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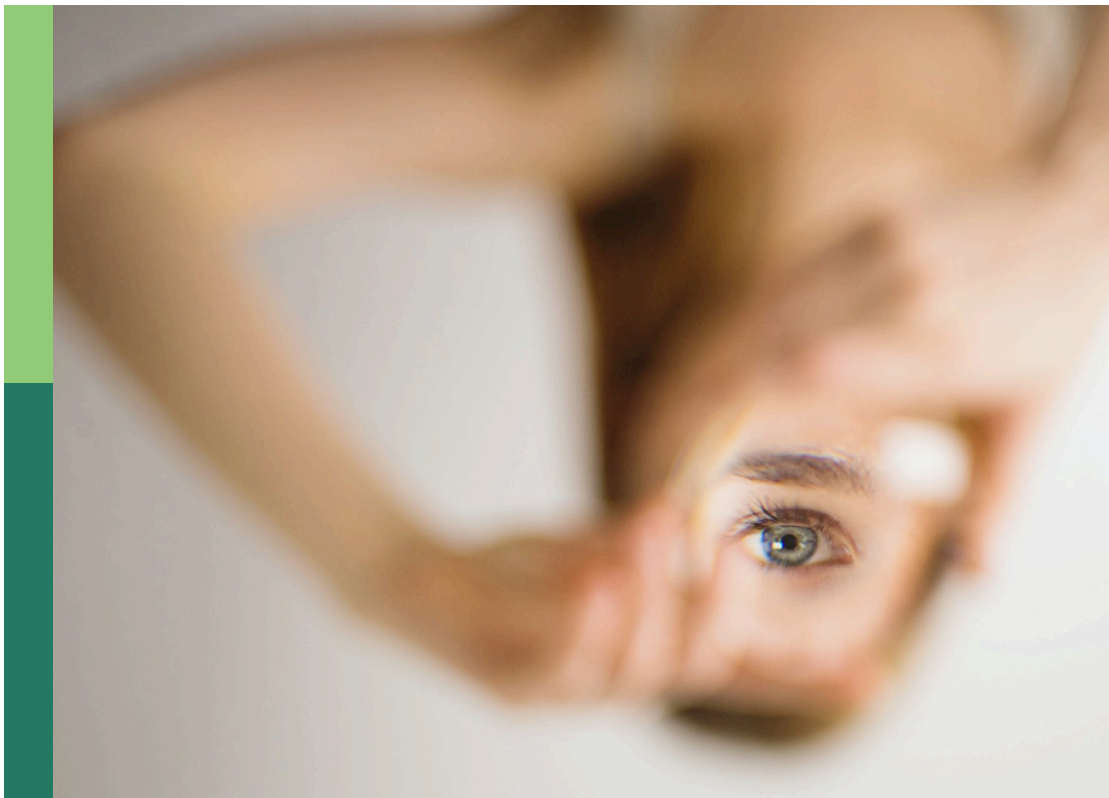
Integrative perspectives on the person-context interplay through the lens of temperament

Edited by
Hedwig Teglasi, Samuel P. Putnam and Mirjana Majdandzic

Published in
Frontiers in Psychology



ISSN 1664-8714
ISBN 978-2-83251-946-2
DOI 10.3389/978-2-83251-946-2

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Integrative perspectives on the person-context interplay through the lens of temperament

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Citation

Teglasi, H., Putnam, S. P., Majdandzic, M., eds. (2023). *Integrative perspectives on the person-context interplay through the lens of temperament*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-83251-946-2

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frontiers | Frontiers in Psychology

TYPE Editorial
PUBLISHED 03 March 2023
DOI 10.3389/fpsyg.2023.1156267

OPEN ACCESS

EDITED AND REVIEWED BY
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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 01 February 2023
ACCEPTED 20 February 2023
PUBLISHED 03 March 2023

CITATION
Teglasi H, Putnam SP and Majdandžić M (2023) Editorial: Integrative perspectives on the person-context interplay through the lens of temperament. *Front. Psychol.* 14:1156267. doi: 10.3389/fpsyg.2023.1156267

Editorial: Integrative perspectives on the person-context interplay through the lens of temperament

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KEYWORDS

temperament, *goodness-of-fit*, person-context dynamics, children, bidirectional, personality, individual differences, emotional development

Editorial on the Research Topic
Integrative perspectives on the person-context interplay through the lens of temperament

Temperament is accorded a prominent role in psychology as the biologically-based mechanism by which individuals contribute to their own learning and development, distinct from, but related to, higher-order personality traits involving specific thoughts, values, and conceptions of self, others, and the world (e.g., Henderson and Wachs, 2007). Certain dispositional traits confer vulnerability to adverse outcomes, in part by influencing the "*goodness-of-fit*" between the individual and the surroundings. The role of temperament in the "fit" is complex, involving multiple interrelated layers in the person-context dynamic. Cascade models of development posit that early appearing risk factors are magnified over time because processes that shape children's functioning in one domain progressively influence functioning in other domains (Masten and Cicchetti, 2010). Accordingly, temperamental tendencies that increase risk for maladaptive transactions with the surroundings not only undermine *goodness-of-fit* in the moment, but may also disrupt longer term wellbeing. Temperament plays a role in shaping both overt transactions with the environment and the self-organizing processes of learning from experience, which eventuate in understandings that inform subsequent transactions (e.g., Verron and Teglasi, 2018).

In addressing various aspects of the person-context interplay, the studies in this Research Topic contribute to its overall aim of promoting integrative perspectives on *goodness-of-fit* as involving three layers of transaction between person and context. The person-in-context layer involves moment-to-moment transactions between the individual and the surroundings. Person-as-context encompasses self-organizing processes within the individual, including the interplay of multiple temperamental traits and the cognitive/affective processes that jointly shape what is learned. The assumptions and understandings gained from prior self-organizing processes function as pre-conceptions that influence current responses, referring to person-of-prior-context.

Person-in-context

Temperament comprises inborn proclivities to respond in certain ways to one's surroundings that, in turn, elicit responses from others, giving rise to reciprocal patterns

of transactions. Although temperament is characterized as relatively consistent across time and situations (see Rothbart and Bates, 2006), the *goodness-of-fit* concept implies context as an elicitor of temperamental tendencies.

Certain temperamental tendencies, such as behavioral inhibition, are more salient in some contexts than in others and may be more precisely understood in relation to features of the context. In this Research Topic, Zhou et al. identified three subtypes of fearful temperament that corresponded to situational elicitors (i.e., threat level) and differed in their associations with later anxiety problems, especially in boys. Preschoolers' negative affective reactivity made a unique contribution to social functioning in novel but not in routine contexts, whereas effortful control made a unique contribution to functioning in routine but not novel contexts (Vaughan and Teglasi).

The responses of others (parents, teachers, peers) to the child's individuality are key aspects of the child's context that may enhance or impede the "fit," moderating and mediating the effects of temperamental risk on developmental outcomes. In this Research Topic, parenting mediated the links between temperament and externalizing problems of children referred with conduct problems (with moderation by sex; Garon-Carrier et al.), and the quality of the teacher-student relationship during preschool moderated the link between temperament and internalizing problems (Susa-Erdogan et al.).

Goodness-of-fit is increasingly recognized as the product of bidirectional transactions such as those between broad societal influences and temperamental individuality. Investigated within and across 14 cultures (Pham et al.), bedtime parenting practices (i.e., active and passive sleep-supporting techniques) were related to both cultural context and toddler temperament. The dynamic nature of parent-child exchanges over time is captured in studies that model reciprocal influences longitudinally. Even before a child is born, parents have expectations that, along with the child's actual characteristics, have been found to shape parent-child transactions (Van den Akker et al.). Underscoring long-term bidirectional influences, Tan and Smith found that child negative affectivity influenced maternal expression of negative emotions and that maternal negative expressivity influenced child negative affectivity, but only in specific age periods. Finally, investigating reciprocal relations between child temperament and engagement with contextual stimuli, Fitzpatrick et al. demonstrated that toddler screen media intake predicted subsequent lower effortful control, but not vice versa.

Person-as-context

Individuals are endowed with multiple temperamental dispositions, and others respond to the whole child, not to isolated traits. For these reasons, there is increasing appreciation of *person-centric* research, the child as context. Using latent profile analysis of teacher-rated child temperament, Martin and Lease found that the configuration of temperamental traits of a particular child (person-as-context) was associated with other children's perceptions of their influence on peers in school and with socially relevant attributes (person-of-prior context), and that temperament profiles associated differently with peer influence depending on the school community (person-in-context).

Though understudied, the role of temperament on *goodness-of-fit* is augmented through its relations with the self-organizing processes by which the individual makes sense of, and learns from, experiential "data." For example, young children's emotional tendencies were related, over time, to how they processed social information (Davies et al., 2020). In this Research Topic, Zdebik et al. investigated uncertainty intolerance as an aspect of social information processing arising from both temperament and attachment, and found that uncertainty intolerance mediated the relation between behavioral inhibition in childhood and adult generalized anxiety disorder. Over time, self-organizing processes eventuate in pre-conceptions (e.g., cause-effect connections; assumptions, understandings) that subsequently inform transactions and self-organization. Smith et al. considered the multiple interactive influences of cognitive/affective experiences within adolescents, where temperament moderated the effects of appraisal and coping on psychopathology. In these ways, temperament individualizes the "raw data" of experience not only by eliciting responses from others but also by shaping the organization of the subjective world (Teglasi and Epstein, 1998).

Person-of-prior-context

Pre-conceptions, consolidated through prior self-organizing processes take on a life of their own, influencing subsequent responses and, by extension, *goodness-of-fit*. For example, children's understanding that beliefs drive actions (theory of mind) correlated with the effectiveness of their social behavior (Teglasi et al., 2022). In this Research Topic, the finding that uncertainty intolerance, which shapes information processing, mediated the relation between child temperament and adult outcomes (Zdebik et al.) speaks to the role of prior information processing (person-as-context) on subsequent wellbeing (person-of-prior context). The study of Smith et al. also alludes to the person-of-prior-context perspective because coping and appraisal are products of the synthesis of prior transactions.

To fully unpack the factors influencing *goodness-of-fit* at any particular time in development, it is necessary to consider current transactions (*in context*), the intra-individual dynamic, including self-organization (*as context*), and the impact of prior understandings and temperament on both the transactions and self-organizing processes (*of context*). The studies in this Research Topic support a dynamic conception of *goodness-of-fit* as encompassing an ongoing interplay among temperament, pre-conceptions, context, and self-organizing processes that accommodates the complexities of temperament-informed assessment and interventions across the age span.

Author contributions

HT drafted the editorial which was informed by discussion among the authors. SP and MM provided feedback. All

authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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ORIGINAL RESEARCH
published: 17 May 2022
doi: 10.3389/fpsyg.2022.874733

Maternal Functioning and Child's Externalizing Problems: Temperament and Sex-Based Driven Effects

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This study examines how maternal adverse parenting (hostility, neglect, low warmth) and psychological distress explain the associations between child temperament factors and externalizing problems. It also examines if these associations differ according to the child's biological sex. The sample consists of 339 school-age children receiving in-school services for conduct problems. Data were collected through questionnaires completed by mothers at 3 time points, at one-year intervals. Results from path analyses revealed that maternal psychological distress partly explained the associations between each child temperamental factors (negative affectivity, surgency/extraversion, effortful control) and levels of externalizing problems. Specifically, the indirect effect of psychological distress between child negative affectivity and externalizing problems was only significant for boys, not girls. Maternal hostility, on the other hand, mediated the association between child surgency/extraversion and externalizing problems in both boys and girls. Interestingly, neglectful parenting and maternal warmth did not explain the association between child temperamental factors and externalizing problems. The findings suggest small but significant temperament child-driven effects on maternal psychological distress and hostility, in turn, translating into higher levels of externalizing problems. These findings support the relevance of temperament-based interventions for children with conduct problems and of increased mental health support for their mothers. By aiding mothers in developing a larger repertoire of parenting strategies, mothers may be better equipped to respond appropriately to their child's various temperamental characteristics, hence, reducing their psychological distress and hostile behaviors and limiting the development of child externalizing problems.

Keywords: psychological distress, neglect, hostility, warmth, temperament, sex differences, externalizing problems

OPEN ACCESS

Edited by:
Samuel P. Putnam,
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Reviewed by:
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Specialty section:
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

Received: *12 February 2022*
Accepted: *19 April 2022*
Published: *17 May 2022*

Citation:
Garon-Carrier G, Pascuzzo K, Gaudreau W, Lemelin J-P and Déry M (2022) Maternal Functioning and Child's Externalizing Problems: Temperament and Sex-Based Driven Effects. Front. Psychol. 13:874733. doi: 10.3389/fpsyg.2022.874733

INTRODUCTION

Children exhibiting externalizing problems, characterized by non-compliance to rules and aggression, represent the majority of referrals to elementary school-based mental health services (Burnett-Zeigler and Lyons, 2012; Briesch et al., 2013). In the US, the prevalence of children with externalizing problems ranges between 1% and 10%, with longitudinal and epidemiological

studies consistently showing a greater proportion of boys than girls displaying such behaviors (Berkout et al., 2011; American Psychiatric Association., 2013). These children often experience chronic difficulties in both academic and social domains (Deighton et al., 2018), which evolve into more severe problems in the absence of intervention, including juvenile delinquency and adult crime (Wertz et al., 2018).

In an effort to prevent the development of these behaviors, many scholars have investigated the child-context interplay leading to externalizing problems. An approach that has received great attention over the last decade and has guided research on this dynamic interplay is the transactional perspective (Sameroff, 2009). Central to this perspective is the bidirectional and interdependent association between children and their social context. To guide our understanding of the link between child temperamental factors and the parenting context, this perspective would suggest that a child with a higher level of irritability could elicit lower levels of maternal warmth, which would subsequently lead to increased child externalizing problems.

Another theoretical perspective focusing on the child-context interplay to understand the development of externalizing problems is the differential susceptibility model to environmental influences (Belsky, 2013; Slagt et al., 2016). According to this model, specific dispositional traits could place children at greater risk for negative outcomes when confronted with poorer parenting. Conversely, these same traits could enhance adaptation under positive parenting circumstances. This model has received empirical support, showing differential susceptibility to externalizing behavior at age 12 among children presenting negative affectivity, depending on parenting quality (Stoltz et al., 2017).

Stemming from the transactional (Sameroff, 2009) and the differential susceptibility (Belsky, 2013) perspectives, the present study focuses on child-context interplay leading to externalizing problems. More specifically, we sought to examine how child temperamental factors (individual dispositional traits) are associated with adverse maternal parenting (hostility, neglect, low warmth) and psychological distress (family-wide context) and explain child levels of externalizing problems.

Child Temperament as Dispositional Traits to Externalizing Problems

Child temperament refers to individual differences in reactivity as expressed at the emotional, attentional, and motor levels (negative affectivity, surgency/extraversion), and in the ability to regulate reactivity (effortful control) (Putnam and Stifter, 2008; Rothbart, 2012). These individual differences emerge early in children's lives, have a biological base, and are relatively stable across time and contexts (Rothbart, 2012). Negative affectivity is the child's tendency to react to new, unpleasant or potentially threatening situations with various negative emotions (e.g., fear, anger, sadness), and to be difficult to soothe. Surgency/extraversion reflects the child's levels of sociability, impulsivity and activity, as well as their propensity to seek sensations. Lastly, effortful control refers to the child's ability to focus attention and inhibit inappropriate behaviors.

Studies have consistently and reliably shown that children presenting temperamental vulnerability for psychopathology, characterized by high negative affectivity and surgency/extraversion and low effortful control, are at greater risk of externalizing problems (Nielsen et al., 2019). For instance, higher surgency and negative affectivity, such as anger proneness, have been associated with an increased risk for externalizing behaviors (Scheper et al., 2017; Sirois et al., 2019). Effortful control also plays a role in shaping both externalizing and internalizing problems (Scheper et al., 2017), with stronger associations reported for externalizing difficulties (Liu et al., 2020). Moreover, sex differences in temperamental characteristics revealed that girls are less likely to present temperamental susceptibility to externalizing problems. Based on the findings of a meta-analytic review, girls exhibit higher levels of regulatory ability than boys (Else-Quest et al., 2006), which could partly explain the lower prevalence of externalizing problems among girls than boys.

Parenting as Contextual Factors to Externalizing Problems

Parenting behaviors such as maternal hostility, physical and emotional neglect, low levels of warmth/sensitivity, and psychological distress (e.g., anxiety, depressive symptoms) have been consistently associated with child externalizing problems, and to a lesser extent, with child internalizing problems (Pinquart, 2017; Hecker et al., 2019; Bellina et al., 2020; Khoury et al., 2021; Yan et al., 2021). Indeed, hostile parenting and psychological distress have been more systematically linked with externalizing problems compared to internalizing problems (Stone et al., 2016; Khoury et al., 2021; Yan et al., 2021). Research underscoring the interlock between maternal psychological distress and child externalizing problems (Yan et al., 2021) suggests that maternal psychological distress is associated with more erratic and unpredictable parenting behaviors (Dubois-Comtois et al., 2013), which could amplify child externalizing problems. As for hostile parenting, it has been more strongly associated with externalizing problems compared to neglect or low warmth/sensitivity (Pinquart, 2017; Khoury et al., 2021). Some studies have also revealed sex-based differences, showing hostile parenting and psychological distress to predict greater externalizing problems for girls, but not for boys (e.g., Burnette et al., 2012). Other studies, however, provide no such evidence (e.g., Yan et al., 2021).

Child Temperament as a Predictor of Parenting: A Child-Driven Perspective

Child temperamental factors are known predictors of parenting behaviors (Liu et al., 2020). Parents' capacity to manage the child's temper may be undermined in two ways when confronted with a child presenting difficulties in regulating behaviors and emotions. First, the parent may exhibit adverse parenting including hostility and coercion (Silinskas et al., 2015), and lower warmth/sensitivity toward the child (Harvey and Metcalfe, 2012). Second, the parent may exhibit greater psychological distress resulting in increased stress and depressive symptoms (Choe et al., 2014).

These findings support the view that child temperament may act as a dual risk factor for adverse parenting and psychological distress. It also suggests that child temperament, as a child-driven effect, could predict externalizing problems through its effects on parenting. Indeed temperament has been shown to have direct effects on the development of externalizing problems (Scheper et al., 2017; Nielsen et al., 2019; Sirois et al., 2019), but also indirect effects through selection or structuring of the environment, eliciting different patterns of parenting (Liu et al., 2020). By ignoring this potential child-driven effect, the impact of adverse parenting and psychological distress on child externalizing problems might have been overestimated in previous studies, at least to some extent.

This study investigates the transactional associations by which maternal hostility, neglect, warmth, and psychological distress explain the association between child temperament factors and levels of externalizing problems. Given that parenting variables (hostility, neglect, and warmth) include a relational dimension with the child, whereas psychological distress is person specific, maternal adverse parenting variables and maternal distress were treated separately in this study. This choice was further guided by recent findings underscoring that parenting and psychological distress are distinctively linked to child adaptation (Khoury et al., 2021).

Based on prior research, we expect that high reactivity and low regulatory abilities will be associated with more adverse parenting and psychological distress. We also expect maternal adverse parenting (especially hostility) and psychological distress to mediate the associations between child temperamental factors and externalizing problems. This study also tests the differential susceptibility of boys and girls to elicit adverse maternal parenting and psychological distress, by examining if the sex of the child moderates the associations between temperamental factors and adverse parenting and distress in the prediction of externalizing problems. Considering that girls are less likely than boys to present temperamental risk for externalizing problems (Else-Quest et al., 2006), variations in the propensity to elicit specific parenting behaviors are expected. At last, the current study seeks to expand the current state of knowledge by examining these mediational effects among a clinically relevant population of boys and girls with conduct problems. While most studies have drawn conclusions from children in the general population (e.g., Nielsen et al., 2019), this study rests on an early-onset clinical sample of school-aged children and overcomes limitations of sex-based differences in the prevalence of externalizing problems among children.

METHODS

Participants

Participants were part of an ongoing longitudinal study aiming to understand the development, persistence, and consequences of conduct problems throughout childhood and adolescence as a function of child sex/gender ($N = 744$). Children under the age of 10 years (with and without conduct problems) were recruited in three cohorts with the help of eight French-speaking school boards from four administrative regions in the province of Quebec (Estrie, Montérégie, Montréal, and Capitale-Nationale) in Canada between 2008 and 2010.

The recruitment process targeted children receiving psychosocial services for conduct problems in public schools. This is considered an ecologically valid method of recruitment since 95% of children in Quebec attend public elementary schools (Government of Quebec, 2013), and only children with a formal assessment of conduct problems by professionals (e.g., school psychologists) can receive psychosocial services in school. Additionally, children had to reach the borderline clinical cut-off (T-score ≥ 65) on the DSM-oriented scales for conduct problems and oppositional defiant problems (Achenbach and Rescorla, 2001) based on parent and teacher reports. Children with an intellectual or sensory disability or a pervasive developmental disorder, as indicated by an administrative code informing on whether the child received a formal diagnosis, were excluded from the study. To ensure an equal proportion of participating boys and girls with conduct problems, all girls receiving services at school for conduct problems and approximately one out of four boys receiving these services (randomly selected) were recruited to participate in the study ($n = 339$; 41.0% of girls). Further details on the recruitment and procedure of this longitudinal study can be found in Boutin et al. (2020).

The current study draws on data collected from children with conduct problems assessed yearly over a 3-year period reflecting three waves of data collection: T1 ($n = 339$), T2 ($n = 311$) and T3 ($n = 308$). The proportion of missing data ranged from 0.1% to 9.1%, with a low yearly attrition rate of 3.0% across the three-time points. Missing data were examined with the Missing Value Analysis module in SPSS. According to Little's missing completely at random (MCAR) test, data were missing completely at random ($\chi^2 = 93.79$, df = 82, $p = 0.176$), suggesting that children did not differ according to whether they had missing data or not.

Procedure

Data were collected through questionnaires reported by mothers prior to the COVID-19 pandemic. All the questionnaires were administered in French. Child temperament was measured at T1 ($M = 8.50$, $SD = 0.93$), maternal adverse parenting and psychological distress were assessed at T2 ($M = 9.41$, $SD = 0.96$) and child level of externalizing problems was collected at T3 ($M = 10.38$, $SD = 0.94$). All covariates were also measured through questionnaire at T1.

Measures

Child Externalizing Problems

Externalizing behaviors were assessed using the rule-breaking behaviors scale (e.g., "steals outside the home") and the aggressive behaviors scale (e.g., "cruelty, bullying, or meanness") of the Child Behavior Checklist (CBCL/6-18; Achenbach and Rescorla, 2001). We used a French-Canadian translation of the CBCL/6-18, along with the original norms and standards (Achenbach et al., 2003). Mothers rated 35 items on a 3-point Likert scale from 0 (not true) to 2 (very true or often true) and the items were summed. The reliability estimate indicates a satisfactory internal consistency of 0.89. T-scores were used in the analyses, with higher scores indicating higher levels of *externalizing behaviors.*

Child Temperament

Temperamental factors were evaluated using the French version of Children's Behavior Questionnaire—Short Form (CBQ-SF; Lemelin et al., 2020). Items were rated by the mother on a 7-point Likert scale ranging from 0 (extremely false) to 6 (extremely true): *negative affectivity* (31 items, "Has temper tantrums when she/he doesn't get what he/she wants"; $\alpha = 0.84$); *surgency/extraversion* (25 items, "Usually rushes into an activity without thinking about it"; $\alpha = 0.85$); and *effortful control* (26 items, "Can lower his/her voice when asked to do so"; $\alpha = 0.76$). A total mean score for each temperamental factor was computed with higher scores indicating higher levels of the given trait.

Maternal Parenting

The Parental Acceptance-Rejection Questionnaire (PARQ; Rohner, 2005) is a self-report questionnaire designed to assess the mother's perceptions of acceptance and rejection of her child. Three scales of the French version of the PARQ were used to measure *hostility* (15 items, "I hit my child even when he/she may not deserve it"; $\alpha = 0.82$), *neglect* (15 items, "I pay no attention to my child"; $\alpha = 0.71$), and low *warmth* (20 items, "I say nice things about my child"; $\alpha = 0.87$). Items were rated on a 4-point Likert scale from 1 (almost always true) to 4 (almost never true). A total sum score for each scale was computed with higher scores indicating higher levels of the given dimension.

Maternal Psychological Distress

Maternal *psychological distress* was measured using a French version of the Psychiatric Symptom Index (Boyer et al., 1993). This self-reported questionnaire, consisting of 14 items, estimates the frequency with which the mother has experienced symptoms of psychological distress (depression, anxiety, irritability, and cognitive problems) over the last 7 days (e.g., During the last week, how often did you: "feel nervous or shaky inside," "cry easily or feel like crying"). Items were rated on a 4-point Likert scale ranging from 1 (never) to 4 (very often). The internal consistency of this scale was excellent, $\alpha = 0.90$. A total sum score was computed with a higher score indicating greater levels of psychological distress.

Confounding Variables

Among participating children, 74.0% were taking medication for their behavioral difficulties. Approximately 21.0% and 26.0% of children were living with one family member with alcohol or drug problems, respectively. About one third of children (34.5%) came from low-income families (< $30,000/year), 42.5% were from middle-income families ($30,000 to $69 999$/year) and 23.0% of children were from high-income families ($70,000/year or more). These variables were controlled in our analyses, in addition to the age of the child at T1 and the child's initial level of externalizing problems at T1.

Analytic Strategy

First, we tested the extent to which the associations between temperamental factors (negative affectivity, surgency/extraversion, effortful control) and externalizing problems were mediated by maternal hostility, neglect, warmth, and psychological distress. A total of 12 mediation models were conducted. Child age, initial level of externalizing problems, and medication usage, as well as family income and history of drug and alcohol problems were controlled for in the analyses. The indirect effects were tested with bias-corrected bootstrapping ($n = 1{,}000$), which does not require the assumption of normal distribution (Preacher et al., 2007). The 95% confidence intervals (CI) of the indirect effect parameter indicates statistical significance. Second, we examined if the sex of the child moderated the associations between child temperament and maternal parenting and psychological distress. When significant, the subgroup method and bootstrapping were applied, which test the mediation effect separately at each level of the moderator. Each model was tested through path analysis using Mplus 7.4. The full information maximum likelihood was used to provide parameter estimates even in the presence of missing data. The model fit was determined using the comparative fit index (CFI, good at 0.95 or above), the Tucker-Lewis Fit index (TLI, acceptable at >0.95), and the root mean square error of approximation (RMSEA, acceptable at 0.06 or below) (Hu and Bentler, 1999).

RESULTS

Descriptive statistics presented separately for boys and girls are provided in **Table 1**. On average, girls had higher levels of negative affectivity and effortful control than boys. No significant differences between boys and girls were found on externalizing behaviors or any of the maternal parenting and psychological distress measures. Correlations presented in **Table 2** show significant associations between measures. Interestingly, temperamental factors of negative affectivity, surgency/extraversion, and effortful control were not significantly correlated with one another.

According to CFI, TLI and RMSEA indexes, all path analysis models presented a good fit. **Table 3** shows the standardized path estimates of the total, direct, and indirect associations between

TABLE 1 | Descriptive statistics, for boys and girls, on main study variables.

	Mean (SD)		*t*-test	
	Boys $n = 200$	**Girls $n = 139$**	***t***	***p***
Child temperament T1				
Surgency/extraversion	4.98 (0.83)	4.92 (0.87)	0.62	0.535
Effortful control	**4.72 (0.67)**	**4.92 (0.57)**	**-2.94**	**0.003**
Negative affectivity	**4.33 (0.76)**	**4.55 (0.81)**	**-2.46**	**0.015**
Maternal parenting T2				
Hostility	24.60 (5.59)	25.45 (5.78)	−1.30	0.196
Neglect	19.82 (4.18)	20.23 (3.84)	−0.87	0.385
Warmth	74.69 (5.99)	74.50 (4.39)	0.31	0.759
Psychological distress	24.17 (7.27)	24.42 (7.35)	−0.30	0.766
Child externalizing behaviors T3	67.01 (7.82)	67.52 (7.82)	−0.57	0.567

Bolded indicates statistically significance, $p < 0.05$.

TABLE 2 | Associations between child externalizing problems, child temperament, and maternal parenting.

Variables	1	2	3	4	5	6	7	8
1. Externalizing behaviors	–							
2. Negative affectivity	0.363	–						
3. Effortful control	−0.299	−0.083 *ns*	–					
4. Surgency/extraversion	0.305	0.034 *ns*	−0.146	–				
5. Hostility	0.332	0.180	−0.247	0.196	–			
6. Neglect	0.242	0.142	−0.249	0.113	0.568	–		
7. Warmth	−0.187	−0.106 *ns*	0.281	−0.116	−0.399	−0.617	–	
8. Psychological distress	0.311	0.179	−0.095 *ns*	0.145	0.453	0.410	−0.256	–
Mean(SD)	67.22 (7.81)	4.42 (0.79)	4.80 (0.64)	4.95 (0.84)	24.93 (5.67)	19.98 (4.05)	74.62 (5.41)	24.26 (7.30)
Min-max	34–84	2.45–6.26	2.62–6.31	2.16–6.96	15–47	15–37	32–80	14–51

All statistically significance with $p < 0.05$ unless indicated otherwise (ns, not significant).

child negative affectivity, maternal parenting and psychological distress, and externalizing problems. Results revealed only one significant indirect effect *via* maternal psychological distress. Specifically, while child negative affectivity was not significantly associated with child externalizing problems, the standardized indirect effect through maternal psychological distress was significant (β = 0.028, SE = 0.011, [CI = 0.009, 0.055]), explaining 38.9% of the total effect. Furthermore, this indirect effect was moderated by the child's sex (CFI = 0.995, TLI = 0.987 and RMSEA = 0.017 [0.000, 0.088]). As shown in **Figures 1**, **2**, the indirect link between negative affectivity and externalizing problems *via* maternal psychological distress was significant for boys (β = 0.285, SE = 0.076, $p = 0.000$), but not for girls (β = 0.029, SE = 0.096, $p = 0.764$). No mediated or indirect link between child negative affectivity and externalizing problems *via* maternal hostility, neglect, or warmth was revealed.

Next, we examined the standardized path estimates of the total, direct, and indirect associations between child surgency/extraversion, maternal parenting and psychological distress, and externalizing problems. As shown in **Table 4**, child surgency/extraversion directly predicted externalizing problems, with total effects accounting for 13–14% of the variance. Maternal psychological distress significantly mediated this association (β = 0.021, SE = 0.010, [CI = 0.005, 0.045]), explaining 15.3% of the total effect. Similarly, maternal hostility significantly mediated the association between child surgency/extraversion and externalizing problems (β = 0.015, SE = 0.009, [CI = 0.001, 0.045]), explaining 11.3% of the total effect. These mediation models were not moderated by child sex, suggesting a similar pattern of associations for boys and girls. No indirect or mediated link between child surgency/extraversion and externalizing problems *via* maternal neglect or warmth was revealed.

Lastly, we examined the standardized path estimates of the total, direct, and indirect associations between child effortful control, maternal parenting and psychological distress, and externalizing problems. **Table 5** shows that higher child effortful control directly predicted lower levels of externalizing problems, with total effects accounting for 12–13% of the variance. Maternal psychological distress significantly mediated this association (β = −0.017, SE = 0.010, [CI = −0.042, −0.002]), explaining 13% of the total effect. This mediation model was not moderated by the child's sex. No indirect or mediated link between child effortful control and externalizing problems *via* maternal hostility, neglect or warmth was revealed.

Overall, child temperament factors explained most of the variance of externalizing problems, even if maternal psychological distress (and maternal hostility for the model with child surgency/extraversion) partly explained these associations.

DISCUSSION

The current study indicates a child temperament-driven effect on maternal psychological distress and hostility, which in turn, predicts externalizing problems among a clinical population of children with conduct problems. By showing the effects of child temperament on levels of externalizing problems directly and indirectly *via* adverse maternal parenting (hostility) and psychological distress, our findings lend support to the transactional perspective.

Specifically, greater maternal psychological distress contributed to higher levels of externalizing problems among boys with higher negative affectivity; an indirect model that was not found for girls. This finding suggests differential susceptibility to externalizing problems among boys with negative affectivity confronted with maternal psychological distress. A potential explanation may hinge on mothers' expectations about how their children should behave based on their gender schema, and their acceptance (or lack thereof) of these behaviors. Considering that negative affectivity is more commonly reported by mothers (and perhaps more socially accepted) of girls than boys (Olino et al., 2013; a finding corrborated in the present study), mothers of boys exhibiting negative affectivity may have difficulty accepting their son's negative emotions, resulting in greater maternal psychological distress.

As for child surgency/extraversion, this temperamental factor was directly associated with the development of externalizing problems. Furthermore, this association was partially mediated by maternal hostility and psychological distress. Children with high levels of surgency/extraversion are likely to be overly

TABLE 3 | Mediation of maternal parenting and psychological distress in the association between negative affectivity and externalizing problems.

	Mediation						Model fit					
	Total effect with no mediator	Direct effect with mediator	Indirect effect	a-link	b-link	c´-link	χ^2	*df*	*p*	CFI	TLI	RMSEA
Hostility	0.061 (0.045)	0.051 (0.045)	0.010 (0.005)	0.080 (0.049)	0.123 (0.043)*	0.051 (0.045)	10.55	6	0.103	0.978	0.945	0.048 [.000, 0.095]
Neglect	0.059 (0.045)	0.056 (0.045)	0.003 (0.003)	0.046 (0.045)	0.073 (0.039)	0.056 (0.045)	9.19	6	0.163	0.985	0.962	0.041 [.000, 0.089]
Warmth	0.066 (0.045)	0.062 (0.045)	0.004 (0.005)	−0.090 (0.048)	−0.050 (0.048)	0.062 (0.045)	10.46	6	0.106	0.977	0.942	0.048 [.000, 0.095]
Psychological distress	0.072 (0.045)	0.044 (0.045)	0.028 (0.011)*	0.179 (0.060)**	0.155 (0.040)***	0.044 (0.045)	12.69	6	0.048	0.966	0.916	0.059 [.005, 0.104]

All estimates in parentheses correspond to standard errors. All estimates are standardized, therefore, coefficients in this table correspond to effect sizes. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

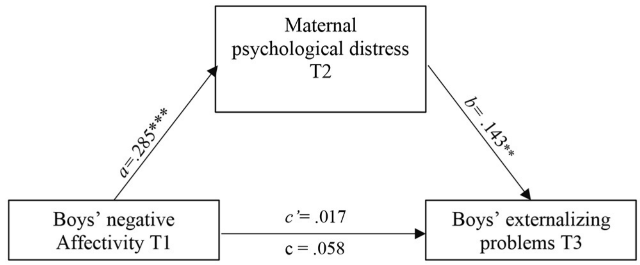

FIGURE 1 | Mediation of psychological distress in the association between boys' negative affectivity with a small a and externalizing problems. All estimates are standardized. ** *p*< 0.01. *** *p*< 0.001.

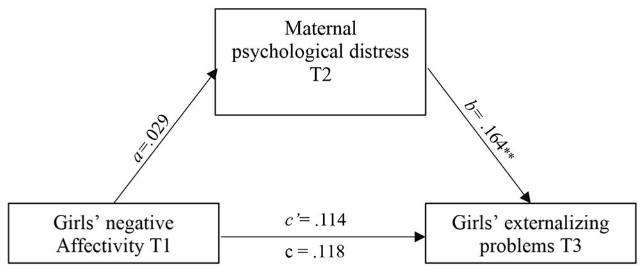

FIGURE 2 | Mediation of psychological distress in the association between girls' negative affectivity with a small a and externalizing problems. All estimates are standardized. ** *p*< 0.01.

outwardly engaged, while simultaneously exhibiting a general disregard for social rules and boundaries. They have been found to use aggressive strategies to overcome barriers or limits when seeking something that is perceived as highly rewarding and to manifest frustration when goals are denied (Berdan et al., 2008). They are also likely to exhibit impulsive, risk taking, and seeking sensation behaviors (Rothbart, 2012). Child surgency/extraversion, contrary to effortful control and negative affectivity, may thus be linked with parental behaviors management. Indeed, mothers of children with high levels of surgency/extraversion may be more likely to resort to hostility or coercion to restrain their child's difficult to manage behaviors. They may also feel powerless or overwhelmed in the face of their child's challenging and risky behaviors, leading to greater psychological distress. On the other hand, effortful control is narrowly linked to cognition and executive functions (Bridgett et al., 2013), and negative affectivity is closely related to emotional self-regulation (Uhl et al., 2019), which may explain why these temperamental factors did not elicit higher maternal hostility.

