8, 38.5	922.4	0.99	<0.001

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., not confident) = 0.00 and the right side of the pole = 1.00 (e.g., confident).

more excited, and as more ashamed when displaying shame as compared to the neutral expression.

Expected Feelings/Cognitions Items

The univariate analysis and descriptive statistics of the eleven anticipated feelings and thoughts toward the next penalty kick scales are displayed in **Table 2**.

Planned contrasts revealed that the fist above head expression significantly differed from the neutral condition on most of the expected feelings and cognition measures (all $\eta_p^2 > 0.82$ for the significant measures), except for confidence ($p = 0.091$; $\eta_p^2 = 0.19$), focus ($p = 0.921$; $\eta_p^2 = 0.01$), and control ($p = 0.797$; $\eta_p^2 = 0.01$). A similar pattern was evident for the comparisons between the chest expanded and the neutral condition (all $\eta_p^2 > 0.52$ for the significant measures), showing significant differences between all measures except for the confidence ($p = 0.244$; $\eta_p^2 = 0.10$), focus ($p = 0.858$; $\eta_p^2 = 0.01$), and control ($p = 0.431$; $\eta_p^2 = 0.05$) measures as for the other pride expression. Opposing goalkeepers expected to feel less proud, more ashamed, more unhappy, more on edge, more stressed, more excited, more worried, and more uncomfortable when observing an opposing penalty taker display pride as compared to a neutral expression. Both shame expressions significantly differed from all the expected feelings and cognitions scales compared to the neutral condition (all $\eta_p^2 > 0.76$). Opposing goalkeepers expected to feel prouder, less ashamed, happier, more composed, more relaxed, calmer, more content, more confident, more in control, more focused and more comfortable when observing an opposing penalty taker display shame as compared to a neutral expression.

Expected Quality of Next Penalty Kick and Performance Toward Shootout

The univariate analysis and descriptive statistics of the two expected quality scales and the three confidence scales are displayed in **Table 3**.

Planned contrasts revealed that both pride expressions significantly differed from the neutral condition on all of the expected quality of penalty kick and performance measures (all $p < 0.012$; all $\eta_p^2 > 0.37$). Opposing goalkeepers expected a more accurate penalty kick, a more powerful penalty kick, and to perform worse in the shootout when observing an opposing penalty taker display pride as compared to a neutral expression.

The same was true for the two shame expressions (all $p < 0.012$; all $\eta_p^2 > 0.77$). Opposing goalkeepers expected to feel prouder, less ashamed, happier, more composed, more relaxed, calmer, more content, more confident, more in control, more focused, and more comfortable when observing an opposing penalty taker display shame as compared to a neutral expression.

Control Group of Outfield Players

In order to replicate the pattern of results (i.e., positive emotion expressions have a negative effect and negative expressions a positive effect on opponents) amongst opponent goalkeepers, we additionally tested a group of 20 experienced male outfield players ($M_{age} = 24.8$; $SD = 6.3$) who had on average 17 years ($SD = 3.0$) of amateur to semiprofessional playing experience (using the stimulus material from Experiment 2 which showed the players perspective instead of the goalkeeper perspective). The outfield players were asked to assume the role of the next opponent penalty taker in line and give their ratings toward their next penalty kick. The pattern of results amongst opponent penalty takers was almost identical to opponent goalkeepers. When factoring in the between group independent variable (goalkeepers/players) the Two-Way mixed ANOVA did not reveal any between group main effects on any of the dependent variables (all $p > 0.3$) and showed a very similar pattern of results compared to the goalkeepers, scrutinizing the finding that displayed pride had a negative effect on opponents and displayed shame had a positive effect upon opponents.

Discussion

The results obtained in Experiment 1 suggest that pride and shame expressions displayed by a player after taking a penalty

TABLE 2 | Univariate analysis of Experiment 1 for the main effects of post-performance NVB on the expected feelings/cognitions items.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2p	*p*
Not proud–proud	0.24(0.14)	0.41(0.17)	0.53(0.14)	0.85(0.09)	0.92(0.05)	1.7, 24.4	136.3	0.90	0.000
Not ashamed–ashamed	0.73(0.12)	0.58(0.17)	0.45(0.15)	0.14(0.09)	0.09(0.07)	1.9, 26.5	94.4	0.87	0.000
Unhappy–happy	0.20(0.10)	0.38(0.07)	0.50(0.10)	0.84(0.10)	0.90(0.06)	1.8, 26.0	175.3	0.93	0.000
On edge–composed	0.24(0.11)	0.38(0.08)	0.50(0.10)	0.85(0.07)	0.88(0.06)	1.8, 25.7	221.2	0.94	0.000
Stressed–relaxed	0.23(0.09)	0.38(0.07)	0.50(0.10)	0.85(0.08)	0.89(0.06)	2.0, 28.2	231.6	0.94	0.000
Calm–excited	0.79(0.12)	0.62(0.16)	0.51(0.13)	0.16(0.10)	0.10(0.08)	1.5, 21.2	135.0	0.90	0.000
Worried–content	0.22(0.06)	0.35(0.07)	0.47(0.07)	0.79(0.11)	0.82(0.11)	1.9, 25.9	174.9	0.93	0.000
Not confident–confident	0.62(0.20)	0.66(0.15)	0.69(0.10)	0.89(0.07)	0.90(0.05)	1.7, 23.1	40.6	0.74	0.000
Not in control–in control	0.66(0.18)	0.68(0.12)	0.67(0.10)	0.84(0.10)	0.88(0.07)	1.4, 19.5	27.9	0.66	0.000
Not focused–focused	0.74(0.13)	0.74(0.12)	0.75(0.10)	0.87(0.09)	0.90(0.06)	1.5, 20.9	31.2	0.69	0.000
Uncomfortable–comfortable	0.23(0.08)	0.38(0.08)	0.49(0.09)	0.80(0.08)	0.84(0.06)	2.2, 30.6	197.1	0.93	0.000

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., not proud) = 0.00 and the right side of the pole = 1.00 (e.g., proud).

TABLE 3 | Univariate analysis of Experiment 1 for the main effects of post-performance NVB on the anticipated next penalty quality and the expected performance toward shootout.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2p	*p*
Inaccurate–accurate	0.87(0.08)	0.72(0.06)	0.57(0.06)	0.25(0.12)	0.21(0.13)	1.3, 18.8	131.5	0.90	0.000
Weak–powerful	0.85(0.10)	0.69(0.06)	0.57(0.06)	0.25(0.13)	0.21(0.12)	1.3, 18.7	111.3	0.88	0.000
Perform to best of ability	0.59(0.18)	0.63(0.15)	0.67(0.13)	0.85(0.08)	0.89(0.06)	1.4, 19.2	52.3	0.79	0.000
Saving penalty	0.54(0.21)	0.61(0.16)	0.66(0.13)	0.86(0.07)	0.88(0.06)	1.5, 20.7	48.7	0.77	0.000
Winning shootout	0.56(0.21)	0.62(0.16)	0.67(0.12)	0.90(0.07)	0.92(0.05)	1.4, 20.1	52.5	0.79	0.000

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., inaccurate) = 0.00 and the right side of the pole = 1.00 (e.g., accurate).

kick can be recognized—although the results indicate that they might not be distinguishable from happy and unhappy expressions when only having access to biological motion information. More importantly, on the whole, the results revealed that opposing goal-keepers (and outfield players) who observed players displaying pride anticipated to: (i) feel less good in terms of higher levels of shame, lower levels of pride and happiness, (ii) feel more stressed; (iii), less positive cognitions by being less confident, in control, focused, and comfortable; and (iv) lower performance quality and expectations in the shootout compared to when observing players displaying a neutral expression. Opposing results were obtained for those goal-keepers (and outfield players) who observed players displaying shame compared to players displaying a neutral expression. These findings suggest that in a competitive context, pride and shame expressions cause opposing feelings and thoughts in observers.

In Experiment 2, we focused on the effects of pride and shame displays upon cooperative others (teammates).

Experiment 2: The Effect of Nonverbal Pride and Shame Expressions on Team-mates

In Experiment 2, we investigated the effects of observing nonverbal expressions of pride and shame on team-mates during a soccer penalty shootout as, according to the EASI-model, it depends on the nature of the situation—competitive or cooperative (Van Kleef et al., 2010) how observers respond to these emotion displays. We hypothesized that the expressions of pride and shame would have different interpersonal effects on the observer if the target was a cooperative team-member as opposed to an opponent as in Experiment 1. After observing pride, we predicted that teammates would anticipate experiencing more positive emotions and higher levels of associated cognitions (e.g., confidence, control, performance expectations). After observing displayed shame, we predicted that teammates would anticipate experiencing more negative emotions and lower levels of associated cognitions. Hence, we predicted that pride expressions would differ from neutral expressions and shame expressions would differ from the neutral expressions on the corresponding measures.

Methods

Participants

Sixteen experienced male outfield players took part in the study (M_{age} = 23.4; *SD* = 2.2), who had on average 15 years (*SD* = 3.2) of amateur to semiprofessional playing experience. Neither age nor playing experience significantly moderated the pattern of results. Informed consent was obtained from every participant before commencing the experiment. The study was carried out in accordance with the Helsinki Declaration of 1975.

Materials and Procedure

The materials and procedure in Experiment 2 were identical to Experiment 1, except for the following changes: We created new point-light stimuli resembling the view that team-mates and opponent penalty takers have when viewing the shootout. This time the actors were filmed from behind. After executing the penalty the actors were instructed to turn round and jog toward the camera while displaying the NVBs in question. The experimental manipulation was identical to Experiment 1; Further, participants were told that they had to take over the role of the penalty taker next in line and give their ratings toward their next penalty kick; The only other difference was that one of the outcome expectation scales was changed and participants had to rate how confident they were that they would score the next penalty. Otherwise, everything was identical to Experiment 1.

Results

Perception of Target Player and Manipulation Check

The univariate analysis and descriptive statistics of the seven perception of target players scales replicated the findings of Experiment 1 (cf. **Table 4**). This confirms that both pride and shame are recognized by others, although they might not be distinguishable from happy and unhappy.

Planned contrasts revealed that the fist above head expression significantly differed from the neutral condition on most of the perception of target player measures (all $\eta_p^2 > 0.27$ for the significant measures), except for on edge-composed ($p = 0.255$; $\eta_p^2 = 0.09$) and stressed-relaxed ($p = 0.328$; $\eta_p^2 = 0.06$). Target players were rated as more confident, happier, more excited, prouder, and as less ashamed when displaying pride as compared to the neutral expression. The chest expanded pride expression did not differ on any of the perception of target player measures from the neutral condition (all $p > 0.388$; all $\eta_p^2 < 0.05$). The hands in front of face shame expression significantly differed

TABLE 4 | Univariate analysis of Experiment 2 (own players) for the main effects of post-performance NVB on the perception of the target player.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2p	*p*
Not confident–confident	0.78(0.20)	0.67(0.09)	0.66(0.09)	0.38(0.21)	0.31(0.25)	1.6, 23.4	20.0	0.57	0.000
On edge–composed	0.69(0.20)	0.62(0.09)	0.63(0.08)	0.56(0.19)	0.31(0.21)	2.2, 33.3	11.6	0.44	0.000
Stressed–relaxed	0.69(0.19)	0.61(0.09)	0.64(0.08)	0.56(0.17)	0.28(0.21)	2.1, 31.6	13.9	0.48	0.000
Unhappy–happy	0.84(0.16)	0.60(0.14)	0.60(0.09)	0.28(0.21)	0.19(0.16)	1.5, 21.8	41.6	0.74	0.000
Calm–excited	0.54(0.15)	0.39(0.08)	0.38(0.08)	0.43(0.17)	0.70(0.21)	2.0, 30.1	11.9	0.82	0.000
Not ashamed–ashamed	0.17(0.17)	0.36(0.13)	0.36(0.07)	0.72(0.21)	0.80(0.19)	1.6, 23.9	37.7	0.71	0.000
Not proud–proud	0.83(0.17)	0.60(0.16)	0.62(0.11)	0.29(0.20)	0.21(0.16)	1.7, 25.3	35.1	0.70	0.000

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., not confident) = 0.00 and the right side of the pole = 1.00 (e.g., confident).

from the neutral expression on all these measures (all $\eta_p^2 > 0.65$ for the significant measures), whereas the gaze down expression (all $\eta_p^2 > 0.66$ for the significant measures) did not differ from the neutral expression on the on edge-composed ($p = 0.221$; $\eta_p^2 = 0.10$); the stressed-relaxed ($p = 0.157$; $\eta_p^2 = 0.13$), and calm-excited ($p = 0.308$; $\eta_p^2 = 0.07$) measures. Collapsing over both shame expressions, target players were rated as less confident, less happy, more on edge, more stressed, more excited, and as more ashamed when displaying shame as compared to the neutral expression.

Expected Feelings/Cognitions Items

The univariate analysis and descriptive statistics of the eleven anticipated feelings toward the next penalty kick scales are displayed in **Table 5**.

Planned contrasts revealed that the fist above head expression significantly differed from the neutral condition on most of the expected feelings and cognition measures (all $\eta_p^2 > 0.23$ for the significant measures), except for on calm-excited ($p = 0.155$; $\eta_p^2 = 0.16$). Teammates expected to feel prouder, less ashamed, happier, more composed, more relaxed, more content, more confident, more in control, more focused and more comfortable when observing a penalty taker from the own team display pride as compared to a neutral expression. Again, the chest expanded pride expression did not differ on any of the perception of target player measures from the neutral condition (all $p > 0.166$; (all $\eta_p^2 < 0.12$). The hands in front of face shame expression and the gaze down shame expression significantly differed from the neutral expression on all the expected feelings and cognition measures (all $p < 0.008$; (all $\eta_p^2 > 0.31$). Teammates expected to feel less proud, more ashamed, more unhappy, more on edge, more stressed, more excited, more worried, less confident, less in control, less focused, and more uncomfortable when observing an opposing penalty taker display shame as compared to a neutral expression.

Expected quality of next penalty and confidence toward shootout

The univariate analysis and descriptive statistics of the two expected quality scales and the three expected performance scales are displayed in **Table 6**.

Planned contrasts revealed that the fist above head expression significantly differed from the neutral condition on all the confidence toward shootouts scales (all $p < 0.02$; all $\eta_p^2 > 0.39$), but not on the expected penalty quality scales (accuracy $p = 0.070$; $\eta_p^2 = 0.20$; power $p = 0.056$; $\eta_p^2 = 0.22$). The chest expanded pride expression only differed on the confidence in performing to the best of their ability ($p = 0.014$; $\eta_p^2 = 0.34$) and confidence in scoring the next penalty measures ($p = 0.020$; $\eta_p^2 = 0.31$) from the neutral expression. Taken together, teammates expected to perform better in the penalty shootout when viewing a pride expression of a fellow teammate compared to a neutral expression. The hands in front of face shame expression differed from the neutral expression on all these measures (all $p < 0.023$; all $\eta_p^2 > 0.30$). The gaze down shame expression significantly differed on all these measures from the neutral condition (all $\eta_p^2 > 0.40$ for the significant measures), except for the expected penalty power ($p = 0.114$; $\eta_p^2 = 0.16$). All in all, teammates expected to perform worse when viewing a shame expression as compared to a neutral expression.

Discussion

As predicted, the results of Experiment 2 on the whole revealed that teammates who observed players displaying pride anticipated feeling more pride and, in turn, expected to be more confident, in control, as well as having higher performance expectations in the shootout compared to when observing players displaying a neutral expression. In addition, shame displays caused teammates to anticipate feeling more ashamed and in turn experiencing less positive cognitions, and lower performance expectations compared to a neutral expression.

Taken together, the pattern of results of Experiment 2 is reversed compared to Experiment 1 and highlights that the social situation has to be taken into account when investigating the interpersonal effects of pride and shame expressions (Van Kleef, 2009; Moll et al., 2010).

A potential limitation of Experiment 2 (and 1) is that participants were not informed about whether the behavioral responses from the penalty kick taker followed in response of a scored or a missed penalty kick. It could be that teammates anticipated emotions, cognitions, and performance expectations were more positive (negative) after observing a pride (shame) expression because they inferred that the observed player had

TABLE 5 | Univariate analysis of Experiment 2 for the main effects of post-performance NVB on the expected feelings items.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2_p	*p*
Not proud–proud	0.76(0.17)	0.62(0.12)	0.59(0.11)	0.40(0.17)	0.36(0.22)	1.2, 18.2	16.6	0.53	0.000
Not ashamed–ashamed	0.25(0.15)	0.36(0.08)	0.37(0.07)	0.57(0.20)	0.61(0.25)	1.2, 17.5	13.3	0.47	0.001
Unhappy–happy	0.76(0.14)	0.60(0.09)	0.61(0.07)	0.39(0.19)	0.33(0.21)	1.2, 18.6	19.6	0.57	0.000
On edge–composed	0.72(0.16)	0.60(0.10)	0.59(0.08)	0.37(0.17)	0.33(0.21)	1.3, 19.1	17.3	0.54	0.000
Stressed–relaxed	0.71(0.17)	0.60(0.10)	0.58(0.08)	0.39(0.15)	0.33(0.21)	1.2, 18.3	15.6	0.51	0.001
Calm–excited	0.37(0.20)	0.44(0.12)	0.45(0.11)	0.61(0.14)	0.70(0.19)	1.4, 20.7	10.5	0.41	0.002
Worried–content	0.71(0.17)	0.58(0.11)	0.59(0.10)	0.40(0.14)	0.33(0.17)	1.4, 21.2	17.5	0.54	0.000
Not confident–confident	0.77(0.14)	0.62(0.11)	0.64(0.12)	0.43(0.22)	0.39(0.25)	1.5, 21.9	14.0	0.48	0.000
Not in control–in control	0.78(0.14)	0.64(0.11)	0.66(0.11)	0.47(0.23)	0.45(0.27)	1.2, 17.6	12.4	0.45	0.002
Not focused–focused	0.85(0.12)	0.73(0.14)	0.70(0.17)	0.57(0.29)	0.53(0.33)	1.3, 18.7	11.2	0.43	0.002
Uncomfort.–comfortable	0.63(0.23)	0.59(0.11)	0.55(0.10)	0.38(0.16)	0.35(0.20)	1.3, 18.9	8.5	0.36	0.006

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., not proud) = 0.00 and the right side of the pole = 1.00 (e.g., proud).