Maternal psychological distress also explained the direct association between lower child effortful control and greater child externalizing problems. In our study, maternal psychological distress included symptoms of depression, anxiety, irritability, and cognitive problems. In support of our finding, child attention and emotion regulatory difficulties have been previously linked to maternal anxiety (Tsotsi et al., 2021). To extend these findings, future studies could focus on the role of specific

TABLE 4 | Mediation of maternal parenting and psychological distress in the association between surgency/extraversion and externalizing problems.

	Mediation						Model fit					
	Total effect with no mediator	**Direct effect with mediator**	**Indirect effect**	**a-link**	**b-link**	**c′-link**	χ^2	***df***	***p***	**CFI**	**TLI**	**RMSEA**
Hostility	0.133 (0.047)**	0.118 (0.046)**	0.015 (0.009)*	0.133 (0.061)*	0.113 (0.041)*	0.118 (0.046)*	10.64	6	0.100	0.978	0.944	0.049 [.000, 0.096]
Neglect	0.130 (0.047)**	0.125 (0.047)**	0.007 (0.005)	0.085 (0.061)	0.069 (0.036)	0.125 (0.047)**	9.08	6	0.169	0.985	0.963	0.040 [.000, 0.089]
Warmth	0.130 (0.047)**	0.127 (0.046)**	0.003 (0.004)	−0.064 (0.056)	−0.044 (0.049)	0.127 (0.046)**	11.82	6	0.066	0.970	0.924	0.055 [.000, 0.101]
Psychological distress	0.137 (0.047)**	0.116 (0.047)*	0.021 (0.010)*	0.144 (0.062)*	0.149 (0.040)***	0.116 (0.047)*	15.45	6	0.017	0.953	0.883	0.070 [.027, 0.114]

All estimates in parentheses correspond to standard errors. All estimates are standardized, therefore, coefficients in this table correspond to effect sizes. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

TABLE 5 | Mediation of maternal parenting and psychological distress in the association between effortful control and externalizing problems.

	Mediation						Model fit					
	Total effect with no mediator	**Direct effect with mediator**	**Indirect effect**	**a-link**	**b-link**	**c′-link**	χ^2	***df***	***p***	**CFI**	**TLI**	**RMSEA**
Hostility	−0.117 (0.045)**	−0.115 (0.045)**	−0.002 (0.009)	−0.012 (0.069)	0.123 (0.040)**	−0.115 (0.045)**	12.21	6	0.057	0.970	0.924	0.056 [.000, 0.102]
Neglect	−0.117 (0.045)**	−0.119 (0.045)**	0.002 (0.005)	0.029 (0.067)	0.076 (0.035)*	−0.119 (0.045)**	9.89	6	0.129	0.982	0.954	0.045 [.000, 0.093]
Warmth	−0.120 (0.046)**	−0.113 (0.045)**	−0.007 (0.014)	0.295 (0.057)***	−0.025 (0.050)	−0.113 (0.045)**	5.38	6	0.496	1.00	1.00	0.000 [.000, 0.068]
Psychological distress	−0.130 (0.045)**	−0.113 (0.045)**	−0.017 (0.010)*	−0.106 (0.055)*	0.156 (0.039)***	−0.113 (0.045)*	17.90	6	0.007	0.943	0.858	0.078 [.038, 0.122]

All estimates in parentheses correspond to standard errors. All estimates are standardized, therefore, coefficients in this table correspond to effect sizes. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

maternal psychological distress symptoms to better understand their unique indirect effects in the associations between child temperament factors and externalizing problems.

Interestingly, neglectful parenting and maternal warmth did not significantly explain associations between child temperament and externalizing problems. While indirect models were not identified, our findings do not exclude the possibility that maternal neglect and warmth may interact with child temperament to predict child externalizing problems. For instance, one study revealed that children with high levels of negative affectivity had higher externalizing problems when exposed to low quality parenting (Stoltz et al., 2017). Similarly, a meta-analysis demonstrated that children with negative emotionality during infancy were more vulnerable to externalizing problems when confronted to negative parenting, but also profited more from positive parenting (Slagt et al., 2016). Such findings were not found for surgency/extraversion or effortful control (Slagt et al., 2016).

Taken together, the present study provides answers to important questions regarding temperament-driven effects on externalizing problems among children with early onset conduct problems. Children's temperament explained most of the variance in the prediction of externalizing problems, controlling for several covariates including the child's initial level of externalizing problems. Furthermore, indirect models via maternal psychological distress and hostility were identified, though the strength of these associations was modest. Nevertheless, our results are congruent with the transactional perspective (Sameroff, 2009) in that different child temperamental factors are distinctly associated with adverse maternal characteristics, which are subsequently linked to greater child externalizing problems. As for next steps, research should center on the bidirectional associations between child temperamental factors and maternal parenting practices and distress, as well as interactions between these factors in predicting child externalizing problems, to further disentangle these links. Our finding also revealed one specific mechanism for boys, which supports the differential susceptibility model. Specifically, boys, but not girls, with negative affectivity may be more susceptible to externalizing problems when exposed to maternal psychological distress (Belsky, 2013; Slagt et al., 2016).

Despite these new insights, results should be interpreted with caution. First, given our sample, our results cannot be generalized to children from the general population. Conducting this study on children with conduct problems might also have limited between-person variations in externalizing problems. Future studies on children from the general population could shed light on whether these mechanisms also exist among non-clinically referred children. Second, our measures of temperament, parenting, and externalizing problems were based on maternal reports only, which can introduce shared measurement bias. The longitudinal design of our study, however, lessens this limitation. The use of well-validated and recognized measures in the field of child development (e.g., CBQ-SF, CBCL) further adds to the robustness of study findings. Third, temperamental characteristics were reported during a specific timeframe (i.e., during the past 6 months) and within various contexts which minimized subjectivity. Lastly, the given that child externalizing and internalizing problems can co-occur (McElroy et al., 2018), future research investigating internalizing problems as a confounding variable is warranted.

CONCLUSION

The results of the present study support the relevance of temperament-based interventions for children with conduct problems and of increased mental health support for their mothers. By aiding mothers in the development of a larger repertoire of parenting strategies for dealing with children with various temperamental characteristics, mothers may be better equipped to respond appropriately to their child, hence, limiting the development of child externalizing problems.

Our findings also support the need to consider child temperament and maternal parenting and mental health in prevention programs targeting child externalizing problems (Smedler et al., 2015). Programs supported by scientific evidence in preventing child externalizing problems focus on parent training (e.g., Incredible Years and Triple-P), family support (e.g., Family Check-Up), management of classroom behaviors (e.g., Good Behavior Game) or cognitive-based intervention [e.g., Coping Power (Smedler et al., 2015)]. While some of these programs target parenting skills, very few (if none) consider child temperamental characteristics. Such considerations could potentially sustain the long-term effects of these programs (Smedler et al., 2015). In addition, reinforcing the child's ability to adequately express emotion, focus their attention (i.e., reactivity) and regulate their emotions before school entry appear to be effective strategies for preventing externalizing problems in middle-school.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: This dataset is not available outside the secure server where the data is hosted. Requests to access this dataset should be directed to michele.dery@usherbrooke.ca.

ETHICS STATEMENT

This study was reviewed and approved by by Le Comité d'éthique de la recherche—Éducation et sciences sociales de l'Université de Sherbrooke (No. 2015-1076, 2015-26-ESS/Dery). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

GG-C conceived the project, conducted and oversaw all aspects of the analyses, and wrote the paper. KP conceived the project contributed to the interpretation, wrote-up, and reviewed the

manuscript. WG contributed to the analyses, interpretation of the findings, and reviewed the manuscript. J-PL contributed to data collection, the interpretation of the results, and reviewed the manuscript. MD managed the data collection, contributed to data collection, the interpretation of the results, and reviewed the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

Data collection of this longitudinal study was supported by grants from the Canadian Institutes of Health Research (Grant NRF 82694) and the Social Sciences and Humanities Research Council (Grant SSHRC 37890). GG-C research is supported by the Canada Research Chair programs.

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frontiers | Frontiers in Psychology

ORIGINAL RESEARCH
published: 27 June 2022
doi: 10.3389/fpsyg.2022.918834

Is the Association Between Early Childhood Screen Media Use and Effortful Control Bidirectional? A Prospective Study During the COVID-19 Pandemic

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OPEN ACCESS

Edited by:
Mirjana Majdandzic, University of Amsterdam, Netherlands

Reviewed by:
Brenna Hassinger-Das, Pace University, United States
Sarah Pila, Northwestern University, United States

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Specialty section:
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

Received: *12 April 2022*
Accepted: *24 May 2022*
Published: *27 June 2022*

Citation:
Fitzpatrick C, Harvey E, Cristini E, Laurent A, Lemelin J-P and Garon-Carrier G (2022) Is the Association Between Early Childhood Screen Media Use and Effortful Control Bidirectional? A Prospective Study During the COVID-19 Pandemic. Front. Psychol. 13:918834. doi: 10.3389/fpsyg.2022.918834

Individual differences in effortful control, a component of temperament, reflecting the ability to use attention and other cognitive processes to self-regulate emotion and behavior, contribute to child academic adjustment, social competence, and wellbeing. Research has linked excessive screen time in early childhood to reduced self-regulation ability. Furthermore, research suggests that parents are more likely to use screens with children who have more challenging temperaments, such as low levels of effortful control. Since screen time by children between the ages of 0 and 18 has increased during the COVID-19 pandemic, it remains timely to investigate the developmental pattern of association between child screen media use and effortful control. We hypothesize that higher levels of screen media intake at age 3.5 will be associated with lower effortful control at age 4.5 and that lower effortful control at 3.5 will contribute to more screen media intake at age 4.5. This study draws on participants followed longitudinally over the span of 2-years for an investigation of Canadian preschoolers' screen media use during the pandemic ($N = 316$, Wave 1). A follow-up with this sample was completed in 2021 ($N = 265$, Wave 2). Analyses using a cross-lagged panel model revealed stability in child screen time and effortful control between the ages of 3.5 and 4.5. Child screen time at age 3.5 significantly contributed to decreased effortful control scores at the age of 4.5, whereas effortful control at age 3.5 did not contribute to screen time at age 4.5. Our results partially confirmed our hypothesis and indicated that higher levels of screen time intake were detrimental to the development of effortful control. These results suggest that screen media use, an exceedingly frequent activity, may play an enduring role in development by shaping young children's temperaments.

Keywords: screen media, screen time, effortful control, early childhood, temperament, family adversity

INTRODUCTION

Child effortful control is a core component of temperament composed of attentional (e.g., attention focusing and shifting) and other cognitive (e.g., planning) skills that allow for the voluntary regulation of emotions and behaviors that may interfere with personal goals or environmental demands (Rothbart and Bates, 2006; Rothbart, 2011; Morris et al., 2013). Before children begin school, around the age of 3 and 4, effortful control contributes to their ability to benefit from informal learning situations and activities in the home and daycare setting (Liew, 2012; Merz et al., 2014). As children transition to school, effortful control is likely to help children succeed through a cascade of effects. For one, effortful control provides a strong basis for cognitive and social dimensions of school readiness (Potmesilova and Potmesil, 2021). Furthermore, better effortful control also contributes to child academic achievement indirectly through improved learning behaviors (Blair and Razza, 2007; Sánchez-Pérez et al., 2018). More specifically, child effortful control is associated with better classroom engagement and social competence, which each make contributions to academic achievement (Valiente et al., 2008; Sánchez-Pérez et al., 2018).

In addition, decades of research support the hypothesis that higher levels of child effortful control benefits mental health and wellbeing. Lower levels of effortful control are related to increased risk of behavior problems and psychopathology including aggression and antisocial behavior (Murray and Kochanska, 2002; Olson et al., 2005; Eisenberg et al., 2009, 2015; Gartstein et al., 2012; Wang et al., 2016; Diaz et al., 2017; Jonas and Kochanska, 2018; Smith and Day, 2018; Wichstrøm et al., 2018). To a lesser degree, lower levels of child effortful control have also been linked to increased risk of experiencing internalizing problems such as anxiety and depression (Santens et al., 2020). The ability to deploy attentional and cognitive resources to effectively control one's behaviors and emotions during the preschool years may also foster benefits well beyond early childhood. In particular, research has found that higher levels of effortful control can provide children with long-term advantages including better health, financial successfulness, family stability, and lower risk of criminal conviction by adulthood, regardless of their IQ and parent's social status (Moffitt et al., 2011).

Effortful Control in the Context of Early Childhood Experience

Early childhood is a sensitive and foundational time for the strengthening of effortful control skills (Potmesilova and Potmesil, 2021). Between the ages of 3 and 4, child self-regulation skills evolve rapidly (Montroy et al., 2016). Individual differences in effortful control are in part driven by genetic differences and maturation (Diamond, 2002; Rothbart and Bates, 2006). Nevertheless, experiences and environments also play an essential and formative role in shaping children's self-regulation skills (Rothbart, 2011; Tiberio et al., 2016). Longitudinal and experimental research indicate that sensitive caregiving and exchanges help children build these skills (Diamond et al., 2007; Blair and Raver, 2015; Landry et al., 2017; Nix et al., 2018; Warren and Barnett, 2020; Park et al., 2022). Raising children with low regulation skills can be especially challenging, even for the most sensitive, warm, and patient caregivers (Moffitt, 1993). Families that face higher levels of adversity in particular, are likely to experience challenges in providing the types of experiences that help build effortful control. As a result, disadvantaged children are more likely to develop lower levels of effortful control than their more advantaged peers (Lengua, 2012; Zalewski et al., 2012).

Preschool Screen Time and Child Effortful Control

Screen time by young children has been linked to negative developmental outcomes (Pagani et al., 2013; Madigan et al., 2019), yet research has yet to examine its contribution to effortful control. From a prevention perspective, a focus on preschool children is advantageous because screen time habits adopted early on are likely to be carried forward later in life (Jones et al., 2013). Even though pediatric and health organizations recommend limiting screen time with preschool-aged children to 1 h a day, screen media use with preschool-aged children is increasingly common (Rideout, 2020). According to two Canadian studies conducted prior to the pandemic, only 46–58% of preschool-aged children respect the recommendation of <1 h/day of screen media (Tamana et al., 2019; Madigan et al., 2020).

There is evidence that non-adherence to pediatric screen time recommendations between the ages of 3 and 5 is associated with suboptimal development in the frontal-occipital fasciculus, a brain area involved in cognitive control (Hutton et al., 2020). Furthermore, *real world* longitudinal research supports these findings by indicating that children who accumulate too much time in front of screens may experience developmental delays across cognitive, social, and motor domains and are more at risk of arriving less well prepared to learn in kindergarten (Pagani et al., 2013; Madigan et al., 2019). Research has also linked early childhood screen time to reduced executive function ability in preschoolers (Nathanson et al., 2014; Ribner et al., 2017; Konok et al., 2021). More specifically, according to one cross-sectional study, the negative association between preschooler screen time and school readiness appears to be partially mediated by reduction in child executive functions (Ribner et al., 2017). Executive functions and effortful control both represent key mechanisms of self-regulation that share much overlap in their underlying neurological circuitry, developmental trajectories, function in modulating emotions and behavior, and measurement (Zhou et al., 2012).

These studies are consistent with displacement hypotheses. That is, too much media intake during a sensitive time for the development of self-regulation may create a time dept for other important experiences and activities. That is, media use may take time away from self-regulation building pursuits such as imaginary play, storytelling, or games that present motor challenges (Diamond and Lee, 2011). Given the importance of the preschool period for building the foundations of effortful control, devoting too much time to screen media use at

the expense of other activities may be particularly costly at this age.

Family Distress, the COVID-19 Pandemic, and Preschooler Screen Time

Research has found that families facing higher levels of adversity and who have less personal, social, and financial resources, are likely to expose children to more screen time (Hartshorne et al., 2021). Indeed, parents are likely to use more screens with children that are less-well regulated (Thompson et al., 2013; Coyne et al., 2021; Parrish et al., 2022). In addition, children with a low level of effortful control may have greater difficulty regulating emotional and physiological responses to media as well as disengaging from media (Clifford et al., 2020). Furthermore, screen-based activities generally require minimal effortful attention focusing from young children (Goodrich et al., 2009). For this reason, engaging young children in screen-based activities may place less strain on parents, particularly in the context of increased distress during the pandemic. Indeed, toddlers' lower effortful control has been indirectly associated with greater screen use (Shin et al., 2021). Furthermore, research on 4–8-year-olds and older school-aged children has linked impulsivity and attention problems to more compulsive and problematic media use habits (Gentile et al., 2011; Paulus et al., 2018). The extent to which effortful control prospectively contributes to the development of screen time habits in young children during the pandemic remains to be examined.

In further support of the hypothesis that family distress contributes to child screen time, children in disadvantaged homes are more likely to spend time in front of screens, view developmentally inappropriate content, and view media without adult supervision (Wright et al., 2001; Asplund et al., 2015). Parent mental health may also contribute to parental practices surrounding child media use. For instance, parents who report being more stressed set less limits on their children's screen time (Walton et al., 2014). To help inform effective child and family level interventions, it is therefore important to consider how family distress contributes to child screen time.

Research suggests that screen time has increased for children between the ages of 0 and 18 during the pandemic (Hartshorne et al., 2021). Parents are likely to have used more screen media during this time to keep young children busy or provide them with a respite from parenting responsibilities. Recent work from our group suggests that the majority (63%) of preschoolers were exposed to more than 2 h of screen time daily during the pandemic (Fitzpatrick et al., 2022). Furthermore, according to another recent study with Spanish children, accelerometer measured sedentary behavior and self-regulation problems have increased among preschoolers during the pandemic (Alonso-Martínez et al., 2021).

The Current Study

The direction of the association between child screen time and effortful control, amidst increased screen media use by children during the pandemic remains unknown. Since early childhood represents a key developmental time for the strengthening of effortful control and the shaping of screen media habits, it is important to examine longitudinal associations between these variables. Previous research using cross-sectional and longitudinal designs has been unable to account for the direction of influence when examining associations between screen time and child outcomes. The present study attempts to address this limitations by simultaneously examining both directions of influence and by accounting for stability in screen time habits and effortful control. We predict that screen time at age 3.5 will be prospectively associated with lower levels of child effortful control by age 4.5. In addition, we hypothesize a bidirectional effect by which child effortful control at age 3.5 will predict screen time at age 4.5. Given that family distress is likely to have contributed to child media use during the pandemic, parenting stress, maternal education, satisfaction with the division of childcare, and the use of daycare will be considered as control variables.

MATERIALS AND METHODS

Sample

This study focuses on Canadian preschool-aged children and their parents followed longitudinally at two-time points for an investigation of child digital media use during COVID-19 pandemic. Participants were recruited by distributing eye catching posters and flyers to preschools and pre-kindergarten classes, through sign-up sheets and presentations given at preschool and pre-kindergarten registration nights, a Facebook page, and newspaper and radio advertisements broadcast across Nova Scotia, Canada. At the initial assessment, the sample was composed of 316 children aged between the ages of 2 and 5 years (168 boys and 146 girls; M age = 3.45 years, SD = 0.85). This first assessment took place between April and August 2020 during a provincially declared state of emergency and lockdown. A follow-up with this sample was completed in 2021 between April and August (N = 266, M age = 4.33, SD = 0.86, 84% retention rate). Participants with missing data at age 4.5 did not differ from retained participants on their average screen time and effortful control scores at 3.5. Most parents were married (82%), born in Canada (91%), Caucasian (90.5%) and English-speaking (88.1%). Mothers were the primary respondents for 93.4% of the sample.

Procedure

Parents completed the web-based Media use Questionnaire when children were 3.5 and 4.5. This assessment has been described in detail elsewhere (Barr et al., 2020). This assessment includes questions on child sex, parent education, family income, parenting stress, childcare use, and parent satisfaction with the division of childcare. For the purpose of our study, we integrated questions on child temperament using the Children's Behavior Questionnaire – Short Form, described below. The present research was approved by Université Sainte-Anne (#0090.d) and Université de Sherbrooke's IRB (2021–2927). Informed consent to participate was obtained from parents.

Measures

Child Screen Time

Parents indicated the average amount of time children spent doing each of the following activities on weekdays and weekend days separately: (1) watching TV or DVDs; (2) using a computer; (3) playing video games on a console; (4); Using an iPad, tablet, LeapPad, iTouch, or similar mobile device (excluding smartphones); or (5) Using a smartphone. Response options included: (1) Never; (2) Less than 30 min; (3) 30 min to 1 h; (4) 1–2 h; (5) 2–3 h; (6) 4–5 h; and (7) more than 5 h. Each categorical answer was then converted to a numerical score variable reflecting the number of hours spent with each type of media. Our approach involved using the midpoint for each response range, with the exception of "5 or more hours a day" where a more conservative score of 5 was used. Weighted daily estimates were then estimated by multiplying weekday estimates by 5 and weekend day estimates by 2 and dividing the total by 7. Finally, we calculated an overall daily screen time estimate by summing average daily usage across media devices. The same procedure was used to estimate screen time at ages 3.5 and 4.5.

Effortful Control

Temperament was measured using the Children's Behavior Questionnaire – Short Form (Putnam and Rothbart, 2006). This instrument measures several distinct dimensions of temperament that can be grouped into three factors: negative affectivity, surgency/extraversion, and effortful control. Effortful control was based on combined scores on the dimensions of attentional focusing (six items, i.e., Sometimes becomes absorbed in a picture book and looks at it for a long time) and inhibitory control (six items, i.e., Can wait before entering into new activities if s/he is asked to). The short version uses a 7-point Likert scale ranging from 1 (*extremely untrue of your child*) to 7 (*extremely true of your child*). Cronbach's alphas were 0.79 and 0.79 at age 3.5 and 4.5, respectively.

Family Distress

Parents reported level of education, satisfaction with the division of childcare, use of childcare, and parenting stress. Education reflects the highest school grade completed by the parent. Responses were dichotomized as: (0) High school or college vocational or (1) Undergraduate or Graduate degree. Satisfaction with childcare was assessed with the following question: How satisfied are you with the division of childcare between you and your partner? Responses were recorded on a Likert scale ranging from: (1) Very satisfied; (2) Satisfied; (3) Not satisfied or unsatisfied; (4) Unsatisfied; and (5) Very unsatisfied. Parents completed the parenting distress subscale of the Parent Stress Index (Abidin, 2012). In total, parents completed 12 items (i.e., I find myself giving up more of my life to meet my child's needs than I ever expected). Items were rated on a 5-point Likert scale as: 1 (strongly disagree); 2 (disagree); 3 (not sure); 4 (agree); or 5 (strongly agree), and were then summed to create a total score, Cronbach's alpha = 0.85. Finally, parents reported whether or not their child was enrolled in daycare. Daycare closures were directly inferred based on the dates that daycares were ordered to close and eventually allowed to reopen[1]. Children were then categorized into three groups: (1) Daycare Non-user; (2) User daycare open; and (3) User daycare closed.

Data Analytic Strategy

Given that greater levels of family distress are likely to contribute to greater screen time, we first considered associations between indicators of family distress and child screen media use at age 3.5 and 4.5, respectively. We then retained significant predictors of child screen media habits. To simultaneously measure associations between screen time and effortful control between the ages of 3.5 and 4.5, we then estimate a cross-lagged panel model using Mplus (Muthen and Muthen, 2018). Kline (2015) recommends achieving a ratio of $N = 20$/estimated parameter to ensure sufficient statistical power for detecting small to moderate effects in cross-lagged panel models. With a total of 15 parameter, and a sample size of 315, our study is sufficiently powered for detecting the hypothesized associations ($N = 315 > 20 \times 15$ parameters).

RESULTS

Descriptive Statistics

Descriptive statistics are presented in **Table 1**. Frequencies for categorical variables are presented in **Table 2**. Children spent on average $M = 3.46$ ($SD = 2.44$) and $M = 3.25$ ($SD = 2.38$) hours daily with screens at the ages of 3.5 and 4.5, respectively. As expected, child effortful control scores increased significantly between the ages of 3.5 and 4.5 [$M = 4.71$ vs 4.88) $t\ (263) = 4.31$, $p < 0.001$]. In total, 26% of parents had attained a high school or vocational degree. Finally, 22.3% ($n = 59$) of our sample reported not using daycare, 18.1% ($n = 48$) reported that their daycare was closed at the first assessment, and 59.6% ($n = 158$) reported that their daycare was open at the time of the first assessment.

Family Distress and Child Screen Media Habits

We conducted a multiple linear regression to estimate the contribution of indicators of family distress to child media habits. More specifically, we regressed screen time in hours at the ages of 3.5 and 4.5 on parental education, child sex, satisfaction

[1]https://novascotia.ca/news/release/?id=20200313009

TABLE 1 | Descriptive statistics for continuous study measures.

Variables	*M* (*SD*)	*N*
Age 3.5		
Effortful control	4.70 (0.85)	315
Screen time (hours/day)	3.42 (2.44)	315
Parenting stress	27.14 (7.88)	315
Division of childcare	2.15 (1.04)	305
Age 4.5		
Effortful control	4.88 (0.82)	264
Screen time (hours/day)	3.25 (2.38)	265

TABLE 2 | Frequencies for categorical variables.

Variables	%	N
Child sex		296
Girls	46	
Maternal education		316
High school or vocational	26	
Daycare		265
Non-user	22	
Closed	18	
Open	60	

TABLE 3 | Associations between family characteristics and child screen time at Ages 3.5 and 4.5.

Independent variables	Screen time (in hours/day)			
	Age 3.5		Age 4.5	
	(95% CI)	ß	B (95% CI)	ß
Child sex				
Girls	0.27 (−0.33–0.86)	0.05	−0.21 (−0.84–0.42)	−0.04
Boys (ref)	–		–	
Parent education				
High school or vocational	1.37 (0.64–2.10)*	0.23*	1.76 (0.96–2.56)*	0.30*
University degree (ref)	–			
Parenting stress	0.01 (−0.03–0.05)	0.02	0.00 (−0.04–0.04)	0.01
Division of childcare	−0.42 (−1.09–0.26)	−0.08		0.00
Daycares				
Non-user	−0.30 (−1.04–0.45)	−0.05	−0.44 (−1.21–0.33)	−0.08
Closed	0.28 (−0.51–1.07)	0.05	−0.28 (−1.12–0.57)	−0.04
Open (ref)	–			
R-Square	0.04		0.06	

*Ref, reference group. *p ≤ 0.05.*

with the division of childcare, parenting stress, and daycare use. Regression coefficients are reported in **Table 3**. Lower parental education contributed to more child screen time at the ages of 3.5 (ß = 1.37, $p < 0.001$) and 4.5 (ß = 1.76, $p < 0.001$), respectively. None of the other variables were significantly related to child screen time. As such, we did not retain these variables in our cross-lagged panel model.

Cross-Lagged Panel Model

Our model is presented in **Figure 1**. Our cross-lagged panel model provided good fit (CFI = 0.988; TLI = 0.965; RMSEA = 0.069 [0.000; 0.113]) and accounted for 49 and 54% of the variance in child screen time and effortful control at age 4.5, respectively. Analyses revealed considerable stability in child screen time (ß = 0.70, SE = 0.031; $p < 0.001$) and effortful control (ß = 0.72, SE = 0.030; $p < 0.001$) between the ages of 3.5 and 4.5. In terms of the cross-lagged associations, child screen time at age 3.5 significantly contributed to decreased effortful control scores at age 4.5 (ß = −0.10, SE = 0.042; $p = 0.023$) whereas effortful control at age 3.5 did not contribute to child screen time at age 4.5 (ß = 0.016, SE = 0.046; $p = 0.729$). Parental education (ß = −0.24, SE = 0.053; $p < 0.001$) was also significantly negatively associated with more child screen time at age 3.5. As indicated by the strength of the standardized coefficient, the effect size for the associations between child screen time at ages 3.5 and 4.5 (ß = 0.70) and effortful control at 3.5 and 4.5 (ß = 0.72), were large. The cross-lagged association between screen time at 3.5 and effortful control at 4.5 (ß = 0.10) was small (Cohen, 1994).

Practical Significance

Each hour of daily screen time contributed to 10% of a standard deviation decrease in effortful control scores. Despite its small size, this association is likely to be more clinically meaningful for heavy screen media exposure. That is, for children using screen media for 4 h or more per day (32% of our sample), the contribution of daily screen time would result in 40% of a standard deviation decrease in effortful control scores. Furthermore, some have argued that even small effect sizes in psychological and behavioral medicine research can be of real-world practical significance (Rutledge and Loh, 2004).

DISCUSSION

The purpose of our study was to examine associations between child screen time and effortful control during the COVID-19 pandemic. Our results partially confirmed our hypotheses by indicating that higher levels of screen media intake during the pandemic at age 3.5 are prospectively associated with lower levels of effortful control at age 4.5. In contrast, lower levels of child effortful control at age 3.5 did not contribute to more screen media intake at age 4.5. Furthermore, we found partial support for the family distress hypothesis in that lower parental education was associated with higher levels of screen media use by children. Though the strength of the observed association was small, our models suggest more clinically significant effects for children exposed to high levels of screen time. These findings suggest that too much screen time media in early childhood can undermine effortful control, a key building block of personality and personal success (Kochanska and Knaack, 2003; Moffitt et al., 2011).

Theory and research suggest that child media use displaces time for self-regulation building activities such as sensitive parent-child interactions or play (Diamond and Lee, 2011). Our results indicating a prospective association over time provide support for this pathway. Future longitudinal research can seek to clarify the extent to which the displacement of children's interactions and activities may account for the observed effects. For instance, according to one study, sedentary behavior increased among preschoolers during the pandemic whereas sleep and physical activity decreased (Alonso-Martínez et al., 2021). As such, research could examine the extent to which links between screen time and self-regulation may be accounted

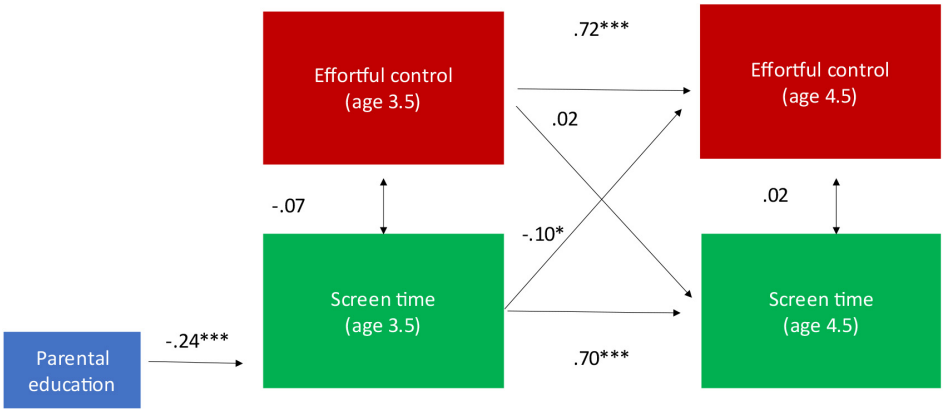

FIGURE 1 | Longitudinal cross-lagged associations between preschool screen media use and effortful control. *$p \leq 0.05$ and ***$p \leq 0.001$.

for by the displacement of social interactions, play, sleep, and physical activity.

The impact of digital media on young children's development may also be driven by features of media content. The overstimulation hypothesis predicts that child media use is likely to undermine children's development of sustained attention and ability to inhibit distractors over time (Christakis et al., 2018). In particular, this is believed to be the case because media directed at young children features a high frequency of perceptually salient elements such as frequent camera cuts and quick pacing, which are effective in eliciting child engagement without cognitive effort (Goodrich et al., 2009). Experimental research has also found that preschooler's exposure to media content that is fantastical can deplete executive functions minutes after exposure (Lillard et al., 2015). This type of content is believed to mentally overwhelm young minds because it contradicts children's basic understanding of the world (Smith, 2020). This would be the case, for instance, when a program or movie depicts a human character that can fly. As such, frequent exposure to fast paced and unrealistic or fantastical elements may be especially harmful.

Finally, research could examine the extent to which media use contexts including joint media engagement with parents and timing of use may further contribute to and moderate children's development of effortful control. For instance, according to an experimental study, preschoolers assigned to view 10 episodes of the show *Daniel Tiger's Neighborhood*, showed more gains in their empathy and emotional regulation if their parents engaged them in conversations about the content (Rasmussen et al., 2016). Furthermore, other research suggests that using media before bedtime contributes to decreased sleep quality, which then contributes to reductions in effortful control (Nathanson and Beyens, 2018). However, these associations have yet to be explored longitudinally.

By the time children enter school, the foundations of their temperaments and media habits have been established (Rothbart, 2011; Jones et al., 2013). Furthermore, early childhood interventions aimed at helping children develop healthy media habits are more likely to be effective than those undertaken with older school-aged children and adolescents (Wahi et al., 2011). For this reason, it remains important to sensitize parents and early childhood professionals that screen media can pose risks to the development of effortful control. In the context of increasing media use during the pandemic, supporting parents especially parents facing higher levels of socioeconomic vulnerability in their efforts to regulate young children's digital media habits is especially timely. Our results reaffirm the importance of encouraging parents to establish a family media plan and to provide children with ample opportunities to engage in play and literacy building activities which can strengthen effortful control. In particular, plans can help parents implement digital media use limits for children, as well as make previsions for which contents to favor and how to accompany children's use (Reid Chassiakos et al., 2016).

Child effortful control is narrowly linked to executive functions (Bridgett et al., 2013), school readiness (Gobeil-Bourdeau et al., 2021; Potmesilova and Potmesil, 2021), and academic competence (Liew, 2012). As such, early childhood professionals can also help support school readiness by implementing evidence-based intervention programs or strategies that benefit children' development of skills such as inhibitory and attentional control. Furthermore, school-based programs such as *INSIGHTS into Children's Temperament* (McClowry et al., 2005), which aim to sensitize children about their own temperaments and their challenges, have been found to be effective in reducing child behavior problems (O'Connor et al., 2014). Finally, screen time is common in childcare settings and likely to take time away from more developmentally enriching formal and informal learning opportunities (Christakis and Garrison, 2009). As such, we encourage early childhood professionals to limit their use of screen media in this setting.

Strengths and Limitations

Strengths of the present study include our ability to establish the direction of the association between screen media use and effortful control. Furthermore, our analytical strategy also allowed us to consider developmental continuity and stability in these variables. Finally, to our knowledge, there remains limited research on the association between young children's media habits during the COVID-19 pandemic and the development of self-regulation.

The present results are not without limitations. First, our correlational approach does not allow us to conclude that a causal association exists between child screen time and the development of effortful control. Even though we were able to provide evidence that changes in screen time habits are associated with changes in child effortful control and that changes in screen time precede changes in temperament, our design does not allow us to rule out third variable confounding. Second, as previously mentioned, we did not account for the content to which children were exposed nor did we account for the context (i.e., timing of use, adult accompaniment) in which media was used. Considering these features of media use in addition to screen time will be useful in better understanding multifinality in child outcomes. Third, both our measures of screen time and effortful control were parent reported which can introduce shared measurement bias. Fourth, our study only included two of the four possible subscales designed to measure effortful control. The inclusion of 2-year-olds in our study could also represent a limit as our temperament scale was designed for 3–7-year old's. Nevertheless, the observed Cronbach's alphas indicate good internal consistency. Another limit of our study is the use of a relatively homogenous, low risk convenience sample. As such, our findings may not be generalizable to the population of Canadian preschoolers. Despite this limitation, we detected a significant association between parent education and child screen time. Nonetheless, our inability to detect associations between child effortful control and later screen time habits could reflect the fact that our sample is relatively homogenous in terms of its demographic characteristics. Previous studies have found that child temperamental characteristics such as surgency and negative affectivity predict preschooler screen time in contexts of high social risks, defined by low maternal education, income, and higher levels of maternal depression (McArthur et al., 2022). Future research should seek to examine these associations in larger more diverse samples. Last, although our sample was sufficiently powered for our analyses, we were limited in our ability to detect small effects.

CONCLUSION

To our knowledge, this is the first study to examine how higher amounts of preschooler screen time are prospectively associated with decreases in effortful control in the context of a pandemic. Our results suggest that screen media use during early childhood, a sensitive period for the development of lifelong temperament, should be closely monitored by parents. Furthermore, our findings add to the literature suggesting that limiting screen time during the preschool period may benefit child socio-emotional and school readiness skills.

DATA AVAILABILITY STATEMENT

The data presented in this article are not readily available. As per the participant consent form, data are only available to the research team. Requests to access the data should be directed to caroline.fitzpatrick@usherbrooke.ca.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comité d'Étique, Université Sainte-Anne; Comité d'Étique, Université de Sherbrooke. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

CF designed the study and drafted most of the manuscript. GG-C conducted the analyses and EC drafted the methods. EH, AL, J-PL provided critical theoretical feedback on the entire manuscript. All authors have read and approved the manuscript.

FUNDING

This research was funded by grants from the Social Sciences and Humanities Research Council (430-2019-00196), Research Nova Scotia (PSO-EST-2019-2061).

ACKNOWLEDGMENTS

We would like to acknowledge the work of Rachelle Wakeham Lewis for her assistance in the data collection and all the participating families for their time.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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TYPE Original Research
PUBLISHED 08 August 2022
DOI 10.3389/fpsyg.2022.911913

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 03 April 2022
ACCEPTED 18 July 2022
PUBLISHED 08 August 2022

CITATION
Zhou AM, Trainer A, Vallorani A, Fu X and Buss KA (2022) Are fearful boys at higher risk for anxiety? Person-centered profiles of toddler fearful behavior predict anxious behaviors at age 6. *Front. Psychol.* 13:911913. doi: 10.3389/fpsyg.2022.911913

Are fearful boys at higher risk for anxiety? Person-centered profiles of toddler fearful behavior predict anxious behaviors at age 6

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Dysregulated fear (DF), the presence of fearful behaviors in both low-threat and high-threat contexts, is associated with child anxiety symptoms during early childhood (e.g., Buss et al., 2013). However, not all children with DF go on to develop an anxiety disorder (Buss and McDoniel, 2016). This study leveraged the data from two longitudinal cohorts (N = 261) to (1) use person-centered methods to identify profiles of fearful temperament, (2) replicate the findings linking DF to anxiety behaviors in kindergarten, (3) test if child sex moderates associations between DF and anxiety behaviors, and (4) examine the consistency of findings across multiple informants of child anxiety behaviors. We identified a normative fear profile (low fear in low-threat contexts; high fear in high-threat contexts), a low fear profile (low fear across both low- and high-threat contexts) and a DF profile (high fear across both low- and high-threat contexts). Results showed that probability of DF profile membership was significantly associated with child self-reported overanxiousness, but not with parent-reported overanxiousness. Associations between DF profile membership and overanxiousness was moderated by child sex such that these associations were significant for boys only. Additionally, results showed that probability of DF profile membership was associated with both parent-reported social withdrawal and observations of social reticence, but there were no significant associations with child self-report of social withdrawal. Results highlight the importance of considering person-centered profiles of fearful temperament across different emotion-eliciting contexts, and the importance of using multiple informants to understand associations with temperamental risk for child anxiety.

KEYWORDS

temperament, fear, anxiety, early childhood, latent profile analysis

Introduction

Approximately, 10% of preschoolers in the United States meet diagnostic criteria for a DSM anxiety disorder (Egger and Angold, 2006). Anxiety disorders during childhood significantly impact daily functioning. Children with anxiety symptoms tend to avoid social interactions with peers, are perceived as less socially competent, have fewer friendships, and are more likely to be bullied by peers (e.g., Rubin et al., 2009; Huber et al., 2019). Additionally, anxiety symptoms during early childhood are also associated with both severity and chronicity of later anxiety disorders (Pine et al., 1998; Bittner et al., 2007). The early identification of which children are at higher risk for anxiety symptom development may be informative for intervention and prevention of the development of maladaptive socioemotional outcomes. Fearful temperament during toddlerhood is associated with increased risk for later anxiety symptoms during childhood and early adolescence (Degnan and Fox, 2007). However, not all fearful children develop anxiety symptoms or disorders (Degnan and Fox, 2007; Buss and McDoniel, 2016). This highlights that researchers should consider alternative ways to characterize fearful temperament as a marker of anxiety risk and examine how fearful temperament may interact with other factors to better identify which children are at the greatest risk. This study uses person-centered methods to examine how temperamental fear across contexts of varying threat levels may interact with child sex as a predictor of later childhood anxiety outcomes.

Fear across varying threat contexts as a marker of risk

There is evidence for the normative development of fear from infancy to early childhood (Beesdo et al., 2009; Muris and Field, 2011). For example, fears such as fear of heights and fear of strangers are considered universal and normative during infancy, while fears of animals emerge in toddlerhood (Beesdo et al., 2009; LoBue et al., 2019). Children may express different levels of fears as part of typical development, which differs from children who exhibit persistent or extensive degrees of anxiety and avoidance that are associated with subjective levels of distress and impairment (Beesdo et al., 2009). Additionally, there are individual differences and variability in fearful behaviors, namely temperament, that may be predictive of developmental outcomes such as anxiety symptoms (LoBue et al., 2019).

Temperament refers to biologically based, early emerging individual differences in emotion and its regulation (Shiner et al., 2012). Individual differences in fearful temperament are often considered an early risk factor for the development of anxiety (Klein et al., 2012; Nigg, 2006; Pérez-Edgar and Fox, 2005). Klein et al. (2012) review the multiple perspectives and models in which researchers have considered the relations between temperament and psychopathology, one of which is the predisposition model that posits (1) there are distinct etiological bases to temperament and psychopathology, and (2) there is a complex interplay among multiple risk factors (including temperament) that lead to the development of psychopathology. In this paper, we consider associations between fearful temperament and anxiety symptoms using the predisposition model.

Fearful temperament is a multifaceted construct that includes motivational/affective, behavioral, and physiological aspects of fear (Rothbart and Bates, 2006). One subtype of fearful temperament is behavioral inhibition (BI), which is the tendency to withdraw from and/or exhibit negative affect in response to novelty (Garcia Coll et al., 1984; Kagan et al., 1984; Fox et al., 2005). Both fearful temperament as well as BI have been associated with anxiety symptoms, although not all fearful or behaviorally inhibited children go on to develop an anxiety disorder (e.g., Buss and McDoniel, 2016). While there are some who suggest extreme fearful temperament (i.e., BI) is a prodromal level of anxiety manifesting earlier in development, our view is shaped by Pérez-Edgar and Guyer (2014) who explain and review literature supporting the differences in the two constructs. Consistent with the predisposition model, fearful temperament is distinct from anxiety but is indicative of greater risk for anxiety development. Thus, the focus of the current study is expanding our understanding of which fearful children will develop anxiety symptoms.

Traditional observational approaches to fearful temperament average fearful behavior across highly novel and threatening situations, and do not consider differences in fearful behavior across different tasks of varying threat levels (e.g., Goldsmith and Campos, 1990; Garcia Coll et al., 1984; Talge et al., 2008). Additionally, there is an assumption that fearful behaviors are maladaptive without consideration of the context. Fear is adaptive and normative in contexts where there is threat present. However, when fear is extremely intense and present during situations that are not threatening, fear may be maladaptive and contribute to the development of anxiety (Buss et al., 2004; Goldsmith and Davidson, 2004). Thus, it is important to consider situational context when characterizing fearful temperament as a risk marker for anxiety symptom development.

A previous work identified a type of temperamental fear, called "dysregulated fear (DF)," which is characterized by displays of high-fear behaviors in both low and high-threat contexts (Buss, 2011). Most toddlers in the initial study exhibited what was deemed "normative fear," a pattern of low levels of fear in low-threat situations, and higher levels of fear behavior in high-threat situations. However, an additional group of toddlers were identified as dysregulated in their pattern of fear as follows: Toddlers who exhibit high levels of fear across all levels of threat, most notable in low-threat tasks. Toddlers

exhibiting DF may be experiencing difficulty in appropriately regulating across changing contexts, potentially placing them at higher risk for developing anxiety (Buss and McDoniel, 2016). While DF and BI are conceptually similar, empirical work demonstrates distinctions between a DF profile and a BI profile during toddlerhood (Buss et al., 2004; Buss, 2011) whereby only about one third of toddlers observed would be classified as both BI and DF. One key distinction is how DF reflects a type of high sensitivity to novel stimuli relative to the eliciting contexts vs. just extreme fear averaged across contexts.

The hypothesis that toddler DF is associated with later anxiety symptoms has been supported across two samples wherein DF at age 2 was associated with increased risk of social withdrawal and social anxiety symptom development across early childhood (Buss, 2011; Buss et al., 2013, 2018, 2021a). Specifically, DF during toddlerhood predicted higher ratings of social withdrawal by parents at ages 3, 4, and 5, as well as the ratings of social withdrawal by teachers at age 5 (Buss, 2011). These associations were also replicated when examining associations between DF and social anxiety symptoms reported through clinical interviews with parents at age 5 (Buss et al., 2013). Additionally, toddler DF was associated with observed social reticence during structured lab tasks with an unfamiliar peer during the early childhood (Buss et al., 2013). A previous work has also demonstrated that DF was associated with parents' report of social anxiety symptoms during the early childhood above and beyond the associations between BI and anxiety symptoms (Buss, 2011). Taken together, DF has been associated with higher levels of social withdrawal and social anxiety across multiple informants and methods of assessment.

While DF is directly associated with parent and teacher reported social withdrawal and social anxiety, there is emerging evidence that DF may be associated with increased risk for generalized anxiety symptoms (e.g., overanxiousness and worry). Prior studies of fearful temperament and BI have demonstrated associations with the maternal report of generalized anxiety symptoms at age 6 (Hudson et al., 2011). Recently, Buss et al. (2021b) found that DF is indirectly associated with maternal reports of children's general anxiety symptoms *via* parenting behaviors. However, there were no direct associations between DF and child general anxiety symptoms (Buss et al., 2021b). In summary, there are associations between DF and both general anxiety and social anxiety symptoms, although there may only be direct associations between DF and social anxiety symptoms specifically when considering the reports of parent, teacher, and observer reports children's anxiety behaviors (Buss, 2011; Buss et al., 2013, 2018, 2021b).

It is also important to consider how DF, or other putative patterns of fear across different emotion-eliciting contexts, is measured. Latent profile analysis (LPA) provides a person-centered approach to characterizing temperament types based on different patterns of fear behaviors across different contexts, which may increase the nuance in the identification of temperamental risk during early childhood. Examining the broader temperament literature, the previous studies using latent profile analyses identified different groups of infants and toddlers with differing patterns of temperamental characteristics using parent reports of toddler temperament (Beekman et al., 2015; Gartstein et al., 2017). Additionally, one study found evidence that the profiles of temperament were associated with psychopathology outcomes during middle childhood and early adolescence (Rettew et al., 2008), demonstrating that the person-centered profiles may increase our ability to identify temperamental risk associated with psychopathology outcomes. However, these studies did not examine specific temperamental traits across varying contexts. While there is growing evidence in the literature identifying a profile of DF when considering fearful behavior across varying threat contexts, it is less clear if there may be other subtypes of fearful temperament or patterns of fearful behavior across varying threat contexts. These person-centered profiles may contribute to our understanding of the development of child anxiety and help better identify which children are at greater risk for anxiety development.

Child sex as a moderator of fearful temperament and child anxiety

Child sex may be another potential factor that moderates associations between fearful temperament and anxiety outcomes. Findings of sex differences in temperament and anxiety during the early childhood period are often small or non-significant. A meta-analysis on gender differences in temperament in children aged 3–13 years only found a very small gender difference between boys and girls in fear ($d = -0.12$) (Else-Quest et al., 2006). Similarly, research on pre-adolescent anxiety finds little evidence for sex differences in anxiety symptoms (e.g., Roza et al., 2003; Jacques and Mash, 2004; Bosquet and Egeland, 2006) although there are studies that find sex differences during adolescence with girls exhibiting higher levels of anxiety symptoms than boys (e.g., Jacques and Mash, 2004). These findings are not surprising as child sex may not have a direct effect on socioemotional development, but instead may play a moderating role (Crick and Zahn-Waxler, 2003). Turning back to the broader temperament literature, fearful boys may be at higher risk for anxiety-related outcomes compared to girls (Kagan et al., 1998; Henderson et al., 2001). Fearful boys exhibited greater social wariness during early childhood compared to fearful girls (Kagan et al., 1998; Degnan and Fox, 2007). In addition, toddler inhibited temperament was significantly associated with social wariness in boys at age 4, but these associations were not significant for girls (Henderson et al., 2001). Additionally, studies have demonstrated that shy boys may be more sensitive to social feedback (Howarth et al., 2013).

These sex differences may be due to the ways in which parents respond to boys' and girls' expressions of the same behaviors and emotions, such as fearful behavior (Mills and Rubin, 1990; Park et al., 1997). Prior studies demonstrate that parents respond to boys' fearful behaviors with greater concern, intrusiveness and protective parenting compared to girls (e.g., Park et al., 1997; Kiel et al., 2016). Additionally, boys and girls may also elicit different parenting behaviors in order to regulate their fear (Buss et al., 2008). Thus, sex differences in how parents respond to their children, as well as how children may rely on their parents to regulate their fearfulness may contribute to sex differences in the associations between fearful temperament and anxiety outcomes.

However, not all studies find moderation by child sex when examining associations between temperament and anxiety. For example, Skarpness and Carson (1986) found that associations between mom-rated inhibition and teacher-rated withdrawal were the same across both boys and girls. Similarly, Morales et al. (2015) found that toddler fearful temperament was associated with parental reports of internalizing behaviors at age 5, but was not moderated by child sex. Additionally, the previous studies examining associations between DF and anxiety/social withdrawal did not find sex differences in either fearful behavior across tasks at age 2 (Buss, 2011) or in the external observers' ratings of social interactions with an unfamiliar peer at age 6 (Buss et al., 2013). With the mixed available findings in the literature, it is important to consider child sex as a moderator when examining associations between temperament and anxiety.

Multiple informants of child anxious behavior

Lastly, one major consideration in characterizing risk for anxiety development is utilizing multiple informants of child anxiety. Parent-reported child anxiety is often utilized through questionnaires or structured clinical interviews. However, using measures such as child self-report and observer ratings of child behavior can be informative for developing a comprehensive understanding of child anxiety symptoms by considering the presence of anxiety symptoms in multiple contexts. One challenge of child self-report has been eliciting reliable self-reports due to developmental factors. However, child self-report measures such as the Berkeley Puppet Interview (BPI; Ablow et al., 1999) were designed with developmental considerations for children aged 4-8 years to report on their symptomatology and distress. Research has demonstrated associations between children's social reticence and self-perceptions of social competence from age group 4-7 years (Nelson et al., 2005), thus highlighting the importance of considering children's self-ratings of anxiety symptoms. While there have been low levels of agreement between different informants in past studies (Achenbach et al., 1987; Ablow et al., 1999), a previous study has also demonstrated that young children's self-report of core anxiety symptoms are associated with parent report when measures are administered concurrently (Luby et al., 2007). In particular, children are able to accurately report on behaviors such as being shy with peers and having bad dreams (Luby et al., 2007).

The current study

This study had the following four main goals: (1) To use person-centered methods to identify profiles of fearful temperament, (2) to replicate of findings linking DF to anxiety behaviors in kindergarten, (3) to test if child biological sex is a moderator of associations between DF and later anxiety behaviors, and (4) to examine the consistency of findings across multiple informants of child anxiety behaviors. The extant literature provides evidence that variation in fearful behavior across contexts may indicate risk for anxiety development (e.g., Buss, 2011; Buss et al., 2018). However, the previous studies of DF may have been limited by sample size to identify different profiles of fearful behavior across contexts using a person-centered approach. This study combined two samples of children, including the participants from the previous studies (e.g., Buss et al., 2013; 2018) to generate a larger sample size to examine if there may be profiles of fearful behavior across varying threat contexts beyond the normative and DF profiles. To address the first goal, we used LPA to identify different profiles of fearful temperament across six fear-eliciting episodes of varying threat contexts. Only one previous study of DF used LPA in a single sample, which identified the following two patterns of fearful behavior across profiles: A normative fear subtype characterized by low fear in low-threat contexts and high fear in high-threat contexts, and a DF subtype characterized by high fear in both low- and high-threat contexts (Buss, 2011).

As the previous literature demonstrated associations between DF and later anxiety (Buss, 2011; Buss et al., 2013, 2018), we hypothesized that DF will be associated with anxiety symptoms associated with generalized anxiety (or overanxiousness) and social withdrawal. We aimed to replicate these associations with a larger sample size by combining two cohorts to increase statistical power. Additionally, we considered child sex as a moderator of the association between profiles during toddlerhood and anxiety symptoms during early childhood. Through leveraging two cohorts of children, we may have a larger sample size that is able to detect moderation.

Finally, we examined if the associations were robust across child self-report, parental report of child general and social anxiety symptoms, and behavioral coding of social withdrawal when interacting with a novel peer. The previous studies examining associations between DF and child anxiety have not

utilized child self-report in the past. Thus, the current study aimed to extend the extant literature by incorporating measures of child self-report of anxiety and examining if associations with parent-report and observed social reticence are consistent with associations with child self-report. We hypothesized that higher likelihood of DF profile membership would be positively associated with anxiety symptoms at age 6, and that these associations would be stronger for boys than for girls. Additionally, we expected to find robust associations across child self-report and parental report of child anxiety symptoms, and behavioral coding of social reticence when interacting with a novel peer. Thus, we hypothesized that the associations between DF and anxiety symptoms would be similar across different informants and when examining behavior.

Materials and methods

Participants

The data was obtained from 261 children (54% boys, 46% girls, M_{age} = 24.39 months, SD = 1.4 months) and parents participating in a two-cohort longitudinal study of toddler's temperament and socioemotional development in age group 2–6 years. The participants for both cohorts were recruited using community-based sampling, such as birth announcements and a database of families interested in participating in research, from small Midwestern and Northeastern cities and their surrounding rural counties (Cohort 1 and Cohort 2, respectively). As part of the larger longitudinal study, toddlers for Cohort 2 were oversampled for anxiety risk and high fear at 18 months (see Buss, 2011 and Buss et al., 2018, for full sampling details).

Of participating families, 84% identified as White, 6% identified as Black, 4% identified as Asian, 2% identified as Hispanic, 1% of families identified as American Indian, and 3% identified as another race/ethnicity or did not respond. A total of 42.5% of participating families reported an income of over $60,000 a year, 33.5% of families reported an income of between $31,000 and $59,000, 12% reported an income of $29,000 or less, and 12% did not respond. 25.3% of mothers reported having completed high school and some college, 28.3% reported having completed their undergraduate degree, 22.7% reported having 1–3 years of graduate education, 9.7% of mothers reported having completed 4+ years of graduate education, and 14% of mothers did not report their education level. A total of 31.6% of fathers reported having completed high school and some college, 27% reported having completed their undergraduate degree, 15.6% reported having 1–3 years of graduate education, 12.2% reported having completed 4+ years of graduate education, 1% reported having not completed high school, and 12.7% of fathers did not report their education level.

Procedures and measures

Age 2 procedures and measures

During the first laboratory visit at age 2, mothers and children participated in a series of six tasks modeled from the toddler version of the Laboratory Temperament Assessment Battery and other fear-eliciting laboratory tasks (Toddler Lab-TAB; Nachmias et al., 1996; Buss and Goldsmith, 2000). Toddlers were introduced to six novel emotion-eliciting stimuli of varying threat levels, including watching a puppet show (low threat), being approached by an unfamiliar adult (medium threat), and being approached by automated toy spider (high threat). Toddlers were allowed to respond naturally (see for full description of tasks Buss, 2011).

Each task began with toddlers seated on their mother's lap. "Clown" task and "puppet show" were designed to be novel but engaging and non-threatening (i.e., low threat). During the clown task, a female experimenter entered the room dressed as a clown (i.e., multicolored wig, red nose) and invited the child to play with them. During the puppet show, two animal puppets played games with each other and invited the child to play with them. Two tasks were designed around interacting with strangers and considered to be moderate threat. In the "stranger working," a female stranger would enter the room and pretend to work, not interacting with the child unless initiated by the child. In stranger approach, a male stranger wearing a baseball cap would enter the room, slowly approaching the child, asking the toddler several short questions (e.g., "Are you having fun today?"). The high-threat tasks included Spider and Robot, in which toddlers began seated in their mother's lap facing a small animatronic object (a large plush spider affixed to an RC car or small anthropomorphic robot, respectively). The Robot sat motionless for a brief period and then moved around on a platform, making sounds, and lighting up. During Spider, after a similar period of inactivity the spider moved slowly toward the child and retreated (this occurred twice).

Observed fear during toddlerhood

Children's observed fear was calculated using second-by-second coding of facial fear, bodily expressions of fear, freezing, and proximity to caregivers during each task. Facial fear was coded using the AFFEX coding system (Izard et al., 1983), while bodily fear was coded as the presence and duration of bodily expressions of fear such as diminished play. Freezing was coded as the child becoming still or rigid in response to a stimulus for durations of 2 s and longer. Proximity to mother was calculated using the duration of time spent in maximum proximity to caregiver (i.e., sitting on mother's lap, physically touching). Finally, the latency to freeze was measured as the number of seconds between the beginning of the task and the first onset of freezing behaviors. A composite of the duration fear behaviors

was calculated (with latency to freezing reverse coded) and transformed into a proportion score (divided by total length of the episode).

Coders were rated at 90% interrater agreement and levels of internal consistency were acceptable for both cohorts (Buss et al., 2008, Buss, 2011). As such, the behaviors were averaged and compared to the total length of each episode to determine the percentage of each episode spent engaging in fearful behavior per episode.

Age 6 procedures and measures

Families were invited to participate in a multipart assessment during the fall and spring of children's kindergarten year. After agreeing to participate, the parents completed a series of at home questionnaires prior to the first of two laboratory visits (typically within one week). During the first laboratory visit, the children participated in a variety of tasks, including the Berkeley Puppet Interview (BPI; Measelle et al., 1998) in which children provided self-reports of their socially inhibited and anxious behaviors. During this task, the parents remained in another room so as not to influence children's responses; children received a small prize after completing the interview.

During the spring of the kindergarten year, parents who had expressed interest in participating in the study completed another series of questionnaires about children's socioemotional adjustment. Families returned to the lab for their second visit, in which children participated in a laboratory peer-visit. During this task, groups of 3–4 years of age, unfamiliar, same-sex children engaged in a 15-min free play episode as part of the activities under the Play Observation Study (Rubin, 1989). Children were provided a variety of activities and instructed to play "however you like."

Parent report of overanxiousness and social withdrawal

Parent reports of children's overanxiousness and social withdrawal were assessed using parent versions of the MacArthur Health and Behavior Questionnaire (HBQ; Armstrong et al., 2003). The parents were asked to report how accurately a variety of descriptions and behaviors represented the child on a scale from 0 = never/not true, 1 = sometimes/somewhat true, or 2 = often or very true. The overanxiousness subscale was composed of 12 items (i.e., "Has nightmares", or "Is Self-Conscious or easily embarrassed"), which were averaged to create one composite overaxiousness score (M = 0.39, SD = 0.24). Responses for parents and teachers were found to be reliable across both cohorts (Cohort 1 α = 0.70, Cohort 2 α = 0.66). Social withdrawal (M = 0.44, SD = 0.24) was measured as the mean of the 6-item Asocial with Peers subscale (i.e., "Is a solitary child," "prefers to play alone") and the 3-item Social Inhibition subscale (i.e., "Shy with other children" and "Is afraid of strangers"). Responses for parents and teachers were found to be reliable across both cohorts (Cohort 1 Parent α = 0.77, Cohort 2 Parent α = 0.76).

Child self-report of overanxiousness and social withdrawal

Children's self-report of overanxiousness and social withdrawal were assessed using children's video recorded responses to the BPI. During the BPI, each of the hand puppets offered opposing statements describing themselves such as "I have lots of friends at school" and "I don't have lots of friends at school," and then asked the child "What about you?" Children's responses were coded by trained coders on a 7-point Likert scale in which very positive self-reports (e.g., "I'm friends with everyone at school") were coded at one endpoint (1), and very negative self-reports (e.g., "I have no friends at school") were coded at the other endpoint (7). Interrater agreement (Cohort 1 = 96%, Cohort 2 = 93%) and reliability (Cohort 1 κ = 0.90, Cohort 2 κ = 0.83) were acceptable for both cohorts.

The overanxiousness subscale was composed of 6 items (i.e., "I have/don't have lots of bad dreams" and "I worry/don't worry a lot"), which were averaged to create one composite overanxiousness score (M = 5.07, SD = 0.90; Cohort 1 α = 0.52, Cohort 2 α = 0.50) As with the HBQ, social withdrawal (M = 4.88, SD = 0.88; Cohort 1 α = 0.70; Cohort 2 α = 0.75) was assessed using the mean of the Asocial with Peers subscale (five items, i.e., "I'd rather play games by myself/with lots of kids") and the Social Inhibition subscale (six items, i.e., "I worry/don't worry if other kids will like me"). Internal consistency for scales on the BPI are often lower for children recruited from the community compared to a clinic-referred sample as items with low base rates in a non-clinical samples can contribute to decreased internal consistency (Ablow et al., 1999).

Observed social reticence

Children's social reticence was assessed through observational coding of children's behaviors during the peer-visit task using the Play Observations Scale (POS; Rubin, 1989). Coders scored for a wide range of play and non-play behaviors in 10-s epochs with only one play behavior coded for each epoch. In line with Rubin, 1989, when multiple play behaviors occurred within a given epoch the behavior observed for the majority of the epoch was coded as predominant. Among these behaviors, unoccupied behavior was coded when children were staring blankly or wandering without purpose. Onlooking behaviors included watching children from a distance (e.g., further than three feet) without attempting to join the activity. As per a later work by Rubin et al. (e.g., Coplan et al., 1994; Rubin et al., 2002), these behaviors were collapsed into a single social reticence code containing any instance of unoccupied or onlooking behaviors. The proportion of time children were socially reticent (number of epochs in which social reticence was predominant divided by the total number of epochs) were computed and used for analyses. Interrater agreement (Cohort

TABLE 1 Means and standard deviations of key variables of interest by child gender.

	Full sample			Boys			Girls		
Variable	***M***	***SD***	***n***	***M***	***SD***	***n***	***M***	***SD***	***n***
Proportion of Fear									
Clown	24.70	22.64	261	24.31	23.41	141	25.17	21.79	118
Puppet show	30.60	22.23	259	30.25	23.66	141	31.02	22.80	118
Stranger working	23.17	17.09	259	22.81	18.33	142	23.61	15.51	115
Stranger approach	24.67	19.97	254	23.72	20.63	138	25.79	19.17	116
Robot	55.53	28.09	255	54.96	23.75	138	59.73	25.50	117
Spider	54.24	22.41	256	52.83	23.70	140	55.95	20.72	116
Anxiety behaviors at age 6									
BPI overanxiousness	5.07	0.90	128	5.04	0.91	69	5.11	0.90	59
BPI social withdrawal	4.88	0.88	128	4.81	0.89	68	4.94	0.90	59
Health and Behavior Questionnaire (HBQ) overanxiousness	0.39	0.24	157	0.39	0.25	84	0.38	0.22	73
HBQ social withdrawal	0.44	0.30	157	0.45	0.32	84	0.42	0.28	73
POS reticence	0.10	0.14	141	0.11	0.17	76	0.09	0.09	65

TABLE 2 Bivariate correlations of key variables of interest.

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Proportion of fear											
(1) Clown	1.00										
(2) Puppet Show	0.43*	1.00									
(3) Stranger Working	0.36*	0.34*	1.00								
(4) Stranger Approach	0.33*	0.24*	0.26*	1.00							
(5) Robot	0.19*	0.21*	0.17*	0.13*	1.00						
(6) Spider	0.26*	0.15*	0.06	0.06	0.35	1.00					
Anxiety behaviors at age 6											
(7) BPI overanxiousness	0.14	0.26*	0.08	−0.05	0.14	0.09	1.00				
(8) BPI Social withdrawal	0.17	0.19*	0.25*	0.04	0.17*	0.17*	0.24*	1.00			
(9) HBQ overanxiousness	0.15	0.06	−0.09	−0.02	−0.06	−0.06	−0.05	−0.05	1.00		
(10) HBQ social withdrawal	0.17*	0.27*	0.11	−0.01	0.01	0.01	0.12	0.02	0.43*	1.00	
(11) POS reticence	0.21*	0.13	0.05	0.16	0.05	0.05	0.09	−0.02	−0.03	0.24*	1.00

*$p < 0.05$.

1 = 93%, Cohort 2 = 94%) and reliability (Cohort 1 κ = 0.61, Cohort 2 κ = 0.85) were acceptable for both cohorts.

Data analytic plan

Missing data

There were data missing in this study (see **Table 1** for the number of the participants who provided data for each variable of interest). There were 22 patterns of missing data, and Little's MCAR test indicated that data was missing completely at random, $\chi^2 = 229$, $p = 0.06$. However, there were more missing data from Cohort 1 participants than Cohort 2 for the age 6 anxiety measures as well as sampling differences between the two cohorts, and so cohort was included as a covariate in all analyses with anxiety measures. Full information maximum likelihood (FIML) estimator in multiple regression models with missing data have shown to produce less biased parameter estimates, especially compared to listwise deletion, pairwise deletion and mean imputation (Enders, 2001). As such, all multiple regressions in this study were conducted using FIML.

Latent profile analyses

To identify the latent groups of the participants based on observed patterns of behaviors across the six fear-eliciting episodes, LPA was employed to estimate the profiles and the probability of profile membership for each individual within the same model (Mplus version 5.1; Muthén and Muthén, 2007). The latent profile models specified with two, three,

and four latent classes were evaluated. The best fitting model was selected based on the fit statistics (i.e., BIC and AIC), entropy, and bootstrapping likelihood ratio tests, as well as theoretical considerations.

Regression analyses

Multiple regressions were conducted using the *lavaan* package (Rosseel, 2012) in R (R Core Team, 2020). We used the probability of profile membership in the DF group to characterize DF using the full sample (N = 261). We ran five regression models to examine if child sex moderated the following associations between DF and different child anxiety outcomes: (1) Child self-reported overanxiousness, (2) child self-reported social withdrawal, (3) parent-reported overanxiousness, (4) parent-reported social withdrawal, and (5) observer coding of social reticence during the play task. Cohort was also included as a covariate in all models. When significant interactions were detected, simple slope tests (at 1 SD above and below the mean, and at the mean) were embedded within the model to help interpret the interaction terms.

Results

Descriptive statistics

Table 1 contains the means, standard deviations, and sample sizes of key variables of interest by child sex.

Table 2 contains bivariate correlations of all key variables of interest. Child report of overanxiousness was significantly, positively associated with child report of social withdrawal (r = 0.24), and parent report of overanxiousness was positively correlated with parent report of social withdrawal (r = 0.43). Across informants, child and parent reports of anxiety were not correlated with each other, but there was a significant, positive correlation between parent report of social withdrawal and observed reticence during the peer interaction task (r = 0.24).

Latent profile analysis

For the two-profile solution, the entropy was greater than 0.80, indicating this solution had adequate precision of individual profile membership (Celeux and Soromenho, 1996). The significant VLMR-LRTs for the two- and three-profile models suggested further consideration of these models. The BIC value was smallest for the three-profile model, and the entropy value of the three-profile model is close to 0.80. Hence, we selected the three-profile model as the best-fitting model due to both fit indices as well as theoretical considerations (Table 3).

Through visual inspection and statistical tests, all three profiles of fear across threat contexts were significantly different between groups across tasks. Average fear across each episode by profile can be found in Table 4 and Figure 1. One-way analyses of variance (ANOVAs) indicated that there were statistically significant differences between groups on fear across all tasks [clown task: $F(2, 250) = 184.70$, $p < 0.01$; Puppet Show: $F(2, 250) = 62.08$, $p < 0.01$; stranger working: $F(2, 248) = 28.63$, $p < 0.01$; stranger approach: $F(2, 245) = 12.36$, $p < 0.01$; Robot: $F(2, 246) = 233.70$; $p < 0.01$; Spider $F(2, 247) = 27.16$, $p < 0.01$]. Tukey *post hoc* tests were conducted to examine differences between specific profiles for each task. Profile 1 (N = 127) was labeled as "normative fear," as children exhibited low levels of fearful behaviors in low-threat tasks but exhibited higher levels of fear during high-threat tasks. Profile 2 (N = 84) was characterized by low fear across all tasks, thus labeled "low fear." Lastly, children in Profile 3 (N = 50) exhibited patterns of higher levels of fearful behavior across both high- and low-threat tasks and was thus labeled "dysregulated fear."

Does profile membership interact with child sex to predict anxiety symptoms at age 6?

Overanxiousness

Associations with child self-report

Table 5 contains the results of the multiple regression with probability of membership in the DF profile, child sex, their interaction as predictors of child self-reported overanxiousness, with cohort as a covariate (R^2 = 0.08, f^2 = 0.09). The probability of DF profile was significantly associated with child self-report of overanxiousness, β = 1.90, $p < 0.01$, while there were no main effects of child sex. The interaction between probability of profile membership and child sex was significantly associated with overanxiousness symptoms. Simple slopes testing demonstrated that probability of DF profile is positively associated with overanxiousness for boys (β = 0.96, $p < 0.01$), while probability of DF profile was not significantly associated with overanxiousness for girls (β = 0.00 $p > 0.05$). Figure 2 depicts the interaction between probability of DF profile membership and child sex to predict child self-reported overanxiousness.

Associations with maternal report

Multiple regressions with probability of profile membership, child sex, and their interaction as predictors of maternal report of child overanxiousness on the HBQ at age 6, with cohort as a covariate were not significant (R^2 = 0.02, f^2 = 0.02).

Social withdrawal

Associations with child self-report

Multiple regression with probability of DF membership, sex, and their interaction were not significantly associated with child self-report of social withdrawal on the BPI after controlling for cohort (R^2 = 0.08, f^2 = 0.09).

TABLE 3 Fit for latent profile models of age 2 fear behavior.

	1-Profile	2-Profile	3-Profile	4-Profile	5-Profile	6-Profile
Information criteria						
AIC	13907.01	13713.87	13675.56	13658.32	13649.93	13628.06
BIC	13949.78	13781.60	13768.24	13775.95	13792.51	13795.60
Adj. BIC	13911.75	13721.36	13685.81	13671.32	13554.69	13646.59
Log likelihood	−6941.504	−6837.934	−6811.780	−6796.158	−6784.963	−6767.032
Model convergence	Yes	Yes	Yes	Yes	Yes	Yes
Entropy	–	0.873	0.772	0.833	0.776	0.836
Relative fit tests						
VLMR	–	$p = 0.0000$	$p = 0.0108$	$p = 0.1828$	$p = 0.8315$	$p = 0.2986$
LMR Adj.	–	$p = 0.0000$	$p = 0.0 0122$	$p = 0.1908$	$p = 0.8347$	$p = 0.3057$
Bootstrapped LRT	–	$p = 0.0000$	$p = 0.0000$	$p = 0.0000$	$p = 0.0984$	$p = 0.0000$

TABLE 4 Means and standard deviations for fear during each Lab-TAB event by profile.

Profile	Clown *M* (*SD*)	Puppet show *M* (*SD*)	Stranger working *M* (*SD*)	Stranger approach *M* (*SD*)	Robot *M* (*SD*)	Spider *M* (*SD*)
(1) Normative fear	17.61 (12.58)	27.18 (19.83)	21.77 (14.74)	23.15 (18.85)	73.20 (14.98)	57.06 (20.87)
(2) Low fear	14.31 (16.22)	19.57 (15.91)	16.65 (14.15)	20.02 (20.14)	22.46 (15.43)	41.66 (22.14)
(3) Dysregulated fear (DF)	60.57 (15.57)	56.94 (21.59)	37.55 (18.33)	36.65 (17.03)	65.92 (21.88)	68.38 (16.36)

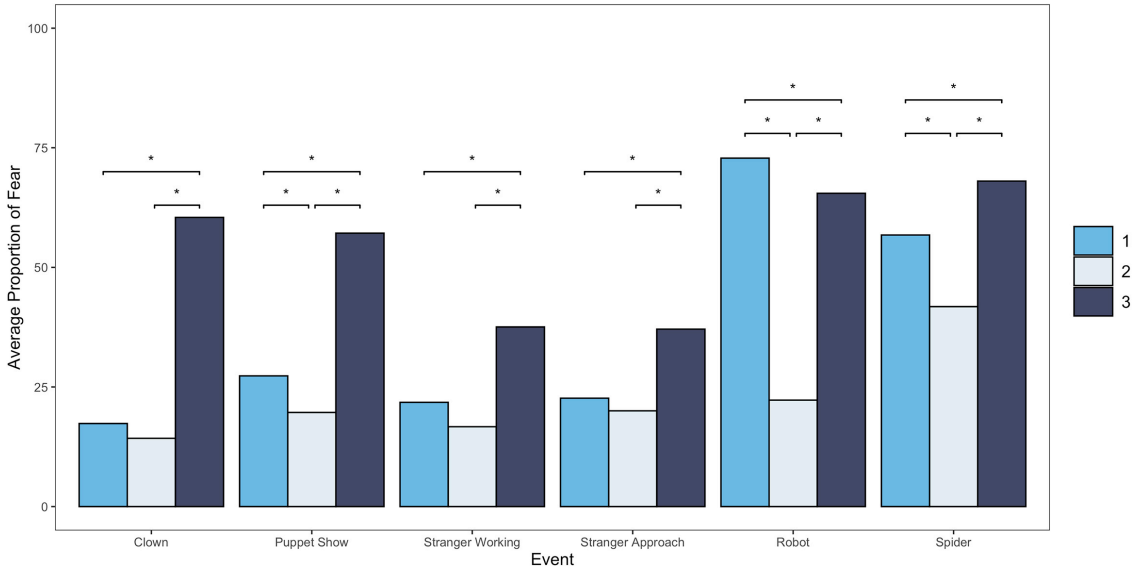

FIGURE 1
Bar chart showing average proportion of fear for each event by profile, with significant differences between profiles indicated. *$p < 0.05$.