TABLE 6 | Univariate analysis of Experiment 2 for the main effects of post-performance NVB on the anticipated next penalty quality and the expected performance toward shootout.

Item	*M*(*SD*) NVB1	*M*(*SD*) NVB2	*M*(*SD*) NVB3	*M*(*SD*) NVB4	*M*(*SD*) NVB5	*df* (model, error)	*F*	η^2_p	*p*
Inaccurate–accurate	0.75(0.15)	0.66(0.06)	0.66(0.11)	0.42(0.24)	0.36(0.23)	1.9, 28.1	18.8	0.56	0.000
Weak–powerful	0.70(0.20)	0.65(0.14)	0.62(0.14)	0.51(0.26)	0.44(0.25)	1.3, 19.7	5.25	0.26	0.025
Perform to best of ability	0.74(0.18)	0.68(0.14)	0.63(0.16)	0.47(0.22)	0.45(0.26)	1.2, 18.6	11.8	0.44	0.002
Scoring penalty	0.76(0.16)	0.67(0.12)	0.62(0.14)	0.45(0.21)	0.42(0.25)	1.3, 19.1	15.0	0.50	0.001
Winning shootout	0.76(0.19)	0.66(0.10)	0.62(0.16)	0.43(0.21)	0.38(0.23)	1.6, 24.2	13.1	0.48	0.000

NVB1, fists above head; NVB2, chest expanded; NVB3, neutral; NVB4, head down; NVB5, hands in front of face.
The left pole of the scale (e.g., inaccurate) = 0.00 and the right side of the pole = 1.00 (e.g., accurate).

scored (missed) his kick, rather than being a direct effect of the observed expression.

Second, a limitation of Experiment 2 (and 1) is that both the perceived emotions as well as the anticipated emotions were assessed with several exploratory measures that have not been established in previous research on emotion expressions.

Therefore, the rationale of Experiment 3 was to address these limitations by informing observers about the outcome (always a score) and using established scales to further examine how pride and shame expressions influenced teammates' anticipated emotions during a soccer penalty shootout focusing solely on the distinct emotions: pride, happiness, and anxiety.

Experiment 3: The Effect of Nonverbal Pride and Shame Expressions on Team-mates after Scoring a Penalty

In contrast with Experiment 2, teammates (participants) were informed about the outcome of the kick (score) when observing the behavioral responses of the penalty kick takers. Furthermore, we solely focus on how pride and shame expressions influence teammates anticipated emotions by using established scales to assess the distinct emotions: pride, happiness, and anxiety.

First, we hypothesized that pride and shame expressions could be distinguished based on biological motion information from neutral expressions on the corresponding emotion measures. Further and similar to Experiment 2 we predicted that teammates would anticipate experiencing more pride and happiness observing teammates expressing pride compared to a neutral expression. After observing displayed shame, we predicted that teammates would anticipate experiencing less pride and happiness compared to a neutral expression. In addition, we explored the effects of pride and shame expressions on anticipated anxiety.

Methods

Participants

Fifteen experienced male soccer players (M_{age} = 22.13; SD = 1.25) took part in the study. They had on average 14.47 years (SD = 2.20) of playing experience at a competitive level. Neither age nor playing experience significantly moderated the pattern of results. Informed consent was obtained from every participant before commencing the experiment. The study was carried out in accordance with the Helsinki Declaration of 1975.

Materials and Stimuli

For the stimuli in Experiment 3, we used three different post-performance NVB's from the point-light stimuli created in Experiment 2. These were: the first pride expression (cf. left most image of the top panel of **Figure 2**)—chosen because of the highest pride recognition ratings and the most beneficial effects

upon teammates in Experiment 2 (see also Tracy et al., 2009; Moll et al., 2010); the neutral condition; and the first shame expression (cf. left most image of the bottom panel of **Figure 2**)—chosen because of being the better recognized shame expression of the two previously used (Tracy et al., 2009) and being frequently displayed after having scored a penalty kick (Moll et al., 2010[1]). In addition, the results of Experiment 1 and 2 for the hands in front of face condition (high ratings for excited, stressed, and on edge) might indicate that this expression was not perceived as shame—typically regarded as a low intensity emotion—was not perceived as shame, but instead as despair[2].

Measures

Similar to Experiment 2, participants rated the observed players as well as their feelings regarding the next penalty kick except for the following change: the response stem on the semantic differential scales was modified to adapt to the changing emotion measures from 0 (*not at all*) to 1 (*extremely*).

Perceived emotions of target player

Similar to Experiment 2, the first set of items provided data on the perceived emotions of the observed penalty taker (manipulation check; see **Table 7**).

Pride

To increase the reliability of measuring pride compared to the 1-item in Experiment 1 and Experiment 2, pride was calculated as the mean response to the items: confident, successful, achieving, and accomplished. These 4 items are those that loaded highest on the achievement related State Authentic Pride subscale of the Pride Scale by Tracy and Robins (2007a). We only used items of the authentic pride subscale given the context (displayed pride after a score) to measure how displayed pride would be perceived by observers. The Cronbach alpha coefficient for perceived pride was good ($\alpha = 0.90$).

Happiness

To increase the reliability of measuring happiness, happiness was calculated as the mean response to the items: cheerful, happy, joyful, and pleased. These four items stem from the happiness subscale of the Sport Emotion Questionnaire by Jones and colleagues (SEQ, Jones et al., 2005). The Cronbach alpha coefficient for perceived happiness was good ($\alpha = 0.92$).

Anxiety

Anxiety was calculated as the mean response to the five items—uneasy, anxious, apprehensive, tense, and nervous—from the Anxiety subscale of the SEQ (Jones et al., 2005). The Cronbach alpha coefficient for perceived anxiety was good ($\alpha = 0.93$).

Shame

Shame was assessed with the same 1-item measure (ashamed) used in Experiments 1 and 2.

Expected emotions

Similar to Experiment 2, the next set of items provided data with regard to how participants anticipated feeling toward taking the next penalty in line in the shootout. Participants rated their expected feelings of pride ($\alpha = 0.84$), happiness ($\alpha = 0.93$), and anxiety ($\alpha = 0.94$) toward the next penalty with the same items used to measure the perceived emotions of the target player. The only modification was that the pride items: "successful," "achieving," and "accomplished" were changed into "I feel like being successful," "I feel like achieving," and "I feel like accomplishing."

Procedure

The procedure in Experiment 3 was identical to Experiment 2 except for the following changes: (i) Every participant only viewed 12 videos in a random order. (ii) Participants were instructed that they would be observing point-light video clips of different penalty takers scoring a penalty kick in a soccer penalty shootout and that they had to assume being a teammate of the penalty kick taker and the next one in line to take a kick for their team.

Results

Perceived Emotions of the Target Player and Manipulation Check

The univariate analysis and descriptive statistics of the four perceived emotions felt by target players are displayed in **Table 7**.

Planned contrast revealed that the fist above head expression was rated significantly higher than the neutral condition on the pride scale [$F_{(1, 14)} = 10.427$, $p = 0.006$, $\eta_p^2 = 0.43$] and the shame expression significantly lower than the neutral condition [$F_{(1, 14)} = 41.08$, $p = 0.001$, $\eta_p^2 = 0.75$]. Planned

[1]Moll et al. (2010) showed that in penalty shootouts occurring in World Cups and European Championships, 109 of the 151 penalty kick takers (72%) gazed down after scoring when the standing was equal.

[2]We thank a reviewer for this suggestion.

TABLE 7 | Univariate analysis of Experiment 3 for the effects of post-performance NVB's on the perceived emotions felt by the target player.

Emotion	*M*(*SD*)NVB1	*M*(*SD*)NVB2	*M*(*SD*)NVB3	*df* (model, error)	*F*	$\eta^2 p$	*p*
PERCEIVED EMOTION TARGET PLAYER							
Pride	0.76(0.13)	0.60(0.17)	0.25(0.11)	2, 28	52.1	0.79	<0.001
Happiness	0.78(0.13)	0.52(0.13)	0.22(0.12)	2, 28	67.2	0.83	<0.001
Anxiety	0.26(0.13)	0.33(0.18)	0.49(0.21)	2, 28	7.3	0.34	0.003
Shame	0.12(0.09)	0.26(0.16)	0.57(0.23)	2, 28	32.3	0.70	<0.001

NVB1, fists above head; NVB2, neutral; NVB3, head down.

The left pole of the scale (e.g., less pride) = 0.00 and the right side of the pole = 1.00 (more pride).

contrast revealed that the fist above head expression was rated significantly higher than the neutral condition on the happiness scale [$F_{(1, 14)} = 28.521$, $p = 0.001$, $\eta_p^2 = 0.67$] and the shame expression significantly lower than the neutral condition [$F_{(1, 14)} = 46.84$, $p = 0.001$, $\eta_p^2 = 0.77$]. Planned contrast revealed that the fist above head expression did not significantly differ from the neutral condition on the anxiety scale [$F_{(1, 14)} = 2.678$, $p = 0.124$, $\eta_p^2 = 0.16$], but the shame expression was rated significantly higher than the neutral condition [$F_{(1, 14)} = 5.724$, $p = 0.031$, $\eta_p^2 = 0.29$]. Planned contrasts on the perceived shame item revealed significant differences from neutral for both the pride expression [$F_{(1, 14)} = 12.087$, $p = 0.004$, $\eta_p^2 = 0.46$] and the shame expression [$F_{(1, 14)} = 24.616$, $p = 0.001$, $\eta_p^2 = 0.64$] with the shame expression being rated higher and the pride expression lower.

Expected Emotions Toward the Next Penalty Kick

The univariate analysis and descriptive statistics of the three expected emotions felt toward the next penalty are displayed in **Figure 4**.

The One-Way ANOVA for post-performance NVB on expected pride revealed a significant effect [$F_{(2, 28)} = 31.13$, $p < 0.001$, $\eta_p^2 = 0.69$]. Planned contrast revealed that the fists above head expression did not significantly differ from the neutral condition on the pride scale [$F_{(1, 14)} = 0.877$, $p = 0.365$, $\eta_p^2 = 0.06$], but the shame expression was rated significantly lower than the neutral condition [$F_{(1, 14)} = 37.81$, $p = 0.001$, $\eta_p^2 = 0.73$].

The One-Way ANOVA for post-performance NVB on expected happiness revealed a significant effect [$F_{(1.45, 20.31)} = 27.62$, $p < 0.001$, $\eta_p^2 = 0.66$]. Planned contrast revealed that the fist above head expression was rated significantly higher than the neutral condition on the happiness scale [$F_{(1, 14)} = 12.47$, $p = 0.003$, $\eta_p^2 = 0.47$] and the shame expression significantly lower than the neutral condition [$F_{(1, 14)} = 21.81$, $p = 0.001$, $\eta_p^2 = 0.61$].

The One-Way ANOVA for post-performance NVB on perceived anxiety revealed a significant albeit weaker effect [$F_{(2, 28)} = 9.58$, $p = 0.001$, $\eta_p^2 = 0.41$]. Planned contrast revealed that the fist above head expression did not significantly differ from the neutral condition on the expected anxiety scale [$F_{(1, 14)} = 0.284$, $p = 0.602$, $\eta_p^2 = 0.02$], but the shame expression was rated significantly higher than the neutral condition [$F_{(1, 14)} = 10.478$, $p = 0.006$, $\eta_p^2 = 0.43$].

Discussion

The NVBs were perceived in the predicted manner. Experiment 3 showed that teammates anticipated feeling less proud, less happy, and more anxious toward taking the next penalty kick in line after observing a post-performance expression of shame compared to a neutral post-performance expression. However, the pattern of results was not as clear cut for the pride expression. Pride expressions only lead team-mates to feel more happy compared to the neutral expression and not more proud and less anxious. **Figure 4** shows that pride expression only significantly differed from shame expressions on expected feelings of pride ($p = 0.001$, $\eta_p^2 = 0.78$) and anxiety ($p = 0.001$, $\eta_p^2 = 0.57$).

Given the effects of pride and shame expressions on anxiety and happiness on taking the next penalty kick it seems likely that teammates interpreted the displayed expressions (inferential processing) to shape their emotions (at least to some extent) about their next kick in line particularly because they first rated the emotions experienced by the observed penalty kick taker. The likelihood that cognitive processing played a role in this context is further enhanced because of asking teammates to rate their emotions in relation to the next kick in line. We did exclude the possibility that the ratings were primarily influenced by the inferred outcome of the penalty observed and not the displayed NVB as observers were informed that all players scored. In this respect it is important to note that penalty takers frequently display the shame expression (gaze down, shoulder slumped) when scoring a penalty in actual game situations (Moll et al., 2010)[1].

The rationale of Experiment 4 was to rule out the possibility that participants may have been influenced by first rating the emotions experienced by the observed penalty kick taker, and to examine the direct link between the observed emotion expressions and teammates' anticipated emotions. Therefore, teammates solely rated how they expected to feel after observing the differing NVBs in Experiment 4.

Experiment 4: Feelings of Players after Observing a Team-mate Displaying Pride or Shame

The hypotheses were identical to Experiment 3.

Method

Participants

Twenty four experienced male soccer players ($M_{age} = 22.00$; $SD = 2.11$) took part in the study. They had on average 14.08 years ($SD = 2.24$) of playing experience at a competitive level. Neither age nor playing experience significantly moderated the pattern of results. Informed consent was obtained from every participant before commencing the experiment. The study was carried out in accordance with the Helsinki Declaration of 1975.

Materials and Stimuli

The materials and procedure in Experiment 4 were identical to Experiment 3, except that participants were only asked to rate how the penalty kick takers would make them feel after watching the penalty kick taker score. Participants rated their expected feelings of pride ($\alpha = 0.93$), happiness ($\alpha = 0.97$), and anxiety ($\alpha = 0.93$) on the same measures as in Experiment 3.

Results

Expected Emotions

The univariate analysis and descriptive statistics of the three expected emotions felt in response to observing the penalty kick taker immediately after scoring his kick are shown in **Figure 5**.

The One-Way ANOVA for post-performance NVB on expected pride revealed a significant effect [$F_{(1.52,34.95)} = 20.06$, $p < 0.001$, $\eta_p^2 = 0.47$]. Planned contrast revealed that the fist above head expression was rated significantly higher than the

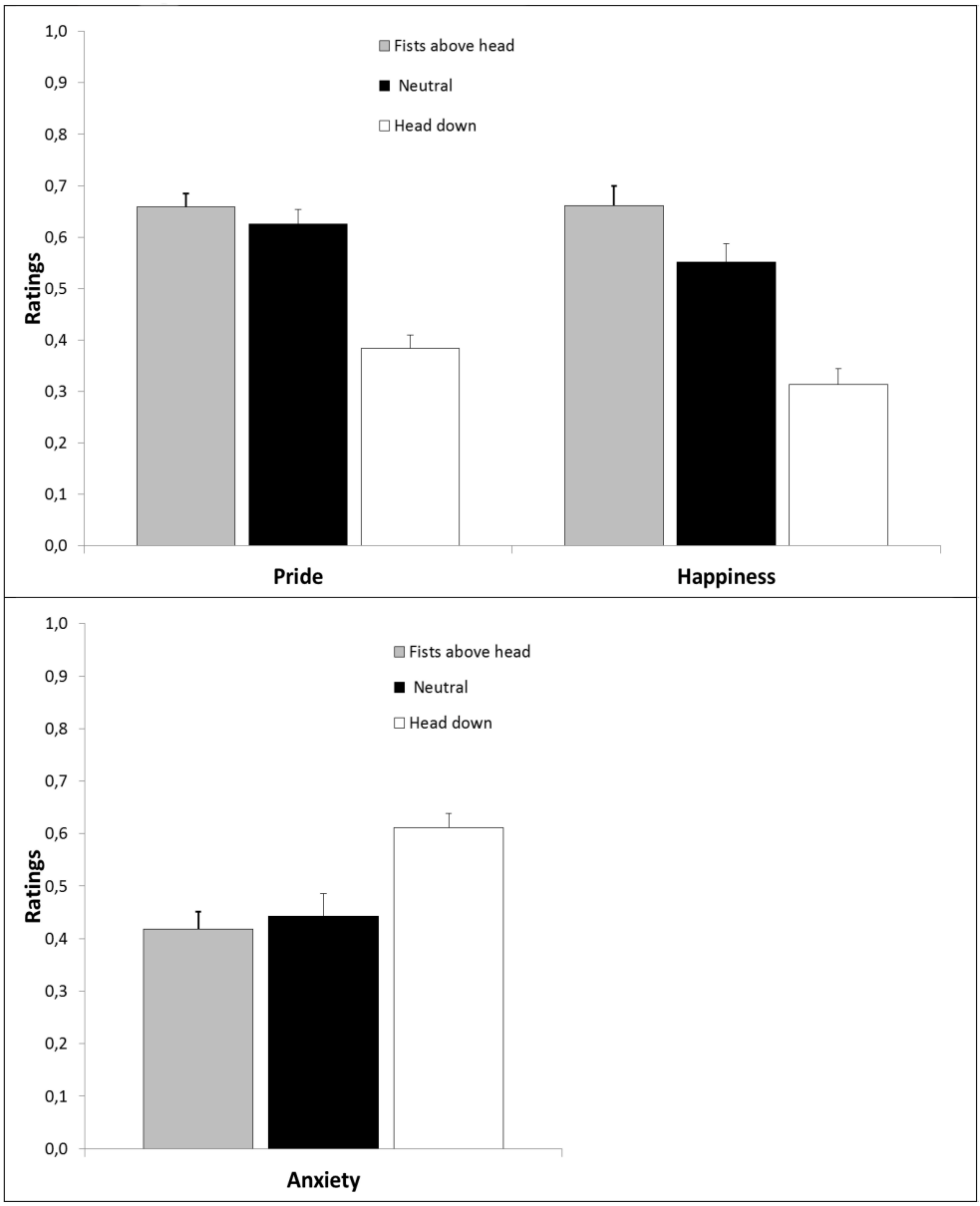

FIGURE 4 | Top: Expected pride, happiness, and anxiety in Experiment 3 as a function of post-performance NVB; **Bottom:** Expected anxiety as a function of NVB. Error bars represent standard errors.

neutral condition on the pride scale [$F_{(1,\ 23)} = 14.11$, $p = 0.001$, $\eta_p^2 = 0.38$] and the shame expression significantly lower than the neutral condition [$F_{(1,\ 23)} = 13.37$, $p = 0.001$, $\eta_p^2 = 0.37$].