Associations with maternal report

A multiple regression with the probability of DF membership, sex, and their interaction were significantly associated with maternal report of social withdrawal on the HBQ at age 6 after controlling for cohort ($R^2 = 0.04, f^2 = 0.04$). Table 6 contains the results of the multiple regression with probability of membership in the DF profile, child sex, their interaction as predictors of child-reported social withdrawal

TABLE 5 Summary of multiple regression of membership in dysregulated fear (DF) profile, child sex, and their interactions on child self-report of overanxiousness on the BPI.

Predictors	Estimate	SE	95% CI		*p*
			Lower	Upper	
Cohort	−0.227	0.164	−0.548	0.094	0.165
Probability of DF membership	1.837	0.656	0.003	0.307	0.005
Child Sex	0.078	0.154	−0.223	0.379	0.611
Probability of DF × Sex	−0.956	0.426	−1.792	-0.121	0.025

on the BPI, with cohort as a covariate. The probability of membership in the DF profile was significantly associated with parent report of social withdrawal, β = 0.43, $p = 0.03$, while there were no main effects of child sex. The interaction between probability of profile membership and child sex was trending toward significance. Figure 3 depicts the interaction between probability of DF profile membership and child sex to predict maternal report of social withdrawal.

Associations with observed reticence during a peer task

A multiple regression with the probability of DF membership, child sex, and their interactions on reticence during a peer interaction task with cohort as a covariate ($R^2 = 0.08$, $f^2 = 0.09$). Table 7 contains the results, showing a main effect of probability of DF membership was positively associated with reticence (β = 0.13 $p < 0.01$). Additionally, the interaction between probability of DF membership and child sex was trending toward significance (β = −0.10 $p = 0.06$), with simple slopes demonstrating that probability of DF membership is positively associated with reticence for boys (β = 0.11, $p = 0.01$), while probability of DF membership was not significantly associated with reticence for girls (β = 0.01 $p > 0.05$). Figure 4 depicts the interaction between the probability of DF profile membership and child sex to predict external observers' scores of social reticence.

Discussion

The current study extends the findings of previous studies on fearful temperament as a marker of anxiety risk by using person-centered methods to characterize fearful temperament across six tasks of varying threat. The results were largely consistent with our hypotheses that DF was associated with features of social anxiety. Additionally, we found evidence that child sex may moderate associations between DF and child anxiety symptoms, such that toddler boys exhibiting DF may be at higher risk for developing later anxiety symptoms during early childhood. Additionally, we found the differential associations between fearful temperament and child anxiety symptoms during the early childhood period depending on the reporter of anxiety symptoms, highlighting the importance of utilizing a multi-method and multi-reporter approach.

Three-profile solution for fearful temperament across contexts

The uniqueness of our person-centered approach enabled us to characterize fearful temperament by examining fearful

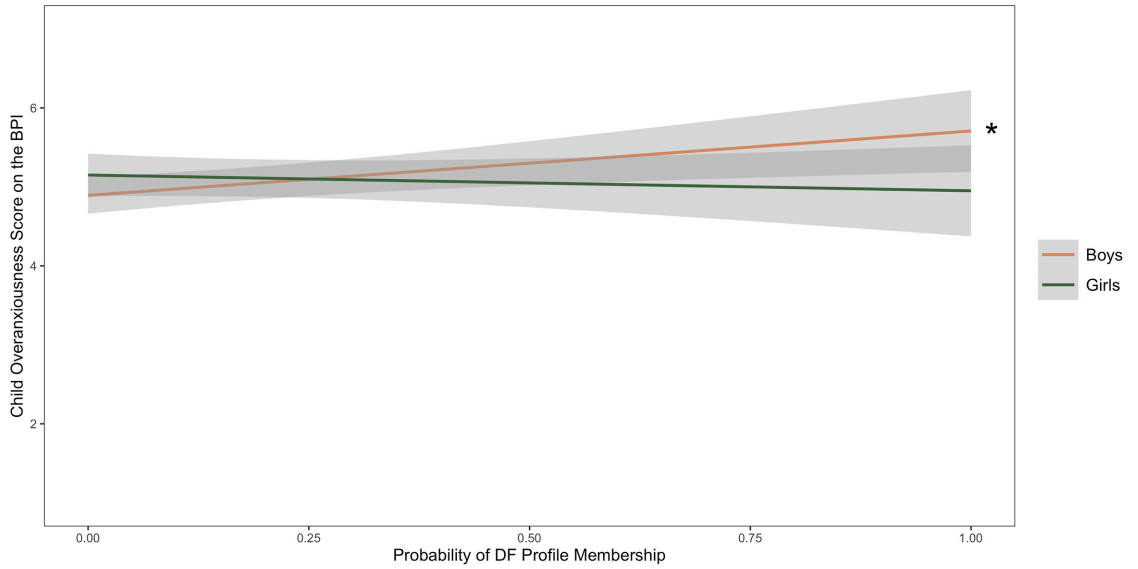

FIGURE 2
Line graph depicting associations between the probability of dysregulated fear (DF) profile membership and child self-report of overanxiousness on the BPI, with child sex as a moderator. The symbol * indicates a significant slope ($p < 0.05$).

TABLE 6 Summary of multiple regression of membership in dysregulated fear (DF) profile, child sex, and their interactions on maternal report of social withdrawal on the Health and Behavior Questionnaire (HBQ) at child age 6.

Predictors	Estimate	SE	95% CI		*p*
			Lower	Upper	
Cohort	0.003	0.049	−0.093	0.099	0.947
Probability of DF membership	0.434	0.196	0.046	0.386	0.026
Child Sex	−0.035	0.047	−0.128	0.058	0.462
Probability of DF × Sex	−0.218	0.127	−0.468	0.031	0.086

behaviors across contexts, instead of considering fearful temperament as an average of fearful behavior across tasks. From the analyses conducted, we find evidence for three different profiles of temperamental fear across threat levels. Consistent with the findings from Buss (2011), we identified patterns of fearful behavior across contexts that were normative (low fear in low-threat contexts, and high fear in high-threat contexts) as well as dysregulated (high fear in both low- and high-threat contexts). We expected most children to express lower levels of fearful behavior in low-threat contexts, and higher levels of fearful behavior in high-threat contexts, a pattern that is consistent with adaptive fear and stress responses in humans. Additionally, consistent with the previous studies, we identified a group of children who did not appear to regulate their emotions across different contexts and displayed high levels of fear across both low- and high-threat contexts. It is important to note that children in the DF profile do not always exhibit more fear that other children, especially other types of fearful children. Because fear can be adaptive in high-threat contexts we have reported elsewhere that DF children are indistinguishable if only observed in high-threat contexts (Buss, 2011). Instead, DF children exhibit fearful behaviors even in low-threat contexts, which sets them apart from the normative fear profile and likely indicates their lack of ability to regulate their fear across different contexts.

Additionally, through increasing the sample size by leveraging data from two cohorts, we were able to identify a third profile of low fear (low fear in both low- and high-threat contexts). It is possible that children in the low fear group may be exuberant or surgent, and exhibit higher levels of approach (Putnam and Stifter, 2005). Exuberant and surgent children have been found to display lower levels of fearful behavior even in the context of higher levels of threat (Fox et al., 2001). Additional work suggests these children may be higher in approach toward novelty and may also be indicative of poor (or inappropriate) emotional reactivity to high-threat contexts. More work is needed to replicate our findings as there has not been work done on children expressing low fear (and possibly high approach) across varying contexts of low and high threat. It could be that this pattern of low fear across low- and high-threat contexts may be one way to characterize exuberant temperament, and may play a role in identifying which of these

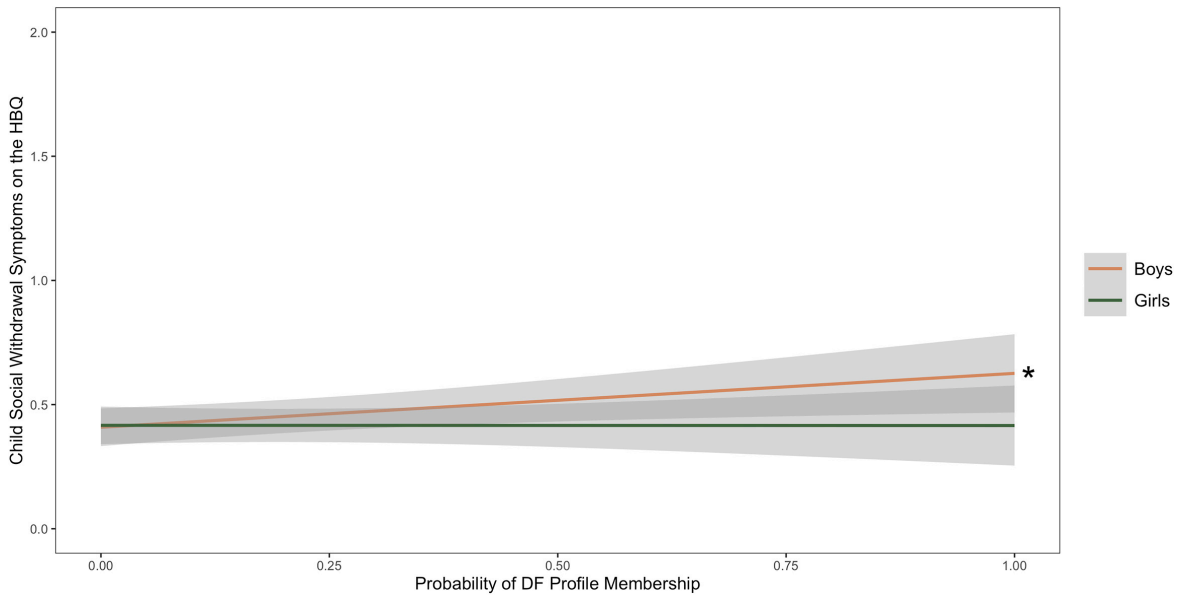

FIGURE 3
Line graph depicting associations between the probability of dysregulated fear (DF) profile membership and parental report of social withdrawal symptoms on the Health and Behavior Questionnaire (HBQ), with child sex as a moderator. Other multiple regressions with probability of profile membership, child sex, and their interaction as predictors of maternal report of child social withdrawal on the Health and Behavior Questionnaire (HBQ), with cohort as a covariate were not significant (R^2 = 0.01, f^2 = 0.01). The symbol * indicates a significant slope ($p < 0.05$).

TABLE 7 Summary of multiple regression of membership in dysregulated fear (DF) profile, child sex, and their interactions on behavioral coding of reticence during a peer play task.

Predictors	Estimate	SE	95% CI		*p*
			Lower	Upper	
Cohort	−0.029	0.021	−0.076	0.015	0.168
Probability of DF membership	0.126	0.037	0.057	0.215	0.001
Child Sex	−0.013	0.020	−0.057	0.029	0.515
Probability of dysregulated fear DF × Sex	−0.102	0.053	−0.223	0.002	0.055

children may be at risk for developing externalizing symptoms (Degnan et al., 2011).

Fearful boys may be at greater risk for anxiety

Our findings using person-centered methods are consistent with the previous studies that show DF as a marker of anxiety risk. Additionally, our findings suggest that DF may be a risk factor for anxiety development specifically for boys during the early childhood period. We found that DF was positively associated with child self-reported general anxiety symptoms in boys. Additionally, the interaction between DF and child sex was approaching significant in the models examining parent-reported social withdrawal and observed social reticence. While the results should be interpreted with caution given that they were not significant, the findings provide preliminary evidence that DF may be positively associated with both parent-reported social withdrawal and observed reticence in boys, but not in girls. Taken together, we find evidence that child sex may moderate some associations between DF and anxiety, and that in particular, fearful boys might be at higher risk of anxiety development during this early childhood period.

Some of the findings in this study are consistent with the previous research demonstrating associations between inhibited temperament and social wariness in young boys but not in girls (Henderson et al., 2001). One mechanism through which sex differences may emerge could be through parenting behaviors and socialization of emotion. There is growing evidence that fearful temperament is associated with child anxiety through maternal protective behavior (Kiel et al., 2016; Buss et al., 2021b). Additionally, Kiel et al. (2016) demonstrate that child sex interacts with DF and maternal accuracy in relation to protective parenting behaviors, and that this may be a pathway by which DF is associated with later anxiety. Parents may respond to their children's fearfulness differently based on child sex, as some evidence suggests parents respond to boys' fearful behaviors with greater concern, intrusiveness and protective parenting compared to girls (e.g., Park et al., 1997; Kiel et al., 2016). Additionally, the previous studies also show that boys and girls may differ in seeking out their parents for help with regulating distress, and there were only associations between distress during fear-eliciting tasks with contact-seeking for boys, not girls (Buss et al., 2008). Future work should examine the role that protective parenting, or parental socialization of emotion

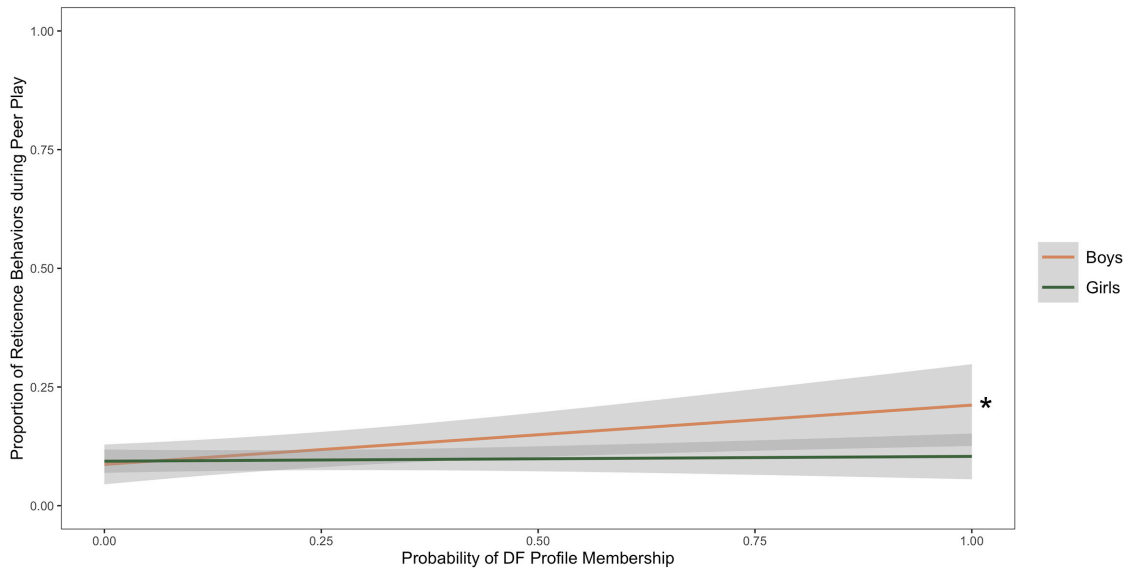

FIGURE 4
Line graph depicting associations between the probability of dysregulated fear (DF) profile membership and proportion of reticence behaviors during a peer play task, with child sex as a moderator. The symbol * indicates a significant slope ($p < 0.05$).

may differ for fearful boys vs. fearful girls, and how that may be a pathway by which fearful temperament is associated with later anxiety outcomes.

Multiple informants of child anxiety

Lastly, one of the strengths of the current study is the use of multiple informants to assess child anxiety and social withdrawal. Contrary to our hypotheses, we did not find consistent robust associations between fearful temperament and anxiety outcomes for different measures of anxiety. We did not find significant associations between DF and child self-report of social withdrawal, and we did not find associations between DF and maternal report of child overanxiousness. Of note, child self-report measures of overanxiousness and social withdrawal were not significantly correlated with parent-reported overanxiousness and social withdrawal as well as observed social reticence. A previous research in an adolescent sample found that child- and parent-reported anxiety are differentially associated with anxious behaviors in different contexts (Bowers et al., 2020). As such, parent report of social withdrawal is more strongly associated with observational coding of reticence during an unfamiliar play task likely because parents have had the opportunity to observe their children in these situations. On the other hand, child self-report of social withdrawal not being associated with observed reticence at this early developmental period may not be that surprising. One possibility to explain the consistency between parent and external observer reports of social withdrawal is that both measures may be based more on observable anxiety behaviors of the child, whereas child self-report may reflect elements of children's understanding of emotion and cognitive processes. There is evidence that children exhibit self-appraisal biases in social situations (Lau et al., 2022), which could lead to disparities between child self-report with observer (including parental) reports. Additionally, research on children's social withdrawal demonstrate that there are shy children who are motivated to seek out peers and social interactions, but are too shy to do so (Coplan et al., 2004). This highlights the importance of considering multiple informants, as they may capture different processes underlying social withdrawal and reticence in children.

At the same time, with the age of the sample, findings with child self-report should be viewed with caution. While the BPI has been established as a valid instrument to collect child self-report of clinical symptoms when children are between 4 and 8 years of age, it is important to note that reliabilities for child self-report of overanxiousness was relatively low in this sample ($\alpha = 0.51$). Ablow et al. (1999) found that internal consistency for scales on the BPI were often lower for children recruited from the community compared to a clinic-referred sample. It is possible that for items with low base rates in a non-clinical sample can contribute to decreased internal consistency, and the samples in the current study were not clinically referred. One other possibility is that some research demonstrates children may endorse items regardless of their content and acquiesce more during interviews due to developing socioemotional competencies and understanding of emotion, leading to more inconsistencies across scales (Soto et al., 2008; Denham et al., 2009). Future studies should extend the current findings to examine if there may be differences in ways children are interpreting their own emotions and feelings of anxiety compared to how parents and external observers are observing their anxiety behaviors across the later developmental periods.

Limitations

The current findings should be interpreted within the context of design limitations. First, the sample is majority white and relatively low risk, although we oversampled for fearful behaviors during toddlerhood for Cohort 2. Future studies should examine whether these findings may extend to other populations. Although mean anxiety levels across the sample are consistent with community samples (Ablow et al., 1999), studies have demonstrated poorer internal consistency within community samples compared to clinical samples. This work should be replicated in higher risk samples with higher endorsement of anxiety symptoms to assess if these associations between DF and anxiety are still present, as there may be differences in fearful temperament profiles for children developing in different contexts. Additionally, as factors such as parenting or parental socialization of emotion were not examined, our understanding of why fearful boys may be at higher risk for anxiety development is limited. Future research should aim to explore the mechanisms that may place boys at higher risk for anxiety development if they exhibit profiles of DF, such as observing parenting behavior in response to children's fearful behaviors across contexts or considering parental socialization of emotion as a pathway. Future studies should also consider the differential roles that mothers and fathers may play, as the previous studies show that fathers may respond differently to children's negative emotionality compared to mothers (Engle and McElwain, 2011). Lastly, while this study is a longitudinal study, repeated measures of child anxiety symptoms were not assessed. Examining change in fearful temperament and/or child anxiety symptoms can further our understanding of how risk factors influence the developmental trajectories of anxiety development across time. Although a previous work demonstrates that girls exhibit higher levels during adolescence (Letcher et al., 2012), future work should examine if fearful temperament is associated with sex differences in trajectories of anxiety development from early childhood through adolescence.

Conclusion

This study provides evidence that it is important to consider the emotion-eliciting contexts in which fearful behavior occurs to characterize fearful temperament. Consistent with the previous literature, children who display elevated fear across contexts of varying threat are at greater risk for anxiety development. This study extends the extant literature by leveraging two cohorts to increase power to detect multiple patterns of fearful behavior across context, identifying a low fear profile in addition to replicating patterns of normative fear and DF. Additionally, this study contributes to the literature on DF as a marker of risk for anxiety by findings showing higher risk for DF boys, and by utilizing child self-report outcomes. Our study highlights the importance of (1) considering fearful temperament as characterized by behavior across different contexts and (2) using multiple informants to assess anxious behaviors during childhood. Through extending our knowledge of how to characterize risk for anxiety development across different contexts and using multiple measures, we can better understand how to best identify children at the greatest risk for anxiety development.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions. The data are not publicly available due to privacy or ethical restrictions. Requests to access these datasets should be directed to KB, kab37@psu.edu.

Ethics statement

The studies involving human participants were reviewed and approved by University of Missouri Human Subjects Research Office and The Penn State Office of Research Protections. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

KB and AZ conceived and designed the study. AZ, AT, AV, and XF contributed to the statistical analyses presented in the manuscript. AZ wrote the first draft of the manuscript. AT wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

The data for this study was supported by grants from National Institutes of Health (MH067797 and MH075750 to KB). KB was also supported by the PSU Social Science Research Institute and holds the Tracy Winfree and Ted H. McCourtney Professorship in Children, Work, and Families.

Acknowledgments

We thank the families who participated in this project and the staff and students of the Emotion Development Labs at University of Missouri and Penn State who helped to collect and prepare the data.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 06 September 2022
DOI 10.3389/fpsyg.2022.933213

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 30 April 2022
ACCEPTED 22 July 2022
PUBLISHED 06 September 2022

CITATION
Zdebik MA, Pascuzzo K, Bureau J-F and Moss E (2022) Childhood behavioral inhibition and attachment: Links to generalized anxiety disorder in young adulthood.
Front. Psychol. 13:933213.
doi: 10.3389/fpsyg.2022.933213

Childhood behavioral inhibition and attachment: Links to generalized anxiety disorder in young adulthood

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Generalized anxiety disorder (GAD) is under-treated yet prevalent among young adults. Identifying early risk factors for GAD would contribute to its etiological model and identify potential targets for intervention. Insecure attachment patterns, specifically ambivalent and disorganized, have long been proposed as childhood risk factors for GAD. Similarly, childhood behavioral inhibition has been consistently associated with anxiety disorders in adulthood, including GAD. Intolerance of uncertainty (IU), the tendency to react negatively to uncertain situations, has also been shown to be a crucial component of GAD. Furthermore, maternal anxiety is an important feature of developmental models of anxiety including GAD. Yet, to date, no study has examined, within a comprehensive model, how attachment and behavioral inhibition in childhood, maternal anxiety in adolescence, and IU in emerging adulthood contribute to GAD in adulthood. The present study thus examines these links using a longitudinal design with 62 Canadian participants and their mothers. At age 6, participants' attachment and behavioral inhibition were assessed observationally. Maternal anxiety was measured when participants were 14 years of age. IU and GAD were assessed when participants were 21 and 23 years of age, respectively. Structural equation modeling showed that IU mediates the relationships between behavioral inhibition and GAD, while controlling for maternal anxiety. Ambivalent and disorganized-controlling attachment patterns are also indirectly associated with increased GAD symptoms via greater IU scores. Furthermore, a direct and positive effect of behaviorally disorganized attachment was found on GAD symptoms. This longitudinal study supports integrating attachment, behavioral inhibition, and IU in a model of GAD.

KEYWORDS

attachment, behavioral inhibition, generalized anxiety disorder, intolerance of uncertainty, longitudinal design, temperament

Introduction

Generalized anxiety disorder (GAD), a common mental health disorder characterized by excessive worry, is frequently undertreated among adults (Robichaud et al., 2019). Individuals suffering from GAD experience reduced quality of life and notable functional impairment, and GAD is associated with high societal and economic costs due to overuse of health care services and impacts on work productivity (Wittchen, 2002; Hoffman et al., 2008). GAD is most commonly diagnosed in adulthood with the majority of cases appearing around late adolescence and early adulthood (Rogers et al., 1999; Kessler et al., 2001). However, individuals that suffer from GAD commonly describe themselves as being lifelong worriers (American Psychiatric Association, 2013). Furthermore, individuals with GAD wait on average nearly 25 years before seeking clinical help (Rapee, 1991). Hence identifying childhood and developmental risk factors associated with GAD would help develop effective early prevention and intervention programs, in order to obviate or reduce long term suffering.

Over the years, several theoretical models of GAD have been proposed (see Behar et al., 2009 for review). Three models stand out as leading to possible clues to early life factors related to GAD. Borkovec's (Borkovec, 1994; Borkovec et al., 2004) avoidance model of worry and GAD stipulates that worry is seen as an ineffective cognitive strategy to confront threatening stimuli which also leads to avoidance of the negative physical and emotional arousal triggered by the feared situation. More recently, Sibrava and Borkovec (2006) suggested that certain predispositions linked to early life experiences can affect an individual's perception of threat, such as childhood insecure attachment. An insecure attachment could lead an individual to perceive his environment as threatening but lack the emotional regulation skills to adequately respond and hence be more at risk for GAD (Cassidy, 1995; Sibrava and Borkovec, 2006; Cassidy et al., 2009). The intolerance of uncertainty model (Freeston et al., 1994; Dugas et al., 1998, 2004) stipulates that those individuals that are unable to cope with uncertain and ambiguous situations are more at risk for increased worry and hence to develop GAD. Individuals with higher levels of intolerance of uncertainty tend to react more intensely and negatively to uncertain, novel, and ambiguous situations (Dugas et al., 2004; Dugas and Robichaud, 2007), pointing to a possible physiological predisposition. A more recent model of GAD, the emotional dysregulation model (Mennin et al., 2004, 2005), stipulates that those individuals that suffer from GAD have a lower threshold for emotional activation and experience emotions more intensely, perceive emotions more negatively, have a poorer understanding of their emotions and have inadequate emotional regulation. This model highlights both physiological predispositions for heightened emotional responses and a lack of emotional regulation skills to manage responses. Taken together, these models point to potential etiological clues viewed from the perspective of a physiological vulnerability, such as a lower threshold to react to negative stimuli more intensely, as seen in some temperamental profiles such as behavioral inhibition, and inadequate emotional regulation skills, which have been associated with insecure attachment. Indeed, merging of certain models, like the intolerance of uncertainty model and the emotional dysregulation model in order to have a more complete view of GAD, has been recently suggested (Ouellet et al., 2019).

Developmental models of GAD (Rapee, 2001) have also emphasized similar variables as important in its development. Childhood factors such as the child's own characteristics and vulnerabilities including temperament (particularly behavioral inhibition), emotional dysregulation and cognitive biases related to perception of threat, parental characteristics such as parental anxiety and parent-child interactions, and environmental factors such as stressful life events that can impact an individual's sense of control, have all been identified as possible contributing factors to the development of GAD (Rapee, 2001; Newman et al., 2013). In this paper we thus focus on four factors that have been identified as important contributors to GAD: intolerance of uncertainty (cognitive bias), behavioral inhibition (temperament), insecure attachment (parent-child interaction) and maternal anxiety (familial and heritable transmission).

IU and GAD

Intolerance to uncertainty (IU) is the tendency to perceive and react negatively to uncertainty on a behavioral, cognitive, and emotional level. Being intolerant to uncertainty can lead to long-term negative effects, since uncertain situations can be encountered daily (Dugas et al., 2004). Indeed, IU has been consistently associated with worry and anxiety in adulthood (see Dugas et al., 2004; Behar et al., 2009), increasing the risk of developing an anxiety disorder, particularly GAD. IU is thus a central precursor in the theoretical model of GAD, as it acts as a filter in ambiguous situations, leading to negative interpretations (Dugas and Robichaud, 2007; Robichaud et al., 2019). Few studies have investigated childhood risk factors contributing to IU in adulthood (for exceptions see: Tan et al., 2010; Zdebik et al., 2018) and only one has done so prospectively, linking insecure attachment and behavioral inhibition at age 6 to IU in emerging adulthood at age 21 (Zdebik et al., 2018). Since IU is highly associated with GAD, such work supports the assumptions of theoretical and developmental models of GAD that insecure attachment, as well as increased physiological responsiveness to novelty such

as seen in behavioral inhibition, could pose significant risk for later GAD.

Behavioral inhibition, IU, and GAD

Behavioral inhibition, a tendency to withdraw in the face of novelty and uncertainty, is also linked to anxiety disorders, including GAD (Svihra and Katzman, 2004; Degnan and Fox, 2007; Karevold et al., 2009; Sandstrom et al., 2020). From birth, behaviorally inhibited children respond strongly and negatively to unfamiliar, novel, or ambiguous stimuli or situations (Kagan and Snidman, 2004). Due to this physiological predisposition, they prefer to avoid uncertain circumstances at an early age. In doing so, their avoidant behaviors are reinforced, decreasing the opportunity to habituate to these situations which puts them at risk of developing an anxiety disorder (Manassis and Bradley, 1994; Lonigan and Phillips, 2001). Recent research has also linked inhibited child behaviors (i.e., low sociability and shyness) and IU in adolescence (Hawes et al., 2021) and in adulthood (Zdebik et al., 2018). Behavioral inhibition has also been associated with anxiety disorders and GAD in children and adolescence (Hudson and Dodd, 2012; Stumper et al., 2017; Sandstrom et al., 2020). However, few studies have examined associations between this temperamental profile and GAD in adulthood prospectively (Moffitt et al., 2007; Beesdo et al., 2010).

Attachment, IU, and GAD

Problematic parent-child relationships, particularly insecure attachment, have been associated with anxiety in children and adolescents (Kerns and Brumariu, 2014 for review) as well as in adults (Dagan et al., 2020 for review), and have been specifically linked with GAD in adulthood (Eng and Heimberg, 2006; Viana and Rabian, 2008; Cassidy et al., 2009; Schimmenti and Bifulco, 2015; Newman et al., 2016). However, most longitudinal investigations were done retrospectively and very few studies have specifically examined the links between attachment and GAD in younger populations (Hale et al., 2006). Children's reactions in stressful situations depend on their interpretations and expectations of their caregiver's behaviors and responses to their needs for comfort and care (Goldberg, 2000). According to attachment theory, a child that learns that their caregiver can be relied on for comfort and for help to regulate distress in stressful or uncertain situations will develop a secure attachment (Bowlby, 1969/1982). Conversely, when the parent is inconsistent in their ability to provide support, or alternatively rejects the child's bids for proximity when confronted with a stressful or uncertain situation, the child is at risk of developing an insecure attachment (Bowlby, 1969/1982; Chorpita and Barlow, 1998). Under such conditions, children may not learn to adequately regulate their distress, leading to a sense of uncertainty and to negative interpretations of ambiguous situations (Dykas and Cassidy, 2011).

In preschool and school-aged children, secure (B), avoidant (A), ambivalent (C), disorganized-controlling (Dcont) (caregiving-type and punitive type) and behaviorally disorganized (BehD) attachment patterns have been identified (Main and Cassidy, 1988; Cassidy et al., 1992). Studies linking these attachment patterns to parental psychological wellbeing, parental sensitivity, and child outcomes have been the object of recent systematic reviews and meta-analyses (Badovinac et al., 2018, 2021; O'Neill et al., 2021). According to attachment theory, when caregivers are sensitive, warm, predictable, responsive, and accessible, children are more likely to develop a secure attachment (B) to their caregiver (Bowlby, 1969/1982; Ainsworth et al., 1978). Within a secure relationship, the caregiver comforts their child and reduces their distress in stressful situations, thus helping the child regulate their emotions and develop capacities to self-regulate (Kopp, 1989; Cassidy, 1994; Bretherton and Munholland, 1999). An avoidant attachment pattern (A) can be observed when caregivers are less sensitive, more inaccessible, and rejecting, and children minimize their dependency upon the caregiver by acting and playing autonomously (Main and Cassidy, 1988). As for children with an ambivalent attachment pattern (C), they tend to have caregivers that can be characterized as inconsistent, unpredictable, and unreliable which can lead to feelings of uncertainty and worry about parental availability in stressful situations (Main and Cassidy, 1988). These children typically show greater vulnerability and immaturity. In a disorganized (D) attachment, caregivers can be simultaneously a source of comfort and of fear and anxiety. These caregivers are known to show frightening or frightened behaviors toward the child (e.g., blank facial expressions or severe hostility), stemming from potential mental health problems, such as severe depression, or parental maltreatment (Moss et al., 2011). An inability to tolerate the uncertainty and fear related to the caregiver leads some of these children to attempt to control their environment, including their parent, in order to regulate their own anxiety through role-reversal behaviors (disorganized-controlling pattern – Dcont), where they act in either a caregiving or punitive manner toward the parent (Main and Cassidy, 1988; Solomon et al., 1995; Moss et al., 2004). Specifically, children with a controlling-caregiving attachment pattern may want to help or cheer-up their parent, whereas children with a controlling-punitive attachment can show hostile or punitive behaviors toward their parent (Cassidy et al., 1992). As for children classified with a behaviorally disorganized and/or insecure-other attachment pattern (BehD), they can display unusual, conflicting, or incomplete movements, disoriented and disordered behaviors, confusion, and apprehension with an absence of a coherent strategy to regulate comfort-seeking behavior (Main and Solomon, 1990). These children do not and cannot attempt to regain control over the uncertainty in their

family environment as it may be too chaotic (Moss et al., 2011). For all the insecure attachment patterns, caregivers' behaviors fail to contribute to the child's development of adequate emotional self-regulation. In our previous work, we found that insecure attachment in childhood at age 6, specifically the ambivalent and disorganized-controlling attachment patterns, contribute to the development of IU 15 years later, in emerging adulthood (Zdebik et al., 2018). Insecure attachment characterized by inconsistent, unavailable, and unpredictable parenting or by role-reversal in the parent-child dyad has also been linked to the development of GAD in adulthood (Cassidy et al., 2009; Tan et al., 2010), however, these studies measured attachment retrospectively.

Maternal anxiety, IU, and GAD

It has been well documented that anxiety disorders, including GAD, run in families (Noyes Jr et al., 1987; Gerull and Rapee, 2002; Hudson and Rapee, 2004; Aktar et al., 2017; Lawrence et al., 2019). Indeed, several studies documented genetic heritability of GAD from parent to child (Scherrer et al., 2000; Hettema et al., 2001). Furthermore, environmental transmission of GAD from parent to child has been associated with parental modeling of anxious behaviors, parenting characteristics, and transmission through cognitive biases such as intolerance of uncertainty (Aktar et al., 2017 for review). Accordingly, maternal anxiety should be considered as a control variable when investigating the unique contribution of child specific risk factors of GAD.

Prospective studies of risk factors associated to GAD

Although the aforementioned risk factors have been investigated in childhood anxiety disorders in general, relatively few studies have prospectively examined the early factors that contribute to GAD in adulthood (Moreno-Peral et al., 2014 for review). As identified in developmental models of GAD, factors found to be linked to GAD in adulthood were behavioral inhibition, previous mental health problems, parenting characteristics (low warmth and caring, high overprotection and control), parental mental health problems, stressful life events including parental divorce and childhood separation events, childhood adversity (neglect, physical, and sexual abuse), neuroticism, and smoking. However, only two of the 17 studies (Clark et al., 2007; Moffitt et al., 2007) assessing GAD in adulthood identified by Moreno-Peral et al. (2014) had a childhood age at baseline with all other studies starting their assessment in adolescence or adulthood. Hence, most risk factors were assessed during adolescence and adulthood or retrospectively. In one of the studies reviewed, following over a thousand children from the age of 3 to 32 (Moffitt et al., 2007), childhood risk factors associated with GAD in adulthood included behavioral inhibition, problematic parent-child relationship (maltreatment), maternal internalizing symptoms, and low socioeconomic status. Accordingly, no study to date has examined the longitudinal contribution of childhood behavioral inhibition, childhood attachment, and IU to the development of adult GAD, while considering the confounding influence of maternal anxiety.

Objectives

The objective of the current study is to expand on our previous work examining longitudinal prediction of IU in emerging adulthood (Zdebik et al., 2018). Specifically, we want to examine if childhood behavioral inhibition and attachment at age 6 and IU at 21 years of age directly contribute to GAD in young adulthood (at age 23), while controlling for maternal anxiety, and whether the associations between behavioral inhibition and attachment and GAD are mediated by IU. Based on previous empirical work and models of the development of anxiety, we predicted that behavioral inhibition would independently contribute to the development of GAD (Svihra and Katzman, 2004; Degnan and Fox, 2007). Insecure-ambivalent and disorganized-controlling attachment patterns are also predicted to be associated with GAD (Cassidy, 1995; Warren et al., 1997; Dugas et al., 2004). IU is predicted to be directly associated with higher levels of GAD symptoms (Dugas et al., 2004; Behar et al., 2009). Furthermore, as previously found (Zdebik et al., 2018), behavioral inhibition and insecure-ambivalent and disorganized-controlling attachment types are also predicted to be associated with IU. This study is thus an important step, extending previous findings by Zdebik et al. (2018) by testing a comprehensive model that includes both child and mother known predictors of GAD, and considering an integrative approach to temperament and childhood contexts with cognitive factors that can mediate relationships to later mental health outcomes.