The One-Way ANOVA for post-performance NVB on expected happiness revealed a significant effect [$F_{(1.59,36.47)} = 27.14$, $p < 0.001$, $\eta_p^2 = 0.54$]. Planned contrast revealed that the fist above head expression was again rated significantly higher from the neutral condition on the happiness scale [$F_{(1,\ 23)} = 24.78$, $p = 0.001$, $\eta_p^2 = 0.52$] and the shame expression significantly lower than the neutral condition [$F_{(1,23)} = 11.94$, $p = 0.002$, $\eta_p^2 = 0.34$].

The One-Way ANOVA for post-performance NVB on perceived anxiety revealed a significant effect [$F_{(2,46)} = 4.24$, $p = 0.021$, $\eta_p^2 = 0.16$]. Planned contrast revealed that the fist above head expression did not significantly differ from the neutral condition on the expected anxiety scale [$F_{(1,23)} = 0.033$, $p = 0.86$, $\eta_p^2 = 0.001$], but the shame expression was rated significantly higher than the neutral condition [$F_{(1,23)} = 10.178$, $p = 0.004$, $\eta_p^2 = 0.31$].

Discussion

The results of Experiment 4 showed that teammates also anticipated feeling less proud, less happy, and more anxious after

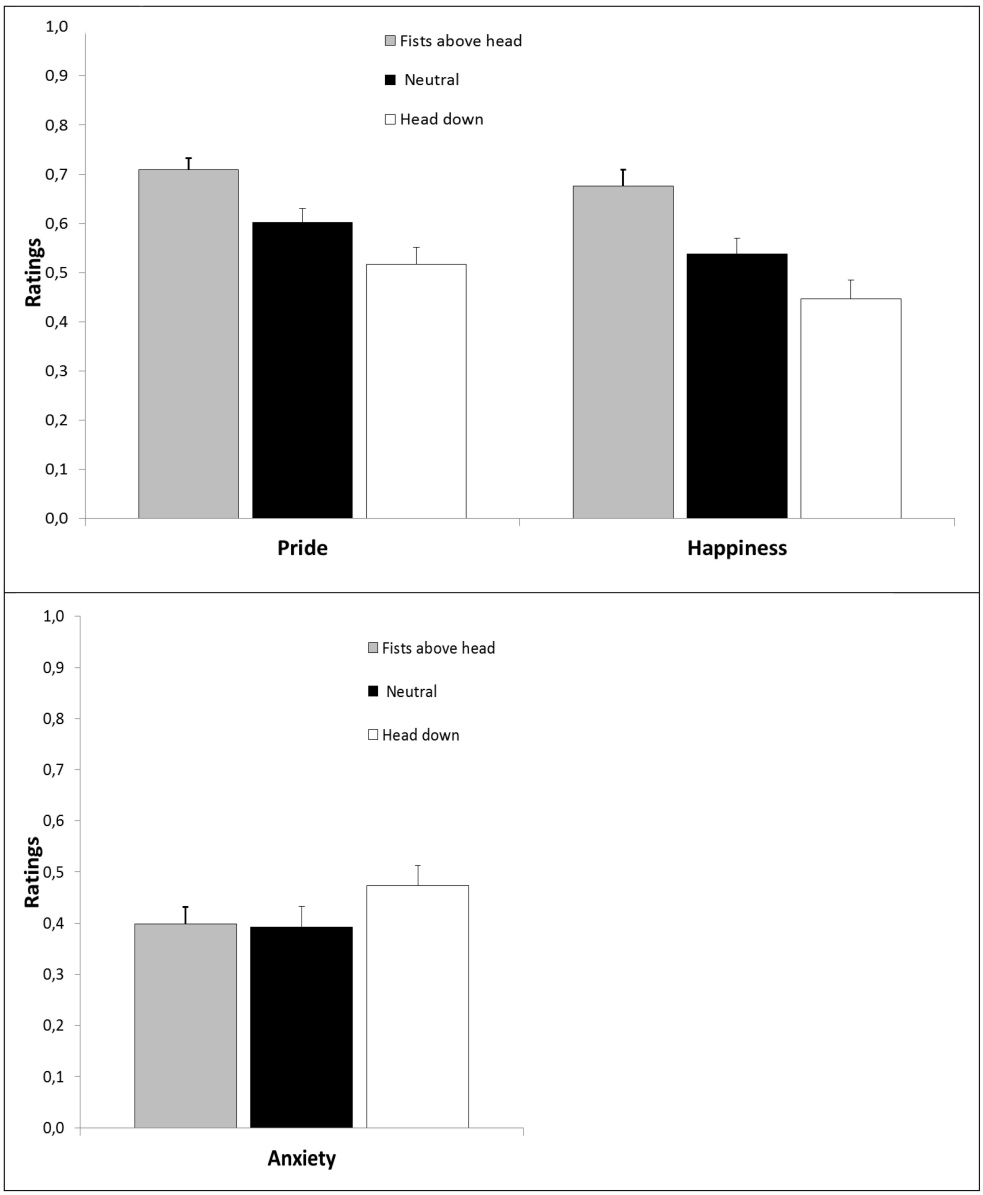

FIGURE 5 | Top: Expected pride and happiness in Experiment 4 as a function of post-performance NVB; **Bottom:** Expected anxiety as a function of NVB. Error bars represent standard errors.

observing a post-performance expression of shame compared to a neutral post-performance expression, when not being asked to rate the emotion expression of the target player. This time, teammates also anticipated feeling significantly more pride (and happiness; a point we return to in the General Discussion) after observing a penalty taker displaying pride compared to a neutral expression. As this pattern was also evident in Experiment 3, and Experiment 4 had a higher power to detect this effect, we do not consider the findings of Experiment 3 as "evidence of absence" for an interpersonal effect of pride expressions compared to neutral expressions (see Stanley and Spence, 2014 for a detailed discussion of this).

The findings are similar to those observed in Experiments 2 and 3, but extend these findings by showing a more direct link between the observed expression and teammates' anticipated emotions suggesting that cooperative observers may have caught the emotion they observed (Van Kleef, 2009). Fitting with this direct link is that observing a pride expression as a cooperative individual resulted in higher pride (and happiness ratings) but not in lower anxiety ratings. We will return to this point in the general discussion.

General Discussion

The general aim of this study was to examine whether post-performance nonverbal expressions of pride and shame influence cooperative and competitive observers in a hypothetical soccer penalty shootout and thereby add to the understanding of the reported association between outcomes in soccer penalty shootouts and pride and shame expressions (Moll et al., 2010). Across four experiments, pride and shame expressions exerted strong effects upon observers' anticipated emotions, associated cognitions, and performance expectations, presumably because these expressions are implicitly associated with status (Pilot Study 1) and performance related attributes (Pilot Study 2). In line with Van Kleef's (2009) *EASI* model the present studies provide evidence that displays of pride and shame can exert substantial interpersonal effects upon observers that differ depending on the context.

In an initial step we demonstrated that the point-light expressions of pride and shame are implicitly associated with status and performance related attributes. These findings are important as they suggest that the results of Experiments 1–4 are not likely to be solely explained by demand effects of the experimental within-subject design. Instead, although we did not directly control for the alternative explanation of general positivity or negativity in the present IAT studies, previous research by Shariff and Tracy (2009) has rendered this unlikely. Given the similarity of the present IAT findings to the findings by Shariff and Tracy (2009), it seems more plausible that pride and shame expressions have discrete interpersonal effects on both team-mates and opponents that go beyond the simplistic notion that positive expressions are good and negative expressions are bad as they were automatically linked with status and performance. Therefore, this implicit association was likely to have been responsible for some of the variance in participant's ratings. In addition, if our findings would be solely explained by general positivity and negativity, one would have expected to find that participants in Experiments 3 and 4 would have also anticipated feeling less anxious after observing a pride expression of a team-mate, which was not the case. However, we acknowledge that further work is needed to gain a better understanding on the discrete interpersonal effects of pride and shame expressions in real-world performance environments such as sports.

In Experiment 1, observing pride expressions led participants who assumed the role of an opponent player to expect feeling less good in terms of lower levels of pride and happiness, more stressed, less confident, less in control, less focused, less comfortable, and having lower performance expectations in the shootout compared to when observing players displaying a neutral expression. Opposing results were observed for shame expressions in comparison with neutral expressions. These findings are in agreement with the EASI model and suggest that in a competitive context, pride and shame expressions cause opposing feelings and thoughts. It seems likely that opponents extracted and processed the information conveyed by the displayed expressions (inferential processing), which, in turn, influenced the way opponents felt and thought about their upcoming penalty kick. We can, however, not rule out that through an affective reaction, the expressed emotions may have led to corresponding emotions (Van Kleef, 2009).

In contrast, the findings of Experiments 2–4 revealed that teammates who observed players displaying pride anticipated feeling more pride, more happiness, and, in turn, expected to be more confident, in control, as well as having higher performance expectations in the shootout compared to when observing players displaying a neutral expression. In addition, shame displays caused teammates to anticipate feeling more ashamed and in turn experiencing less positive cognitions, and lower performance expectations compared to a neutral expression. In line with the EASI model (Van Kleef et al., 2010; Visser et al., 2013), it seems feasible that the pride and shame expressions infected team-mates in the soccer penalty shootouts and, in turn, influenced their thoughts and feelings (regarding the situation). However, the present series of studies does not provide direct evidence for this assumption. By informing participants about the outcome of the penalty (Experiments 3 and 4) and asking them directly how they would feel (Experiment 4), we excluded some sources that render inferential processing more likely. Still, there is reason to believe that in these cooperative situations, also inferential processes played a role in shaping the observers' emotions and thoughts. For example, In Experiment 3, the observed effects upon teammates may have been fueled by both affective reactions and inferential processing as the display of pride may have signaled that something good occurred—"the penalty kick taker scored easily," and therefore, teammates felt more happy toward taking the next kick in line but not necessarily more proud and less anxious. As Experiment 4 examined the direct link between the observed emotion and teammates' anticipated emotion, the results that teammates felt more proud (and happy) but not less anxious after observing pride could indicate that observers caught the expressed emotion they observed. Still, also here, we cannot rule out that inferences predicted the felt emotions as teammates may have inferred that the display of pride signaled dominance and power causing them to feel more proud.

Hence, the present findings do not allow specifying the relative contribution of either inferential processing or emotional contagion in mediating the pattern of results in this series of experiments and in Moll et al. (2010). Most likely, both processes play an important role in influencing others in soccer penalty shootouts and future research is needed on their respective contributions in cooperative and competitive performance contexts. The findings do provide strong evidence that the nature of the situation—competitive vs. the cooperative—plays a fundamental role in shaping the interpersonal effects of pride of shame. In this respect, it seems likely that the real-world effect of pride and shame expressions in soccer penalty shootouts reported in Moll et al. (2010) was likely caused by a complex interplay of affective and inferential processes occurring when observing opponents and team-mates, and not solely by the process of emotional contagion as proposed by Moll and colleagues.

An issue that requires discussion was that the happiness ratings were similar to the pride ratings for each displayed NVB—e.g., penalty kick takers displaying pride yielded high pride ratings and equally high happiness ratings. This might suggest that the pride expression with fists above the head may also be regarded as an expression of happiness which fits with the findings of previous work (Wallbott, 1998; Coulson, 2004). Another explanation is that the point light displays used in the present experiments did not allow for the visibility of the small smile, an essential component of the prototypical pride expression (Tracy and Robins, 2007b), and therefore the pride expression yielded equally high pride and happiness ratings. Hence, the present experiments suggest that biological motion information alone does not seem to be sufficient to distinguish the distinct emotion pride from happiness, and that facial features seem necessary to disambiguate these emotions.

Martens et al. (2012) noted that displaying shame after failure has personal benefits by avoiding social rejection by the group of significant others (Gilbert, 2007). In sport teams, displaying shame may certainly appease teammates and avoid their social rejection. However, if this means that the display of shame weakens teammates and strengthens opponents, it is worth considering whether individuals should display shame after failure. To downplay the shame expression might require initial personal sacrifices (Kalokerinos et al., 2014) but if this ultimately results in winning the competitive encounter, it certainly seems worthwhile. Needless to say, it is vital for future research to focus on observers' actual emotions and behaviors such as performance within the representative contexts.

Across the four experiments, the expressions of shame seemed to have stronger effects on observers compared to the expressions of pride. These findings fit well with the pattern that the impact of "bad is stronger than good" (see for a review, Baumeister et al., 2001) suggesting that there may be asymmetries in the relative strength of negative vs. positive emotional expressions (van Kleef, 2014). Other evidence for this suggestion comes from a negotiation study by van Kleef et al. (2004) who showed that expressions of anger had a stronger impact than expressions of happiness on the counterpart's negotiation behavior. Interestingly, in our series of experiments, the asymmetrical pattern was observed in both cooperative and competitive observers. Thus also competitive observers benefited more from viewing the shame expression of opponents, than being "put off" by viewing their pride expressions.

Despite the merits of the present research, several limitations have to be acknowledged. First and foremost, it has to be noted that the present findings are derived from an artificial laboratory situation which is obviously quite different from the intense emotions experienced and expressed during actual penalty shootouts. However, the present study is in line with Moll et al. (2010) who retrospectively analyzed the influence of pride and shame expressions during actual penalty shootouts. In tandem with this field observation, the present findings can be regarded as providing converging evidence for the interpersonal effects of expressing pride and shame.

Following from the point above, the large effect sizes found across the studies, especially in Experiments 1 and 2, require discussion. In this respect, it is important to acknowledge that high levels of experimental control come at the cost of ecological validity. Therefore, a limitation of the present design was that it made sure that no other information could be integrated to inform the participant's ratings and therefore the NVB effect was most likely exaggerated compared to the actual effects of NVB in the field. Pertinent to the present results, Kahneman (2011) argues that people in general do not acknowledge that they might be missing important information in social encounters. Instead, they tend to treat the limited information available as if it where all there is to know which Kahneman explains with reference to his WYSIATI ("What you see is all there is") rule. This argumentation is supported by the comparison of Experiments 1 and 2 with Experiments 3 and 4 as Experiments 3 and 4 revealed smaller effect sizes in which participants were aware of the outcome of the penalty kick. In addition, the sample sizes across all experiments were small and therefore it is possible that the reported effect size estimates are inflated.

Conclusion

In conclusion, the present research adds to the growing body of literature on nonverbal behavior in sports (Furley and Schweizer, 2014a) and its potential influence on observers (Furley and Schweizer, 2014b). Specifically, the series of studies highlights the potential interpersonal influence of the nonverbal expressions of pride and shame in competitive social situations and importantly that these depend on the social context, i.e., depending on whether these are displayed by cooperative or competitive others. Further, the results suggest that athletes are well advised to display pride after success in high-stakes sport situations, but importantly should also avoid showing shame as these expressions will influence observers and in turn might affect the final outcome of their endeavors.

Author Contributions

PF and TM developed the study concept, and both authors contributed to the design. PF and TM collected the data and analyzed it in collaboration with DM. PF and TM wrote the first draft of the manuscript, and DM helped edit and revise it. All authors approved the final, submitted version of the manuscript.

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Feeling right is feeling good: psychological well-being and emotional fit with culture in autonomy- versus relatedness-promoting situations

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The current research tested the idea that it is the cultural fit of emotions, rather than certain emotions *per se*, that predicts psychological well-being. We reasoned that emotional fit in the domains of life that afford the realization of central cultural mandates would be particularly important to psychological well-being. We tested this hypothesis with samples from three cultural contexts that are known to differ with respect to their main cultural mandates: a European American ($N = 30$), a Korean ($N = 80$), and a Belgian sample ($N = 266$). Cultural fit was measured by comparing an individual's patterns of emotions to the average cultural pattern for the same type of situation on the Emotional Patterns Questionnaire (De Leersnyder et al., 2011). Consistent with our hypothesis, we found evidence for "universality without uniformity": in each sample, psychological well-being was associated with emotional fit in the domain that was key to the cultural mandate. However, cultures varied with regard to the particular domain involved. Psychological well-being was predicted by emotional fit (a) in autonomy-promoting situations at work in the U.S., (b) in relatedness-promoting situations at home in Korea, and (c) in both autonomy-promoting and relatedness-promoting situations in Belgium. These findings show that the experience of culturally appropriate patterns of emotions contributes to psychological well-being. One interpretation is that experiencing appropriate emotions is itself a realization of the cultural mandates.

Keywords: Emotion, culture, well-being, emotional fit, cultural fit, autonomy, relatedness, psychological well-being

Introduction

Within a given culture, people tend to experience similar patterns of emotions, given the same situation. This becomes particularly clear when contrasting the emotional patterns from people from different cultures. Take for instance a student at an end-of-the-year ceremony who receives an applause for being the 'best student of the year': a European American student would typically experience pride and excitement in this situation; a typical Belgian student would experience embarrassment in addition to pride and excitement. The example illustrates that the typical patterns of emotions are culture-specific; a finding that has been confirmed by systematic cross-cultural studies on emotion (Kitayama et al., 2006; De Leersnyder et al., 2011, 2013, submitted).

Culture-specific patterns of emotions reflect cultural values and priorities (Mesquita, 2003; Mesquita and Leu, 2007). The emotions of the typical European American student in the example above (pride and excitement) emphasize the value of individual success and autonomy (e.g., Lazarus, 1991; Tracy and Robins, 2004); the emotions of the typical Belgian student (embarrassment in addition to pride and excitement) reflect a concern with others and the relationship as well as with autonomy (e.g., Parrott and Smith, 1991; Keltner and Buswell, 1997). Seen this way, the extent to which an individual's emotions are similar to the culture's average emotional pattern in the situation reflects his or her adoption of cultural values and priorities. Cultural fit, or having the typical or 'right' emotions, is tantamount to meeting 'the cultural mandate' (Kitayama et al., 2010).