Methods

Participants

Participants were 62 children and their mothers, representative of the general Quebec (Canada) population, taking part in an ongoing longitudinal study examining the parent-child relationship and children's socioemotional adaptation (see Moss et al., 2006). Participants were followed from early childhood to adulthood with observational measures of behavioral inhibition and attachment, sociodemographic and psychopathology symptom measures. Participants were recruited from non-profit daycares in the Montreal, Quebec

area. Non-profit daycares represent more varied socioeconomic levels than private daycares. Initial recruitment was done on a voluntary basis via announcements made by daycare management to parents whose children were 4 years-old. Parents wishing to participate in the study completed a consent form and were then contacted by phone to schedule a visit for the mother and her child to the laboratory. About 50% of parents from participating daycares, whose child was in the correct age range, agreed to participate in the research. This initial time point was not included in the current study.

In the current study, of the 129 participants at Time 1 (T1, 69 girls and 60 boys), 38% of participants were lost to attrition at Time 2 (T2), the adolescent phase (T2, $N = 80$, 47 girls and 33 boys). At Time 3 (T3), 23% ($N = 18$) of participants did not complete the young adult phase (T3, $N = 62$, 40 young women and 22 young men). At the final time point (T4), another 19% ($N = 12$) was lost to attrition (T4, $N = 50$, 33 young women and 17 young men). At T4, 42% of participants still lived at home at the time of the study and 48% were in a relationship. Twenty-four percent of participants had completed a high school degree, 29% had college-level schooling, and 47% had some university-level training. *T*-tests and χ^2 analyses of sociodemographic variables (age, sex, maternal education, family income) were conducted to compare participants lost to attrition with those remaining in the study. These analyses revealed no significant differences between T1 and T4 (all $ps > 0.05$).

At Time 1 (T1) of the present study, the sample was heterogeneous with respect to family income level (CAD in 1992) with 18% earning <$20,000, 48% earning between $20,000 and $50,000 and 34% earning over $50,000. Average maternal education at T1 was 14.9 years (SD = 2.79) with 77% having more than a high school education. Age of the 62 participants at T1 ranged between 5 and 7 years old (M = 6.14, SD = 0.99). Time 2 (T2) measures were taken 8 years later, when participants had a mean age of 13.6 years (SD = 0.59, range = 12.6–15.0 years). Seven years later, at Time 3 (T3), participants had a mean age of 21.2 years (SD = 0.81, range = 20–23 years). Approximately 2 years later, at Time 4 (T4), participants were young adults with a mean age of 23.4 years (SD = 0.93, range = 22–25 years). The final sample of 62 participants (40 girls and 22 boys) of the present study was based on having at least one variable at the last 2 time points (T3 or T4).

General procedure

Participants were contacted by telephone before each phase of the project. At T1 of the current study, when children were between 5 and 7 years old, participants were sent questionnaires to complete at home which were collected by the research assistants during the laboratory session. Mothers and their children were invited to the laboratory to complete a battery of measures, which included a free-play session, a separation-reunion procedure, and questionnaires. Two research assistants greeted participants, collected the completed questionnaires and explained the sequence of the visit. The dyad was invited into an unfamiliar experimental room where they were given 2 min to explore the room and toys (free play). The child's behaviors during this initial free-play session (exploration of the room and toys with the mother) were used to code behavioral inhibition. This was followed by a joint mother-child task and a 45-min separation task during which the mother left the room to fill out additional questionnaires with an experimenter and the child completed problem-solving tasks with another experimenter in the room. Preceding each mother-child reunion was a 5-min period during which the child was free to play with toys in the room. The mother then rejoined her child in the experimental room for a 5-min reunion. Following the reunion period, the mother-child dyad remained in the room for a 10-min snack time. A second separation (about 30 min) followed the snack time and was structured similarly to the first separation. It was followed by a 5-min reunion. The child's responses during the two reunions were used to code the child's attachment classification. This procedure is similar to the procedure by Main and Cassidy (1988). It was used since the children were of late preschool and early school age. The validity of this procedure for classifying attachment behavior in preschool and early school age children has been repeatedly demonstrated (Moss et al., 2004; Groh et al., 2012; Badovinac et al., 2018, 2021; O'Neill et al., 2021).

At T2, when the children were between 13 and 15 years old, adolescents and mothers filled out questionnaires at the laboratory. For mothers, questionnaires included a measure of anxiety symptoms. At T3, when participants were approximately 21 years of age, they came to the laboratory without their mothers to complete questionnaires including a measure of intolerance of uncertainty. Finally, at T4, when participants were approximately 23 years of age, they returned to the laboratory on their own to fill out questionnaires including a measure of generalized anxiety symptoms. Participants were given $20 for their participation at each phase of the study and informed written consent from all participating families was obtained at each assessment. The study was approved by the Université du Québec à Montréal and the Université du Québec en Outaouais Research Ethics Committees.

Measures

Behavioral inhibition (T1)

Behavioral inhibition was measured observationally by coding child behaviors such as spontaneous vocalizations, displays of negative affect, play, and proximity to the mother in terms of frequency and length from the videotaped initial free play session at the beginning of the laboratory visit, when children were aged between 5 and 7 years

old (Zdebik et al., 2018). The video segments used to code behavioral inhibition did not overlap with the video footage used to code attachment classification. Frequency or duration (in seconds) of the operationalized behaviors were divided by the total length of the duration of the free play session and standardized. Behaviors that were not observed for over 20% of the sample were coded as either present or not (0 or 1). The behavioral inhibition score was composed of the sum of reversed spontaneous vocalizations, negative affect, proximity to mother 0 to 1 meters, reversed proximity to mother 1 meter to 2 meters, reversed proximity to mother 2 meters and over, and reversed play scores, where higher scores represented higher levels of behavioral inhibition. Videotapes were coded for behavioral inhibition by the main author, who was blind to attachment classification. A second coder, trained by the main author, coded 15% of randomly selected videotapes and was blind to behavioral inhibition and attachment classification. Intraclass correlations ranged from.83 to 1.00 (all *ps* <0.001).

Attachment classification (T1)

The Preschool Attachment Classification System (Cassidy et al., 1992) for the 5-year-olds and the Main and Cassidy (1988) system for the 6- to 7-year-olds, were used to classify the children's reunion behaviors. Both systems use a six-category attachment coding scheme to classify children into three organized (A, B, and C) and three disorganized (D) (controlling-caregiver [Ccare], controlling-punitive [Cpuni], and behaviorally disorganized [BehD]) attachment patterns. Videotaped reunions were coded by two authors on the current paper who were blind to the participant scores on any of the other measures. Both coders were trained by R. Marvin and achieved reliability with him on a separate sample of tapes. All coding discrepancies were resolved by reviewing the tapes until consensus was achieved. Reliability for the classifications of the 5-year-old children was calculated separately from that of the 6- and 7-year-old children, which were comparable, and both indicated excellent agreement (k = 0.86 and 0.88, respectively). Overall agreement for the major classifications (A, B, C, and D) was 88% (k = 0.81), calculated on 30% of the sample. Reliability was calculated for the disorganized classification subtypes for the 14 disorganized attachment videotapes in the reliability pool, with agreement being as follows: 4/4 (100%) for Ccare, 4/5 (80%) for Cpun, and 4/6 (67%) for BehD (overall agreement for the D subtypes was thus 80%). In the current study, in order to test if disorganized-controlling and ambivalent attachment patterns are related to the development of IU and GAD, both disorganized-controlling (Dcont) subtypes were combined for analyses as they are theoretically similar in terms of role reversal and the child's expectations of their caregiver related to feeling unprotected and vulnerable (Moss et al., 2004). BehD was left as a distinct category since it was expected to lead to different outcomes than Dcont patterns (O'Connor et al., 2011). Fifty-seven percent of the sample had a secure attachment pattern (B, $N = 35$), 18 % had an avoidant attachment pattern (A, $N = 11$), 13 % had an ambivalent attachment pattern (C, $N = 8$), 7% had a D-controlling attachment pattern (Dcont, $N = 4$) and 5% had a behaviorally disorganized attachment pattern (BehD, $N = 3$).

There were no significant differences in the relative proportions of the various attachment classifications between time points (χ^2 tests; all *ps* >0.05), indicating no differences in attrition rates. Attachment was coded into dummy variables contrasting each specified attachment group (A, C, Dcont, and BehD) to the reference secure group (B; Cohen and Cohen, 1983). In order to identify how different attachment groups (A, B, C, Dcont and BehD) may differ on sociodemographic variables, ANOVAs and χ^2 tests were performed at T1 with participant age, sex, maternal education, and family income. Attachment groups did not differ on any of these sociodemographic variables (all *ps* > 0.05).

Maternal anxiety symptoms (T2)

Maternal anxiety was measured using the anxiety scale of the Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994). This self-report 90-item questionnaire evaluates symptoms of psychopathology. Mothers rated if each symptom applied to them in the last 7 days with a scale ranging from 0 (not at all) to 4 (extremely). The anxiety scale measures symptoms such as tension, nervousness, trembling, and feelings of terror and panic. A total average anxiety score is calculated and can range from 0 to 4. As participants were from the general population, over 25% of mothers scored zero on the scale (scores ranged from 0 to 3.1 with a median score of 0.2). Therefore, the score was dichotomized and mothers scoring 0 were classified as "non-anxious" and those scoring above 0 were classified as "anxious." The SCL-90-R demonstrates high internal consistency, and its validity and reliability have been well documented (Derogatis and Lynn, 1999). For the current study, the measure showed excellent internal consistency ($\alpha = 0.91$).

Intolerance of uncertainty (T3)

Intolerance of uncertainty was measured using the Intolerance of Uncertainty Scale - Short Form (IUS-12; Carleton et al., 2007). This 12-item self-report questionnaire is the short form version of the original 27-item Intolerance of Uncertainty Scale (Freeston et al., 1994). Participants rated items related to uncertainty, ambiguous situations, and future events using a scale from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). Items include statements such as "unforeseen events upset me greatly" and "uncertainty keeps me from living a full life." A total score is calculated and can range from 12 to 60. Higher scores indicate higher levels of intolerance of uncertainty. The IUS-12 is comparable and highly correlated

TABLE 1 Main study variables: Correlations and descriptive statistics ($N = 62$).

Variables	B	A	C	Dcont	BehD	BI	IU	GAD
Attachment								
Secure (B vs. other)[a]	—							
Avoidant (A vs. other)[a]	−0.54**	—						
Ambivalent (C vs. other)[a]	−0.45**	−0.18	—					
Disorganized-controlling (Dcont vs. other)[a]	−0.31*	−0.12	−0.10	—				
Behaviorally disorganized (BehD vs. other)[a]	−0.26*	−0.11	−0.09	−0.06	—			
Behavioral inhibition (BI)	−0.19	0.11	0.16	0.04	−0.03	—		
Intolerance of uncertainty (IU)	−0.25	−0.07	0.33*	0.30*	−0.10	0.31*	—	
Generalized anxiety disorder (GAD)	−0.16	0.08	0.10	0.02	0.06	0.25†	0.45**	—
M						0.00	26.82	4.0
SD						3.26	8.74	3.55
Range						−7.15–6.36	13–53	0–19

[a]Attachment coded as dummy variables.
†p < 0.1, * p < 0.05, ** p < 0.01.

($r = 0.96$, $p < 0.01$) to the original long form (Carleton et al., 2007; Khawaja and Yu, 2010). It has good internal consistency, convergence, and discriminant validity (Carleton et al., 2007; McEvoy and Mahoney, 2011). For the current study, the measure showed excellent internal consistency ($\alpha = 0.89$).

Generalized anxiety disorder (T4)

Generalized anxiety symptoms were measured using the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006), a 7-item self-reported questionnaire based on the DSM-IV definition of GAD. Participants are asked to rate how often they were bothered by given symptoms during the last two weeks on a scale from 0 (not at all) to 3 (nearly everyday). Items include statements such as "feeling nervous, anxious or on edge" and "not being able to stop or control worrying." A total score is calculated and can range from 0 to 21. Higher scores indicate higher levels of GAD symptoms. The GAD-7 has excellent internal consistency, and good test-retest reliability, and convergence and discriminant validity (Spitzer et al., 2006). For the current study, the measure showed excellent internal consistency ($\alpha = 0.84$).

Sociodemographic questionnaires (T1-T2-T3-T4)

Sociodemographic questionnaires were completed by mothers at T1 and T2. Information relating to family income, parental education and marital status, child sex, and child age was included in the questionnaire. At T3 and T4, the young adults completed a sociodemographic questionnaire, which included items referring to income, education, living situation, and relationship status.

Results

Initial results

All main analyses were conducted with the 62 participants with at least one valid data point at T3 or T4. Full Information Maximum Likelihood (FIML) was used to account for missing data at T4 ($N = 50$). Correlations, ANOVAs and *t*-tests were performed with participant age, sex, maternal education, and family income in order to identify potential sociodemographic covariates related to the dependent variable, that is, GAD scores. No significant associations were identified (all *ps* >0.05: age: $r(48) = -0.03$, $p = 0.86$; sex: $t(43) = 1.63$, $p = 0.11$; maternal education: $r(48) = 0.07$; $p = 0.63$; family income: $F_{(2,47)} = 0.96$, $p = 0.39$); therefore, they were not included in subsequent analyses. Correlations between main variables are presented in Table 1. Maternal anxiety was significantly associated to GAD, with higher maternal anxiety scores being significantly associated with higher participant GAD symptoms $t(46) = 2.27$, $p = 0.03$. Hence, maternal anxiety was included in the analysis as a control variable.

Analysis–mediation/indirect effect

A structural equation model was tested with Mplus 8.3 (Muthén and Muthén, 1998–2011) to examine longitudinal effects of behavioral inhibition and attachment (age 5–7) on GAD symptoms in young adulthood (age 23), while controlling for maternal anxiety (measured when child was age 14). The indirect effects of behavioral inhibition and attachment on GAD symptoms via IU (age 21) were also tested.

First, base models were tested for direct effects of independent variables on a dependent variable and then a model

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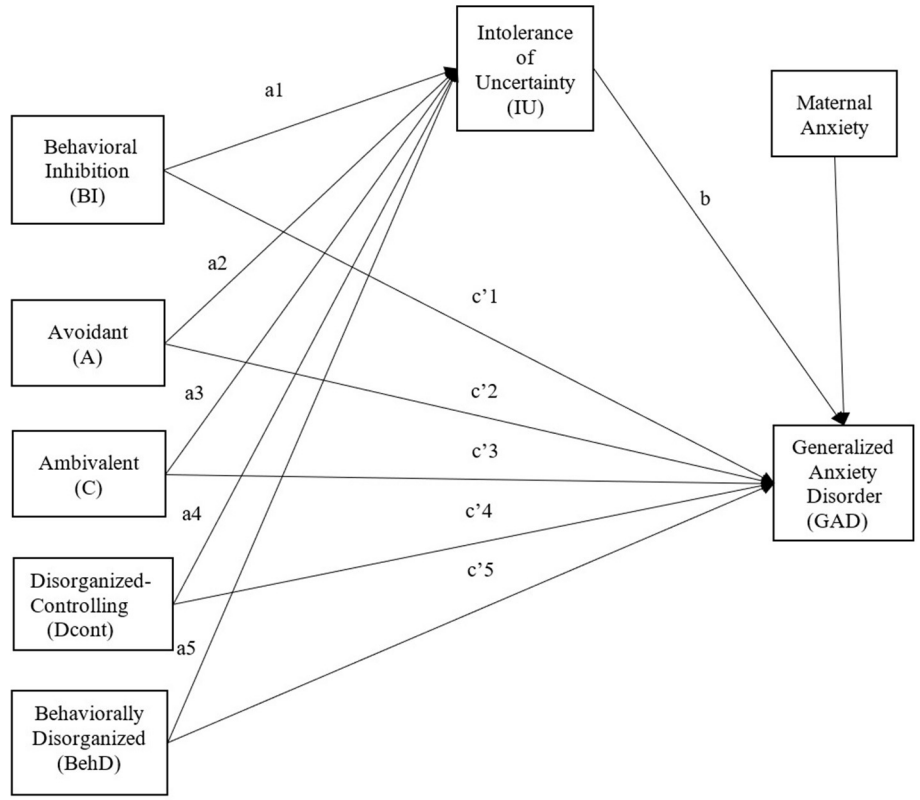

FIGURE 1
Tested model of direct and indirect effects of behavioral inhibition and attachment on GAD symptoms through IU, controlling for maternal anxiety.

TABLE 2 Results of the base model—Behavioral inhibition (link c).

		Fit Indices			
	Chi-Square	0.656			
	df	2			
	p-value	0.720			
	RMSEA	0.000			
	CFI	1.000			
		Unstandardized paths			
		b	se	*p*-value	Beta
Maternal anxiety	T3	0.98	0.37	0.01	0.28
	c1	0.25	0.11	0.03	0.22

TABLE 3 Results of the base model—attachment groups (links c).

		Fit Indices			
	Chi-Square	2.756			
	df	5			
	p-value	0.738			
	RMSEA	0.000			
	CFI	1.000			
		Unstandardized paths			
		b	se	*p*-value	Beta
Maternal anxiety	T3	1.10	0.37	0.03	0.31
	*c*2	0.93	0.87	0.29	0.10
	*c*3	1.36	2.22	0.54	0.13
	*c*4	−0.08	1.98	0.97	−0.01
	*c*5	1.94	2.36	0.41	0.12

was tested for indirect effects through a mediator (Figure 1). Significant indirect effects were determined using bias-corrected bootstrap confidence intervals (CI) with 2000 iterations. All models respected the usual fit indices (Hu and Bentler, 1999).

The base model for the behavioral inhibition direct effect shows that higher levels of behavioral inhibition are significantly associated with greater GAD symptoms at T4 while controlling for maternal anxiety at T2 (Table 2). We then tested for a mediation mechanism via IU. The base model examining direct effects of attachment groups on GAD while controlling for maternal anxiety (Table 3) did not reveal any significant associations. Hence, an indirect model via IU was tested.

TABLE 4 Results of the mediation model (links a, b and c').

		Fit Indices			
	Chi-Square	4.171			
	df	7			
	p-value	0.760			
	RMSEA	0.000			
	CFI	1.000			
		Unstandardized paths			
		b	se	*p*-value	Beta
Maternal anxiety	T3	0.71	0.30	0.02	0.21
	a1	0.27	0.11	0.02	0.27
	a2	−0.01	0.12	0.91	−0.01
	a3	0.36	0.12	0.00	0.35
	a4	0.30	0.12	0.01	0.30
	a5	−0.05	0.08	0.53	−0.05
	b	1.39	0.45	0.00	0.41
	c'1	0.33	0.36	0.36	0.10
	c'2	0.20	0.38	0.59	0.06
	c'3	−0.21	0.66	0.75	−0.06
	c'4	−0.41	0.47	0.37	−0.12
	c'5	0.48	0.24	0.05	0.14

Explained variances: Intolerance of Uncertainty = 31.1%; Generalized Anxiety = 23.4%.

TABLE 5 Indirect effects (Bias-corrected Bootstrap−CI).

	Lower 2.5%	a*b	Upper 2.5%
a1*b	0.066	0.379	1.074
a2*b	−0.387	−0.018	0.391
a3*b	0.059	0.499	1.183
a4*b	0.089	0.422	1.362
a5*b	−0.434	−0.072	0.144

The indirect model showed very good fit indices (Table 4). Results showed that behavioral inhibition and both attachment groups C and Dcont present higher levels of intolerance of uncertainty at T3 and then, increased GAD symptoms at T4 (while controlling for maternal anxiety at T2) (Table 4). Also, a direct and positive effect ($p < 0.047$) of BehD attachment was found on GAD symptoms.

Table 5 presents the confidence intervals (estimated via bootstrap) of the indirect links tested between the independent variables and GAD via IU. The final model shows that IU mediates the relationship between behavioral inhibition and GAD ($0 \notin 0.066; 1.074$) (Figure 2). The mediation is complete, as the direct effect of behavioral inhibition on GAD is no longer significant in the final model. Furthermore, attachment groups C ($0 \notin 0.059; 1.183$) and Dcont ($0 \notin 0.089; 1.362$) are also indirectly associated with increased GAD symptoms via greater IU scores.

Discussion

While previous work has linked both childhood behavioral inhibition and attachment to IU in emerging adulthood (Zdebik et al., 2018), the longitudinal influence of these key variables for GAD in adulthood was still unknown. We thus expanded on this previous work and examined the direct contribution of behavioral inhibition and attachment in childhood (6 years old) and of IU in emerging adulthood (21 years old) to the development of GAD in young adulthood (23 years of age), while controlling for maternal anxiety. We also examined whether the associations between childhood attachment and behavioral inhibition and future GAD were mediated by IU in emerging adulthood.

As expected, results of SEM analyses revealed that IU in emerging adulthood was significantly associated with GAD symptoms in adulthood. This finding is in line with the intolerance of uncertainty model of GAD elaborated by Dugas et al. (1998), highlighting the role of IU as a main contributor to worry and GAD symptoms. Numerous studies have provided support for this model (e.g., Buhr and Dugas, 2002; Sexton et al., 2003; Koerner and Dugas, 2008), considering that individuals presenting a high level of IU are at risk of perceiving and reacting to ambiguous situations negatively. Namely, previous research has shown that individuals with higher levels of GAD symptoms report higher intolerance of uncertainty (Buhr and Dugas, 2002; Dugas et al., 2007). More recently, a meta-analysis reported that the association between IU and symptoms of GAD is significantly stronger compared to associations with IU and other disorders, such as depression, obsessive compulsive disorder, social anxiety, and eating disorders (McEvoy et al., 2019). Hence, the role of IU as a contributing and maintaining factor of GAD is undeniable (Dugas and Robichaud, 2007; Robichaud et al., 2019). While our results are in line with the intolerance of uncertainty model of GAD and previous research, it also expands on this model by integrating early risk factors of GAD, as we discuss below.

Among childhood predictors, only behavioral inhibition was directly associated with GAD over a span of 17 years, which supports previous research identifying this temperament profile as a risk factor for anxiety disorders in general in children and adults (Hudson and Dodd, 2012; Sandstrom et al., 2020) as well as for GAD specifically (Moffitt et al., 2007). Heightened negative reactions to novel or uncertain situations puts a child at risk of avoiding such situations. Over time, these avoidant behaviors, observed among children presenting high levels of behavioral inhibition, are reinforced, given their short-term appeasing effects, therefore putting the child at risk for anxiety. Having a physiological vulnerability for heightened emotional reactions to uncertain stimuli is supported by the emotional dysregulation model of GAD (Mennin et al., 2004). However, when considered in a comprehensive model including IU, results showed that behavioral inhibition was not directly

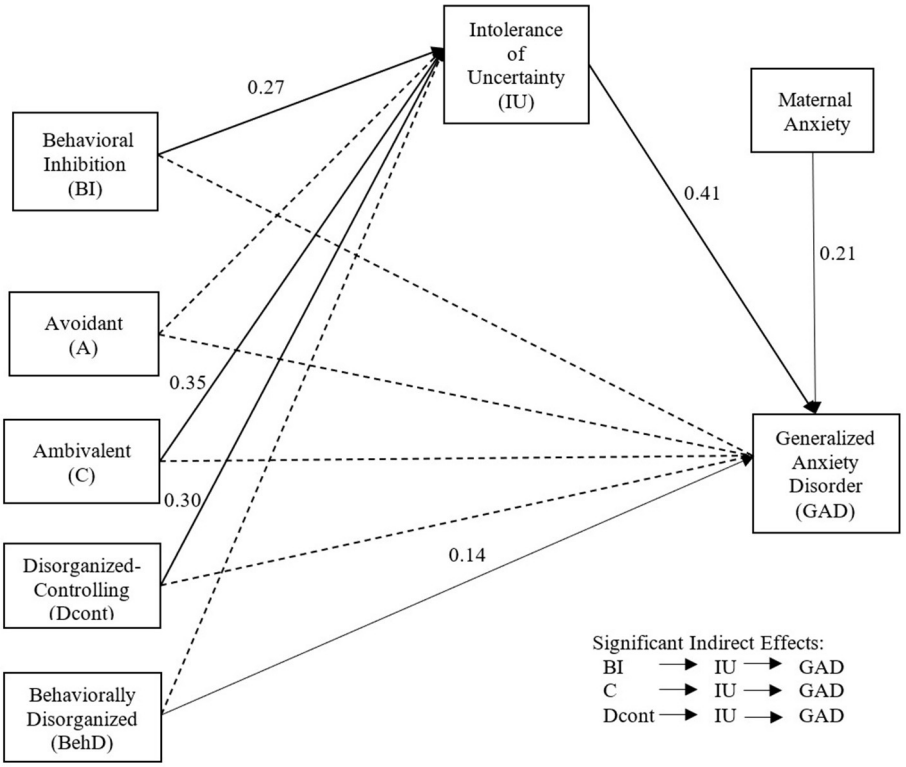

FIGURE 2
Final model of direct and indirect effects of behavioral inhibition and attachment on GAD symptoms through IU, controlling for maternal anxiety.

related to GAD and that the association was indirect via IU. While empirical support for the association between childhood behavioral inhibition and IU in emerging adulthood has already been provided (Zdebik et al., 2018), the findings of the present study underscore the mediating role of IU in the longitudinal association between childhood behavioral inhibition and future GAD in adulthood. Indeed, behavioral inhibition has long been conceptualized as a "... vulnerability to the uncertainty caused by unfamiliar events that cannot be assimilated easily" (Reznick et al., 1989, p. 30). Behaviorally inhibited children demonstrate attentional bias toward threat, novelty, or negative stimuli and have difficulty disengaging from it (Blackford and Pine, 2012; Henderson et al., 2015). Such a cognitive bias has been proposed as a link between temperament and the development of anxiety disorders (Vasey and MacLeod, 2001; Nozadi et al., 2016). The heightened physiological reactions observed in behaviorally inhibited children could lead to a biased perception of novelty and uncertainty as threatening, increasing the risk of developing IU and eventual anxiety symptoms. Indeed, several studies found that such attentional biases, including biases against novelty, have been associated with increased risk for anxiety in behaviorally inhibited children (McDermott et al., 2009; Reeb-Sutherland et al., 2009; Lahat et al., 2014). Identifying behavioral inhibition early in a child's life would enable the implementation of prevention programs aimed at reducing heightened physiological reactions to novelty in order to prevent future intolerance to uncertainty and mental health problems (Rapee, 2013). Furthermore, individuals seeking help for GAD in adulthood that have been behaviorally inhibited as children may particularly benefit from exercises of exposure to uncertainty as treatment for their GAD (Hebert and Dugas, 2019).

Ambivalent and disorganized-controlling attachment patterns were also indirectly associated with increased GAD symptoms via greater IU scores. While previous research has shown ambivalent and disorganized-controlling attachment to be associated with an increased risk for anxiety disorders, including GAD in adulthood (Warren et al., 1997; Muris et al., 2001; Cassidy et al., 2009), we did not find such direct links. Nonetheless, the findings of the present study shed light on the underlying mechanism via IU. Indeed, children with ambivalent and disorganized-controlling attachment patterns are faced with daily uncertainty in terms of parental responses to their needs. Specifically, parents of children with ambivalent attachment are known to be inconsistent and unpredictable in their care, whereas those of children with disorganized-controlling attachment are known to be frightening or to display frightened behaviors toward their child. To gain access to their

parent and minimize this uncertainty, these children have developed maladaptive socio-emotional patterns. Ambivalent children exaggerate their signals of distress to ensure their parent's responses whereas disorganized-controlling children adopt role reversal behaviors by which they take on the role of their parent (Moss et al., 2011). It is thought that taking control over the relationship is an attempt to regulate internal states such as feeling helpless and to gain control over their environment and prevent the parent from being frightening or frightened (George and Solomon, 2008). The findings of the present study suggest that over time, these children are at risk of developing a greater intolerance to uncertainty, subsequently increasing their risk of developing GAD symptoms.

Finally, a direct and positive effect of behaviorally disorganized attachment was found on GAD symptoms. A body of empirical work suggests that a behaviorally disorganized attachment pattern in the preschool years may stem from chaotic family environments in which, contrary to children with a disorganized-controlling attachment pattern, children are incapable of taking control of the situation and their environment (Moss et al., 2011). O'Connor et al. (2011) compared the disorganized-controlling and behaviorally disorganized groups in the NICHD-SECCYD sample (n = 1,364) at age 3 and found that the behaviorally disorganized group was associated with poorer outcomes than the disorganized-controlling subtypes on all of the 18 variables assessed in the study, covering maternal psychological symptoms (e.g., depression, stress), mother-child interaction (e.g., maternal hostility, lack of support) and child social adaptation (e.g., disruptive, internalizing, and externalizing behaviors). Moreover, in a small prospective longitudinal study of families at high socioeconomic risk, Bureau et al. (2009) showed that disorganized-controlling patterns in middle childhood were predicted by either maternal withdrawal (controlling-caregiving subtype) or maternal disrupted communication (controlling-punitive subtype) in infancy. In comparison, continued signs of disorganization and fear in middle childhood were associated with more severe factors such as violent and chaotic family patterns in infancy as well as maternal reports of partner physical abuse and severe physical abuse of the child. Thus, as these children presumably experience fear and anxiety on a regular basis, such an unpredictable environment can cause severe difficulties in emotional and stress regulation. Indeed, research has shown that children that experience maltreatment and bullying are at greater risk of later GAD (Copeland et al., 2013; Lakhdir et al., 2021). One striking difference between GAD and other anxiety disorders is that individuals with GAD have a large number of worries related to everyday life as opposed to specific ones (Dugas et al., 1998). Behaviorally disorganized children may hence be prone to worry more diffusely about everything in general as these children experience fear and anxiety on a regular basis which can be related to common daily life.

Taken together, the present study provides important insights into the longitudinal influences of childhood attachment and behavioral inhibition on IU, and how IU then influences GAD in early adulthood. These results are further strengthened by the fact that maternal anxiety symptoms were controlled for, since this has been repeatedly shown as an important contributor to offspring anxiety (Lawrence et al., 2019). Hence, our results support an integrative approach to GAD, one that incorporates certain aspects of prominent theoretical models of GAD, such as the intolerance of uncertainty model, the emotional dysregulation model, and the avoidance model of GAD, thus facilitating a more complete view of the development and maintenance of this disorder (Dugas et al., 2004; Mennin et al., 2004, 2005; Sibrava and Borkovec, 2006).

Limitations and future directions

Despite the new insights our study provides, it has some limitations. First, our sample is small as it has suffered from attrition due to its longitudinal design. Attrition usually diminishes statistical power, yet we detected significant associations between variables. Still, replication in other larger populations would be beneficial. Second, attachment and behavioral inhibition were assessed using the video footage collected at the same time point of the longitudinal study creating a potential for shared method variance. However, different segments of the laboratory sessions were used to code each measure and no relation was found between the two variables, hence reducing the possibility of shared variance. Also, since behavioral inhibition was correlated with GAD while attachment was not, shared variance cannot fully account for our findings. Third, maternal anxiety was measured when participants were adolescents, meaning we were unable to control for maternal anxiety symptoms when participants were children (at age 6) or when they were older (young adulthood). Future studies should include maternal and paternal anxiety symptoms at these key developmental periods to further control the potential effects of parental anxiety in the development of GAD. Furthermore, although this is a longitudinal study, we cannot infer causality between our variables. However, our results are in line with the theoretical models of GAD, where it is widely proposed that a temperamental vulnerability and insecure attachment could have long-term effects on socio-emotional adaptation. Still, it would be important to replicate these findings in a larger longitudinal study with repeated measures from childhood to adulthood of all the main variables (attachment, temperament, child and parent anxiety) in order to better understand the temporal relationships between them.

This would allow examination of the longitudinal influence of attachment and temperament from childhood to adulthood on anxiety symptoms at different stages of life. Lastly, considering the known influence of stressful life events in the development of GAD (Moffitt et al., 2007; Kessler et al., 2008; Beesdo et al., 2010), the addition of a stress indicator could extend the identified model and provide additional information on the unique contributions of attachment, behavioral inhibition, and IU in the etiology of GAD. Nevertheless, the integrative life span approach of the study strengthens the presented model.

Conclusion and implications for practice

In sum, the findings of the current study expand the existing body of literature on the etiology of GAD by providing a clearer understanding of the direct and indirect associations between childhood behavioral inhibition and attachment, intolerance of uncertainty in emerging adulthood and GAD in young adulthood. The prospective longitudinal design and SEM statistical approach strengthen the robustness of the study. This study highlights the importance of identifying behavioral inhibition and certain types of attachment early on to reduce future risk for GAD. A particularly interesting finding is the indirect effect of IU, emphasizing that treating IU may be a key method to consider for preventing GAD among children presenting insecure ambivalent and disorganized-controlling attachment and those with high behavioral inhibition. Still, our results highlight the relevance of early and direct preventative interventions aimed at increasing attachment security and reducing behavioral inhibition in order to reduce future risk of psychopathology (Bakermans-Kranenburg et al., 2003, 2005; Mountain et al., 2017) as well as integrative interventions for current psychopathology (Chigwedere and Moran, 2022). Furthermore, the direct association, across a 17-year period, between behaviorally disorganized attachment in childhood and GAD in adulthood, is particularly striking. For these children, early interventions aiming to promote security within the parent-child relationship is especially crucial to ensure their emotional developmental and future mental health.

Since young adulthood is a developmental period particularly marked by important changes and uncertainty (e.g., important decisions, start of graduate studies, entering the work force, developing long-term relationships, moving out on one's own, etc.), learning to adequately cope with uncertainty and the potential stresses that accompany these monumental life events is crucial for promoting the well-being and mental health of young adults. Hence, strategies to help tolerate uncertainty would be of importance in emerging adulthood, but preventative measures to help with the precursors of intolerance of uncertainty and GAD, with interventions targeting behavioral inhibition and attachment, would be important avenues to pursue.

Data availability statement

The datasets presented in this article are not readily available due to participant confidentiality. Requests to access the datasets should be directed to EM (sheiner-moss.ellen@uqam.ca).

Ethics statement

The study was approved by the Université du Québec à Montréal and the Université du Québec en Outaouais Research Ethics Committees. Written informed consent to participate in this study was provided either by the participants' legal guardian/next of kin or the participants themselves.

Author contributions

MZ and KP contributed to conception and design of the study. EM is the senior researcher who launched the longitudinal cohort study. MZ wrote the first draft of the manuscript. MZ, KP, and J-FB wrote sections of the manuscript. MZ, KP, J-FB, and EM reviewed the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by the Quebec Culture and Society Research Fund (2022-NP-297325), Canada's Social Science and Humanities Research Council, the Université du Québec en Outaouais, and the Université du Québec à Montréal.

Acknowledgments

The authors thank Annie D. Lemieux for statistical consultation and all of the participating families in the study.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 September 2022
DOI 10.3389/fpsyg.2022.942392

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 12 May 2022
ACCEPTED 22 August 2022
PUBLISHED 20 September 2022

CITATION
Van den Akker AL, Majdandzic M, de Vente W, Asscher JJ and Bögels S (2022) Just as they expected: How parents' expectations about their unborn child's characteristics provide a context for early transactions between parenting and child temperament. *Front. Psychol.* 13:942392. doi: 10.3389/fpsyg.2022.942392

Just as they expected: How parents' expectations about their unborn child's characteristics provide a context for early transactions between parenting and child temperament

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Prenatal expectations about what children will be like after birth may provide a context for how parents perceive their infant's actual temperament. We examined how these expectations and perceptions are associated and together predict early parenting behavior, with parenting behavior in turn predicting changes in temperament. Reports of 125 families ($N = 122$ fathers; $N = 123$ mothers; sample 1) about their expectations of their unborn child's temperament (negative affectivity, surgency, regulation, T1), their infant's temperament at 4 and 12 months post-partum (T2 and T3), and their hostile, responsive, warm, and overprotective parenting (T2) were included. We also included data from an independent sample of 168 mothers (sample 2), with the same measures, except that mothers reported on Big Five personality traits at T1. Results indicated that in both samples, parents' expectations were positively associated with perceptions of infant temperament. Prenatal expectations and newborn temperament independently predicted parenting behavior, and maternal and paternal parenting in turn predicted infant temperament at T3, controlling for infant temperament at T2. Although overall findings indicated associations between (expectations of) a more difficult temperament and more negative/less positive parenting, significant combinations of specific traits and parenting behaviors were sample-specific—indicating that more research is necessary to draw a conclusion about specific links. Both maternal and paternal expectations about their unborn child's temperament appear to carry over into the postpartum reality and provide a context for shaping early interactions between caregivers and their children, which may further shape the developing temperament of the child.

KEYWORDS

prenatal expectations, infant temperament, parenting, mothers, fathers, transactions

Introduction

Parents' prenatal expectations provide an important context for early family life and may affect their parenting behavior and the newborn's unfolding temperament. While most pregnant women have positive expectations about their life with their newborn child, some women mostly worry that having a baby will negatively impact their life (Robakis et al., 2015). Pregnant women's expectations about their life after childbirth have previously been shown to predict their postpartum adjustment, with negative expectations associated with lower postpartum adjustment overall (Lawrence et al., 2007; Henshaw et al., 2014). Whereas previous studies have mostly investigated how prenatal expectations are associated with parental (mainly mothers') adjustment after childbirth, we examine how both mothers' and fathers' prenatal expectations of their children's characteristics are associated with their parenting behavior toward the newborn. Additionally, we examine how this early caregiving may have a lasting impact on the developing child, by predicting further development of the child's temperament traits across the first year of life.

Prenatal expectations of child temperament and parenting behavior

Most studies on prenatal expectations have included general expectations about what it will be like to care for the baby (Kalmuss et al., 1992; Harwood et al., 2007; Henshaw et al., 2014; Robakis et al., 2015). Overall, the conclusion points to negative expectations carrying forward into the post-partum period, predicting depressed mood and lower marital relationship satisfaction after the child is born. A study that specifically investigated how expectations about the child's temperament traits were associated with post-partum adjustment found that when mothers expected their child to have a more difficult temperament overall, they reported a decline in marital satisfaction across the transition to parenthood (Lawrence et al., 2007). Expectations about child temperament may also be predictive of early parenting behavior toward the newborn, as many studies have supported the idea that after the child is born, child temperament traits elicit differences in parenting behavior (for a review, see Kiff et al., 2011).

Research of infant temperament has mostly converged on a model including three higher-order traits: Negative emotionality—indicating how easily children become distressed, fearful, and sad; Surgency—the tendency to experience positive emotions, have a high activity level and approach tendencies in social situations; and regulation—assessing attentional control and soothability (Gartstein and Rothbart, 2003). Children who are high on Negative emotionality and/or low on Regulation can be frustrating to deal with, and parents may exhibit hostile behavior toward children who are quick to cry (Scaramella et al., 2008) or not easily soothed (Morrell and Murray, 2003). At the same time, parents may display overprotective behavior in an effort to prevent their children from becoming upset (Booth-LaForce and Oxford, 2008). Additionally, parents may experience difficulty in establishing a positive relationship with their child and may report less warmth and responsivity (Mills-Koonce et al., 2007). Conversely, interacting with children who are high on Surgency might be rewarding for parents; when a child enjoys the interaction and exhibits positive emotions, parents may display more warmth in return. Parents may also indicate they are more responsive to the needs of their child, as they may interpret their child's behavior as positive feedback about their own parenting competencies.

In addition to actual infant temperament, parental expectations of infant temperament may be important in determining parenting behavior, because how parents experience their infants' temperament is likely to be partially determined by their own prenatal expectations about the infant's temperament. The same level of Regulation may, for instance, be interpreted differently by mothers when it is higher than they expected—a positive surprise—than when it is lower than expected—a negative surprise. Whether mothers are positively or negatively surprised may in turn impact how they treat their child. Parents who experience a positive surprise may exhibit more competent parenting, characterized by more warmth, responsiveness, less hostility, and overprotection. With regards to more general expectations about life after childbirth, a negative surprise has indeed been associated with maladjustment, with greater discrepancies between expectations and actual experiences, for instance, associated with a decline in relationship adjustment and an increase in depression postpartum (Kalmuss et al., 1992; Harwood et al., 2007).

Research into predictors of early caregiving is important, as early caregiving has enduring consequences for child development (Fraley and Roisman, 2015). Specifically, with regard to temperament development, evidence is accumulating that parenting behavior is not only shaped by child temperament traits, but also impacts the development of the child's temperament characteristics (e.g., Van Den Akker et al., 2010). Most evidence overall points to mutually reinforcing cycles of associations, with a more easy temperament predicting more positive parenting and this in turn predicting the development of a more easy temperament, and a similar transaction for negative parenting and a more difficult temperament. However, links between specific parenting behaviors and child traits are not always replicated (Kiff et al., 2011).

This study

The overall aim of this study was to examine how prenatal expectations of child characteristics play a role

in the early establishment of transactional associations between temperament and parenting. We used data from two longitudinal studies (Project 1: $N = 122$ fathers/123 mothers/Project 2: $N = 168$ mothers) that both included a prenatal assessment of expected child temperament characteristics (T1), and actual child characteristics several months post-partum (T2 at 4 months for Project 1; at 6 months for Project 2), and when infants were 12 months old (T3). We sought to answer the following research questions: What levels of temperament traits do expecting parents expect in their future child, and are expected trait levels associated with actual traits of their newborns? Do infant temperament traits interact with prenatal expectations about child traits to predict early parenting behavior, with this parenting behavior in turn predicting infant temperament at 12 months? Data from Project 1 were used to study these questions in fathers and mothers. Data from Project 2 were used for a conceptual replication in mothers with the same hypotheses, but with different, conceptually related, expected characteristics assessed (Tackett et al., 2013). We replaced expected Negative Affectivity with expected Neuroticism, expected Regulation with expected Conscientiousness, and expected Surgency with expected Extraversion.

We formulated the following hypotheses: First, in line with previous findings of relatively positive prenatal expectations overall (Robakis et al., 2015), parents will expect their future child to have relatively favorable characteristics, with mean expected levels of Regulation and Surgency above the midpoint of the scale and levels of Negative Affectivity below the midpoint of the scale (for the Big Five traits from Project 2, we also included Agreeableness, and Openness, with expected values above the midpoint); Second, expecting parents' expectations about infant temperament will be positively associated with reported temperament of the newborn, as parents may use knowledge of their own (and/or their partners') characteristics to base their expectations on. Some evidence from previous studies also indicates that parents' expectations of infant temperament are associated with temperament assessed after the child is born (Mebert and Kalinowski, 1986; Zeanah et al., 1986; Diener et al., 1995). Third, infants' temperament at 4 months is associated with parenting behavior at 4 months, with (a) higher levels of infant Negative Affectivity associated with more hostility and overprotection, and less warmth and responsivity, (b) higher levels of Surgency associated with less overprotection and more warmth and responsivity, and (c) lower levels of Regulation associated with more hostility, and less warmth and responsivity. Fourth, parents' prenatal expectations about temperament and infant temperament assessed at 4 months (6 in Project 2) interact to predict parenting behavior as follows: When infants' temperament is easier to deal with than parents expect (i.e., lower Negative Affectivity, higher Regulation, or higher Surgency)—a positive surprise, they report more warmth and responsivity. When infants' temperament is more difficult to deal with than parents expect (i.e., higher Negative Affectivity, lower Regulation, or lower Surgency)—a negative surprise—they report more hostility, less warmth and responsivity, and more overprotection. Fifth, parenting at 4–6 months in turn predicts development in infant temperament from 4/6 months to 12 months. Parents' higher levels of hostility and overprotection predict lower levels of infant Regulation, higher levels of Negative Affectivity, and lower levels of Surgency, controlling for previous levels of the same temperament dimensions. Parents' higher levels of warmth and responsivity predict lower levels of infant Negative Affectivity and higher levels of Surgency and Regulation, controlling for previous levels of the same temperament dimensions. Sixth, we assessed mediation and expected that temperament expectations at T1, infant temperament at T2, and the interaction of these temperament characteristics would be associated with temperament at T3 *via* the parenting variables at T2. For a conceptual model, see Figure 1.

Materials and methods

Sample

In Project 1, the first three waves from the longitudinal study of The Social Development of Children (Majdandžić et al., 2016) were included. Couples who were expecting their first child were recruited through leaflets provided by midwives in Amsterdam and in cities within a range of 50 km around it, at pregnancy courses, at baby shops, and through advertisements in magazines and on websites on parenthood. Recruitment was done by a team of researchers and research assistants and took place from June 2007 to June 2009 (T1). There were follow-up data waves at the child's age of 4 months (T2), 1 year (T3), 2.5 years (T4), 4.5 years (T5), and 7.5 years (T6). At the data waves, families participated with their children in lab tasks and home visits and filled out questionnaires on paper. After completing a data wave, families received a 20 Euro gift voucher, and (at the postnatal data waves) a small present for the child and a recording of the laboratory sessions. Of the 151 couples for whom either the father or the mother provided information for the expected child characteristics at the prenatal assessment (T1), we included as part of the longitudinal sample those families for whom either the father or the mother also participated at T2, resulting in a total sample size of $N = 125$ families ($n = 122$ fathers; $n = 123$ mothers; babies: 69 girls (55%) 56 boys). Of these, $n = 114$ families also participated at T3 ($n = 110$ fathers; $n = 113$ mothers). The vast majority of parents were of Dutch origin (90% of mothers and 95% of fathers). Educational level was fairly high; 20% of mothers and 38% of fathers had finished vocational training, and 63% of mothers and 62% of fathers had an associate degree or higher. Mothers' mean age at Time 2 was

32.08 years, *SD* = 4.10, and fathers' mean age was 34.97 years, *SD* = 5.32.

In Project 2, mothers who were expecting a baby were recruited from December 2013 through April 2014 (T1). There were follow-up data waves at 6 months (T2), 1 year (T3), and 3.5 years (T4), and we used the data of the first three waves here. Students collected data as part of a research practicum, and recruited participants online, through websites for expecting women and young parents, Facebook, and face-to-face in Amsterdam. Mothers who participated in wave 1 were eligible to win a 100 Euro gift certificate, and for each subsequent wave, mothers could win a 50 Euro gift certificate. Mothers filled out an online questionnaire (Qualtrics). Of the 560 participants who participated at T1, we included those who also participated at T2, resulting in a final sample size of *N* = 168. Of these, *n* = 130 also participated at T3. Of the final sample, 2% were single mothers. Educational levels were as follows: 30% had finished vocational training and 70% had

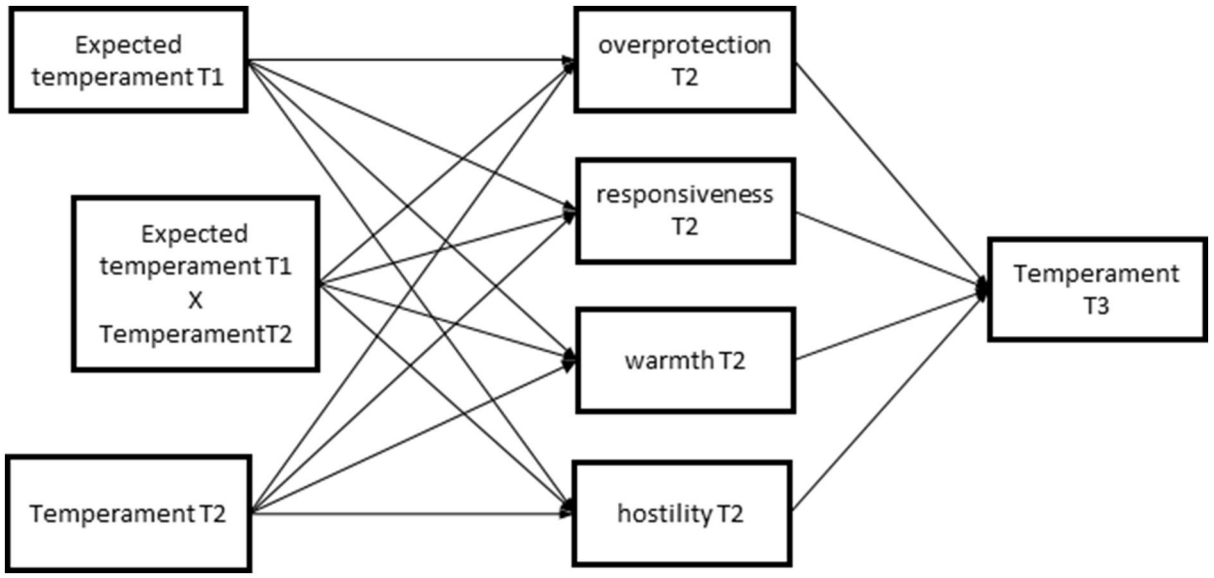

FIGURE 1
Graphical representation of the estimated models including the interaction. Please note a direct effect from temperament T2 to temperament T3 was also included, as were squared terms for expected temperament and temperament at T2, and covariances between the parenting variables – but are not depicted in this figure for the sake of clarity. In our initial plan we had included covariances between expected temperament and temperament T2 and their interaction, but these resulted in estimation problems and had to be removed.

TABLE 1 Overview of included measures.

	T1			T2			T3		
	During pregnancy			4 months post-partum		6 months post-partum	12 months post-partum		
	S1 mothers	S1 fathers	S2 mothers	S1 mothers	S1 fathers	S2 mothers	S1 mothers	S1 fathers	S2 mothers
Regulation	X	X		X(c)		X	X	X	X
Surgency	X	X		X(c)		X	X	X	X
Negative affectivity	X	X		X(c)		X	X	X	X
Big five personality			X						
Hostility				–	X	X			
Overprotection				X	X	X			
Responsivity				X	X	X			
Warmth				X	X	X			

S1, sample 1; S2, sample 2. (c) Indicates measures were combined. Dashes indicate the measure was not included because it was not sufficiently reliable.

an associate degree or higher. Most mothers were of Dutch origin (96%).

Measures

For an overview of the measures included in this study, see Table 1.

Expected child traits

In Project 1, parents' expectations about their child's temperament were assessed by having mothers and fathers fill out a balanced set of representative items selected from the following instruments: the Infant Behavior Questionnaire-Revised (Gartstein and Rothbart, 2003), the Early Childhood Behavior Questionnaire (Putnam et al., 2006), and the Children's Behavior Questionnaire (Rothbart et al., 2001) at Time 1. We computed higher-order scales for expected infant Negative Affectivity (13 items, example item: "I expect that my child has temper tantrums when s/he doesn't get what s/he wants"; discomfort: 3 items, sadness: 3 items, fear: 4 items, anger: 3 items), Regulation (15 items, example item: "I expect that my child can wait patiently when asked to wait for a desirable item"; inhibitory control: 3 items, attentional focusing: 3 items, attentional shifting: 3 items, low-intensity pleasure: 3 items, soothability: 3 items), and Surgency (19 items, example item: "I expect that my child gets very excited when given a new toy," impulsivity: 3 items, shyness (recoded): 4 items, activity level: 3 items, approach: 3 items, high-intensity pleasure: 3 items). Items were rated on Likert-type scales ranging from 1 (*never*) to 7 (*always*). Cronbach's alphas for mothers' reports were 0.73 for expected Regulation, 0.70 for expected Negative Affectivity, and 0.85 for expected Surgency. For fathers' reports, Cronbach's alphas were 0.62 for expected Regulation, 0.73 for expected Negative Affectivity, and 0.81 for expected Surgency. Confirmatory factor analysis was performed on the lower-order scales for the expected temperament measures in JASP version 0.16 (Team, 2021). Results indicated that a three-factor solution, with residual covariances added when they were indicated by the modification indices and did not result in problems in estimating the model, provided a sufficient fit to the data for both mothers: $\chi^2(70) = 112.93$, CFI = 0.913, RMSEA = 0.069 [0.044, 0.092], and fathers: $\chi^2(67) = 111.21$, CFI = 0.909, RMSEA = 0.071 [0.047, 0.094]. All scales loaded significantly and in the expected direction, except for discomfort in the mother data, for which the loading was not significant (albeit in the expected direction). We decided not to remove these items from the scales to allow for comparability of the measures across mothers and fathers.

In Project 2, pregnant mothers filled out the Dutch version of the Ten Item Personality Inventory (TIPI) (Hofmans et al., 2008) about their child, which includes two items for each of the Big Five scales (Extraversion, example item: "extraverted, enthusiastic," Agreeableness, example item: "critical, argumentative," Conscientiousness, example item: "thorough, disciplined," Neuroticism, example item: "fearful, easily upset," Openness-to-experience, example item: "open to new experiences, active imagination") (Gosling et al., 2003). Items were rated on Likert-type scales ranging from 1 (*not at all*) to 7 (*very much*). This version has been shown to be a valid alternative covering the five dimensions when time is limited (Hofmans et al., 2008). As this measure was designed to have the most coverage of the personality dimensions with the fewest items, this necessarily results in lower internal consistency than choosing items that measure the same aspect of the dimension (Hofmans et al., 2008). Consequently, alphas ranged from 0.22 for Conscientiousness to 0.46 for Neuroticism in the present sample. As models with <3 indicators per factor are subject to estimation problems (Kline, 2005, p. 114), confirmatory factor analysis of the TIPI was not attempted in this sample.

Infant temperament

In Project 1, mothers and fathers filled out the Infant Behavior Questionnaire Revised (Gartstein and Rothbart, 2003) for children aged 4 months and 1 year. We computed higher-order scales for Negative Affectivity (59 items, example item: "When tired, how often did your baby show distress?", sadness: 14 items, fear: 16 items, falling reactivity (reversed): 13 items, distress to limitation: 16 items), Regulation (60 items, example item: "How often during the last week did the baby stare at a mobile, crib bumper or picture for 5 min or longer?", cuddliness: 17 items, duration of orienting: 12 items, low-intensity pleasure: 13 items, soothability: 18 items), and Surgency (60 items, example item:" When tossed around playfully how often did the baby laugh?", activity level: 15 items, smiling and laughter: 10 items, vocal reactivity: 12 items, approach: 12 items, high-intensity pleasure: 11 items). Items were rated on Likert-type scales ranging from 1 (*never*) to 7 (*always*), with an option for when the item was not applicable. Cronbach's alphas were good, ranging from 0.80 to 0.91 for fathers, and from 0.85 to 0.89 for mothers. Mother and father reports were significantly correlated, range $r = 0.25$–0.64. We combined mother and father reports by averaging them to obtain robust measures of infant temperament at 4 months and 1 year.

In Project 2, mothers filled out the Infant Behavior Questionnaire Revised—Short form (Putnam et al., 2014) at child aged 6 months and 1 year. We computed higher-order scales for Negative Affectivity (25 items, example item: "When tired, how often did your baby show distress?", sadness: 6 items, fear: 6 items, falling reactivity (reversed): 6 items, distress to

limitation: 7 items), Regulation (26 items, example item: "How often during the last week did the baby stare at a mobile, crib bumper or picture for 5 min or longer?", cuddliness: 6 items, duration of orienting: 6 items, low intensity pleasure: 7 items, soothability: 7 items), and Surgency (34 items, example item:" When tossed around playfully how often did the baby laugh?", activity level: 7 items, smiling and laughter: 7 items, vocal reactivity: 7 items, approach: 6 items, high intensity pleasure: 7 items). Items were rated on Likert-type scales ranging from 1 (*never*) to 7 (*always*), with an option for when the item was not applicable. Cronbach's alphas were good, ranging from 0.81 to 0.91.

Parenting behavior

In Project 1, mothers and fathers filled out the Comprehensive Parenting Behavior Questionnaire at 4 months (Majdandžić et al., 2008), and in Project 2, mothers filled out the same questionnaire at 6 months. We computed mean scale scores for hostility (6 items, example item: "When my child cries for a long time, I yell at him/her"), overprotection (9 items, example item: "I try to minimize sound around my child as much as possible"), responsivity (5 items, example item: "When my child cries, I know what's wrong"), and warmth (6 items, example item: "I regularly cuddle with my child"). Parents rated how much the items applied to them on Likert-type scales ranging from 1 (*not at all*) to 7 (*completely*). Except for hostility as reported by mothers in Project 1 (Cronbach's alpha = 0.46), Cronbach's alphas were acceptable to good, ranging from 0.64 to 77 for mother reports and 0.65 to 0.80 for father reports in Project 1, and from 0.61 to 71 for the mothers in Project 2. As we could not obtain sufficient reliability (i.e., >0.60) for maternal hostility in Project 1 by removing items, we excluded maternal ratings of this measure in Project 1 from further analysis.

Analysis plan

We tested our first hypothesis—that parents have relatively favorable expectations of their future child's temperament—by testing (one-sided) whether the observed sample mean of each expected temperament scale differs significantly from the value representing the midpoint of the scale. To test Hypotheses 2–4, we fit three structural equation models in Mplus (Muthén and Muthén, 1998)—one for each expected temperament characteristic—according to the model as shown in Figure 1. For Project 1, separate models were fitted for mothers and fathers. Covariances between expected temperament at T1 and temperament at T2 were included (hypothesis 2), as well as covariances between the parenting variables at T2. The main effects of newborn temperament on parenting were tested (hypothesis 3). To study the effects of a positive or negative surprise (i.e., newborn temperament is less or more difficult than expected, respectively), we examined whether associations between newborn temperament and parenting were moderated by expected temperament (hypotheses 4 and 5). We therefore included the main effects of both expected and newborn temperament, quadratic terms for these main effects, and interaction effects between the expected temperament characteristics and newborn temperament at T2 (Laird and De Los Reyes, 2013). This approach has been shown to be preferable over for instance including different scores (Edwards, 2001). The main effects were mean-centered and quadratic and interaction terms were computed using mean-centered variables. To test mediation, indirect effects from expected temperament at T1 and infant temperament at T2, as well as their interaction, on temperament at T3, *via* parenting T2 were tested (hypothesis 6). The direct effects from Temperament T2 to Temperament T3 were controlled for.

To determine absolute model fit, we used the Root Mean Square Error of Approximation (RMSEA), with RMSEA <0.05 was considered a good fit and 0.05–0.08 as an acceptable fit (Browne and Cudeck, 1992), and the Comparative Fit Index

TABLE 2 Descriptives of the study variables.

	Project 1		Project 2
Measure	**Mothers** ***M (SD)***	**Fathers** ***M (SD)***	**Mothers** ***M (SD)***
Exp. Negative affectivity/Neuroticism	3.32 (0.57)	3.28 (0.59)	2.71 (0.92)
Exp. Regulation/Conscientiousness	4.78 (0.51)	4.77 (0.44)	4.95 (0.91)
Exp. Surgency/Extraversion	4.94 (0.56)	4.90 (0.55)	5.19 (0.95)
Exp. Agreeableness	–	–	5.57 (0.84)
Exp. Openness-to-Experience	–	–	5.41 (0.88)
Overprotection T2	2.07 (0.55)	2.02 (0.57)	2.03 (0.55)
Responsiveness T2	4.18 (0.39)	3.83 (0.45)	4.56 (0.38)
Hostility T2	–	1.40 (0.39)	1.44 (0.40)
Warmth T2	4.80 (0.26)	4.61 (0.44)	4.97 (0.11)
	Composite		
Infant Negative affectivity T2	2.93 (0.57)		2.50 (0.75)
Infant Regulation T2	5.07 (0.37)		5.58 (0.56)
Infant Surgency T2	3.96 (0.50)		4.81 (0.72)
Infant Negative affectivity T3	2.98 (0.56)		2.72 (0.86)
Infant Regulation T3	4.86 (0.38)		5.38 (0.57)
Infant Surgency T3	4.68 (0.42)		5.16 (0.53)

Parenting dimensions were rated on scales ranging from 1 to 5. Temperament and personality scores were rated on scales ranging from 1 to 7.

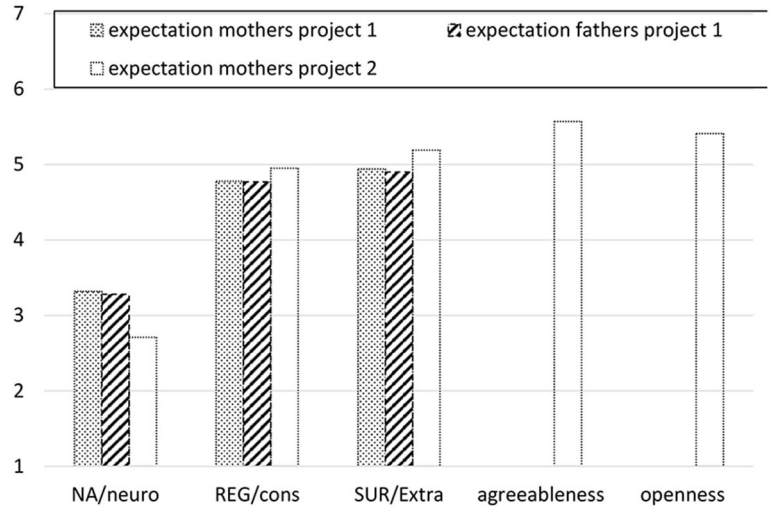

FIGURE 2
Expected temperament and personality traits scores. NA, Negative affectivity; REG, Regulation; SUR, Surgency.

(CFI), with CFI >0.95 is considered good fit (Hu and Bentler, 1999). Given that some of the variables were expected to be non-normally distributed (hostility and overprotection) and in view of missing data, we used Full Information Maximum Likelihood estimation with a Robust estimator. Outliers—outside the 1.5 Interquartile range—were winsorized to the nearest value within that range. The hypotheses and analysis plan were preregistered on the Open Science Framework (https://osf.io/k53zt/?view_only=221fbc060e5d4a11bc60ddf8f8a95d0e).

Results

Descriptives of the study variables are presented in Table 2.

Expectations about temperament

As expected, both mothers and fathers in Project 1 had positive expectations about the child's temperament traits, with all means significantly different from 4, at $p < 0.001$. Both mothers and fathers expected their child to be lower on Negative Affectivity and higher on Surgency and Regulation than the midpoint of the scale. Paired samples t-tests indicated that mothers' and fathers' expectations did not differ significantly [$t_{\text{Negative Affectivity}}(113) = -0.15$, $p = 0.879$; $t_{\text{Regulation}}(113) = 0.43$, $p = 0.668$; $t_{\text{Surgency}}(113) = 0.90$, $p = 0.369$]. Results from Project 2 also confirmed our hypothesis, with all means significantly different from 4, at $p < 0.001$. Mothers expected their children to be more extraverted, agreeable, conscientious, and open to experience than the mid-point of the scale, and less neurotic. For a visual representation of expected levels of the traits see Figure 2.

Expected temperament, parenting, and actual temperament

We fitted models with the main effects of expected temperament and newborn temperament as well as their squared terms and interactions, on parenting, with parenting in turn predicting 12-month temperament (Figure 1). For model fit statistics, see Table 3. In these models, we first examined associations between expected and actual temperament (hypothesis 2). We predicted that expecting parents' expectations about infant temperament would be positively associated with the reported temperament of the newborn. In both Project 1 and Project 2, we found that higher levels of expected Regulation were associated with higher levels of actual Regulation of the newborn (see Table 4). In Project 2, mothers' higher expected Surgency was also associated with higher Surgency at 4–6 months, and in Project 1, fathers' expected Negative Affectivity was associated with higher actual Negative Affectivity. For estimates of the associations, see Table 4.

Our third hypothesis addressed the associations between infant temperament at T2 and parenting at T2. In sample 1, we did not find any significant associations between infant Negative Affectivity at 4 months and parenting, whereas in sample 2 we found two associations in the expected direction: higher infant Negative Affectivity at 6 months was associated with lower responsivity and higher hostility (see Table 5). Of note, we could not include hostility for mothers in Sample 1, as this measure was not sufficiently reliable.

With regard to Regulation, we found that for mothers in both samples 1 and 2, higher infant Regulation was associated with more responsivity, with a quadratic effect significant

TABLE 3 Model fit statistics.

	Project 1							Project 2		
	Mothers			Fathers				Mothers		
Model	RMSEA	CFI	χ^2 (*df*)	RMSEA	CFI	χ^2 (*df*)		RMSEA	CFI	χ^2 (*df*)
Negative affectivity	0.069	0.909	15.56 (10)	0.000	1.000	8.13 (10)	Neuroticism	0.058	0.971	10.91 (7)[a]
Regulation	0.000	1.000	6.64 (10)	0.000	1.000	4.83 (10)	Conscientiousness	0.000	1.000	4.98 (10)
Surgency	0.060	0.933	14.20 (10)	0.000	1.000	8.57 (10)	Extraversion	0.068	0.925	17.87 (10)

[a]The squared term for the main effect of infant temperament at T2 was removed to be able to fit the model.

TABLE 4 Associations between expected temperament T1 and infant temperament T2.

	Project 1				Project 2	
	Mothers		Fathers		Mothers	
covariances	σ (*SE*)	*p*	σ (*SE*)	*p*	σ (*SE*)	*p*
Exp. NA/neuro←→ NA T2	0.01 (0.09)	0.910	0.24 (0.07)	0.001	0.09 (0.08)	0.239
Exp. REG/cons ←→REG T2	0.25 (0.10)	0.013	0.15 (0.08)	0.084	0.18 (0.07)	0.015
Exp. SUR/extra ←→ SUR T2	0.14 (0.09)	0.118	0.13 (0.08)	0.093	0.20 (0.07)	0.006

NA, Negative Affectivity; REG, Regulation; SUR, Surgency; neuro, Neuroticism; cons, Conscientiousness; extra, Extraversion.

for sample 1: the effect became stronger at higher levels of Regulation (see Table 5). For fathers in sample 1, and mothers in sample 2, higher Regulation was associated with more warmth. For mothers in sample 2, higher Regulation was also associated with less hostility.

For Surgency, we found that for mothers in sample 1, infant Surgency was associated with more warmth, whereas for fathers in sample 1 and mothers in sample 2, infant Surgency was associated with more responsiveness. For mothers in sample 2 infant Surgency was additionally associated with lower overprotection. Overall, the associations were all in the expected direction.

Next, we examined the interactions between expected and newborn temperament in predicting parenting in the models (hypothesis 4). There was only one significant interaction: for mothers in sample 1, expected Regulation and actual Regulation interacted to predict responsiveness, such that for mothers who expected lower Regulation (effect significant up to 0.3 *SD* above the mean of expected Regulation), higher infant Regulation was related to more responsivity (or vice versa—lower Regulation was related to less responsivity). For mothers who expected levels of Regulation higher than 0.3 *SD* above the mean, infant Regulation was not related to their responsivity overall, except that for mothers who expected very high Regulation (effect significant from 1.8 *SD* above the mean), higher Regulation was related to less responsivity. For a graphical presentation of the Johnson-Neyman interval for the interaction effect, see Figure 3. None of the other interactions were significant.

To test the interactions, we also included the main effects of expected temperament on parenting behavior. Expected Negative Affectivity was associated with all parenting dimensions in sample 1: for mothers, higher expected infant Negative Affectivity was associated with lower warmth at 4 months, and for fathers with higher overprotection and hostility, and lower responsivity. There were no quadratic effects here. For sample 2, there were no significant effects for expected Neuroticism overall, but for its relation with responsivity, the quadratic effect was significant. When the quadratic effect is statistically significant, it should be interpreted together with the linear effect: higher levels of expected Neuroticism were associated with lower maternal responsivity, with the effect becoming stronger at higher levels of expected Neuroticism. With regards to expected regulation, for both mothers and fathers in sample 1, it was associated with more responsivity, and for mothers, it was also related to less overprotection. For mothers in sample 2, expected Conscientiousness was associated with lower hostility. Regarding expected Surgency, for mothers in sample 1, it was associated with more responsiveness and less overprotection, and the quadratic term for expected Surgency was significant for warmth, indicating that at lower and at higher levels of expected Surgency, warmth was lower. There was also a quadratic effect of expected Extraversion in sample 2, however, the main effect was significant here as well. Together, the effects in sample 2 indicated that higher expected Extraversion was associated with more warmth and that this effect became stronger at higher levels.

10.3389/fpsyg.2022.942392

TABLE 5 Effects of expected temperament T1, infant temperament T2, and their interaction on parenting.

	Overprotection T2		Responsivity T2		Hostility T2		Warmth T2	
Project 1	**β (S.E.)**	***p***	**β (S.E.)**	***p***	**β (S.E.)**	***p***	**β (S.E.)**	***p***
Mother								
Negative Affectivity								
Exp. NA	0.17 (0.09)	0.052	−0.10 (0.10)	0.343	–	–	−0.22 (0.11)	0.046
NA T2	0.10 (0.09)	0.303	−0.17 (0.10)	0.090	–	–	0.15 (0.09)	0.097
[Exp. NA]^2	−0.02 (0.08)	0.859	−0.06 (0.09)	0.516	–	–	−0.12 (0.12)	0.349
[NA T2]^2	−0.08 (0.10)	0.389	0.09 (0.08)	0.268	–	–	−0.04 (0.11)	0.730
Exp. NA × NA T2	−0.01 (0.08)	0.877	0.13 (0.11)	0.234	–	–	0.08 (0.12)	0.518
Regulation								
Exp. REG	−0.17 (0.09)	0.048	0.31 (0.07)	<0.001	–	–	0.18 (0.10)	0.074
REG T2	−0.06 (0.10)	0.558	0.31 (0.06)	<0.001	–	–	0.00 (0.11)	0.997
[Exp. REG]^2	0.09 (0.11)	0.393	−0.03 (0.08)	0.708	–	–	0.13 (0.09)	0.142
[REG T2]^2	0.16 (0.10)	0.115	0.30 (0.08)	<0.001	–	–	0.13 (0.12)	0.272
Exp. REG × REG T2	0.17 (0.11)	0.112	−0.27 (0.08)	0.001	–	–	−0.10 (0.15)	0.510
Surgency								
Exp. SUR	−0.19 (0.09)	0.046	0.24 (0.09)	0.004	–	–	0.01 (0.12)	0.950
SUR T2	−0.07 (0.09)	0.436	0.16 (0.10)	0.107	–	–	0.29 (0.10)	0.002
[Exp. SUR]^2	−0.07 (0.11)	0.517	−0.07 (0.07)	0.301	–	–	−0.40 (0.09)	<0.001
[SUR T2]^2	−0.02 (0.09)	0.796	0.02 (0.11)	0.839	–	–	−0.11 (0.10)	0.248
Exp. SUR × SUR T2	0.11 (0.10)	0.306	−0.02 (0.09)	0.829	–	–	0.03 (0.11)	0.806
Father								
Negative affectivity								
Exp. NA	0.24 (0.08)	0.004	−0.28 (0.09)	0.002	0.23 (0.10)	0.017	−0.17 (0.12)	0.138
NA T2	0.05 (0.11)	0.649	0.16 (0.10)	0.125	0.14 (0.08)	0.084	−0.01 (0.11)	0.930
[Exp. NA]^2	0.11 (0.09)	0.224	0.06 (0.10)	0.554	−0.02 (0.09)	0.823	−0.08 (0.12)	0.483
[NA T2]^2	0.00 (0.13)	0.978	0.18 (0.10)	0.074	−0.14 (0.09)	0.136	−0.01 (0.09)	0.936
Exp. NA × NA T2	−0.08 (0.11)	0.436	−0.12 (0.10)	0.257	0.13 (0.09)	0.181	0.14 (0.13)	0.267
Regulation								
Exp. REG	−0.06 (0.08)	0.446	0.29 (0.10)	0.003	−0.04 (0.09)	0.630	0.17 (0.11)	0.136
REG T2	−0.03 (0.10)	0.733	0.18 (0.11)	0.101	−0.13 (0.09)	0.172	0.19 (0.07)	0.011
[Exp. REG]^2	0.03 (0.08)	0.746	−0.02 (0.07)	0.775	0.02 (0.09)	0.843	−0.07 (0.08)	0.383
[REG T2]^2	0.02 (0.10)	0.863	−0.05 (0.11)	0.661	−0.07 (0.10)	0.510	0.06 (0.07)	0.370
Exp. REG × REG T2	−0.04 (0.10)	0.680	0.11 (0.13)	0.408	0.06 (0.09)	0.475	−0.08 (0.12)	0.499
Surgency								
Exp. SUR	−0.19 (0.10)	0.073	−0.01 (0.10)	0.932	−0.03 (0.10)	0.739	0.16 (0.10)	0.109
SUR T2	0.09 (0.08)	0.253	0.30 (0.10)	0.002	0.03 (0.09)	0.771	0.11 (0.14)	0.412
[Exp. SUR]^2	−0.11 (0.12)	0.339	0.06 (0.10)	0.538	0.02 (0.10)	0.816	0.07 (0.09)	0.434
[SUR T2]^2	−0.06 (0.08)	0.479	−0.02 (0.10)	0.834	−0.03 (0.08)	0.747	−0.13 (0.16)	0.425
Exp. SUR × SUR T2	−0.03 (0.09)	0.730	−0.06 (0.09)	0.493	0.16 (0.09)	0.059	0.01 (0.09)	0.888
Project 2								
Neuroticism/								
Exp. Neuro.	0.10 (0.07)	0.150	−0.11 (0.07)	0.152	0.02 (0.07)	0.777	0.02 (0.13)	0.897
NA T2	0.04 (0.08)	0.592	−0.18 (0.08)	0.027	0.38 (0.08)	<0.001	0.01 (0.05)	0.809
[Exp. Neuro]^2	−0.13 (0.07)	0.072	−0.16 (0.08)	0.038	0.07 (0.08)	0.388	−0.07 (0.13)	0.590
[NA T2]^2	–	–	–	–	–	–	–	–
Exp. Neuro. × NA T2	0.04 (0.08)	0.650	0.10 (0.07)	0.163	−0.03 (0.09)	0.746	0.08 (0.14)	0.083

(Continued)

TABLE 5 (Continued)

Project 1	Overprotection T2		Responsivity T2		Hostility T2		Warmth T2	
	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
Conscientiousness								
Exp. Cons.	−0.08 (0.07)	0.309	−0.07 (0.07)	0.265	−0.15 (0.07)	0.043	−0.01 (0.11)	0.905
REG T2	−0.13 (0.07)	0.078	0.51 (0.06)	<0.001	−0.16 (0.07)	0.028	0.10 (0.05)	0.072
[Exp. Cons]^2	−0.00 (0.08)	0.986	0.04 (0.06)	0.450	−0.01 (0.07)	0.342	−0.11 (0.10)	0.271
[REG T2]^2	−0.07 (0.08)	0.332	−0.04 (0.06)	0.583	0.07 (0.07)	0.940	0.03 (0.06)	0.637
Exp.Cons. × REG T2	0.08 (0.06)	0.218	0.01 (0.07)	0.834	0.08 (0.08)	0.342	0.01 (0.07)	0.894
Extraversion								
Exp. Extra.	−0.02 (0.09)	0.858	−0.01 (0.08)	0.874	−0.03 (0.08)	0.721	0.11 (0.05)	0.024
SUR T2	−0.21 (0.08)	0.007	0.37 (0.07)	<0.001	0.07 (0.08)	0.377	−0.06 (0.10)	0.593
[Exp. Extra]^2	−0.15 (0.09)	0.095	−0.03 (0.07)	0.635	−0.06 (0.07)	0.391	0.13 (0.04)	0.001
[SUR T2]^2	−0.06 (0.08)	0.476	−0.02 (0.06)	0.709	0.06 (0.08)	0.407	−0.07 (0.09)	0.451
Exp.Extra. × SUR T2	−0.09 (0.09)	0.312	−0.10 (0.07)	0.197	0.02 (0.07)	0.773	0.08 (0.09)	0.340

NA, Negative Affectivity; REG, Regulation; SUR, Surgency; neuro, Neuroticism; cons, Conscientiousness; extra, Extraversion.