In the current research, we test the idea that emotional fit with culture (EFC) is linked to psychological well-being – i.e., being satisfied with oneself, having positive feelings, accepting one's body and having no symptoms of depression (e.g., Power et al., 1999). We postulate that people who feel the culturally typical emotions "achieve well-being and health through actualizing the respective cultural mandates" (Kitayama et al., 2010, p. 1), particularly in situations that are crucial for the realization of these mandates. We will test this hypothesis for three contexts that have been associated with different cultural mandates: the United States (Study 1), Korea (Study 2), and Belgium (Study 3).

Cultural Mandates and Emotions

Cultural mandates differ along the dimension of independence and interdependence (D'Andrade, 1984; Markus and Kitayama, 1991a, 2003; Fiske et al., 1998). In 'independent' cultural contexts, such as European American and Western European (e.g., Belgian) contexts, the primary mandate is to be autonomous, distinct, and separate from others. In contrast, in 'interdependent' cultural contexts such as Korea, the primary mandate is to be related, embedded, and connected to others (e.g., Markus and Kitayama, 1991a, 2003; Kim and Markus, 1999; Rothbaum et al., 2000).

People within these contexts may realize the cultural mandates in different ways. One way is by engaging in everyday cultural practices that instantiate the cultural mandate; examples are sleeping arrangements for infants that either emphasize autonomy (sleeping alone) or relatedness (sleeping with the parents; Shweder, 1991; Morelli et al., 1992), award ceremonies that highlight autonomy (D'Andrade, 1984), and politeness rituals that underscore relatedness (Ide, 1998; Burdelski, 2010). Another way to realize cultural mandates is by engaging in one of the many psychological tendencies that ratify autonomy and/or relatedness; examples are self-enhancing strategies that affirm autonomy (Heine et al., 1999), adopting a third-person perspective that underscore relatedness (Cohen et al., 2007), and – last but not least – experiencing and expressing emotions that highlight either autonomy or relatedness (Kitayama et al., 2000; Mesquita and Karasawa, 2002; Mesquita, 2003, 2010; Mesquita and Leu, 2007; Mesquita et al., 2014; De Leersnyder et al., submitted). Referring to the earlier example of the student at the end-of-the-year ceremony: Feeling pride emphasizes the value of the student in the achievement domain, and thus is a realization of the cultural mandate of autonomy; in contrast, feeling embarrassment is proof that the evaluation by others in the social network is salient to the student, and is an instantiation of relatedness.

By experiencing certain types of emotions people may thus realize a given cultural mandate. In this research, we capitalize on the distinction between autonomy-promoting and relatedness-promoting emotions. This dimension has been found to structure the domain of emotional experience across diverse cultural contexts. (Kitayama and Markus, 1990; Kitayama, Markus and Negishi, 1989 as cited in Markus and Kitayama, 1991b; Kitayama et al., 2000, 2006, see also De Leersnyder et al., submitted). Moreover, it is useful in describing cultural differences in emotional experience: Autonomy-promoting emotions are more intense and prevalent in independent cultural context, and relatedness-promoting emotions are more intense and prevalent in interdependent cultural contexts (Briggs, 1970; Frijda and Mesquita, 1994; Markus and Kitayama, 1994; Mesquita and Karasawa, 2002; Cole et al., 2006; Kitayama et al., 2006; Boiger et al., 2013b, 2014).

The current research goes beyond existing research by focusing on *individual differences* in *EFC*. This means that, rather than focusing on cultural differences in mean level intensities of autonomy-promoting and relatedness-promoting emotions, we will examine individuals' cultural fit of a wide range of different emotions in situations that are typically associated either with autonomy or relatedness-promoting emotions; we will call these situations autonomy-promoting and relatedness-promoting, respectively. For instance, the situation we described earlier of the student receiving an applause, can be considered a 'positive autonomy-promoting emotional situation' in both European American and Belgian contexts, because pride was the primary emotion. We expect that fit in situations that are central to the cultural mandate, for example autonomy-promoting situations in European American contexts, will play a positive role in an individual's adjustment.

Emotional Fit with Culture

To establish emotional fit, we consider the *patterns* of emotional experience; i.e., the pattern of co-occurring emotions. Patterns of emotional experience provide a more comprehensive picture of individuals' interpretations of the situation than could be obtained by looking at single emotions alone, and culture-specificity of emotional experience is also better captured by the respective patterns of emotional experience. This is illustrated by the example about the student who receives applause, in the beginning of the section "Introduction." In this example, the most intense emotion for the European American and the Belgian student alike was pride, yet the Belgian student also experienced embarrassment – an emotion that was absent from the European American pattern. The patterns of co-occurring emotions (pride only versus pride and embarrassment) describe the meaning of the event more accurately than would the most intense emotion by itself. Therefore, fit with the cultural mandate is best inferred from the pattern of emotion.

We previously designed a measure of emotional co-occurrence: the Emotional Pattern Questionnaire (EPQ; De Leersnyder et al., 2011). Adopting the EPQ, we have repeatedly found that people fit the average emotional patters of the same culture better than those of another culture (De Leersnyder et al., submitted). We have also found a consistently lower fit of minority than majority members to the average majority emotional pattern, with individual minority member's fit predicted by the level of exposure to the majority culture (De Leersnyder et al., 2011, 2013; Jasini et al., manuscript in preparation). One interpretation of the latter finding is that, over time, immigrants learn to meet the new cultural mandate.

We have some first evidence that an individual's emotional fit to the cultural average predicts positive outcomes. Using the same EPQ, we found that individuals' EFC in *relatedness-promoting situations* predicted their level of *relational well-being* – that is, their satisfaction with social relationships and social support – even after controlling for other types of well-being (De Leersnyder et al., 2014). We replicated this finding in the United States, Belgium, and Korea. The finding was limited to situations that were relatedness-promoting; we did not find any relationship between fit in other situations (i.e., self-focused, autonomy-promoting situations) and relational well-being. Yet, for the Korean sample, we found that cultural fit in relatedness-promoting situations was not only associated with higher relational well-being, but also with higher *psychological well-being*. In the current article, we further investigate the association of emotional fit and psychological well-being across the same three cultural groups[1].

Emotional Fit with Culture in Focal Domains and Psychological Well-Being

The central hypothesis in the current research is that cultural fit in emotions is conducive to *psychological* well-being. Following earlier definitions (e.g., Power et al., 1999), we conceptualize psychological well-being as being satisfied with oneself, having positive feelings, accepting one's body and having no symptoms of depression. In contrast to relational well-being that refers to 'having good relationships' with other people, psychological well-being refers to 'being satisfied with yourself as a person.' Different from relational well-being, which is cross-culturally predicted by emotional fit in relatedness-promoting situations (De Leersnyder et al., 2014), we expect that psychological well-being will be uniquely associated with emotional fit in situations that are central to the cultural mandate. It is these situations that define personhood within the culture. Specifically, we expected that psychological well-being is predicted by the fit of relatedness-promoting situations for interdependent cultures (e.g., Korea), and of autonomy-promoting situations for independent cultures (e.g., United States, Belgium). Moreover, we expected that fulfillment of some cultural mandates may be situation-specific. As we will detail below, work contexts may be better suited to meet cultural mandates of autonomy that require a person, among other things, to "be a strong leader" and to "take initiative to achieve personal success" (Kitayama and Imada, 2010), whereas home contexts may be better suited to meet cultural mandates of relatedness that require a person to "conform and to be obedient," and to "achieve social harmony." Across cultures, different contexts and situations may thus afford the realization of the culture's cultural mandate, which we expect to be associated with psychological well-being.

We thus expect "universalism without uniformity" (Shweder and Sullivan, 1993): Universally, we expect psychological well-being to be associated with emotional fit in domains that are most central to the cultural mandate; however, we expect that the specific domains will vary by culture. This hypothesis is consistent with a growing body of literature suggesting that fulfilling the cultural mandates of autonomy (such as maintaining high self-esteem) may be most conducive to psychological well-being in independent cultural contexts, whereas fulfilling the cultural mandates of relatedness (such as having harmonious social relationships) may be most conducive to psychological well-being in interdependent cultural contexts (Kwan et al., 1997; Kang et al., 2003; Kitayama et al., 2010). In the current research, we extend this hypothesis to the emotional realm.

Two studies provided some first support for the idea that psychological well-being is particularly associated with *emotional* fit in domains that are central to the cultural mandate (Kitayama et al., 2006; Tsai et al., 2006). In an experience sampling study, European American college students' general positive feelings (e.g., feeling happy) were predicted by the intensity ratings of positive autonomy-promoting emotions (e.g., pride), whereas Japanese students' general positive feelings were predicted by the intensity of positive relatedness-promoting emotions (e.g., friendly feelings; Kitayama et al., 2006). In another study with European American and Hong Kong Chinese students, negative psychological well-being (i.c., depressive symptoms) was predicted by the discrepancy between actual emotions and the emotions people "would like to feel" over the course of a week (Tsai et al., 2006), but only with respect to the emotions that were central to the respective cultural mandates (Tsai et al., 2007). Both studies thus provide first support for the hypothesis that emotional fit selectively predicts psychological well-being in different cultures.

However, our understanding of the relationship between EFC and psychological well-being is still fairly limited. Firstly, both studies *inferred* EFC rather than measured the fit. Secondly, both studies predicted well-being from intensity ratings of averaged emotion scales and did not consider the patterning of emotions. Finally, both studies disregarded the situational origin of the emotion intensity ratings when using these intensity ratings to predict well-being. To gain a full understanding of the processes, the current research will *measure actual fit* with cultural patterns of emotions by correlating an individual's pattern of emotion intensities to the culture's average pattern of emotion intensities for a particular type of situation (cfr., De Leersnyder et al., 2011), thereby focusing on the *patterning* of emotions instead of on their mean levels of intensity. Finally, the current research formulates more precise, a priori hypotheses about the relevant situations of emotional fit in different cultures, defining both the types of

[1] In the current research, we will make use of the same three samples as the ones reported on in De Leersnyder et al. (2014); the analyses are not overlapping, since the outcome variable of interest is different.

primary emotions (autonomy versus relatedness-promoting) and the contexts (home, work) involved. Next, we will lay out which situations are central to the respective cultural mandates of the samples included.

European American Cultural Context

As outlined above, independent cultural contexts, such as the European American, highlight the cultural mandates of autonomy. More specifically, European American cultural contexts endorse a pure form of autonomy, where standing out among others, and achieving personal success are important (Schwartz and Ros, 1995; Heine et al., 1999; Kitayama et al., 2009; Stephens et al., 2009; Oishi, 2010; Boiger et al., 2013a; Boiger, unpublished doctoral dissertation). Important cultural mandates are "expressing one's unique self," "being a strong leader," "taking initiative to achieve a personal success" and "being in charge and under control" (Kitayama and Imada, 2010). These cultural mandates are best realized in situations that evoke autonomy-promoting emotions; moreover, work contexts can be expected to be more conducive to the cultural mandate than home contexts. In support of the latter, research in European American contexts has established strong boundaries between work and home contexts, with work contexts stressing competitive autonomy, often at the expense of relatedness (Sanchez-Burks and Uhlmann, 2014). Taken together, we expect that cultural fit of emotions in European American contexts will be most predictive of psychological well-being in *autonomy-promoting situations at work*.

Korean Cultural Context

Interdependent cultural contexts, such as the Korean context, highlight the cultural mandates of relatedness (Markus and Kitayama, 1991a; Rothbaum et al., 2000; Oyserman et al., 2002). Important cultural goals are "conforming and being obedient," "being similar to others," "following social norms and fitting-in," and "achieving social harmony" (Kitayama and Imada, 2010). It has been argued that these cultural mandates are primarily realized in the context of close in-groups (Markus and Kitayama, 1991a), with a particular emphasis on the family within Korean cultural contexts (Neuliep, 2011). Therefore, we expect that emotional fit in Korean cultural contexts will be most predictive of psychological well-being in *relatedness-promoting situations in the family context*.

Belgian Contexts

Although Western European cultures, such as Belgium, are considered to be independent, they endorse a less pure form of independence than European American cultural contexts (Kitayama et al., 2009; van den Bos et al., 2010). The European form of independence stresses "the integrity of the individual within a social network of equal rights" (Boiger, unpublished doctoral dissertation; p. 84) and thus emphasizes that there is room for autonomy as far as it does not jeopardize a person's relatedness within a social network (e.g., Schwartz and Ros, 1995; Boiger et al., 2013a). In the Belgian context, the mandate to be autonomous thus goes hand in hand with the mandate to be related to others in a social network. Therefore, psychological well-being is expected to be *primarily* associated with cultural fit in situations that elicit autonomy-promoting emotions, yet *also* with cultural fit in situations that elicit relatedness-promoting emotions. Moreover, and consistent with the domain-specificity of the opportunities to realize the cultural mandates, we hypothesize that in the Belgian context, psychological well-being will be linked to emotional fit in *autonomy-promoting situations at work* as well as to emotional fit in *relatedness-promoting situations with family and with friends*.

Overview of the Current Research

In three studies, we test the hypothesis that cultural fit predicts psychological well-being in situations and contexts that are central to the cultural mandate. We expect psychological well-being to be predicted by (i) autonomy-promoting situations at work for European Americans (Study1); (ii) relatedness-promoting situations at home for Koreans (Study 2); and (iii) both autonomy-promoting situations at work and relatedness-promoting situations at home and with friends for Belgians (Study 3).

General Method

Materials

Cultural Fit in Emotions

To measure EFC, we adopted the EPQ (De Leersnyder et al., 2011). The EPQ has been validated in previous research on EFC (e.g., De Leersnyder et al., 2011, 2013) and is particularly suited to investigate fit in the outlined types of culturally focal situations. In fact, participants in the EPQ respond to a set of questions after reading a prompt that is defined by valence (positive, negative), social context (Family, Work/School, Friends), and the autonomy versus relatedness-promoting nature of the situation. Prompts for autonomy-promoting situations ask a person to think about an emotional situation that was *"about things that happened to you personally"* and list either positive or negative autonomy-promoting sample emotions that are expected to be most intense in the situation (e.g., pride, on top of the world, superior for positive autonomy-promoting situations); prompts for relatedness-promoting situations ask a person to think about an emotional situation that was *"about your relationship with others"* and list positive or negative relatedness-promoting sample emotions (e.g., ashamed, guilty, indebted for negative relatedness-promoting situations). After reading the prompt, participants were asked to describe (in writing) a situation from their own recent past that matched the prompt. For instance, the prompt for a positive autonomy-promoting situation at work/school read as follows:

> "Sometimes, people find themselves in situations that make them feel ***good for themselves*** (for example, superior, proud, top of the world). Please think about an occasion **at work or at school** in which you felt **good for yourself** (for example, superior, proud, top of the world). Please take your time to remember this

situation. Please describe the situation briefly. Provide as much detail as needed for somebody to understand why you felt that way in this situation."

After describing the situation, participants rated the intensity of their emotions in that situation on a set of emotion scales (20 in Study 1 and 2, and 34 in Study 3) that cover the domain of emotional experience (as in De Leersnyder et al., 2011). The intensity ratings (1 = *totally not* – 7 = *extremely*) of the full set of emotions constitute an individual's emotional pattern for a specific type of situation. We calculated each participant's *EFC* by (i) calculating the cultural sample's average emotion pattern for each type of situation, and (ii) running profile correlations between each individual's pattern and the average cultural pattern for the corresponding situation. In this way, the EPQ captures emotional fit for both positive and negative *autonomy-promoting* and *relatedness promoting* situations across different social contexts such as at home, at work or school, and with friends.

As in our previous studies (e.g., De Leersnyder et al., 2011, 2014), we made use of profile correlations (i.e., Pearson correlations across the individual's and the sample's average emotional profiles) to capture the fit. Profile correlations have the advantage that they (i) take into account the similarity across a whole set of emotions; (ii) capture the idea of emotional patterns (i.e., the relative intensities of different emotions); and (iii) are not prone to individual differences in scale use. Before establishing the correlations, we excluded emotion items from the pattern if there was no within sample agreement on their meaning [as suggested by low or cross-loadings on a (Varimax rotated) solution of a Principal Component Analysis; cfr. infra for more details on these analyses]. Furthermore, each participant's own scores were omitted from the average cultural sample's pattern to which they were compared. The correlation coefficients were Fisher *z*-transformed to achieve a linear distribution of the data (a requirement for the statistical techniques used).

Given that the results for positive and negative situations were similar (see Supplementary Table A2), we collapsed the fit scores across negative and positive situations. Thus we obtained one fit score for autonomy-promoting situations and one fit score for relatedness-promoting situations.

Psychological Well-Being

We measured psychological well-being with either the long (Studies 1 and 2) or the short (Study 3) version of the World Health Organization's Quality of Life Questionnaire (WHOQOL Group, 1995; Power et al., 1999; Skevington et al., 2004). The WHOQOL Group (1995) captures relevant well-being domains across different cultures (e.g., Power et al., 1999), and is suitable for non-clinical samples. Its psychological well-being subscale covers several aspects of psychological well-being, thereby providing a more thorough estimation of the construct than many other scales: 'positive feelings,' 'thinking and concentration,' 'self-esteem,' 'body image,' 'spirituality' (i.e., meaning in life) and 'negative feelings' (reverse coded).

Another advantage is that the WHOQOL Group (1995) captures more well-being domains than only psychological well-being. In fact, both the long and the short version of the WHOQOL cover 24 facets that cluster into four broad domains of well-being: psychological, physical, environmental, and relational well-being. In the current research, all well-being domains that do not refer to psychological well-being (i.e., relational, environmental, and physical well-being) were combined in an *Overall Quality of Life index*. This index was used as a control variable when testing the link between emotional fit and psychological well-being, which allowed us to investigate the *net contribution* of emotional fit to the prediction of psychological well-being above and beyond other indices of well-being (for a similar approach see Carton et al., 1999 and De Leersnyder et al., 2014). Each time, higher domain scores (20-point scale in the long version; five-point scale in the short version) indicate higher well-being.

Demographic Variables and Informed Consent

Before the start of each study, participants received, read, and signed an informed consent about the study (studies approved by the University of California at Santa Barbara Human Subjects Committee). At the end of each study, all participants completed demographic questions for age, gender, and social class. Since these demographic variables are known to be associated with psychological well-being (e.g., González Gutiérrez et al., 2005; Akhtar-Danesh and Landeen, 2007) we will also control for these variables when testing our hypotheses (see Supplementary Table A1, for an overview of the raw correlations between each of the control variables and the variables of interest in the current research.

Data-Analysis

In order to test whether people's psychological well-being is associated with their EFC in either autonomy-promoting or relatedness-promoting situations at home or at work, we conducted a linear regression analysis (see **Table 1**) in which we predicted Psychological Well-being from EFC after controlling for (i) the Context of the emotional fit measurements (Step 1), Demographic variables (Step 2), and Overall Quality of Life index (Step 3). In the fourth step, we always tested the main effects of EFC in autonomy and relatedness-promoting situations and, in the fifth step we finally tested our hypothesis in the form of interactions between EFC and the Context in which fit was measured.

The Context variable was always dummy-coded, with the Family context serving as the reference category. In Studies 1 and 2 we only included Family and Work/School contexts resulting in one dummy variable referring to the Work context: Work-dummy (*0 = Family, 1 = Work/School).* In Study 3, we included a Friends contexts in addition to Family and Work/School contexts, resulting in one Work-dummy (*0 = Family, 1 = Work/School, 0 = Friends)* and one Friends-dummy (*0 = Family, 0 = Work/School, 1 = Friends).* Therefore, the regression coefficients of main effects qualified by interactions pertain to the effects of EFC in Family contexts, and the regression coefficients of interaction terms between EFC and the Work-dummy or Friends-dummy pertain to the effects of EFC in Work contexts and Friends contexts, respectively.

In each study, we excluded participants when the valence of their self-reported situations did not match the valence of the prompt [Study 1, $n = 3$ (9%); Study 2, $n = 5$ (6%); Study 3, $n = 9$ (3%)]. In addition, some participants could not be included in the analyses due to missing data for either the well-being questionnaire or the EPQ prompts [Study 1, $n = 1$, Study 2, $n = 3$, Study 3, $n = 16$].

Study 1

Participants and Procedure

Participants were 30 European Americans from a community sample [66.6% female; M_age = 38.5 years (SD_age = 14); $Median_{\_social\_class} = 3$, corresponding to *solidly middle class*, on a scale from 1 = *working class* – 5 = *upper class*]. Participants were recruited in public places, such as malls, and received $10 for their participation.

All participants completed four versions of the EPQ: two were autonomy-promoting and two were relatedness-promoting (one positive and one negative for each). Context was thus the only between-subjects factor in this study: Each participant completed all prompts with respect to the same context (Family $n = 17$; Work/school $n = 13$). The order of the prompts was counterbalanced, but there were no order effects. Furthermore, a Principal Component Analysis (with Varimax rotation) on the emotion items (interested, strong, proud, close, respect, helpful, guilty, ashamed, afraid, indebt, worthless, embarrassed, upset, irritable, bored, ill feelings, resigned, jealous, relying, surprised) yielded a clear three-factor structure that explained 60% of variance in the data. This means that all emotion items were interpreted in a similar way within this sample, allowing us to retain all emotion items when calculating emotional fit with the cultural sample's average. Participants completed the long version of the WHO Quality of Life scale. *Psychological well-being* was calculated on the basis of four facets because the reliability analysis indicated that the Cronbach's alpha improved by excluding the facets 'spirituality' and 'thinking and concentration' from the scale; (*Psychological well-being* $\alpha_{facets} = 0.87$; $M = 13.91$ SD = 3.21; *Overall Quality of Life index* $\alpha_{facets} = 0.84$; $M = 15.1$ (SD = 2.03).

Results and Discussion

As hypothesized, the regression model including the interaction terms between EFC and Context (i.e., Work-dummy) was

TABLE 1 | Results of hierarchical linear regressions predicting psychological well-being from emotional fit with culture in autonomy- and relatedness-promoting situations in home, work and friend contexts.

Panel A: Study 1: Euro-American cultural context			Panel B: Study 2: Korean cultural context			Panel C: Study 3: Belgian cultural context		
Predictor	**ΔR^2**	**β[a]**	**Predictor**	**ΔR^2**	**β[a]**	**Predictor**	**ΔR^2**	**β[a]**
Step 1	0.001 (0.001)		*Step 1*	0.047† (0.047†)		*Step 1*	0.006	
Work-dum		0.040 (.015)	Work-dum		0.180 (0.180*)	Work-dum		0.049
						Friends-dum		−0.057
Step 2	0.245† (0.245†)		*Step 2*	0.127† (0.127†)		*Step 2*	0.016	
Age		−0.097 (−0.132)	Age		0.144 (0.155)	Age		0.153**
Gender		−0.199 (−0.242*)	Gender		−0.004 (0.002)	Gender		−0.071
Class		−0.211 (−0.217†)	Edu duml		0.028 (0.025)	Edu Mother		0.004
			Edu dum2		0.037 (0.049)	Edu Father		0.025
Step 3	0.409*** (0.409***)		*Step 3*	0.449***(0.449***)		*Step 3*	0.303***	
Overall QOL		0.770*** (0.709***)	Overall QOL		0.695*** (0.694***)	Overall QOL		0.563***
Step 4	0.407 (0.000)		*Step 4*	0.007 (0.005)		*Step 4*	0.037**	
EFC Auto		−0.321 (−0.444*)	EFC Auto		0.009	EFC Auto		**0.138***
EFC Rela		−0.247	**EFC Rela**		**0.260† (0.264*)**	EFC Rela		**0.103†**
Step 5	0.144** (0.134***)		*Step 5*	0.024†† (0.024*)		*Step 5*	0.010	
						Work-dum X EFC Auto		
Work-dum X EFC Auto		**0.511**(0.614***)**	Work-dum X EFC Auto		0.036	Work-dum X EFC Rela		
Work-dum X EFC Rela		0.141	**Work-dum X EFC Rela**		**−0.253† (−0.247*)**	Friends-dum X EFC Auto		
						Friends-dum X EFC Rela		
Total R^2	0.815 *** (0.789***)		Total R^2	0.654 *** (0.606***)		Total R^2	0.363***	

Hypothesized associations appear in bold. Work-dum, Dummy variable representing Work Contexts; Friends-dum, Dummy variable representing Friends Contexts; Family Context is always the reference category; Edu dum1, dummy variable representing tertiary educational level; Edu dum2, dummy variable representing PhD educational level; Edu Mother, educational level mother; Edu Father, educational level father; Overall QOL index, Overall Quality of Life index; EFC Auto, Emotional Fit with Culture in Autonomy-promoting situations; EFC Rela, Emotional Fit with Culture in Relatedness-promoting situations.

[a]*The βs presented here are the ones from the final regression model (i.e., the latest step that significantly contributed to the explained variance).*

The values in between brackets for Study 1 are those for the additionally tested regression model in which we only included Emotional fit in autonomy-promoting situations. The values in between brackets for Study 2 are those for the additionally tested regression model in which we only included Emotional fit in relatedness-promoting situations.

*††$p < 0.15$, †$p < 0.10$, *$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$.*

significant and predicted most variance in Psychological Well-being (Step 5: $\Delta R^2 = 0.114$, $p = 0.010$; see **Table 1**, panel A, for the full results). As expected, only the effect of EFC in *autonomy-promoting situations at school or work* (interaction term) was significant, and it was positively associated with European Americans' psychological well-being ($\beta_{EFC-Autonomy} = -0.321$, $p = 0.103$; $\beta_{Work-dummyX\ EFC\_Autonomy} = 0.511$, $p = 0.010$)[2]. When removing the non-significant EFC predictors from this model, the results were more pronounced, with the negative coefficient of EFC in Autonomy-promoting situations in Family contexts (main effect) becoming significant (see **Table 1**, panel A, in between brackets; Step 5: $\Delta R^2 = 0.134$, $p \leq 0.001$; $\beta_{EFC-Autonomy} = -0.440$, $p = 0.019$; $\beta_{Work-dummy\ X\ EFC\_Autonomy} = 0.614$, $p = 0.001$). Simple slopes analyses on the basis of this latter model (i) confirmed our hypothesis that European American's psychological well-being was positively associated with EFC in Autonomy-promoting situations in Work contexts (simple slope, $B = 3.684$, SE = 1.455, $p = 0.020$), yet also revealed that European Americans' EFC in Autonomy-promoting situations in Family contexts was negatively (instead of not) associated with their psychological well-being (simple slope: $B = -4.134$, SE = 1.619, $p = 0.019$). Follow-up analyses with the four different indices of emotional fit (see Supplementary Table A2, panel A) revealed that this latter effect was driven by the effect of EFC in negative autonomy-promoting situations, which center around irritation and ill-feelings.

Despite its small sample size, Study 1 provides first support for our hypothesis that people's psychological well-being is linked to their emotional fit in situations that are central to the cultural mandate. Indeed, European Americans reported fewer depressive symptoms, more positive feelings about their lives, more self-esteem, etc., as their patterns of emotions fitted those of other European Americans in autonomy-promoting situations at work. To ensure that these findings were specific to emotional fit in culturally focal domains and not due to high levels of autonomy-promoting emotions (which may be linked to self-esteem), Study 2 tested our hypothesis in a sample of Koreans for whom the culturally focal domains do not include situations that foster autonomy-promoting emotions, but rather foster relatedness-promoting emotions.

Study 2

Participants and Procedure

Participants were 75 Koreans from a community sample (60% female; $M\_age = 28$ years; SD_age = 4.25). As an index of socioeconomic status, participants reported their highest degree of education [dummy-coded as 'Edu dum1' = college ($n = 41$); 'Edu dum2' = graduate school ($n = 9$); with "reference group" = high school ($n = 26$)]. Participants received ₩10.000 (about 10 dollars) for completing the questionnaires and were recruited through a Christian mega-church; these churches are common, given that Christianity is widely practiced in Korea (37%). The design and materials were the same as those used in Study 1. Each participant completed all prompts with respect to the same context (Family $n = 35$ Work/school $n = 37$). Again, there were no order-effects and we collapsed the emotional fit scores into one score for EFC in Autonomy-promoting situations and one score for EFC in Relatedness-promoting situations. The Principal Component Analysis (with Varimax rotation) on the emotion data explained 65% of the variance with a three-factor structure on which all but three items (embarrassed, afraid, surprise) loaded well. Consequently, these three items were omitted from our calculations of EFC. As in Study 1, participants completed the long version of the WHO Quality of Life scale (*Psychological well-being* $\alpha_{facets} = 0.71$; $M = 13.94$ (SD = 2.02; *Overall Quality of Life* $\alpha_{facets} = 0.90$; $M = 14.40$ (SD = 1.79).

Results and Discussion

We followed the exact same analytic strategy as in Study 1. The expected model including the interaction terms between EFC and the Context of the situation did not reach significance above and beyond the control variables (Step 5: $\Delta R^2 = 0.024$, $p = 0.147$)[3]. Yet, an inspection of the regression coefficients revealed that the pattern of results was in line with our expectations: a main effect of EFC in Relatedness-promoting situations ($\beta = 0.260$, $p = 0.054$) that was qualified by the interaction between the Work-dummy and EFC in Relatedness-promoting situations ($\beta = -0.253$, $p = 0.054$); no effects pertaining to EFC in Autonomy-promoting contexts were significant. When removing these latter, non-significant effects from our model, Step 5 became significant (see **Table 1**, panel B, between brackets; Step 5: $\Delta R^2 = 0.024$ $p = 0.047$; $\beta_{EFC\_Relatedness} = 0.264$, $p = 0.038$; $\beta_{Work-dummy\ X\ EFC\_Relatedness} = -0.247$, $p = 0.047$. A simple slopes analysis on the basis of this latter regression analysis further confirmed our hypothesis: Korean's psychological well-being was associated with their EFC in Relatedness-promoting situations in Family contexts (simple slope, $B = 1.998$, SE = 0.94, $p = 0.038$), but not with EFC in Relatedness-promoting situations in Work contexts (simple slope, $B = -0.566$, SE = 0.85, $p = 0.510$).

Study 2 thus provides further evidence for the idea that EFC is linked to psychological well-being, but only in culturally focal domains. In Study 3, we again tested this hypothesis in the Belgian cultural context where the cultural mandate is to be autonomous without jeopardizing relatedness.

Study 3

Participants and Procedure

Two-hundred-forty-two psychology freshmen from the University of Leuven (Belgium) participated in this study (83% female; $M_{age} = 18.82$; SD = 1.87; $M_{education\ mother} = 3.58$,

[2]This pattern of results was highly similar if we did not control for the *Overall QOL Index* (see Supplementary Table A3, panel A for the full results of this analysis).

[3]Not controlling for Overall Quality of Life Index, yielded a very similar pattern of results, be it that the interaction effect was even weaker (see Supplementary Table A3, panel B for the full results of this analysis).

SD = 0.59; $M_{\text{education father}}$ = 3.57, SD = 0.70). Students participated in this research for course credit.

In the version of the EPQ that we used in this study, participants rated their emotional experience on 34 (instead of 20) items. In addition to the Family context and the Work/School context, the prompts of the EPQ now also included a Friends context. Different from studies 1 and 2, each student completed the EPQ for two different situations, similar in Valence (*n* positive = 116; *n* negative = 126) and Relationship Context (*n* family context = 82; *n* work/school context = 80; *n* friend context = 82), yet one pertaining to an autonomy-promoting situation, the other pertaining to a relatedness-promoting situation. A Principal Component Analysis (with Varimax rotation, explaining 67 and 62% of the variance for emotion data in the first and the second situation, respectively) revealed a clear four factor structure reflecting positive autonomy-promoting, positive relatedness-promoting, negative autonomy-promoting and negative relatedness-promoting emotions. Four items did not load on a single factor (bored, jealous, feeling resigned, and feeling pity) and were omitted from the emotional fit calculations.

Due to time constraints, students completed the short version of the WHO Quality Of Life Questioannire – i.e., the WHOQOL BREF (Skevington et al., 2004). Although this questionnaire has been successfully used with Belgian students (Baumann et al., 2011), other authors have argued to be cautious about its factor structure (Theuns et al., 2010). Therefore, we first conducted a Principal Component Analysis on the 24 items of the WHOQOL BREF. A solution with six factors yielded interpretable factors and explained 57% of the variance in the data. Four factors were similar to those intended by the WHO and referred to psychological, physical, environmental, and relational well-being. However, two additional factors emerged, one clustering three items referring to transportation and finances, the other clustering the items 'capacity for work,' 'being able to perform daily living activities,' 'being able to concentrate,' and 'feeling that your life is meaningful.' These two latter items were originally proposed to be items of psychological well-being scale; yet, as they loaded on a different scale, we did not include them in our construct of psychological well-being. The other four items ('positive feelings,' 'self-esteem,' 'accepting your body,' and 'negative feelings'; reverse coded) formed a reliable *Psychological Well-being* scale ($\alpha = 0.75$; $M = 3.57$ (SD = 0.60). As in studies 1 and 2, we calculated an *Overall Quality of Life index* including all items except those constituting the psychological well-being scale [$\alpha = 0.83$; $M = 3.84$ (SD = 0.43)].

Results and Discussion

To test whether Belgians' psychological well-being was associated with their EFC in both autonomy and relatedness-promoting situations, we conducted a regression analysis that was the same as in Studies 1 and 2, except that we now included one dummy variable pertaining to Work contexts and one pertaining to Friends contexts; again Family context served as the reference category. The analysis revealed that a model including the main effects of EFC explained most variance in participants' psychological well-being above and beyond the control variables (step 4: $\Delta R^2 = 0.037$ $p = 0.002$); the expected interaction effects did not significantly contribute to the model (step 5: $\Delta R^2 = 0.010$ $p = 0.454$). However, in line with the prediction that Belgian cultural contexts are characterized by a less extreme form of independence and that, therefore, the cultural mandate of autonomy goes hand in hand with the mandate of relatedness, our results indicated that Belgians' psychological well-being was positively associated with their EFC in Autonomy-promoting situations ($\beta_{\text{EFC\_Autonomy}} = 0.138$, $p = 0.018$), and marginally significantly with EFC in Relatedness-promoting situations ($\beta_{\text{EFC\_Relatedness}} = 0.103$, $p = 0.080$; see **Table 1**, panel C)[4]. This latter effect became significant when controlling for the Valence of the situation, although there were no significant interaction effects between Valence and EFC (see Supplementary Table A2, panel C).

General Discussion

Cultural fit of emotions is associated with psychological well-being, yet only when the fit occurs in domains that are central to the realization of the respective cultural mandates. For instance, we found that European Americans' psychological well-being was associated with emotional fit in autonomy-promoting situations at work. In these situations, where autonomy-promoting emotions are most intense, the 'right' patterning of one's emotional experiences – i.e., one's EFC – may reflect to what extent one embodies the cultural mandate of being autonomous in the 'proper European American way.' From fitting in emotionally to these situations, European Americans may thus derive feelings of being a competent member of their society, which may boost their positive self-regard and buffer against depression.

In contrast, yet also in line with their cultural mandate, Koreans' psychological well-being was associated with their EFC in relatedness-promoting situations at home. Finally, we found that whereas Belgians' psychological well-being was most strongly linked to EFC in autonomy-promoting situations, it was also linked to their EFC in relatedness-promoting situations. Although we had expected that these effects would be qualified by the context of interaction – which they were not – the results are nevertheless in line with the Belgian cultural mandate of egalitarian autonomy that mandates autonomy as long as it not jeopardizes relatedness. These findings thus not only support our main hypothesis, but also further support the idea that both autonomy and relatedness define European (i.e., Belgian) mandates (e.g., Kitayama et al., 2009; Boiger, unpublished doctoral dissertation) and the according models of psychological well-being.

Unexpectedly, the European American study yielded a *negative* association between psychological well-being and emotional fit in autonomy-promoting situations at home; a

[4]Not controlling for Overall Quality of Life Index, yielded a similar pattern of results (step with main effects: $\Delta R^2 = 0.036$ $p = 0.015$; $\beta_{\text{EFC\_Autonomy}} = 0.101$, $p = 0.149$; $\beta_{\text{EFC\_Relatedness}} = 0.136$, $p = 0.056$); yet, the overall model was only marginally significantly better than the 0-model (i.e., without any predictors; $F_{8,233} = 1.748$, $p = 0.089$; see Supplementary Table A3, panel C for the full results of this analysis).

finding that was completely driven by the fit in negative situations. We had not predicted this association, but it is intuitive nonetheless. Fit with negative autonomy-promoting situations at home means that emotions such as anger, irritation and ill feelings are most intense. It is not surprising that these feelings are associated with negative psychological well-being, even in European American samples. Conflict at home is not desirable, and European American families form no exception to this rule: Having fewer negative autonomy-promoting emotions than average, and thus having lower cultural fit, is a sign of psychological health.