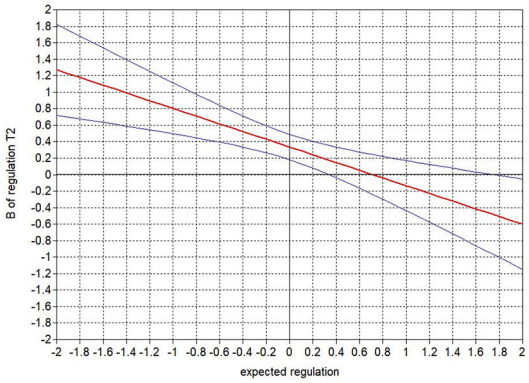

FIGURE 3
Johnson-Neyman interval for the association between Regulation at 4 months (mean centered) and maternal responsiveness, at the different levels of expected Regulation (mean centered).

Infant temperament at 12 months predicted by parenting

Our fifth hypothesis addressed relations between parenting at T2 and the development of infant temperament between T2 and T3. For mothers in sample 1, higher overprotection at 4 months predicted higher Negative Affectivity at 12 months, controlling for earlier Negative Affectivity (see Table 6). For mothers in sample 2, this association was not significant, whereas several other associations were: Regulation was predicted by higher levels of warmth, and Surgency was predicted by lower overprotection and hostility. For paternal parenting in sample 1, we found that higher hostility predicted more infant Negative Affectivity, whereas higher warmth predicted higher Surgency. Here we found one unexpected result: lower—rather than higher—paternal responsiveness was also associated with higher Surgency. Again, although most of the associations were in the expected direction, none of the specific links replicated across the two samples. For estimates, see Table 6.

Finally, to address hypothesis 6, we investigated whether continuity in temperament from T1 and T2 to T3 would be explained by the parenting variables at T2. We found no significant indirect effects either from expected temperament or newborn temperament, or their interaction, *via* parenting on 12-month temperament. For estimates of all indirect effects, see Table 7.

Discussion

The overall aim of this study was to examine how prenatal expectations of child characteristics provide a context for the early establishment of transactional associations between temperament and parenting. We found that parents had relatively optimistic expectations overall, that temperament expectations were positively associated with newborn temperament, and that perceived infant temperament predicted parenting behavior—with more difficult temperament (higher Negative Affectivity, lower Surgency, and Regulation) predicting less positive (lower responsiveness and warmth) and more negative (higher hostility and overprotection) parenting. While expected temperament and infant temperament were approximately equally strong predictors of parenting, there was little evidence for interactions between them, indicating either positive or negative surprises, in predicting parenting behavior. Parenting behavior did in turn predict temperament at 12 months, controlling for earlier infant temperament. Again,

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TABLE 6 Effects of parenting and infant temperament at T2 on infant temperament at T3.

	Mother						Father					
	NA T3		REG T3		SUR T3		NA T3		REG T3		SUR T3	
Predictors T2	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
Project 1												
NA/REG/SUR T2	0.45 (0.07)	<0.001	0.46 (0.09)	<0.001	0.45 (0.08)	<0.001	0.42 (0.08)	<0.001	0.39 (0.09)	<0.001	0.49 (0.07)	<0.001
Overprotection	0.19 (0.09)	0.027	0.01 (0.09)	0.906	0.07 (0.09)	0.423	0.04 (0.08)	0.637	0.07 (0.10)	0.501	−0.02 (0.09)	0.819
Responsiveness	−0.17 (0.10)	0.089	0.11 (0.10)	0.258	−0.05 (0.10)	0.566	0.07 (0.11)	0.517	−0.01 (0.11)	0.931	−0.22 (0.09)	0.014
Hostility	–	–	–	–	–	–	0.31 (0.10)	0.001	0.01 (0.11)	0.941	−0.12 (0.09)	0.172
Warmth	0.10 (0.09)	0.270	0.03 (0.08)	0.682	0.09 (0.10)	0.369	0.11 (0.08)	0.185	0.17 (0.10)	0.101	0.21 (0.08)	0.014
Project 2												
NA/REG/SUR T2	0.76 (0.04)	<0.001	0.57 (0.08)	<0.001	0.42 (0.06)	<0.001						
Overprotection	0.07 (0.06)	0.228	0.05 (0.08)	0.570	−0.15 (0.07)	0.020						
Responsiveness	−0.05 (0.07)	0.485	−0.03 (0.10)	0.750	0.11 (0.08)	0.154						
Hostility T2	−0.12 (0.06)	0.050	0.06 (0.07)	0.393	−0.15 (0.07)	0.042						
Warmth	0.06 (0.07)	0.402	0.15 (0.06)	0.016	0.02 (0.06)	0.728						

NA, Negative Affectivity; REG, Regulation; SUR, Surgency.

almost all associations were in the expected direction, with more negative and less positive parenting predicting a more difficult temperament. Parenting did not mediate associations between earlier and later temperament.

Prenatal expectations of temperament

Our first hypothesis—that parents would expect their future child to have relatively favorable characteristics—was confirmed for both mothers and fathers, and in both samples. Similar to what people would indicate to be the ideal personality, parents expected infant temperament levels toward the ends of the scale but not at the extremes (Borkenau et al., 2009). Our findings are in line with findings that show that expecting parents have optimistic expectations overall (Harwood et al., 2007). At the same time, mean levels of infant Negative Affectivity and Regulation at 4–6 months were even more positive than expected. Previous studies also found that parents' reports of their infant's temperament at 3–4 months were more positive (i.e., less difficult, unadaptable, dull, and unpredictable) than they had expected during pregnancy (Mebert and Kalinowski, 1986; Diener et al., 2014). And similarly, general optimistic prenatal expectations about life after child birth have also been found to be exceeded half a year after childbirth (Harwood et al., 2007). This effect may be temporary; as a study that examined whether expectations were met at 12 months post-partum found that experiences were more negative than expected (Kalmuss et al., 1992). In the latter study, mean levels of the temperament traits had come closer to the prenatal expectations by 12 months than they were at 6 months. We add to previous findings on expectations about temperament by our inclusion of Surgency, for which infant ratings were actually more negative (i.e., lower) than parents expected. This may be important to investigate further as Western mothers of young infants have indicated Extraversion—which is conceptually related to Surgency—as the trait they would most like their children to score high on—more important than high Conscientiousness, low Neuroticism, or even high IQ (Latham and von Stumm, 2017).

Our second hypothesis was also confirmed overall, with expected temperament positively associated with infant temperament assessed at 4–6 months. The specific traits that were significant differed between mothers and fathers, and between the mothers across the two samples. A previous study also found different associations for mothers and fathers of the same children, with mothers' expectations associated with their ratings of the child's unpredictability and fussiness, whereas fathers' expectations were associated with their ratings of the child's dullness and unadaptability (Diener et al., 2014). Thus, our study found evidence of continuity in parents' expectations and their later perceptions of their child's temperament. This may reflect informant bias and/or actual parental ability to predict child temperament (e.g., based on parents' own temperament). The results of sample 1, where fathers' and mothers' ratings of newborn temperament were averaged, reducing informant bias, suggest at least some correspondence of expectations with actual temperament.

TABLE 7 Indirect effects of expected temperament, infant temperament T2, and their interaction, on temperament T3 *via* parenting T2.

	Indirect effect					
	Project 1				Project 2	
	Mother		Father		Mother	
IV → DV	**β (*S.E.*)**	***p***	**β (*S.E.*)**	***p***	**β (*S.E.*)**	***p***
Exp. NA/neuro → NA T3	0.03 (0.03)	0.422	0.04 (0.04)	0.321	0.01 (0.02)	0.512
NA T2 → NA T3	0.06 (0.04)	0.088	0.06 (0.04)	0.134	−0.03 (0.03)	0.193
Exp. NA/neuro × NA T2 → NA T3	−0.02 (0.02)	0.482	0.04 (0.04)	0.278	0.01 (0.01)	0.684
Exp. REG/cons → REG T3	0.04 (0.04)	0.297	0.03 (0.02)	0.202	−0.01 (0.02)	0.592
REG T2 → REG T3	0.03 (0.03)	0.298	0.02 (0.03)	0.519	−0.02 (0.05)	0.734
Exp. REG/cons × REG T2 → REG T3	−0.03 (0.03)	0.321	−0.02 (0.03)	0.537	0.01 (0.01)	0.506
Exp. SUR/extra → SUR T3	−0.03 (0.03)	0.369	0.04 (0.03)	0.197	0.01 (0.02)	0.716
SUR T2 → SUR T3	0.01 (0.03)	0.690	−0.05 (0.04)	0.253	0.06 (0.04)	0.077
Exp. SUR/extra × SUR T2 → SUR T3	0.01 (0.01)	0.463	−0.00 (0.03)	0.914	0.00 (0.02)	0.918

IV, Independent Variable; DV, Dependent Variable; NA, Negative Affectivity; REG, Regulation; SUR, Surgency; neuro, Neuroticism; cons, Conscientiousness; extra, Extraversion.

Child temperament and parenting behavior

As prenatal expectations were positively associated with infant temperament, associations between infant temperament and early caregiving may be partially explained by these expectations. For each of the parenting behaviors, we found several associations with both parental expectations of temperament and infants' perceived temperament, which partly confirmed our third hypothesis. However, few of the specific links replicated across multiple samples—with the exception of expected Regulation and infant Regulation at 4–6 months with responsiveness, and infant Surgency with responsiveness. Additionally, some of the associations that differed between mothers and fathers in sample 1, which we might have interpreted as representing differences between maternal and paternal parenting, were similar for fathers of sample 1 and mothers of sample 2, making it unlikely that these differences represent differences between mothers and fathers more generally. A previous study found that early childhood effortful control was associated with more positive parenting for mothers and less negative control for fathers (Tiberio et al., 2016), whereas we found that Regulation—the related trait in infancy—was associated with more positive parenting for both mothers and fathers in sample 1, and to less hostility only for mothers in sample 2. In light of the lack of replication, we found across our samples between specific temperament and parenting dimensions, we will not discuss the results at the level of specific trait-parenting links or differences between mothers and fathers, but rather discuss more general trends.

A consistent finding was that all associations were in the direction that we had expected, with higher Negative Affectivity and lower Regulation and Surgency associated with more overprotection, hostility, and less responsiveness and warmth. Interestingly, there were only two associations between newborn Negative affectivity and parenting behavior, both in sample 2, whereas we did find several (i.e., 3) associations for *expected* Negative Affectivity. When infant Negative affectivity is assessed with parent report, pre-formed expectations may thus explain an important part of the effects of infant Negative affectivity. Overall, expected temperament was at least as much related to parenting at 4–6 months (12 significant associations) as newborn temperament was (10 significant associations), with similar effect sizes. So what appears to be a child effect, may actually oftentimes be a parent effect, with a negative view about what the unborn child's temperament will be like carrying over into the post-partum reality to predict caregiving. Similarly, a previous study found that prenatal optimism about life post-partum was more predictive of mother–infant bonding than whether or not expectations were confirmed (Robakis et al., 2015). Relatedly, a study found that prenatal expectations about how mothers would parent predicted children's distress to limitations (Perry et al., 2018). This raises questions of how specific the associations with parenting in our study are for prenatal views of the child, or whether these are already related then to expectations about parenting.

Comparing the different parenting dimensions, there were more significant associations of child temperament with responsiveness (10) than with the other parenting dimensions (4 for each). Responsiveness captures how parents feel they can respond effectively to the baby and is closely related to sensitivity, a key parenting dimension in attachment research (De Wolff and Van Ijzendoorn, 1997). Being about attunement to the child, responsivity may be associated more with the child's behavior and characteristics than the other parenting dimensions. In turn, these other parenting behaviors may be linked more strongly with parents' own emotions or traits, with parental anxiety linked to overprotection, positive affect to

warmth, and anger to hostility. Future research could investigate whether different parenting behaviors vary in how much they are determined by the child's reactivity and regulation of emotions vs. the parents' own capacity to regulate their emotions.

In addition to the main effects of expected temperament and infant temperament, we expected in hypothesis 4 that expected temperament might determine the effect of infant temperament on parenting. However, we found only one such effect: In sample 1, infant Regulation was not predictive of maternal responsiveness when mothers expected high Regulation, whereas it was predictive for mothers who expected low Regulation. This effect might be an indication of the advantages of not having too positive expectations (Harwood et al., 2007), because at lower levels of expected Regulation, a high level of actual Regulation, a positive surprise, resulted in higher levels of responsiveness than at higher levels of expected Regulation, or a confirmed positive expectation. However, expecting low Regulation was also risky, because when mothers expected low Regulation and also reported low Regulation in their newborn, a confirmed negative expectation, mothers reported the lowest levels of responsiveness. It is important to note that only one out of all the interactions that were tested was positive, and this interaction did not replicate across samples, indicating that overall the combination of expected and infant temperament was less important than the independent effects of both expected temperament and infant temperament were. Given the knowledge that many factors affect parents' parenting above infant temperament (Taraban and Shaw, 2018), future studies may include parental factors such as parenting stress, coparenting, or parents' own temperament in addition to (expected) child temperament.

Parenting behavior predicting infant temperament at 12 months

In line with our fifth hypothesis, parenting behavior at 4–6 months predicted infant temperament at 12 months, controlling for earlier levels of temperament at 4–6 months, with all temperament traits moderately stable. Again, almost all associations were in the direction of more negative and less positive parenting associated with more difficult temperament. We found only one association that was in the opposite direction: more paternal responsiveness at 4 months predicted lower Surgency at 12 months in sample 1. However, similar to the associations between temperament at 4–6 months and parenting, none of the specific links were replicated here across the two samples or parent genders. Past research has examined many specific parenting behaviors, such as sensitivity, mutual responsive orientation, limit setting, rejection, etc., as well as many different conceptualizations of temperament traits, such as fussiness, difficulty, attention, self-regulation, effortful control, irritability, etc. (Kiff et al., 2011). Results of this study show that it is important to be careful in interpreting all these links as differential effects, as they might not be as replicable as the more general trends with regard to negative parenting behaviors to levels of temperament traits that would signify maladjustment and positive parenting behaviors to levels of temperament traits that would signify better adjustment (Rothbart and Bates, 1998).

Our sixth and final hypothesis regarding the mediation of the association between earlier and later temperament by the parenting behaviors was not confirmed. We did not find any evidence of mediation effects. Temperament was quite stable, as can be expected, and was not very strongly and consistently influenced by parenting at this young age. A study examining mediation of earlier effortful control to later effortful control by maternal and paternal parenting found no significant effects at the youngest ages in their study (between 3 and 7 or between 5 and 11.5 years), and only one effect for maternal parenting at the oldest age, from 7 to 13.5 years (Tiberio et al., 2016). These mediational associations are then likely very small effects that perhaps slowly accumulate over time, only becoming visible later on in development, across larger age ranges.

Strengths and limitations

This study has several strengths. First, we included two independent samples including longitudinal data for three waves. Second, in sample 1, the multi-informant approach allowed us to reduce mono-informant bias in the infant temperament measures. Third, previous studies have more often examined either multiple temperament traits or multiple parenting behaviors, but only very few longitudinal studies have included multiple traits—multiple parenting behavior associations (see Kochanska et al., 2004 for a notable exception).

In addition to these strengths, several limitations are also worth mentioning. First, both studies had a relatively small sample size, due to attrition across the three waves of the longitudinal study. This may have limited our power to detect the interaction and mediation effects. Second, although we did have data for fathers in sample 1, fathers were not included in sample 2. Therefore, we do not know whether the results from the fathers would replicate across samples. Future research is necessary to investigate whether associations between fathers and mothers differ. Third, although we could combine maternal and paternal reports of infant temperament for sample 1, thereby reducing mono-informant bias, this was not possible for sample 2. Including independent observations of infant temperament will be helpful in further elucidating how much of the association between expected and perceived temperament is due to the fact that parents may be correct in their predictions and base it on their knowledge of their own and their partner's characteristics that are genetically passed on

to the child, and how much is due to bias of the parent in how they perceive their child (Stifter et al., 2008). Fourth, it is important to keep in mind that due to the lack of diversity in these samples, results may not generalize to samples of parents with fewer resources or different cultural backgrounds. Especially the expected characteristics may be dependent on cultural background, as well as how parents respond to these, as the desirability of different temperament traits is culturally determined (Desmarais et al., 2021).

Conclusion

Prenatal expectations may provide a context that determines how parents view and respond to their child. Both prenatal expectations about children's temperament and perceptions of infant's temperament were equally and uniquely predictive of parents' early caregiving behavior. Early caregiving behavior in turn predicted changes in infants' temperament across the second half of their first year of life. Our findings may provide an avenue for preventive work with regard to early parenting problems; as prenatal expectations are associated with early caregiving, they may be helpful in identifying parents who are at risk of early maladaptive parenting behavior, with modifying these perceptions perhaps helpful. Especially parents' views of their future child as relatively difficult may signify potential problems, although for Surgency both very low and very high levels were associated with less warmth. It will be important to perform more studies of specific temperament-parenting links before any advice regarding specific parenting practices depending on children's temperament traits is formulated.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethical Review Board Department Child Development and Education, University of Amsterdam. The patients/participants provided their written informed consent to participate in this study.

Author contributions

AV contributed the analysis and interpretation of data for the work and drafted the work. All authors made substantial contributions to the conception or design of the work, acquisition of data, were involved in revising it critically for important intellectual content, provide approval for publication of the content, 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.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 October 2022
DOI 10.3389/fpsyg.2022.983435

OPEN ACCESS

EDITED BY
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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 01 July 2022
ACCEPTED 03 October 2022
PUBLISHED 20 October 2022

CITATION
Tan L and Smith CL (2022) Longitudinal bidirectional relations between children's negative affectivity and maternal emotion expressivity.
Front. Psychol. 13:983435.
doi: 10.3389/fpsyg.2022.983435

Longitudinal bidirectional relations between children's negative affectivity and maternal emotion expressivity

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Although children's negative affectivity is a temperamental characteristic that is biologically based, it is framed within and shaped by their emotional environments which are partly created by maternal emotion expressivity in the family. Children, in turn, play a role in shaping their family emotional context, which could lead to changes in mothers' emotion expressivity in the family. However, these theorized longitudinal bidirectional relations between child negative affectivity and maternal positive and negative expressivity have not been studied from toddlerhood to early school-age. The current study utilized a cross-lagged panel model to examine the reciprocal relations between children's negative affectivity and maternal expressivity within the family over the course of early childhood. Participants were 140 mother–child dyads (72 boys, mean age=2.67 years, primarily White). Mothers reported the positive and negative expressivity in the family and children's negative affectivity in toddlerhood (T1), preschool (T2), and school-age (T3). Maternal negative expressivity and child negative affectivity at T1 were significantly correlated. Maternal negative expressivity at T1 significantly predicted child negative affectivity at T3. Children's negative affectivity at T2 significantly predicted mothers' negative expressivity at T3. Mothers' positive expressivity was not related to children's negative affectivity at any of the three time points. The findings demonstrate the reciprocal relations between children's negative affectivity and maternal negative expressivity in the family, suggesting the importance of the interplay between child temperament and maternal expressivity within the family emotional context.

KEYWORDS

negative affectivity, maternal positive expressivity, maternal negative expressivity, temperament, childhood

Introduction

Temperament is defined as biologically-based individual differences in emotional reactivity and self-regulation influenced by heredity, environment, and experience (Rothbart and Derryberry, 1981; Rothbart et al., 2004). Negative affectivity, which refers to the tendency to become negatively aroused and reactive to stimuli (Rothbart et al., 2001),

is an aspect of temperament that has been found to be related to anxiety and depression symptoms (Lonigan et al., 2003; van der Bruggen et al., 2010), lower social competence (Sallquist et al., 2009), and internalizing and externalizing behaviors (Engle and McElwain, 2011). Although emotional reactivity is biologically based, it is refined within children's environments, particularly the family, from the beginning of development. Therefore, it is important to examine the factors within the family that are related to the changes and development of children's negative affectivity over time.

Previous studies have established parenting behaviors, including psychological control, rejection, parenting efficacy, and harsh discipline (e.g., van der Bruggen et al., 2010; Troutman et al., 2012; Xing et al., 2017; Diaz et al., 2019), as major contributors in determining the development of negative affectivity in young children. These parenting behaviors are often considered in the goodness-of-fit between children's temperament and their environment (Thomas and Chess, 1977), where the expectation is that children have more optimal outcomes when parenting behaviors are in accord with their temperament. However, equally important but much less studied is the emotion expressivity in the family context. Mothers' emotion expressivity – a persistent style in displaying verbal and nonverbal expressions toward other family members (Halberstadt et al., 1995) – contributes to the quality of the family emotional climate (Halberstadt et al., 1999), and thus the current study focused on how mothers' emotion expressivity within the family context and child negative affectivity relate to each other.

Children can directly observe and imitate mothers' emotional reactions to common situations in the family and toward family members, such as expressing gratitude for a favor or voicing anger over a mistake. For children, these emotional reactions may serve as foundational models to how emotions are supposed to be expressed (i.e., emotion display rules). For example, when mothers express frequent and intense negative emotions, in response to mundane situations (e.g., threatening a family member or being angry at a family member's small mistake), children with high negative affectivity (i.e., those with a natural predisposition to react with negative emotions), may think that it is perfectly normal to express these negative emotions regularly or strongly. On the other hand, children with mothers who habitually express more positive and less negative emotions in the family may consider responding to situations with negative emotions to be atypical, which prompts them to learn to down-regulate their negative reactions.

In addition, during mother–child interactions, mothers' emotions are directly expressed toward their children. Exposure to high levels of negative emotions expressed by mothers may lead to over-arousal in children, especially children with naturally high negative affectivity (Eisenberg et al., 2001). High levels of negative expressivity may adversely affect the quality and security of mother–child relationships, precluding mothers from adequately teaching or supporting the development of their children's emotion regulation (Valiente et al., 2004b). These children, thus, may not have opportunities or be supported to learn the skills needed to regulate their emotional reactivity. Similarly, when more positive emotions are expressed toward children, it could provide emotional support to them so that they are better able to regulate their own negative emotions when distressed (Garner, 1995; Eisenberg et al., 2001; Fredrickson, 2001). Many studies have shown that maternal emotion expressivity is related to children's effortful control, emotion regulation, social competence, and problem behaviors (Valiente et al., 2006; McCoy and Raver, 2011; Miller et al., 2015; Are and Shaffer, 2016; Tan and Smith, 2019), and hence more surprising that the empirical evidence for the association between maternal expressivity and child negative affectivity is sparse.

Indeed, the few studies that have investigated this association between maternal expressivity and child negativity found a significant correlation between them. For example, maternal negative expressivity was found to significantly predict children's negative expressions when watching a distressing film in a sample of 7-year-olds (Valiente et al., 2004a). Higher maternal positive and lower negative affective displays during family interactions were significantly related lower adolescent negative affectivity (Davenport et al., 2011). One study, however, showed that parental expressivity was not significantly associated with children's temperamental anger/frustration or sadness in a sample of 4.5-to 8-year-olds (Wang et al., 2016). These mixed findings may be due to the cross-sectional analyses of these constructs. Furthermore, the ages of the samples of these previous studies were middle to late childhood or early adolescence, instead of early childhood. The longitudinal design of the current study allows us to better capture the changes in the relations between child negative reactivity and maternal expressivity from toddlerhood to early school-age. This developmental period is especially important to study because children spend more time in the family in early childhood and early school years than they do in later school years and adolescence. Toddlers often depend on their caregivers to co-regulate their emotions and behaviors and help them learn more advanced forms of emotion regulation strategies and behaviors (Kopp, 1982), and thus mothers' socialization of their children's emotion expression is critical during early childhood, while the executive systems of children undergo rapid development (Zelazo and Carlson, 2012; Fay-Stammbach et al., 2014).

Not only may mothers' emotion expressivity affect children's negative affectivity, but children likely play a role in shaping their family emotional context (Cole and Tan, 2007), which could lead to changes in mothers' emotion expressivity. Negative affectivity, including anger/frustration, sadness, and fear, is considered to be a key aspect of difficult temperament (Bates, 1989; Shiner, 1998). Children high in negative affectivity express frequent and intense negative emotions to stressors and have difficulty adapting (Bates and Pettit, 2007), which may elicit less supportive maternal socialization (van der Bruggen et al., 2010). For example, 3-year-olds' negative expressivity was related to a higher likelihood of mothers expressing more negative emotions when children were

4 years of age (Nelson et al., 2012). Therefore, the relations between mothers' emotional expressivity and children's negative affectivity are likely to be bidirectional. Similar to the process described in the coercive cycles (Patterson, 1982; Scaramella and Leve, 2004), children, who are high in negative affectivity, are highly reactive and express more negative emotions. These negative emotions potentially create distress and disruptions in the family, which evokes more negative and less positive emotions and expressions in their mothers. These maternal emotional expressions then create more stressful emotional contexts for children that amplify negative affectivity in children. Through this process of mutual reinforcement, cycles of negativity, or negative mother–child reciprocities, can be initiated and are detrimental for both parties.

These reciprocal relations between children's negative reactivity and maternal emotion expressivity in the family are important to understanding how temperament intersects with the environment to shape children's emotional development over time. Thus, the current study utilized a cross-lagged panel model to examine the bidirectional relations between children's negative affectivity and mothers' positive and negative expressivity in the family throughout early childhood. We hypothesized that higher levels of maternal positive expressivity and lower levels of maternal negative expressivity would predict lower levels of child negative affectivity over time, and reciprocally higher levels of child negative affectivity would predict lower levels of maternal positive expressivity and higher levels of maternal negative expressivity over time.

Materials and methods

Participants

Children and their mothers in the Mid-Atlantic region of the United States participated in a longitudinal study following children from toddlerhood to school-age from 2005 to 2012. At toddlerhood (T1), 140 mothers and children (72 boys, $M = 2.67$ years, $SD = 0.13$) participated; 116 mothers and children (62 boys, $M = 4.91$ years, $SD = 0.30$) participated again at preschool (T2); 109 mothers (60 boys, $M = 8.80$ years, $SD = 0.42$) completed the questionnaires at school-age (T3). At T1, the majority of mothers, 96.4%, were married or living with their children's father. The average family income was 4.44 on a 7-point scale where 1 = less than $15,000, 4 = $45,000–$60,000, and 7 = more than $100,000. Most mothers, 71.4%, had a college degree or higher, and the majority of mothers, 95.7%, were European American. The families remaining at T3 did not differ significantly from the families who discontinued participation on children's age and sex, maternal report of fathers' age and race/ethnicity, family income, child negative affectivity, and maternal positive and negative expressivity at T1. Mothers were older, $M = 33.32$, $SD = 4.43$, in the families who continued participation compared to those who did not, $M = 31.03$, $SD = 4.15$, $t(134) = -2.50$, $p = 0.01$. Families who continued participation had more White mothers, 98.2%, than those who discontinued participation, 86.7%, Fisher's exact = 0.02, $p = 0.02$.

Procedures

Mothers were recruited to participate in a study when their children were between the ages of 30 and 36 months. At T1, approximately half of the families (51.4%) had participated in a previous study in a different lab and were contacted about participating in the current study. The other half of the families (48.6%) were recruited by placing fliers in places where families of young children would often go (e.g., story time at the local library) and by asking childcare centers to give fliers to families with children between 30 and 36 months of age (T1). Mothers were contacted about a follow-up assessment when children were 4–5 years of age (T2) and again when children were 8–9 years of age (T3). At each assessment, mothers completed several questionnaires, including a demographic form and the Self-Expressiveness in the Family Questionnaire (SEFQ; Halberstadt et al., 1995). At T1, mothers completed the Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006). At T2, mothers completed the Child Behavior Questionnaire – Short Form (CBQ–SF; Putnam and Rothbart, 2006), and they completed the Temperament in Middle Childhood Questionnaire (TMCQ; Simonds and Rothbart, 2004) at T3.

Measures

Maternal emotion expressivity

Mothers reported their positive and negative emotion expressivity in the family on a 9-point scale (1 = rarely express these feelings to 9 = frequently express these feelings) at all three time points. The positive (23 items, αs = 0.88, 0.90, 0.93, e.g., "Expressing deep affection or love for someone.") and negative (17 items, αs = 0.86, 0.87, 0.87, e.g., "Showing how upset you are after a bad day.") subscales from the SEFQ were used. Composite scores of positive and negative expressivity were created by averaging the items in each subscale.

Child negative affectivity

To assess child negative affectivity, mothers rated their children's temperamental frustration/anger, sadness, and fear at all three time points. At T1, mothers completed the frustration/anger subscale (12 items, $\alpha = 0.84$, e.g., "When s/he could not find something to play with, how often did your child get angry?"), sadness subscale (12 items, $\alpha = 0.83$, e.g., "When told "no," how often did your child become sadly tearful?"), and fear subscale (11 items, $\alpha = 0.76$, e.g., "During everyday activities, how often did your child startle at loud noises (such as a fire engine siren)?") from the ECBQ on a 7-point scale (1 = extremely untrue of my child to 7 = extremely true of my child). At T2, the frustration/anger subscale (six items, $\alpha = 0.78$, e.g., "Gets quite frustrated

when prevented from doing something s/he wants to do."), sadness subscale (seven items, $\alpha = 0.62$, e.g., "Tends to become sad if the family's plans do not work out."), and fear subscale (six items, $\alpha = 0.60$, e.g., "Is afraid of loud noises.") from the CBQ–SF was used; mothers rated items on a 7-point scale (1 = extremely untrue of my child to 7 = extremely true of my child). At T3, mothers completed the anger/frustration subscale (seven items, $\alpha = 0.85$, e.g., "Gets angry when s/he cannot find something s/he is looking for."), sadness subscale (10 items, $\alpha = 0.82$, e.g., "Tends to become sad if plans do not work out."), and fear subscale (nine items, $\alpha = 0.80$, e.g., "Is afraid of loud noises.") from the TMCQ on a 5-point scale (1 = almost always untrue to 5 = almost always true). Composite scores of child negative affectivity were computed by averaging scores from the frustration/anger, sadness, and fear subscales at each time point.

Results

Means, standard deviations, and correlations among the study variables are shown in Table 1. Maternal positive expressivity measures at all three time points were significantly correlated with each other as were maternal negative expressivity and child negative affectivity. Maternal negative expressivity and child negative affectivity were significantly correlated to each other within each time point. Maternal positive expressivity was not significantly correlated with maternal negative expressivity or child negative affectivity at any of the three time points. Mothers' age was significantly correlated with child negative affectivity at T2, $r = -0.19$, $p = 0.04$; mothers' education was significantly correlated with mothers' negative expressivity, $r = -0.20$, $p = 0.03$ and child negative affectivity, $r = -0.24$, $p = 0.01$, at T3, so we controlled for them in the cross-lagged longitudinal analysis. Partial correlations controlling for mothers' age and education are also presented in Table 1. Child age, child sex, and maternal race/ethnicity were not significantly related to any of the study variables, and thus they were not controlled for in the following analysis.

To examine the bidirectional relations of maternal emotion expressivity and child negative affectivity, we conducted a cross-lagged longitudinal analysis with MPlus 8.7 using maximum likelihood parameter estimates with robust standard errors (MLR). For model fit indices, we considered RMSEA ≤ 0.08, CFI ≥ 0.90, and SRMR ≤ 0.08 to be adequate fit (Vandenberg and Lance, 2000; Marsh et al., 2004). The results from the cross-lagged longitudinal model, $\chi^2(2) = 0.14$, $p = 0.93$, RMSEA = 0.00, CFI = 1.00, SRMR = 0.00, are shown in Figure 1. Mothers' negative expressivity and child negative affectivity were significantly correlated at T1. Mothers' negative expressivity at T1 significantly predicted children's negative affectivity at T3. Child negative affectivity at T2 was significantly associated with mothers' negative expressivity at T3. Mothers' positive expressivity was not significantly related to children's negative affectivity.

Discussion

The current study investigated the reciprocal relations between maternal emotion expressivity and child negative affectivity across three time points from toddlerhood to early school-age. Although child negative affectivity was modestly stable across the three time points, changes in it over time were related to mothers' negative expressivity in the family. Similarly, the changes in mothers' negative expressivity were associated with child negative affectivity. The findings demonstrate bidirectional relations between children's negative affectivity and mothers' negative expressivity in the family, suggesting the importance of the interplay between child temperament and mothers' expressivity in the family.

TABLE 1 Means, standard deviations, and correlations among study variables.

	1	2	3	4	5	6	7	8	9
T1									
1. Maternal positive expressivity	–	0.16	0.06	0.70*	−0.05	0.03	0.70*	0.01	0.05
2. Maternal negative expressivity	0.11	–	0.31*	0.21*	0.56*	0.25*	0.10	0.58*	0.32*
3. Child negative affectivity	−0.03	0.35*	–	0.11	0.21*	0.55*	0.05	0.31*	0.53*
T2									
4. Maternal positive expressivity	0.69*	0.18	0.04	–	0.20	0.04	0.75*	0.18	0.06
5. Maternal negative expressivity	−0.09	0.54*	0.19*	0.19*	–	0.29*	0.03	0.73*	0.23*
6. Child negative affectivity	−0.03	0.33*	0.58*	0.01	0.28*	–	0.10	0.44*	0.64*
T3									
7. Maternal positive expressivity	0.70*	0.11	0.00	0.71*	0.04	0.07	–	0.10	0.08
8. Maternal negative expressivity	0.02	0.58*	0.35*	0.15	0.71*	0.44*	0.10	–	0.41*
9. Child negative affectivity	0.00	0.34*	0.55*	0.05	0.24*	0.64*	0.05	0.44*	–
M	7.06	4.15	3.24	7.16	4.11	3.51	7.05	3.99	2.58
SD	0.85	1.07	0.63	0.87	1.08	0.74	0.86	1.04	0.56

*$p < 0.05$. Partial correlations controlling for maternal age and education are presented above the diagonal.