The current research contributes to previous research on the link between emotions and psychological well-being in several ways. First, the current studies actually *measured EFC* rather than inferred it. Consequently, they provide more direct evidence for the link between psychological well-being and EFC than previous studies (Kitayama et al., 2006; Tsai et al., 2006). Second, they go beyond traditional studies by considering the *patterns of co-occurring emotions*, rather than discrete emotions. Indeed, traditional approaches have linked well-being to the *intensity* of culturally appropriate emotions, regardless of the situation in which they occurred. In contrast, the current studies linked the *patterning* of a whole set of emotions to psychological well-being. In a series of *post hoc* analyses, we found that cultural fit predicted participants' psychological well-being over and above mean intensity levels of autonomy-promoting (e.g., pride and anger) and relatedness-promoting (e.g., closeness and shame) emotions (see Supplementary Material pages 4–7 and Supplementary Table A4). Thus, indices of cultural fit within particular situations were better predictors of psychological well-being than the mean intensity levels of prototypical emotions; a finding that was true across the three studies and across different situations. As such, the current research highlights the benefits of the *cultural fit*, and suggests that the utility of particular emotions is dependent on the specific situational and cultural context.

Toward a Cultural Psychology of Psychological Well-Being

The current research resonates with a growing body of research that defines psychological well-being in terms of fit with culture. Most of the evidence is indirect, explaining culturally different predictors of well-being from (putative) differences in the cultural mandates. For instance, in a study comparing representative samples of Americans and Japanese (Kitayama et al., 2010), well-being in US contexts was predicted by the level of perceived 'personal control,' whereas in Japanese contexts, the perceived absence of 'relational strain' was a better predictor of well-being. Personal control helps to realize the cultural mandate of autonomy, whereas the absence of relational strain is instrumental to the cultural mandate of relatedness (see also Kwan et al., 1997; Kang et al., 2003). Thus, culture-congruent psychological processes predicted psychological well-being.

More indirect evidence comes from studies showing that the most prevalent or most valued psychological dimensions best predict well-being in a given culture. For instance, the personality traits that best predicted well-being were the ones shared within a cultural group, such as extraversion in a culture with high levels of extraversion (Fulmer et al., 2010). Likewise, adolescents' self-esteem was best predicted by a positive self-evaluation in the domain valued most by others in the culture (Becker et al., 2014). Correspondingly, negative well-being has been related to psychological tendencies that violate the cultural mandate. In Hong Kong and Mexico, where the cultural mandate is relatedness, individuals with an avoidant attachment style (associated with high autonomy and low relatedness) experienced more relationship problems than did individuals with the same attachment style in the US (Friedman et al., 2010).

Even more germane to our research are studies on *cultural consonance* (e.g., Dressler, 2012). Cultural consonance refers to "the degree to which individuals approximate, in their own beliefs and behaviors, the prototypes for belief and behaviors encoded in shared cultural models" (Dressler, 2012, p. 2). Methodologically, cultural consonance is measured in a similar way as EFC – i.e., by calculating profile correlations between an individual's answers to a set of questions in a particular domain and the aggregated set of answers from their own cultural group. Across multiple studies with Brazilians and African Americans, individuals' cultural consonance in the domains of family life, social support, lifestyle, national identity, and food was found to be associated with lower psychological distress and fewer depressive symptoms (Dressler and Bindon, 2000; Dressler et al., 2007). Moreover, these studies revealed that Brazilians' consonance in the domain of family life – which is *most central* to the cultural mandate (e.g., DaMatta, 1985) – was *most* predictive of their changes in depressive symptoms, even after controlling for both the cultural fit in other domains and stressful life events (Dressler et al., 2007).

In all these studies, cultural fit of psychological processes rather than the specific psychological phenomena themselves predict psychological well-being. In our research we found that emotional fit particularly in situations that were central to the realization of the respective cultural mandates counted toward psychological well-being. This finding may have important implications for the clinical practice, as it implies that well-being, and conversely ill-being and psychopathology, may be an emergent property of the interaction between mind and culture (Mesquita and Walker, 2003; Ryder et al., 2011).

Limitations and Avenues for Further Research

The current research is not without its limitations. First, the sample sizes for our studies ranged from very small (Study 1) to medium (Study 3), which may have weakened the power of our regression analyses. However, despite the sample size, the convergence of the results across the three studies is remarkable and strengthens our confidence in the findings. Relatedly, cultural fit of emotions was not established with regard to a *representative* cultural sample. Relatedly, we did not establish cultural fit of emotions with regard to a representative cultural sample. Rather, we established an individual's emotional fit with regard to the cultural subgroup that is socially relevant to the individual as he or she engages in it on a daily basis. Future research should test whether it is emotional fit with the average patterns of one's local community or emotional fit with the representative patterns of one's wider nation that is most closely associated with well-being.

A second limitation of the current studies is that our data are cross-sectional and do not allow us to establish the direction of the link between psychological well-being and EFC. On the one hand, studies have suggested a causal link from better emotional fit to better well-being. For instance, the emotional fit of romantic partners or roommates predicts satisfaction with the relationship 6 months later (Anderson et al., 2003; Gonzaga et al., 2007) and the emotional fit of anxious interaction partners buffers against stress during a following laboratory speech task (Townsend et al., 2013). On the other hand, the *cultural norm hypothesis* on depression proposes that depressive symptoms reduce people's attention to cultural norms of emotional reactivity, thereby suggesting a causal link from well-being (i.c., depression) to emotional fit (i.c., misfit) with cultural norms (Chentsova-Dutton et al., 2007, 2010). Of course, a feedback loop between the two, with links in two directions, is most likely.

Finally, we did not investigate the precise mechanism through which EFC is associated with psychological well-being. Future research may focus on possible mediators of this link, such as (a) the conscious *distress of not fitting in*, which partially mediated the effects of cultural (mis)fit on depression in the studies by Dressler and colleagues (e.g., Balieiro et al., 2011; see also Townsend et al., 2013), (b) perceived *shared reality*, which socially validates 'the way people are' and, as such, boost their sense of epistemic competence and feelings of psychological well-being, as speculated by Fulmer et al. (2010; Hardin and Higgins, 1996), and (c) the *social consequences* of experiencing the 'right' emotions (e.g., Keltner and Haidt, 2001; Szczureck et al., 2012).

Despite these limitations, the current research clearly suggests that psychological well-being is associated with emotional fit in culturally focal domains in which the fit stands for a person's embodiment of the culture's mandate in the culturally appropriate ways.

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Supplementary Material

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/article/10.3389/fpsyg.2015.00630/abstract

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A cross-cultural study on emotion expression and the learning of social norms

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When we do not know how to correctly behave in a new context, the emotions that people familiar with the context show in response to the behaviors of others, can help us understand what to do or not to do. The present study examined cross-cultural differences in how group emotional expressions (anger, sadness, neutral) can be used to deduce a norm violation in four cultures (Germany, Israel, Greece, and the US), which differ in terms of decoding rules for negative emotions. As expected, in all four countries, anger was a stronger norm violation signal than sadness or neutral expressions. However, angry and sad expressions were perceived as more intense and the relevant norm was learned better in Germany and Israel than in Greece and the US. Participants in Greece were relatively better at using sadness as a sign of a likely norm violation. The results demonstrate both cultural universality and cultural differences in the use of group emotion expressions in norm learning. In terms of cultural differences they underscore that the social signal value of emotional expressions may vary with culture as a function of cultural differences, both in emotion perception, and as a function of a differential use of emotions.

Keywords: emotion expressions, social signals, normative behavior

Introduction

Imagine that you watch a group of people. They are taking turns doing a task and when suddenly one person does the task differently, the others look angry. What would you conclude? In a study using such a scenario, participants concluded that if someone wanted to be part of the group, they should do the task like the previous members of the group did it, not like the last member (Hareli et al., 2013). Yet, when the others reacted with sadness, participants were less sure what the proper behavior should be. Thus, the emotions shown by onlookers are one signal people can use to learn how to behave in a new social context.

Emotion Expressions as Social Signals of Norm Violation

Hareli et al. (2013) focused on anger as a strong signal toward the normativeness of a behavior. The authors grounded their argument on appraisal theory (e.g., Frijda, 1986; Scherer, 1987). Specifically, according to appraisal theories of emotion, emotions are elicited and differentiated through a series of appraisals of (internal or external) stimulus events based on the perceived nature of the event (e.g., Frijda, 1986; Scherer, 1987). Negative emotions such as sadness, anger, and fear are characterized by appraisals of goal obstruction/unpleasantness. That is, these emotions occur

when something undesirable happened. For anger, one additional relevant appraisal relates to whether the event is congruent with prevalent norms. As observers can reconstruct appraisals as they apply to a situation (Robinson and Clore, 2002), they can "reverse engineer" or reconstruct the relationship between the person and the event based on the emotion expressed (Frijda, 1986; Weiner, 2006; Hareli and Hess, 2010, 2012). That is, a person who sees an angry other will know that this person encountered an event that was not only undesirable but specifically incongruent with the person's norms – even if the observer does not know anything else about the emoter and the situation within which the emotion occurred (Hareli and Hess, 2010).

In fact, any event that is appraised as obstructing a person's goals or as undesirable might be indicative of a problem with the actor's behavior as well (Scherer, 1987, 1999; Roseman et al., 1990). However, these appraisals simply reflect that something undesirable happened without pointing to norm violations in particular (Scherer, 2001). Thus, these appraisals are a more indirect and less specific sign of non-normative behavior. Consequently, sadness, which signals goal obstruction/unpleasantness but not norm violation, should be less informative regarding norms.

It should be noted that observers are able to deduce a group's norm just by witnessing uniform behavior by its members (see also, Milgram et al., 1969). Thus, the simple fact that one behavior occurred more often than the other can be indicative of a norm. But even though the uniformity of the behavior as such is a sufficient cue to the norm, it is frequently not used as such (Miller and Prentice, 1996).

The goal of the present study was to assess whether the social signal value of anger generalizes across cultures. Different scenarios are possible, leading to different alternate hypotheses. First, anger is always a potent social signal of social norm violation, sadness a less potent one, and statistical information even less as found by Hareli et al. (2013). That is, no cultural differences will be found. Second, in cultures in which the expression of anger is endorsed to a lesser degree, anger should be a less potent signal of norm violation and this effect should be directly mediated by the perception of anger, yet, sadness should still remain a less potent signal compared to anger. Third, in cultures in which the social meaning of anger is different, anger should be a less potent signal of norm violation with a potential shift in the relative ability of sadness and statistical information to signal norm violations. The rationale for these potential alternative hypotheses is detailed in what follows.

Cross-cultural Differences in Emotion Perception

The use of bystanders' emotional reaction to an event to deduce social norms depends essentially on whether these emotional reactions are in fact noticed and decoded. Specifically, if anger serves as a social cue to norm violation, then the perception that a norm violation occurred and the learning of the correct norm should be directly mediated by the degree to which anger is perceived.

Research on cultural differences in the decoding of emotions generally concludes that so-called basic emotions, which include both anger and sadness, are indeed recognized across cultures at above chance levels (Elfenbein and Ambady, 2002; Hess and Thibault, 2009). Yet, these findings refer to highly prototypical intense facial expressions shown without context and even for these facial emotion expressions, differences in decoding accuracy across countries have been observed (Elfenbein and Ambady, 2002). As everyday emotions are typically more subtle and non-prototypical (Motley and Camden, 1988; Ekman, 2003) and occur within a context (Hess and Hareli, 2014) differences in decoding accuracy are very likely. For the decoding of such more subtle expressions, decoders take recourse to stereotype knowledge and socio-cultural norms regarding the "proper" display of emotion expressions when trying to understand these expressions (Kirouac and Hess, 1999).

In fact, there are strong cultural differences in emotional display rules (Matsumoto et al., 2008), that is, the social rules that guide the appropriate display of emotion expressions (Ekman and Friesen, 1971). These differences can in part be related to differences in cultural values such as individualism and collectivism (Matsumoto et al., 2008) but also openness to change (Koopmann-Holm and Matsumoto, 2011) or masculinity (Sarid, 2015) among others. In fact, even though cultural values underpin the establishment of display rules within a culture, it is unlikely that they depend crucially on a single dimension but rather one would expect them to be embedded into a richer cultural fabric. Importantly in this context, social display rules have a converse side in social decoding rules (Buck, 1984; Hess, 2001), such that perceivers tend to be less good at decoding expressions that are proscribed in a given culture. Thus, cultures that differ in anger display rules can also be expected to differ in anger perception.

The present study replicates the study by Hareli et al. (2013) in Germany, Greece, the US, and Israel. These cultures were chosen because they differ with regard to the cultural endorsement of anger. Different underlying social values and motives seem to explain differences in anger display rules between the US and Greece on the one hand and Germany and Israel on the other. In comparison to other individualistic cultures, European Americans in the US tend to avoid negative affect (Koopmann-Holm and Tsai, 2014), which may explain their lower endorsement of anger expressions in comparison to Germans in particular (Koopmann-Holm and Matsumoto, 2011). Therefore, the motivation to shy away from negative affect can be the result of more individualistic concerns to distance from others. On the other hand, Greek participants with higher interdependence tend to show lower attention to negative emotions, including anger expressions, due to collectivism concerns and the keeping of harmony rules (Kafetsios and Hess, 2013).

There are no studies that compare all four countries, but a number of studies exist that allow us to triangulate the likely differences across all four. In a recent study, Hess et al. (in press) found that Greek participants rated spontaneous facial expressions of anger less accurately and less intensely than did German participants. Germans also endorsed anger (as well as sadness) expressions more than US Americans, a finding that the

authors relate to differences in openness to change (Koopmann-Holm and Matsumoto, 2011). In turn, the expression of anger is endorsed to a larger degree in Israel than in the US, a difference that has been explained by differences in power distance (Margalit and Mauger, 1984; Grandey et al., 2010). Based on these data, we predicted that anger expressions would be rated more intensely in Germany and Israel, followed by the US and Greece.

With regard to sadness ratings, unlike the US, Germany, and Israel, Greece is a more interdependent country in which the expression of anger is endorsed less and sadness is valued relatively more and also recognized better than in Germany (Hess et al., in press). Also, Greece is higher in uncertainty avoidance, which has been linked to better sadness decoding (Schimmack, 1996). Thus, sadness should be rated more intensely in Greece than in the other three countries and more intensely in Germany than the US.

Consequently, we hypothesized anger to be a strong social signal of norm violation in Germany and Israel but less so in the US and least in Greece. Specifically, as there is evidence that anger is differentially endorsed and perceived in the four different cultures (H1) we expected that, in line with the second alternative above, in cultures in which the expression of anger is endorsed to a lesser degree, anger should be a less potent signal of norm violation and this effect should be directly mediated by the perception of anger (H2). By contrast, sadness should be a still less potent signal compared to anger. However, as there is some evidence that negative emotions in a relational context have different meanings for German and Greek participants (Kafetsios et al., under review), it may be that in this culture sadness will be a relatively more potent signal of norm violation (H3).

Further, we predicted that the potency of cultural display rules as decoding rules depends on the perspective of the observer. Specifically, it may make a difference whether a situation is supposed to be evaluated from a certain social distance as it relates to other people, or if it is to be evaluated from a first person point of view making it directly relevant to the observer (Ham and van den Bos, 2008). Thus, we expected stronger effects when the situation is to be evaluated from a first person point of view making it directly relevant to the observer (H4).

Overview

Following the design of Hareli et al. (2013), participants were presented with a series of slides that depicted a group of people. In all slides one of the group members was shown drinking tea while the others looked on. The first two slides each showed a different group member holding the teacup in a specific way and the onlookers showed a neutral expression. In the third slide the teacup was held differently and the onlookers either reacted with anger, sadness, or neutrality. The expressions were carefully created to be of medium intensity only. Participants were then asked to: (a) describe the norm in their own words, (b) rate how likely they thought it to be that a norm violation had occurred and (c) rate the emotions shown by the onlookers in the last slide.

As mentioned above, statistical information on the relative frequency of the two behaviors alone can be indicative of the presence of a norm. Yet, as Miller and Prentice (1996) put it, "norm-congruent behaviors are both unremarkable and unlikely to be remarked on" (p. 808). Hence the cup was either held first with one hand in the way commonly done in all four cultures, or with two hands, which should be more salient, as this represents a cultural (but not group) norm violation. We therefore expected statistical information to be more informative when the group norm was to hold the teacup with both hands. Hareli et al. (2013) did not find a significant difference in norm learning as a function of hand position, but the data did show a difference in means congruent with such a possibility. Finally, we varied the personal relevance of the norm by asking participants to adopt either a first or a third person perspective when being asked about the norm. A first person perspective should make the question more personally relevant (Ham and van den Bos, 2008), which should increase motivation and attention. This resulted in a 4 (country) × 3 (last picture emotion expression) × 2 (normative hand position) × 2 (first vs. third person perspective) between subjects design.

Materials and Methods

Participants

A total of 149 (84 men, 56%) individuals with a mean age of 32 years ($SD = 8$) participated in a laboratory setting at the University of Haifa (Israel). Further, 273 (120 men, 44%) individuals with a mean age of 23 years ($SD = 7$) were recruited for an online study using a database of current and former students at the University of Crete (Greece); 261 (84 men, 32%) individuals with a mean age of 26 years ($SD = 5$) were recruited for an online study via the Facebook page of the department of psychology at Humboldt-University, Berlin (Germany), and 452 (247 men, 56%) with a mean age of 33 years ($SD = 11$) were recruited via Amazon Mturk in the US and completed the study.

Procedure

In Haifa, participants came to the laboratory in groups of up to five. They were greeted, informed consent was obtained and they then completed the same computer task as was used in the online studies. For the online studies, participants received the same information and consented by clicking a button[1].

The first screen explained that the study was about social perception and that participants would see three photos that documented part of an event. The next slide described the event. Participants were told that recently four members of a group that belonged to a social order, which is concerned with charitable work, had a meeting. The organization was further described as having an old tradition that includes different ceremonies. Participants had to pretend that they were invited to participate in a traditional tea drinking ceremony by that group. During the ceremony, one after the other, each member has to drink tea from

[1]In previous research we found no differences between emotion ratings effectuated in a laboratory setting and those using the web-based version for the same ratings once appropriate checks on diligence were done. For the MTurk sample, a question regarding the understanding of the instructions and a control item (if you read this, please move the slider to the left) were included to detect automated answers. For all studies, questionnaires that did not include an answer to the open question were considered as incomplete and discarded.

his or her cup. Participants were then told that they would see three photos showing the actions of three group members and the other members' reaction to these actions. They were further told that the photos are presented in the order in which the actions occurred. Participants were warned that the photos would appear for a brief time only and that they would be asked to describe afterward how either someone else who is the next to participate would behave or how they themselves would behave if they were next to participate. The three photos were then presented for 8 s each.

Stimulus Material

The stimulus slides were taken from Hareli et al. (2013) and adapted by removing Hebrew writing visible in the slides. The slides showed one of three group members drinking the tea and the others watching and reacting to this behavior. The first two slides each showed a different group member holding the teacup close to the mouth with both hands and the arms raised away from the body. The third group member was shown as holding the teacup only with the right hand. Non drinking group members were always shown looking at the acting person while expressing emotional neutrality when the member held the teacup with two hands (for an example of the stimulus material, see **Figure 1**). In a second condition, the norm was to drink the tea one handed and the norm violation was two handed drinking. Depending on the experimental condition, group members expressed anger, sadness, or emotional neutrality to the non-normative behavior of the last group member.

FIGURE 1 | Example stimulus.

Dependent Measures

Following the last photo, participants were requested to answer an open question asking them to report either (a) how the participants would expect an acquaintance who wants to behave according to the "group spirit" would act (the original question asked by Hareli et al., 2013) or (b) how they themselves would act if they wanted to behave according to the "group spirit."

Participants' responses to the open question were classified into two categories by two raters. Rare inconsistencies were resolved by discussion. One category included answers that reflected a clear understanding of the norm, such as, "S/he will drink the tea holding the cup with two hands." The other category included answers that reflected that the participants did not understand the norm, such as, "S/he will sit and look and even drink tea."

Once they had completed their answer, participants were referred to the last photo and asked to rate to what extent the group members had expressed sadness or anger or seemed indifferent. Finally, participants were asked to rate in two separate questions the extent to which group members saw the behavior of the person holding the cup as violating conventions and to what extent they saw it as violating social laws or norms. As these two questions correlated substantially ($r_{\text{Greece}} = 0.75$, $r_{\text{Germany}} = 0.88$, $r_{\text{Isarel}} = 0.89$, and $r_{\text{USA}} = 0.90$) they were combined into one variable named norm violation. These ratings were made on seven-point scales anchored at the extremes, ranging from (0) "not at all" to (6) "very much."

Results and Discussion

Because the samples differed with regard to mean age and gender composition, these variables were initially included as covariates in the analyses below. Gender was never significant and age only for ratings of anger (and global intensity which includes anger), such that older individuals rated the expressions as less angry (angry expressions: $r = -0.14$, $p = 0.007$; sad expressions: $r = -0.17$, $p = 0.001$, neutral expressions: $r = -0.11$, $p = 0.031$). None of the ANOVA results changed when the covariates were included and for the mediation analyses the inclusion of the covariates strengthened the effect of anger.

Emotion Perception

Overall Intensity

As we predicted that participants from the four cultures should vary in their ratings of anger (H1) we first assessed whether there were overall differences in the intensity ratings of the emotions expressed. Such differences could be due to culture-specific response styles and hence not specifically related to anger. For this, we summed the emotion ratings across all three scales and conducted a one-way ANOVA with culture as a factor. A significant effect of culture emerged, $F(3,1141) = 2.87$, $p = 0.036$, $\eta_p^2 = 0.01$, which, however, explained only about one percent of the variance. The overall perceived intensity was highest for Israel ($M = 6.95$, $SD = 2.52$), followed by Germany ($M = 6.84$, $SD = 2.92$), the US ($M = 6.53$, $SD = 3.24$), and finally Greece ($M = 6.19$, $SD = 3.15$). A *post hoc* test revealed

that Greece differed from Israel and Germany, which did not differ from each other. Including age as a covariate, a slightly stronger country effect emerged, $F(3,1125) = 3.82$, $p = 0.010$, $\eta_p^2 = 0.01$, and the ratings for the US and Greece differed as well. In all, any differences in perceived anger intensity between Germany, Israel, and the US were not due to an overall trend to rate expressions less intensely. However, this could be the case for Greece, even though the overall difference between Greece and the other countries is rather small.

Is Anger Perceived Differently as a Function of Country?

To assess our prediction that participants from the four cultures should vary in their ratings of anger (H1) we conducted an analysis of variance with a 4 (country) × 3 (emotion expressions in the last picture: Anger, Sad, Neutral) between-subjects design on the anger ratings with age as a covariate, $F(2,1119) = 6.82$, $p = 0.009$, $\eta_p^2 = 0.01$ (for means and standard errors see **Figure 2**). In line with the notion of the universality of emotion expression perception, a significant main effect of last picture expression, $F(2,1119) = 122.81$, $p < 0.001$, $\eta_p^2 = 0.18$, emerged such that across countries, anger expressions were rated as significantly more angry than sadness expressions, which were rated as significantly more angry than neutral expressions. The significant main effect of country, $F(3,1119) = 14.96$, $p < 0.001$, $\eta_p^2 = 0.04$, was qualified by a country × last picture expression interaction, $F(6,1119) = 4.77$, $p < 0.001$, $\eta_p^2 = 0.03$. Specifically, as predicted, *post hoc* tests revealed that anger expressions were rated as more intensely angry in Germany and Israel, which did not differ, than in Greece and the US, which also did not differ (H1).

Post hoc comparisons showed that expressions of sadness were rated as most intensely angry in Germany, followed by Greece, which differed only marginally ($p = 0.066$) from Germany and Israel ($p = 0.071$). Sadness expressions were rated as significantly less angry in both Israel and the US, which did not differ. Neutral expressions were rated as least angry in the US compared to Germany, Greece and Israel, which did not differ. The ratings in Germany did not differ from any other country.

In sum, as expected, anger was rated differently as a function of culture (H1) and whether anger was the focal emotion expression. Interestingly, German participants tended to perceive more anger in all three types of expressions. By contrast, participants from the US perceived generally less anger in all three expressions. Greek participants perceived less anger in angry expressions but relatively more anger in the non-angry expressions, suggesting that they perceive emotions as more mixed.

Are There Differences in the Perception of Sadness and Neutrality?

Sadness Intensity

To assess whether the four countries also differed with regard to their perception of sadness, a 4 (country) × 3 (emotion expressions in the last picture: Anger, Sad, Neutral) analysis of variance was conducted (for means and standard errors see **Figure 3**). Significant main effects of country, $F(3,1133) = 3.63$, $p = 0.013$, $\eta_p^2 = 0.01$, and last picture emotion, $F(2,1133) = 17.63$, $p < 0.001$, $\eta_p^2 = 0.03$, emerged such that, again in line with the notion of the universality of emotion perception, sadness expressions were rated as more sad than anger expressions and neutral expressions, which did not differ. Across expressions *post hoc* comparisons showed that Israeli and Greek participants, who did not differ, perceived more sadness than German and US participants, who also did not differ. The finding for Greek participants is congruent with the notion that individuals from countries high in uncertainty avoidance are more accurate in the perception of sadness (Schimmack, 1996), as Greece (100) is highest on this norm. Even though Israel (81) is lower in uncertainty avoidance than Greece it is still considerably higher than Germany (65) and the US (46, numbers refer to Hofstede, 2015), and this may explain the finding for Israel.

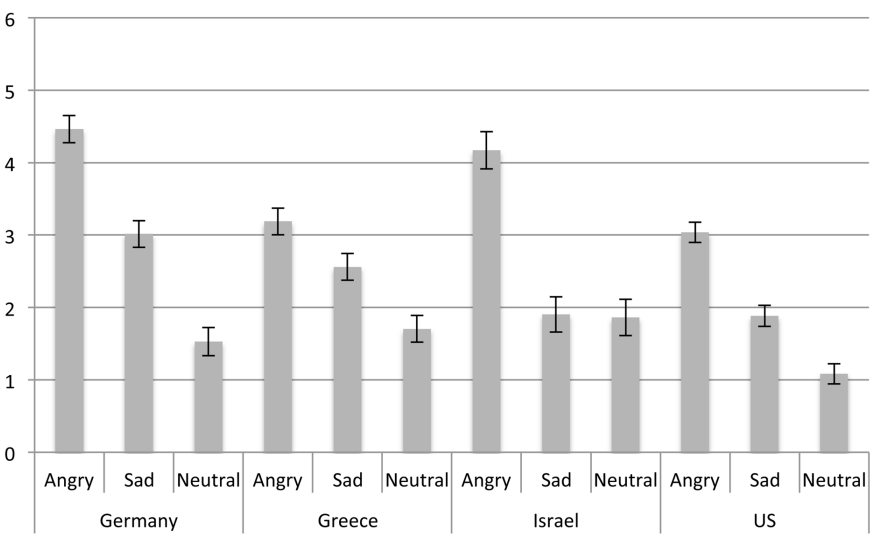

FIGURE 2 | Anger ratings as a function of emotion expression and country.

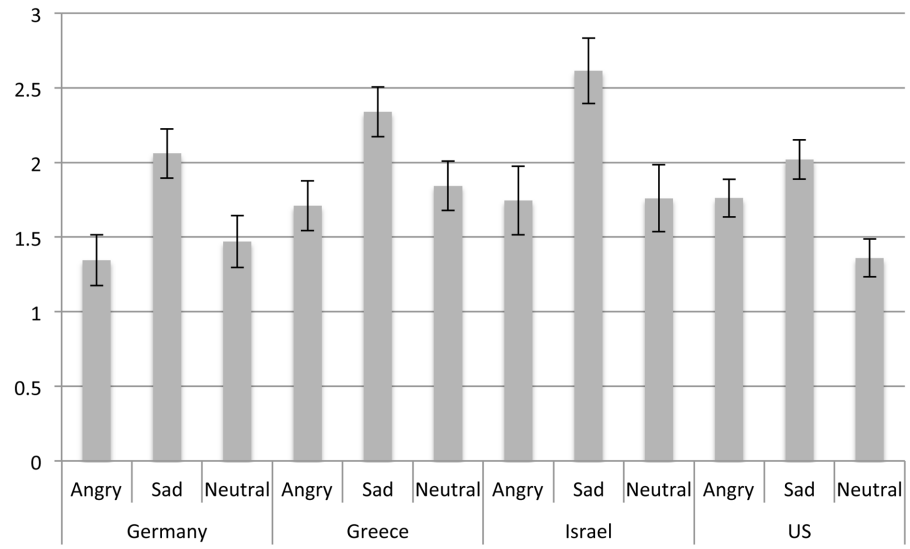

FIGURE 3 | Sadness ratings as a function of emotion expression and country.

Indifference Ratings

To assess whether the four countries also differed with regard to their perception of indifference, a 4 (country) × 3 (emotion expressions in the last picture: Anger, Sad, Neutral) analysis of variance was conducted (for means and standard errors see **Figure 4**). Significant main effects of last picture emotion emerged, $F(2,1133) = 68.87$, $p < 0.001$, $\eta_p^2 = 0.11$, such that neutral expressions were rated as expressing most indifference, followed by sadness and anger expressions, which were rated as least indifferent. The main effect of country, $F(3,1133) = 27.70$, $p < 0.001$, $\eta_p^2 = 0.07$, was qualified by a last picture emotion × country interaction, $F(6,1133) = 4.64$, $p < 0.001$, $\eta_p^2 = 0.02$, such that angry expressions were perceived as most indifferent in the US compared to Greece, Israel, and Germany, which did not differ. *Post hoc* comparisons showed that sadness expressions were also rated as most indifferent by participants from the US as well as least indifferent by Greek participants, with Israeli ($M = 2.29$, $SE = 0.25$) and German participants at intermediate levels. Finally, neutral expressions were rated as least indifferent by Greek participants compared to German, Israeli, and US participants, which did not differ.

Thus overall, participants from the US rated all expressions as indicating relatively high levels of indifference, which matches their lower ratings of anger and sadness across expressions.

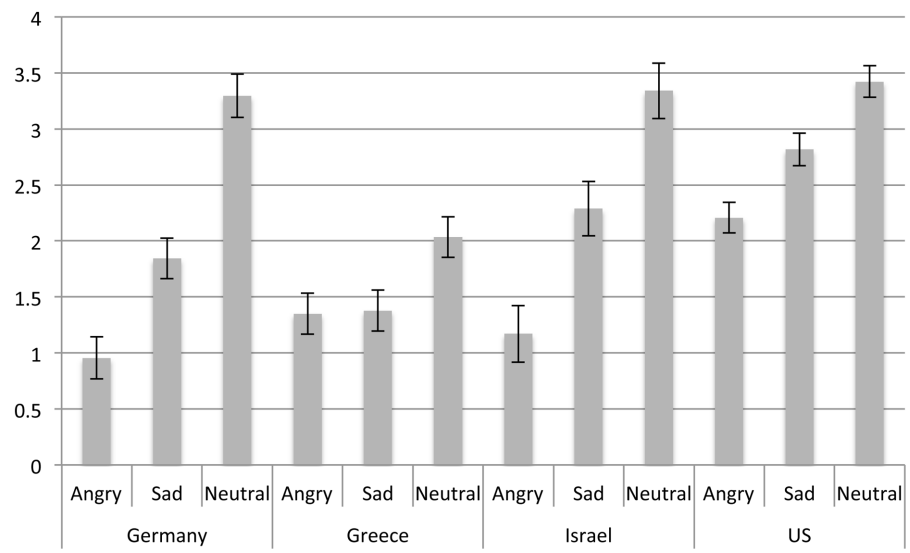

FIGURE 4 | Indifference ratings as a function of emotion expression and country.

By contrast, Greek participants rated expressions generally as showing less indifference, however, they tended to see relatively higher levels of sadness throughout. German participants rated in particular anger expressions as low in indifference, which matches their higher ratings of anger. Overall, Israeli participants tended to be most accurate in their perception.

Are There Differences in Norm Learning?

An open question assessed whether participants had spontaneously learned the tea drinking norm. Importantly, they were only asked how they or another person would act without any verbal hint toward a possible norm transgression. The 0 (inaccurate) −1 (accurate) codes were analyzed using a 4 (country) × 3 (emotion expressions in the last picture: Anger, Sad, Neutral) × 2 (normative hand position: first vs. second hands) × 2 (perspective: first vs. third person) between-subjects design.

Significant main effects of country, $F(3,1078) = 26.22$, $p < 0.001$, $\eta_p^2 = 0.07$, emotion, $F(2,1078) = 15.29$, $p < 0.001$, $\eta_p^2 = 0.03$, and normative hand position, $F(1,1078) = 46.15$, $p < 0.001$, $\eta_p^2 = 0.04$, were qualified by emotion by normative hand position, $F(2,1078) = 6.32$, $p = 0.002$, $\eta_p^2 = 0.01$, and emotion by country, $F(6,1078) = 2.44$, $p = 0.024$, $\eta_p^2 = 0.01$, interactions, respectively. Overall, *post hoc* comparisons showed that participants from Germany were most accurate ($M = 0.48$, $SE = 0.03$), and participants from Greece were least accurate ($M = 0.15$, $SE = 0.04$), with Israel ($M = 0.30$, $SE = 0.04$) and the US ($M = 0.29$, $SE = 0.02$), which did not differ, at intermediate levels (for means and standard errors see **Figure 5**).

Are There Differences in the Appraisal of Norm Violation?

We further assessed whether participants – even if they may not be accurate in reporting the actual norm – did nonetheless realize that a norm violation occurred. For this, we conducted a 4 (country) × 3 (emotion expressions in the last picture: Anger, Sad, Neutral) × 2 (normative hand position: first vs. second hands) × 2 (perspective: first vs. third person) analysis of variance on the appraisal of norm violation.

A significant main effect of emotion expression, $F(3,1097) = 56.98$, $p < 0.001$, $\eta_p^2 = 0.09$, emerged such that, overall and as expected, participants considered a norm violation to be most likely when the group had shown anger ($M = 3.82$, $SE = 0.11$), followed by sadness ($M = 3.17$, $SE = 0.11$), and finally neutrality ($M = 2.24$, $SE = 0.10$). This effect was qualified by an emotion expression by country interaction, $F(6,1097) = 3.19$, $p = 0.004$, $\eta_p^2 = 0.02$, such that this pattern emerged significantly for Germany, Israel and the US, whereas for Greece ratings for sadness and anger did not differ (see **Figure 6**).

Across countries the likelihood that a norm violation occurred also differed. A significant main effect of country emerged, $F(3,1097) = 11.70$, $p < 0.001$, $\eta_p^2 = 0.03$, such that this likelihood was considered lowest in the US ($M = 2.57$, $SE = 0.09$), compared to Germany ($M = 3.13$, $SE = 0.12$), Greece ($M = 3.26$, $SE = 0.11$ and Israel ($M = 3.35$, $SE = 0.15$), which did not differ in the *post hoc* comparisons. Thus, even though Greek participants were especially inaccurate in learning the norm, they were still aware of a norm violation. Notably though, for Greek participants both sadness and anger were equally good signals of norm violation. This finding and the finding that norm learning did not differ between anger and sadness conditions in the Greek sample support Hypothesis 3. This may point to the possibility that negative emotions have a different meaning in relational contexts in an interdependent country as suggested by Kafetsios et al. (under review). Greek participants were also, together with Israel, better at concluding that a norm violation had occurred based on statistical information only.

Are Differences in Norm Learning and Norm Violation Appraisal Mediated by Emotion Perception?

Hareli et al. (2013) found that participants were better at deducing the norm when the group showed anger in response

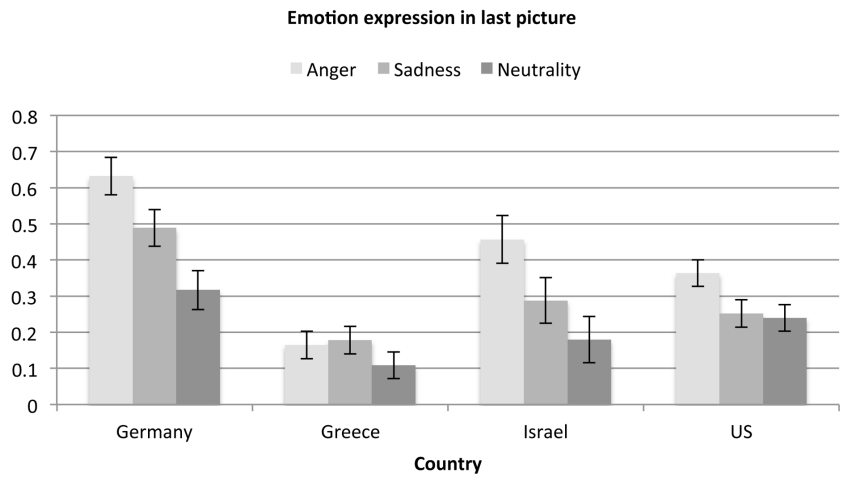

FIGURE 5 | Norm learning as a function of country and emotion expression in the last picture.

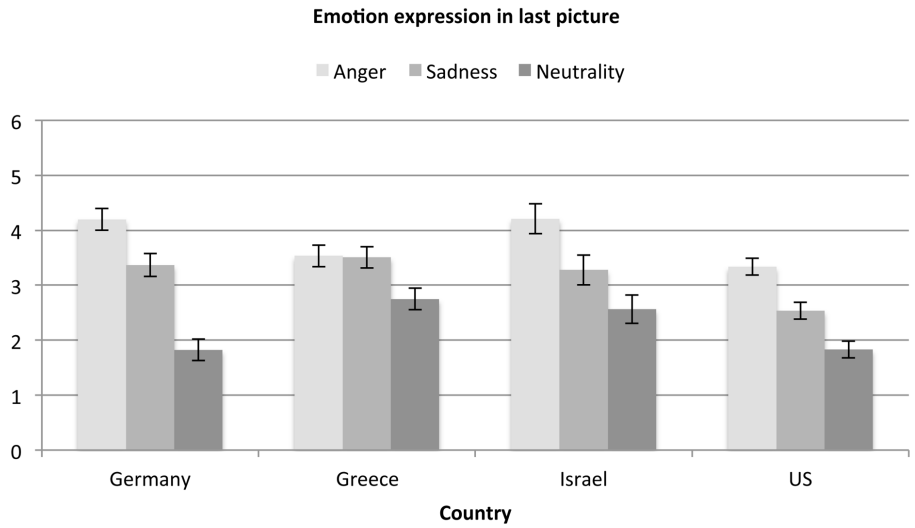

FIGURE 6 | Appraisal of norm violation as a function of country and emotion expression in the last picture.

to the norm violation, followed by sadness while least accuracy was predicted for neutral expressions. In the present study, this pattern emerged again for Israel and for Germany but only for Germany were all three conditions significantly different from each other. For Israel, anger led to a better rate of deducing the norm than did sadness or neutrality. Sadness, however, was not better than neutrality (see **Figure 5**). For Greece there was no difference in accuracy between anger and sadness, whereas for the US there was no difference between sadness and neutrality. This pattern largely matches the pattern of anger perception reported above. We therefore assessed whether accuracy was mediated through anger perception as predicted by Hypothesis 2.

To assess whether anger perception mediated both norm learning accuracy and the appraisal of norm violation (H2), we regressed these variables on the emotion ratings separately for each emotion expression condition as well as across emotion expression conditions with age as a covariate (see **Table 1**). Age was only significant for norm learning, such that older individuals learned the norms more readily when the individuals in the last picture showed either sadness or anger. When age was included as a covariate the beta for the effect of anger ratings on norm learning improved slightly. There was no effect of age on norm appraisal.

The same pattern of significant effects emerged for all conditions[2]. All models were significant for both norm learning accuracy and the appraisal of norm violation. Norm learning accuracy was significantly positively predicted by anger rating intensity and negatively by ratings of indifference but not by sadness ratings. The appraisal of norm violation was also positively predicted by anger intensity ratings and negatively by indifference ratings but also positively by sadness ratings.

[2]In one exception, indifference ratings did not significantly predict the appraisal of norm violation in the neutral emotion expression condition.

Together, these findings suggest that anger is a strong social signal of norm violation even for expressions that do not include anger as the focal emotion. Ratings of indifference are indicative of a perception of a lack of emotionality of the group. According to appraisal theories of emotion (e.g., Scherer, 1987), emotions are only elicited by events that are relevant to the emoter. Hence, when the group seemed indifferent, participants were more likely to conclude that nothing noteworthy had happened, which explains why these ratings are negatively related to perceptions of norm violation and norm learning accuracy. Interestingly, sadness intensity ratings only significantly predicted the appraisal of norm violation but not norm learning accuracy. This is supportive of the notion that an appraisal of goal obstruction/ unpleasantness as indexed by sadness is a sign that something is wrong, but is less indicative of what exactly is wrong.

Does Taking a First Person Perspective Increase Norm Learning and Appraisals of Norm Violation?

A significant main effect of perspective, $F(1,1078) = 6.43$, $p = 0.011$, $\eta_p^2 = 0.01$, emerged for norm learning, such that across conditions and countries, participants' descriptions were more accurate when the first person perspective was adopted ($M = 0.34$, $SE = 0.02$), then when the third person perspective was used ($M = 0.27$, $SE = 0.02$), confirming the notion that personal relevance increases norm learning. As for norm learning, a significant main effect of perspective emerged for norm violation appraisals as well, $F(1,1097) = 6.90$, $p = 0.009$, $\eta_p^2 = 0.01$. Specifically, participants considered it more likely that a norm violation had occurred when they adopted a first person perspective ($M = 3.34$, $SE = 0.08$ vs. $M = 2.92$, $SE = 0.09$) suggesting that personal relevance also increases the awareness of a norm violation. Together these findings suggest that participants paid

TABLE 1 | Significance levels and βs as a function for last picture emotion expression as a function of expression condition.

				β			
	F	***p***	r^2	**Anger**	**Sadness**	**Neutrality**	**Age**
Overall							
Norm learning accuracy	41.97	0.001	0.13	0.35***	−0.04 (ns)	−0.06*	0.09***
Appraisal of norm violation	295.21	0.001	0.51	0.56***	0.17***	−0.17***	−0.04^t
Anger in last picture							
Norm learning accuracy	20.10	0.001	0.18	0.36***	0.01 (ns)	−0.13*	0.11*
Appraisal of norm violation	85.45	0.001	0.48	0.59***	0.11**	−0.16***	−0.03 (ns)
Sadness in last picture							
Norm learning accuracy	16.95	0.001	0.16	0.35***	0.04 (ns)	−0.15**	0.17***
Appraisal of norm violation	95.57	0.001	0.51	0.52***	0.18***	−0.23***	−0.05 (ns)
Neutrality in last picture							
Norm learning accuracy	3.11	0.016	0.03	0.19*	0.02 (ns)	0.08 (ns)	0.03 (ns)
Appraisal of norm violation	65.65	0.001	0.42	0.39***	0.29***	−0.07 (ns)	−0.05(ns)

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

more attention when the task was made personally relevant to them (H4).

Does the Salience of the Hand Position Impact on Norm Learning and Appraisals of Norm Violation?

We had predicted that the norm violation would be more salient when the norm describes a hand position that varies from the culturally normative hand position. This, because culturally normative behavior is generally unremarkable (Miller and Prentice, 1996). Given that the situation has a certain level of complexity, it is more likely that the culturally "deviant" hand position would be salient to the observer and hence the switch to the other hand position would be more noticeable. As such, participants should be better at using simple statistical information when the normative behavior deviates from the cultural norm of drinking tea from a cup held one-handedly rather than two-handedly. In fact, participants were overall better at learning the norm when the norm was to hold the cup with both hands ($M = 0.40$, $SE = 0.20$) rather than one hand ($M = 0.21$, $SE = 0.02$). As expected, no significant difference as a function of normative hand position emerged for the anger expression condition, $t(373) = 1.77$, $p = 0.078$, $d = 0.18$. By contrast, for both the sadness, $t(375) = 6.84$, $p < 0.001$, $d = 0.71$, and neutral conditions, $t(372) = 3.66$, $p < 0.001$, $d = 0.38$, participants were better when the norm involved both hands (see **Figure 7**), thus, for the two conditions in which participants were overall less accurate, the cultural normativeness of the hand position made a difference, however, this difference was larger for sadness than for neutrality. For appraisals of norm violation, by contrast, the main effect of normative hand position was not significant, $F(1,1097) = 1.57$, $p = 0.211$, $\eta_p^2 = 0.00$, suggesting that the salience of the hand position did not tip participants off as to whether a norm violation had occurred. In sum, the culturally normative hand position was most effective as a cue when participants were trying to understand the exact norm and onlookers did not show anger.

General Discussion

The present study was conducted to assess the role of emotion expressions as social signals of norm violation in a cross-cultural context. Because anger expressions are based on an appraisal of norm violation, we had predicted that anger is a powerful signal of norm violation (H2). Yet, cross-cultural research suggests that the perception of anger varies with cultural norms and decoding rules (e.g., Grandey et al., 2010; Koopmann-Holm and Matsumoto, 2011; Hess and Hareli, 2014). More recent research also suggests that emotions may vary in their social-relational meaning between independent and interdependent cultures (Kafetsios et al., under review). These considerations allow for the possibility that the social signal value of anger expressions varies with culture. This can be either as a function of cultural differences in emotion perception, based on display/decoding rules, or as a function of a differential use of emotions in different cultures. The present research provides evidence for both notions.

First, even though across the four cultures clear evidence for the universality of emotion perception emerged, in that anger expressions were rated as most angry, sadness expressions as most sad, and neutral expression as most indifferent, there were nonetheless substantial between-culture differences in emotion ratings (H1). In particular, German participants were especially prone to perceive anger, whereas Greek participants were more likely to perceive sadness, replicating observations by Hess et al. (in press). Also, participants from the US were more likely to perceive the expressers as indifferent. These findings suggest that members of different cultures are differentially sensitive to specific emotions. At the same time, Israeli participants overall differentiated best between the three types of expressions, which may reflect an in-group advantage (Elfenbein et al., 2007) as the expressions were created in Israel.

Importantly, and as expected, these cultural differences in emotion perception predicted cultural differences in norm learning accuracy and appraisals of norm violation (H2).

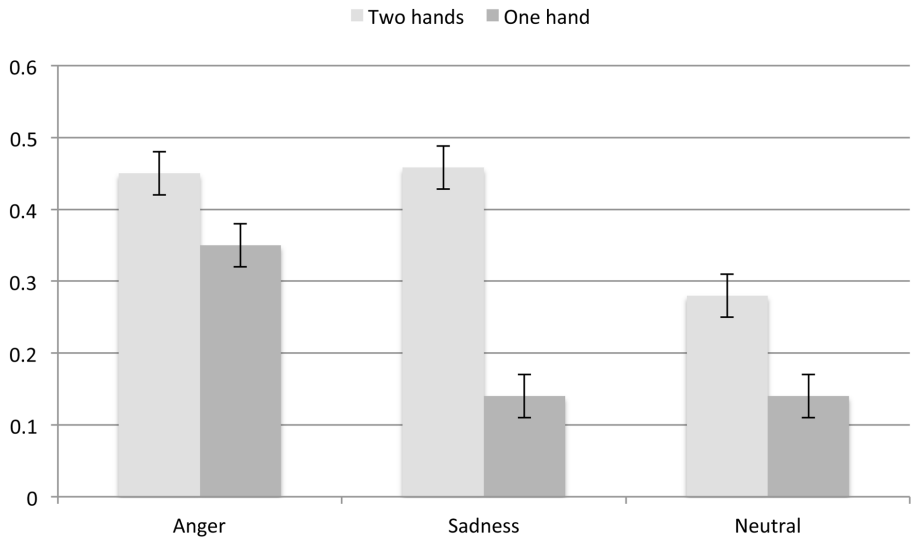

FIGURE 7 | Norm learning as a function of hand position and emotion expression in the last picture.

Specifically, across all emotion expression conditions, ratings of anger were positive and ratings of indifference were negative predictors of both norm learning accuracy and appraisals of norm violation. That is, independent of whether the expressions were angry, sad, or neutral, participants were more likely to learn the norm and perceive the norm violation, to the degree that they considered the expression as showing anger. As such, anger was found to be a potent signal of norm violation not only when shown as a focal emotion, but also to the degree that it was detected within other emotion expressions. Consequently, in cultures in which social norms are more lenient with regard to the expression of anger (Germany and Israel) participants were more likely to describe a norm accurately and appraise the situation as likely to involve a norm violation, when the group reacted with anger to the norm violation.

Appraisals of norm violation, but not norm learning, were also predicted by ratings of sadness, however, the effect was notably weaker. This suggests that an expression linked to an appraisal of goal obstruction/unpleasantness, which signals that something undesirable has happened can, in the right context, be a signal of norm violation as well, yet a less powerful one. Notably, Greek participants, who perceived anger to a lesser degree and sadness to a higher degree than members of the other cultures, were better at using sadness as a sign of a likely norm violation, but not for norm learning. As such, they were aware that a norm was violated but not why. US participants by contrast seemed to be better able to use statistical information for norm learning.

Two additional factors had been varied, normative hand position and the perspective that the participants were asked to assume. Even though the effect of hand position did not reach statistical significance in the study by Hareli et al. (2013), the pattern of means was suggestive of such an effect. In fact, common sense suggests that a behavior that violates a cultural norm (such as the polite way of holding a teacup) is more salient than a behavior that conforms to the norm, which in fact may be invisible to the casual observer (Miller and Prentice, 1996). Thus, it may be expected that group norm effects interact with cultural norms, such that a group norm that conflicts with the cultural expectations for proper behavior is more readily apparent and learned more easily. This was indeed the case but notably only for behaviors that were reacted to with sadness or neutrality. That is, when a behavior was reacted to with anger, participants were not advantaged by the additional salience of the behavior. This suggests that seeing anger is a sufficiently clear signal that observers are able to recreate the scene in their mind to a degree that allows them to describe the group norm even when it is not salient. Interestingly, the salience of the behavior was most effective for expressions reacted to with sadness. As sadness signals that something is wrong, salience may be what is needed to figure out what it is that is wrong. This role of salience is also supported by the fact that emotion expression and hand position combine to affect norm learning but not the appraisal of norm violation, which can be made based on the emotion expression information alone.

Finally, we also varied whether participants adopted a first or a third person perspective when describing the norm. For both norm learning and the appraisal of norm violation, a main effect of perspective emerged. As no interaction effects were found, this seems to simply suggest that participants paid more attention when the task was made more personally relevant by adopting a first person perspective. This suggests that apart from the factors noted above, motivation is also a significant factor in norm understanding (H4).

This factor also seems to play a role in understanding why German participants were especially good, across conditions, at norm learning. This difference cannot be explained by emotion rating tendencies alone as these were not very different between Israel and Germany. However, it has been suggested and demonstrated that members of different cultures are in fact differentially sensitive to norms. Gelfand et al. (2011)

distinguishes between "tight" cultures, which have strong norms and a low tolerance for deviant behavior and "loose" cultures, which have weak norms and a high tolerance for deviant behavior. The expectation is that members of tighter cultures should be more concerned about behaving according to norms and more concerned about social sanctioning because of the lower tolerance by tight cultures for deviance (Gelfand et al., 2006). As Germany is higher in cultural tightness than the other three countries in our study (Gelfand et al., 2011), it is thus likely that German participants were especially sensitive to the norm violation as well as more motivated to learn the correct norm.

The study had some limitations. Notably, the samples varied somewhat in age and gender composition. However, when gender was used as a covariate it was not significant. Even though gender differences in emotion recognition accuracy are frequently reported, they are not always found. In fact, research in this domain has also pointed to strong motivational effects as underlying the observed gender differences in recognition accuracy (Ickes et al., 2000). As only one image had to be rated, it may well be that gender was less influential. By contrast, age was found to influence emotion perception for anger such that older participants tended to rate all images as less angry. The effect was rather weak, but is noteworthy as only 1% of the participants was over 60 and hence the age of our participants was within a range where differences in emotion perception accuracy have not been previously reported. However, the task here regards the sensitivity to anger, that is, the intensity with which anger was perceived and not the question of whether anger was mislabelled, which is the focus of most emotion recognition studies. Nonetheless, when age was included as a covariate, the effect of anger on norm learning was slightly higher and no effect on norm appraisal was found.

Participants in the present study were asked to assume to want to join the group. It is interesting to speculate on the effect of anger expressions by group members in reaction to a norm violation on that motivation. Thus, Heerdink et al. (2013) found that group members whose opinions deviated from a group felt rejected when the group reacted with anger. This finding suggests that even though anger expressions are helpful in facilitating people's integration into a group by allowing them to learn the relevant group norms, they may do so at a cost. This is a question for future research.

In sum, the present study showed that across cultures anger is a potent signal for norm violation. However, whether this signal is used to its full extent depends on the observers' culturally determined sensitivity to anger expressions and the culturally determined use of such expressions. In this sense, the present research demonstrates both cultural universality and cultural differences. Thus, in the terms of Norenzayan and Heine (2005) the use of anger as a signal of norm violation is a functional universal, in that anger perception is a cognitive tool found in all cultures that serves the same function in all cultures, but is used to different degrees in different cultures. In this vein, the present research also underlines the importance of considering both universality and cultural variation when studying emotions. The strong impact of social norms and values on the perception of emotion is congruent with appraisal theory of emotion, which sees emotions determined by such rules and norms. It is therefore only logical that their perception is also influenced by such rules and norms. Focussing exclusively on universality ignores this basic fact but focusing exclusively on cultural variation ignores the existence of basic cognitive tools that all humans dispose of – but simply may use to different extends.

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