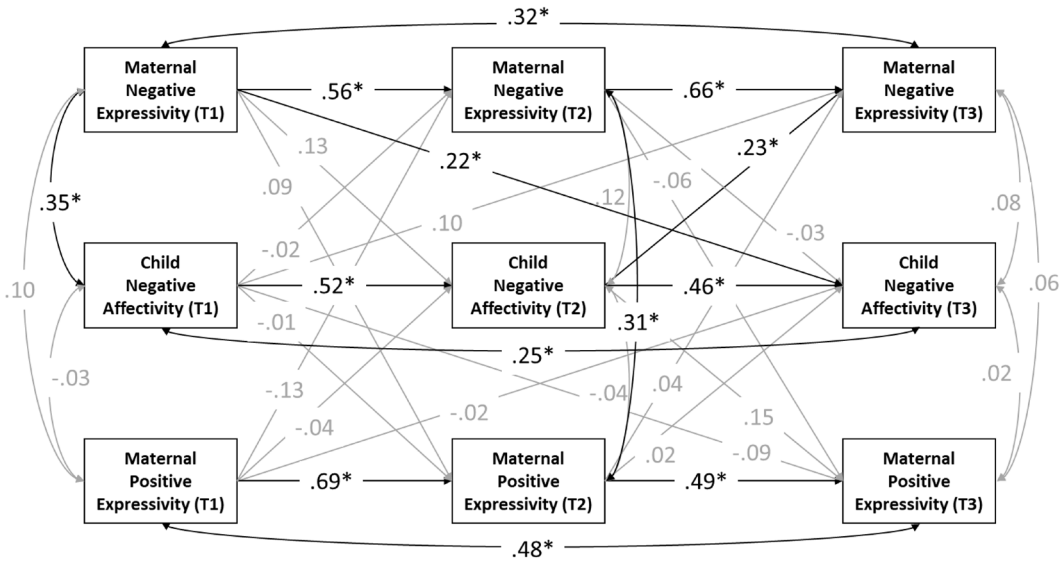

FIGURE 1
Reciprocal relations among child negative affectivity and maternal positive and negative expressivity within the family. Standardized coefficients are presented. Black lines represent significant paths, with gray lines representing non-significant paths. Mothers' age and education were controlled for in the model and for ease of presentation, the paths are not presented. *p<0.05.

Adding to a rich body of literature demonstrating bidirectional relations between child temperament and specific parenting behaviors (e.g., Lengua and Kovacs, 2005; Lee et al., 2012; Klein et al., 2018; Wittig and Rodriguez, 2019), our novel results show higher maternal negative expressivity within the family at toddlerhood predicted higher child negative affectivity at school-age. Higher child negative affectivity at preschool-age predicted higher negative expressivity of the mothers at school-age. Higher maternal negative expressivity and child negative affectivity were correlated at toddlerhood, and the relations between maternal negative expressivity and child negative affectivity may be partially due to shared heritable influences (Boivin et al., 2005; Liu et al., 2020). In addition, mothers' and children's negative expressions may influence each other through emotional contagion (Butler, 2015). For example, by simply being close to their mothers who were having a stress response after a high arousal negative task, infants displayed similar physiological responses (Waters et al., 2017). The findings in our data that maternal negative expressivity in the family and child negative affectivity were correlated in toddlerhood may be explained by emotional contagion, modeling, and socialization, likely due to the great amount of time mothers and their children share together in toddlerhood. To further investigate how negativity of mothers and children influence each other, we encourage future research to take maternal expressivity specifically to the child into consideration to examine how it relates the quality of mother–child interactions.

Our results supported bidirectional relations between child negative affectivity and maternal negative expressivity. Mothers' high negative expressivity in the family may result in an emotionally stressful environment and a poor affective quality of mother–child interactions, which prevents children from being supported to learn emotion regulation skills necessary to control their negative reactivity. Over time, negative mother–child exchanges may lead to greater neural responses to negative emotional information and increased negative reactivity in children (Tan et al., 2020). On the other hand, increased child negative reactivity may elicit more distress reactions from mothers, which may result in mothers expressing more negative emotions within the family. For example, children high in negative affectivity tend to display more emotionally dysregulated behaviors during mother–child interactions and contribute to high maternal distress (Pesonen et al., 2008; Yap et al., 2011).

Although our results supported the bidirectional relations between maternal negative expressivity and child negative affectivity, we do not have evidence for vicious cycles of negativity across early childhood. The findings that child negative affectivity and maternal negative expressivity at school-age but not preschool-age were predicted by earlier maternal negative expressivity and child negative affectivity, respectively, is interesting. It is possible that after the transition to school, children spend considerably less time at home – the environment children are familiar with – and have to face changes and new stressors at school, such as increased peer interactions and pressure from school work. Thus, the risks associated with their negative affectivity became more salient during the school-age period than prior developmental periods, although the early association of negativity between mothers and children in toddlerhood may potentially serve as a basis for the long-term patterns found in this work.

Our findings are consistent with the coercion model which suggests that the significant impact of coercive cycles of

parent–child interactions may not become obvious until after children enter school (Scaramella and Leve, 2004). Because mothers' negative expressivity in toddlerhood appears to have a long-term influence on child negative affectivity, it is important for practitioners to intervene early by teaching mothers strategies to manage their negative emotions to prevent the long-term adverse impact of maternal negative expressivity on children. At the same time, because children's negative reactivity during preschool years may also have an impact on mothers, it is equally important to provide resources and support for children to learn emotion regulation skills to help them regulate and utilize their negative emotions adaptively (Tan and Smith, 2018; Tan et al., 2022). Researchers, practitioners, and schools may consider a family-based program that targets both the parents and the children to help them create a more optimal family emotional climate. Because children's self-regulation develops rapidly across early childhood (Kopp, 1982; Montroy et al., 2016) and it likely plays a critical role in understanding the relations between child negative affectivity and maternal negative expressivity (Bariola et al., 2011), future research should consider examining how children's and parents' self-regulation characteristics, such as effortful control, influence the longitudinal relations between child negative affectivity and maternal negative expressivity.

Unexpectedly, maternal positive expressivity was not significantly related to child negative affectivity, which indicates that positive and negative expressivity may be uniquely associated with child temperament. A previous study found that mothers' positive affect during a play session was associated with child positive affect but not child negative affect, whereas maternal negative affect was related to both child positive and negative affect (Isley et al., 1999). It is also possible that maternal positive expressivity provides a supportive emotional environment for the development of effortful control (Eisenberg et al., 2001), which is related to the regulation of negative emotions, but maternal positive expressivity is not directly associated with child negative affectivity. In addition, the interaction of maternal positive and negative expressivity and how it may impact the goodness-of-fit between mothers and children may be another potential reason why positive expressivity was not related to child negative affectivity. Specifically, emotionally expressive mothers who are high in positive expressivity might express higher levels of negative emotions too. Compared to mothers who were more positive and less negative, emotionally expressive mothers could create a high-arousal emotional climate in the family, which might be particularly stressful for children high in negative affectivity. Future research should investigate how the interaction of maternal positive and negative expressivity would relate to child negative affectivity.

Limitations and future directions

The current study extends the existing literature by examining the bidirectional relations between maternal emotion expressivity and child negative affectivity across three time points. The results provide evidence for bidirectional relations between maternal negative expressivity and child negative affectivity in early childhood. However, the findings of the current study should be interpreted with the following limitations in mind. First, the majority of the sample was middle-class, highly educated, European American two-parent mother–father families. Thus, the findings should be replicated by future studies using samples from other cultures, ethnicities, or socioeconomic backgrounds or samples that have diverse family characteristics. Additionally, all constructs of interest in the current study were measured through maternal report. Although mothers' ratings of child temperament and their own expressivity within the family are reliable and valid measures (Halberstadt et al., 1995; Rothbart et al., 2001), they may have common method bias, which could potentially lead to an inflation of relations among the study variables. Future research investigating the reciprocal relations between child temperament and maternal expressivity should consider using multiple methods, such as observations and multiple reporters. We also focused on a global assessment of maternal expressivity in the family in the current study without considering maternal expressivity specifically to the child. Shared genetic factors also may partially explain the associations between maternal negative expressivity and child negative affectivity. Future studies utilizing other research designs, especially adoption designs (Liu et al., 2020), could further disentangle the genetic and environmental factors contributing to the relations between maternal negative expressivity and child negative affectivity.

Family stressors, such as job loss, may play an important role in the changes in mothers' positive and negative expressivity. How these contextual factors along with other sources of stress and support influence mothers' expressivity is an important research question to be studied. Finally, the emotional context within a family is created by all family members. Because of our study design, we were only able to focus on the emotional dynamics between the mother and one child. Other caregivers and siblings within the family also make an important contribution to the family emotional climate (e.g., Volling et al., 2002; Modry-Mandell et al., 2007; Yaremych and Volling, 2020; MacNeill et al., 2021), so we encourage researchers to continue extending knowledge on how family emotional contexts and child temperament influence each other by including multiple family members. In sum, our findings advance the knowledge of and provide empirical evidence for bidirectional relations between maternal emotion expressivity and child negative affectivity across early childhood.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Virginia Tech Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

LT and CLS contributed to the conception and design of the current study and manuscript writing and revision. CLS was responsible for protocol design, data collection, project administration, and funding acquisition. LT performed the statistical analysis and wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by funds from a Virginia Tech ASPIRES (A Support Program for Innovative Research Strategies) Award, a Virginia Tech College of Liberal Arts and Human Sciences Jerome Niles Faculty Research Award, a Virginia Tech College of Liberal Arts and Human Sciences Faculty Fellowship Award, and the Virginia Tech Institute for Society, Culture & Environment. All funds were awarded to CLS.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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TYPE Original Research
PUBLISHED 21 October 2022
DOI 10.3389/fpsyg.2022.923469

OPEN ACCESS

EDITED BY
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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 19 April 2022
ACCEPTED 26 September 2022
PUBLISHED 21 October 2022

CITATION
Martin RP and Lease AM (2022) Influential children in middle childhood peer culture: Effects of temperament and community culture.
Front. Psychol. 13:923469.
doi: 10.3389/fpsyg.2022.923469

Influential children in middle childhood peer culture: Effects of temperament and community culture

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For children in middle childhood, the social world, particularly the behavior and attitudes of their school peers, has been shown to be an important factor in their educational and mental health outcomes. In the school environment, some children seem to influence the attitudes and behavior of their peers more than others. The behavior patterns of children, as reflected in temperamental traits, have been shown to drive peer perception in important ways and might play a role in identifying the individuals and social processes that operate in peer influence. It seems likely that temperamental traits will have different effects on school peers, dependent on characteristics of the school attended. Fourth and fifth grade children from four rural counties in the southeastern portion of the United States were studied. Temperamental characteristics were assessed based on teacher perception of six characteristics. Peer perceptions of the extent to which each child was perceived to influence others in five areas of school culture (e.g., academics, sports) was measured through a peer nomination procedure. Additional status-related perceptions and behaviors of participating children were also assessed by peer nominations. Teacher ratings of temperamental behaviors were submitted to latent profile analyses resulting in a seven-cluster model. Results indicated temperamental profiles were significantly and meaningfully associated with peer perceptions of influence as well as social status. Further, demographic differences between two groups of schools were found to moderate the effects that temperament profile had on peer influence.

KEYWORDS

temperament, childhood, influence, culture, status

Introduction

Children in middle childhood are acutely attentive to their social world. They have emerged from living in a world of adult caretakers (e.g., parents and teachers) into the complex social world of peers. A good proportion of the social interaction with peers takes place in schools where children must learn to adapt to a staggering array of individual differences in behaviors, attitudes, and expectations. How the child copes with this social

environment has important consequences; it can determine acceptance into subgroups (e.g., cliques; Gazelle and Ladd, 2003; Rubin et al., 2006), as well as general social status, mental health, and academic achievement (Asendorpf, 1990; Rubin et al., 2010; Rubin and Coplan, 2010; Masland and Lease, 2016). One important aspect of the social life of children in middle childhood is that peers, through a variety of means, influence the behavior and attitudes of one another. Peer influence during the late elementary school years has been shown to effect aggressive-disruptive behavior (Powers and Bierman, 2013) as well as academic engagement (Gremmen et al., 2018). Peer influence can stem from close friends but also from the broader peer group (Gottman and Mettetal, 1986). Identifying which children are most likely to be influential, and the social circumstances in which children are influential, is an important question and the focus of the current study. The Dominance-Prestige model of social influence has guided our thinking about how temperament might affect the influence one child has on another. This model posits that there are two pathways that can be used to climb the social hierarchy (Strayer and Trudel, 1984; Cheng et al., 2013; Maner, 2017). The Dominance pathway is established in the context of agonistic exchanges using manipulation and aggressive strategies. It seems likely that children who exhibit higher levels of the temperamental trait labeled irritability or negative emotionality are likely to rely on dominance and antagonistic behaviors to establish influence. The Prestige path, in contrast, is accomplished based on skills, knowledge, and abilities. Those who have higher status based on prestige are perceived as having higher competence and altruistic tendencies. The temperamental characteristics most associated with altruistic behaviors are positive emotionality. Skills and abilities most pertinent in elementary school are academic and athletic abilities. Academic ability is associated with temperamental traits related to self-regulation of attention, which, in turn (Martin, 1989), is strongly linked to school performance (Martin, 1989; Martin et al., 2020). Social skills are related to the temperamental traits of sociability and inhibition (Rubin et al., 2010), and having a high level of gross motor vigor (activity level) is logically related to athletic ability. Temperament research has traditionally focused on the measurement (Rothbart et al., 2001; Halverson et al., 2003; Putnam and Rothbart, 2006) and structure of early appearing individual differences of children (Beekman et al., 2015; Martin et al., 2020), the extent to which they are genetically linked (Saudino and Wang, 2012; Tackett et al., 2013; Scott et al., 2016) as well as the extent to which they are associated with a variety of physiological functions (Kagan et al., 1988; Van Ijzendoorn et al., 2012; White et al., 2012; Marsman et al., 2013). In addition, there has been considerable effort to demonstrate that temperament traits are related to a wide range of behaviors in childhood, including diagnosed mental health problems (Thomas and Chess, 1977; Tackett et al., 2013). Among the most provocative research efforts are those that demonstrate the long-range effects of temperament in early childhood on adult attitudes and behaviors including political orientation (Block and Block, 2006), adult personality (Caspi and Silva, 1995), adult psychiatric disorders (Caspi et al., 1996), antisocial behavior in adulthood (Henry et al., 1996; Moffitt et al., 2002), and gambling (Slutske et al., 2012). There has been much less attention on temperament effects on schooling. The research that has been published has primarily related temperament to achievement and behavior problems (Martin and Holbrook, 1985; Martin, 1989; Nelson et al., 1999; Guerin et al., 2003) as well as the management of individual differences in the classroom (McClowry, 2014). There has been a notable lack of research on temperament as it affects social relationships in general and peer influence, in particular. Given the importance to life-span development of early educational experiences, this is an unfortunate oversight. One recent study by Martin et al. (2020) has addressed the issue of the relationship between peer influence and temperament. This research has shown that the temperamental profiles of children as assessed by parents and teachers are meaningfully related to the influence children have on one another in elementary school. However, this research did not address the issue of the effects of different macro-social environments on this relationship. The purpose of the current study was to refine aspects of the prior research and to directly address the effect of the broad social environment in which children live on temperament-influence relations. Three questions will be addressed in this paper: First, how do temperament-based profiles based on teacher perception relate to the influence peers have on one another as reported by the peers themselves? While this question was addressed in the prior research, the sample analyzed has been changed. The current sample is composed exclusively of 4th and 5th grade students, while the previous sample included 3rd graders. This sharpens the focus of the research on late elementary school. Second, the profile model in the current analysis focuses exclusively on teacher perceptions of temperament and does not include data from parents as was the case in prior analyses. Third, profile models used in the prior research included parental and teacher perception of academic ability (intelligence). The current research focuses exclusively on tradition temperament constructs in the development of profile models. In addition, several refinements are made in the current analysis to help control for gender factors in the peer nomination procedures as well as to control differences among schools in the way that peer nominations were done. When the best fitting temperament profile model has been developed and associations to peer influence determined, the second question to be addressed becomes, what social status and status-related behavioral characteristics are most strongly associated with the temperament profiles of influential children. This analysis is designed to set the stage for future researchers to determine the longitudinal pathways operating from temperamental characteristics and social status characteristics to influence. The characteristics investigated include peer perception of popularity, likability, aggression, a tendency to be sympathetic, to work hard in school, to be perceived as cool, and to be good at sports. The characteristics were selected to present aspects of the dominance versus prestige approach to status attainment. The third question to be addressed relates to the effect of the broader

social-cultural environment of the schools studied in modifying the association between temperament profiles and influence. The specific question that is addressed is: Are the temperamental characteristics of influential children in schools located in counties with higher high school graduation rates in the adult population different from the temperamental characteristics of influential children in schools located in counties with lower high school graduation rates?

Materials and methods

Participants

Lease and colleagues (Kwon and Lease, 2014; Lease et al., 2020) initiated two different data collections designed to compare a variety of social and education outcomes from schools in the southeastern portion of the United States. The children studied included those attending schools in rural and semi-rural counties. The data were collected from rural areas to truncate socio-economic differences within schools which have been shown to relate to a range of schooling outcomes. From this larger project, the data analyzed for the current study were selected to maximize the similarity in age and gender distribution of the children in two groups of schools. The groups of schools were differentiated by demographic characteristics, particularly the education level of the population from which the students were drawn. Data in the current analysis were obtained from teachers and students in six schools in three counties (School Group A: 22 teachers, and 448 students) and four schools in one county (School group B; 24 teachers, 349 students). All children were enrolled in the 4th or 5th grades, and all were between 9 and 12 years-of-age. Table 1 presents the demographic characteristics of the participants in Group A and in Group B schools as well as the total sample. The data in Table 1 indicate that the samples were similar except of the racial/ethnic composition; Group A school served a more diverse group of students.

TABLE 1 Demographic characteristics of children in two school groups.

Cohort	School group A		School group B		Total sample	
	N	%	*N*	%	*N*	%
Sex						
Female	237	52.9	185	53.0	422	52.9
Male	211	47.1	164	47.0	375	47.1
Grade						
4	162	36.2	153	43.8	315	39.5
5	286	63.8	196	56.2	482	60.5
Age						
9	71	15.8	45	12.9	116	14.6
10	162	36.2	144	41.3	306	38.4
11	195	43.5	145	41.5	340	42.7
12	20	4.5	15	4.3	35	4.4
Race/ethnicity						
Black	185	41.0	49	14.1	234	29.4
White	249	55.6	267	76.9	516	64.7
Other	14	3.1	33	9.0	47	5.6
Total	448		349		797	

Demographic characteristics of counties in which schools were located

To help understand the cultural context in which the students lived, we obtained data at the county level in which each school was situated. Data were obtained from the US census for 2010. All four counties were rural with no cities of population greater than 4,000. Between 2000 and 2010, School Group B was in a county that had significantly gained population, while the three counties in which Group A schools were located had lost population. The racial/ethnic composition of the public schools in Group A were more racially/ethnically diverse (44.4% minority children) than the county containing Group B schools (23.0% minority children). The populations in the county served by Group B schools had a higher median family income ($49,700) than the counties served by Group A schools ($38,033), but both were significantly below the United States median family income level in 2010 ($62,664). Both sets of schools served populations with very similar levels of educational attainment. For example, the percentage of the population 25 years or older who did not graduate from high school or obtain a GED was 16.9% (Group A) and 16.8% (Group B), but both were above the national average of 11.6%. However, the minority population was significantly less affluent and had lower mean educational attainment than the White population in all counties. Educational attainment differences were particularly lower for minority males. In the counties containing the Group A schools, the mean percentage of minority males (25 years and older) who did not graduate from high school or have a GED was 40.9%, while in the county containing the Group B schools, this percentage was 19.8%. In summary, both groups of schools were in rural areas in which the median family income was lower than the national average as was the educational attainment for the adult population. However, the minority population was far less affluent and less formally educated than the White population of these counties. Group A schools were in a county with a much higher proportion of minority residents than was the case for Group B schools. Thus, children in Group A schools grew up in an environment in which the adults, particularly males, were less educated and had fewer material resources. This was particularly true of the minority children in Group A.

Study procedure

For the original data collection from which the current participants were selected, approval was obtained from the

superintendent of the school district. Then, individual school principals and staff were contacted; only one school declined participation. Active parental consent for student participation was required, and child assent was obtained prior to the administration of questionnaires. The roster of students used for peer nominations included only the names of students who had obtained parental consent to participate. Nonparticipating students were given the option of working quietly at their desks. All procedures were approved by a university Institutional Review Board.

Measurement

Teacher perception of temperament

Teacher perceptions of their students' temperament characteristics were assessed based on a modified version of the Individual Differences of Children and Adolescents questionnaire (ICID; Halverson et al., 2003). The ICID was designed for parents; the revised form for teachers was modified to make it appropriate for classroom teachers. The measure was an abbreviation of the ICID and was very similar in length and item content to a published abbreviated version of the ICID (Deal et al., 2007). Seven scales from the Teacher ICID measure were used in the current study to develop temperament profiles. These scales were designed to measure classic temperamental traits. Inhibition and fearfulness were combined because they were highly correlated (0.80). This resulted in six temperament scales. The internal consistency reliability as indexed by the alpha coefficient for the 4th and 5th grade children studied in this analysis were as follows: activity level (alpha = 0.80), sociability (alpha = 0.90), positive emotionality (alpha = 0.88), negative emotionality (alpha = 0.93), distractibility (distractibility alpha = 0.81), and inhibition (inhibition and fearfulness, alpha = 0.80). The concurrent validity of the teacher form of the ICID has been documented through scale and profile similarities to parental ratings on the same instrument, as well as to important outcomes for children in elementary school such as behavior problem ratings and academic achievement (Martin et al., 2020).

Peer perceptions

Peer perception of influence was measured by self-report measure based on existing scales and/or theoretical formulation by Hawley et al. (2002), Keltner et al. (2001), and Janes and Olson (2000); see (Lease et al., 2020), for a complete description of these procedures. Influence was assessed in five areas: academics, sports, peer cultural trends (e.g., clothing, music), make-believe games, and inappropriate behavior (e.g., talking back to the teacher; fooling around when the teacher leaves the room). These measures resulted in six indicators of influence for each child, one for each of the five areas of influence and a total influence score created by summing scores across all five areas. An example of the questions used to elicit peer nominations of influence is: "Think of a time when you decided to work really hard on a class project or study hard for a test because other kids were. What kids made you want to study hard, too"? From a listing of consented children provided to each student, they recorded the number of the children who fit this description. In some schools, children were asked to nominate peers from their class (homeroom), whereas in other schools, children were nominated from the grade level. The numbers of nominations children received were standardized ($M = 0$, SD = 1) at the classroom level or at the school level, depending on which procedure was used. Standardization was used to control for the differing number of nominations possible based on the number of participating peers in the classroom or grade level. In addition, standardization was carried out separately for girls and boys. Gender plays a role in many aspects of peer relationship, particularly in middle childhood. Children interact with same-gender peers more often than opposite-gender peers (Martin et al., 2013). To better understand the characteristics of children who were considered most influential, children were asked to nominate children who fit several behavioral or status characteristics. These nomination procedures were based on similar measurement procedures by Parkhurst and Hopmeyer (1998) and Coie et al. (1982). From these descriptions, seven scores were created, following the same standardization procedures described for influence nominations (above). Children were asked to nominate the peers they would most like to play with and those they would least like to play with. A social preference score was derived by subtracting the standardized least liked score from the standardized most liked score (Coie et al., 1982). A similar process was used to obtain a measure of popularity; that is, least popular scores were subtracted from the most popular scores. Further, nominations were obtained for the children who were perceived as 'cool' and well known in the school. Finally, nominations were obtained in response to the following: This person tries hard to do good schoolwork (tries hard); this person shows sympathy to a peer who is sad, hurt, or upset (shows sympathy); and this person is good at sports (good athlete). A final set of five descriptors indicating the tendency to be aggressive were obtained from peers and were aggregated into one score. Examples of these items are: "This person makes mean faces at someone when they are upset with them" and "This person overreacts and is easily pushed to anger." The five-item aggression scale had a coefficient alpha of 0.92.

Statistical procedures

Children were given a score on each of the six temperamental characteristics rated by teachers. These scores were standardized for each teacher/classroom. This procedure helped to control for teacher biases in rating student behavior. These scores were submitted to a latent profile analysis using Mplus (Muthen and Muthen, 1998–2012). This type of analysis assumes that within a large group of children, there are subgroups (clusters) who share common patterns or profiles of characteristics, and that these profiles describe the children

more accurately than any of the individual characteristics. These subgroups occur because there are correlations among the behavioral traits used as indicators of the subgroups. A latent profile is a description of a group (cluster) of individuals that share a pattern of behavior. It is latent in the sense that it is not known by the researchers at the time of data collection or analysis. The goal of the analysis is to statistically determine the smallest number of latent clusters that is sufficient to account for the associations observed among the measured variables. The cluster of individuals within a profile is typically identified by their average score on each indicator variable. All the individuals within the group do not have the same score, but the scores of children in the group are more similar than to children in any other group. A central question in latent profile research is how many clusters best fit the data. It is customary to test a wide range of models to find the one that best fits the statistical criterion. Previous research indicates that from 3 to 9 clusters meet these criteria for temperament and related child behavioral measures (Asendorpf and van Aken, 1999; Martin et al., 2020). The criteria that are most often used include a decline in the three information criteria (Akaike, Bayesian, and Bayesian adjusted for sample size) as more clusters are added to the model. Some researchers (Morin and Marsh, 2015) plot these criteria across models and look for an elbow in the declining plot line. One other criterion that was used in the current analysis is the size of the smallest cluster. Since differences in two groups of school were to be investigated, a minimal cluster size of 30 children was established before the analysis was done (4.0% of the sample). Two simplifying assumptions are made to reduce the number of parameters that are estimated in the model. The first assumption is that the correlation among indicator variables in each profile is zero. This assumption is never exactly met, but in the current analysis, all variables were correlated < 0.30 in each profile. The second assumption is that the standard deviation of each variable is the same for all profiles. Modeling the effects of indicator correlations within profiles and standard deviation differences across profiles would require much large samples than were available in the current analysis. These assumptions are common practice (Muthen and Muthen, 1998–2012).

Results

Temperament profiles

Table 2 presents the outcomes of the latent class analyses for models containing 3 to 9 clusters. All three information criteria declined as the number of clusters in the model increased. The entropy index in all models was excellent. All the lowest mean classification probabilities were also excellent. Thus, these statistical indices were not particularly helpful in determining the best model fit. Consistent with suggestions by Maiano, et al. (2011) and Morin and Marsh (2015), when other indices do not point to a best fitting model, the rate of decline in the information criteria should be examined. At some point, as the number of clusters in the model is increased, the rate of decline in information criteria flattens out. In the current analysis, the rate of decline slowed between the 7- and 8-cluster models indicating that both models should be examined to determine if they fit other criteria (e.g., some cluster is very small; one model fits better with temperament research outcomes in the literature than another). After consideration of all criteria, the 7-cluster model was selected. Table 3 presents the mean temperament score for each profile cluster, the standard deviation of each variable within clusters, and the number of children in each cluster. The clusters in this paper will be identified by a number (1–7) and a brief description. The numbering of the clusters is arbitrary. The clusters have been numbers based on the number of children presenting each temperament profile from larges to smallest. Cluster 1 children are labeled 'average' (41.2% of the sample). All their scores are between +0.70 and − 0.70 standard deviations (the middle 50% of each scale distribution). Cluster 2 was labeled 'average with low levels of expression of negative emotion' (18.4%). These children are hypothesized to have high levels of self-regulation of negative emotion. Cluster 3 children are labeled 'happy, social, and active, with strong self-regulation of negative emotional expression and attention (12.4%). One aspect of their self-regulation of negative emotion is that they are perceived to be uninhibited in new situation and have fewer fears than their peers. Children in Cluster 4 exhibit a similar profile to those in Cluster 3, but their self-regulation of negative emotion and attention are in the average range (10.0%). Cluster 5 children are labeled 'Active, distractible, negative' and their self-regulation of negative emotion and attention is hypothesized to be below average (7.3%). They are marginally more social and uninhibited/fearless than their peers. Cluster 6 and 7 children are perceived by teachers as being far less sociable and more inhibited than their peers. In addition, Cluster 6 children (6.0%) are also far less vigorous and physically active than their peers. Cluster 7 children (4.6%) have similar levels of social withdrawal and fearfulness to children in Cluster 6 but express more negative emotion and are more distractible than their peers to determine if demographic characteristics were related to temperamental profiles, chi square test for cross-tabulation analyses were calculated for profile by child grade, by gender, and by minority/majority status. No significant effects were found. The standardization procedures used in this research (described above) resulted in means of each school group (A and B) being very near zero with standard deviation near 1 for all temperament characteristics in both groups. Thus, there was no difference in temperament ratings by teacher in the two school groups. To check to see if the percentage of children in each profile was similar across the two groups of schools, a 2 (school groups) by 7 (temperament profiles) cross-tabulation was done, and the analyses indicated no significant association of profile proportions for the two school groups.

TABLE 2 Results of latent profile analysis: six temperament indicators.

Clusters	LL[1]	Para[2]	Akaike[3]	BIC[4]	ABIC[5]	Entropy[6]	Small[7]	Prob[8]
3	−5932.7	26	11,917	12,039	11,957	0.88	18.80%	0.87
4	−5822.6	33	11,711	11,866	11,761	0.85	10.7	0.76
5	−5714.4	40	11,509	11,696	11,569	0.85	8.4	0.81
6	−5614.7	47	11,323	11,543	11,394	0.87	4	0.83
7	−5552.5	54	11,213	11,466	11,294	0.85	4.6	0.81
8	−5492.4	61	11,107	11,392	11,199	0.85	4.3	0.81
9	−5441.9	68	11,019	11,338	11,122	0.83	3.3	0.8

$n = 797$.
[1]Log likelihood.
[2]Number of parameters estimated by the model.
[3]Akaike information criterion.
[4]Bayesian information criterion.
[5]Bayesian information criterion adjusted for sample size.
[6]Entropy is an index of cluster separation; > 0.80 is good.
[7]The size of the smallest cluster; we set a cut off at 4.0% of the sample.
[8]Of all clusters in the model, the one with the lowest mean classification probability; > 70 is good.

TABLE 3 Mean temperament scale score (*z* score) for Each Cluster: 7 cluster model.

Cluster	act[1]	soc	pos	neg	dis	inhfer	Cluster size	
							n	%
1	−0.28	−0.35	−0.34	0.35	0.31	0.39	328	41.2
2	−0.39	−0.05	0.32	-0.95[2]	−0.59	−0.23	147	18.4
3	**1.15**[2]	**1.57**	**1.70**	−1.19	−1.27	−1.32	99	12.4
4	**1.06**	**1.04**	**0.64**	0.07	0.33	−0.62	80	10.0
5	**0.81**	0.37	−0.76	**1.51**	**0.72**	−0.50	58	7.3
6	−1.59	−1.70	−0.73	−0.32	0.30	**1.61**	48	6.0
7	−0.59	−1.56	−2.09	**1.79**	**0.77**	**1.00**	37	4.6
Variances[3]	0.45	0.25	0.27	0.32	0.31	0.43		

[1]act, activity level; soc, sociability; pos, positive emotionality; neg, negative emotionality; dis, distractibility; inh/fer, inhibition/fearfulness.
[2]Means in bold are + 0.70 SD and means underlined are − 0.70 SD. These means are highlighted simply to aid the reader in seeing the primary characteristics that differentiate one cluster from another.
[3]Variances around the mean for each temperament score is assumed to be the same for all profiles.
$N = 797$

Temperament and peer influence

To determine the relationship between temperament profiles and influence, the total influence score was entered into a general linear model univariate analysis of variance as the dependent variable and temperament profiles were entered as the independent variables (using SPSS version 28). There was a significant effect for cluster ($F = 17.07$; $df = 6$; $p < 0.001$). The R^2 of 0.109 indicated that about 11% of the variance in peer perceived total influence was associated with temperament profiles. Children in Cluster 6 (withdrawn, fearful, and low activity level) had the lowest average influence score, while children in clusters 1 and 2 (average, and average with low levels of negative emotionality) and 7 (withdrawn, with poor self-regulation of negative emotion and attention) had near average influence scores. The three most influential groups were children in Cluster 3 (happy, social, active, and with strong self-regulation), Cluster 4 (happy, social, active, and with average self-regulation), and Cluster 5 (active, distractible, and negative), and of these three clusters, children in Cluster 5 were perceived to have the most influence on their peers. A *post-hoc* analysis using the Gabriel method (see Table 4) indicated that there were three statistically different (alpha set at $p < 0.05$) homogeneous subgroups of clusters with Cluster 5 being most influential and Cluster 6 being least. All other clusters were not significantly different from one another. Because children with different temperament profiles might be influential in different areas of child behavior, influence scores in each of five areas measured (academics, sports, cultural trends, games, and inappropriate classroom behavior) were analyzed separately. In the area of academics, a significant effect for temperament was obtained ($F = 9.04$; $df = 6$; $p < 0.001$; $R^2 = 0.089$) with Cluster 3 children (happy, social, active, and well self-regulated) having the highest influence score, and Cluster 6 (withdrawn, fearful, and low activity level) children having the least. There was a significant effect for influence in sports ($F = 10.33$; $df = 6$; $p < 0.001$; $R^2 = 0.067$). Children in Cluster 5 (active, distractible, and negative) had the highest influence, and again children in

Cluster 6 had the lowest. Temperament had a significant effect on influence regarding cultural trends (hairstyle, music, etc.; $F = 11.76$; $df = 6$; $p < 0.001$; $R^2 = 0.076$) with children in Clusters 5, 2 (average with low negative emotionality), and 7 (withdrawn, low activity level, and low positive emotionality with low self-regulation) having the most and children in Cluster 6 having the least. Regarding make-believe games, there was a significant effect ($F = 6.16$; $df = 6$; $p < 0.001$; $R^2 = 0.038$), but the effect was small. Only Cluster 5 children were distinct from the remaining clusters, and they had the most influence. By far the strongest effect of temperament on influence was on inappropriate classroom behavior (e.g., fooling around when the teacher was out of the classroom, talking back to the teacher; $F = 30.41$; $df = 6$; $p < 0.001$; $R^2 = 0.184$). For these types of behaviors, children in Clusters 5 active, distractible, negative had the highest scores, and children in Clusters 6, 2, and 1 had the lowest. In summary, children who exhibited a high activity level, distractibility, and high negative emotionality (Cluster 5) were clearly the most influential children in these schools, while children who were socially withdrawn exhibited low levels of positive emotionality, and had a low activity level had the least influence on their peers.

TABLE 4 Cluster effects on peer nomination for total influence on peers.

Cluster	*n*	Homogeneous subgroup		
		1	2	3
6	48	−0.70		
2	146		−0.19	
1	322		−0.06	
7	37		−0.06	
3	99		0.11	
4	78		0.22	
5	58			0.97

Gabriel *post-hoc* test isolated statistically homogeneous subgroups of clusters.

Association of temperament profiles with social status measures

One purpose of this research was to determine if dominance and/or prestige-related behaviors were characteristic of children who had different temperament profiles. Seven different measures of student status-related characteristics as perceived by peers were examined. A series of ANOVAs were calculated in which scores on each peer nominated status-related variable served as the dependent variable and cluster by grade level, cluster by gender, and cluster by minority/majority were entered separately as the independent variables. These results indicated the variance explained by cluster in all analyses explained three to four times the amount of variance explained by grade, gender, or minority/majority status. A small number of analyses resulted in significant main effects for the three demographic variables, and an even smaller number resulted in an interaction. Because the effects other than temperament explained less than 3.0% of the variance, these effects are not reported. Children in the three most influential cluster (5, 2, and Cluster 3) had a different blend of status-related attributes as viewed by their peers (see Table 5). Children in Clusters 2 and 3 are likely influential because they have skills (e.g., good at sports), valued attributes (e.g., tries hard at school), and interpersonal skills (e.g., sympathetic to peers) that contribute to being likeable and popular. Cluster 5 children who are the most influential are likely influential due to dominant, coercive behaviors (e.g., aggression) as well as being good at sports. Children in Cluster 6 were perceived as having the lowest social status of all six clusters and were the least influential.

Marco-environmental effect on the association of peer influence and temperament profiles

Children who attended schools in two different kinds of social environments were examined in this research. While the environmental contexts were similar for the two groups of schools in many ways (e.g., lived in rural areas and had median family

TABLE 5 Mean social status descriptors by profile.

Profile	*n*	SPre[1]	Pop	Sym	Cool	Agg	Ath	Tries
1	313	0.07	−0.03	−0.21	0.00	0.00	−0.08	−0.28
2	144	**0.29**[2]	−0.07	**0.31**	−0.22	−0.24	−0.08	**0.39**
3	99	**0.53**	**0.58**	**0.49**	0.11	−0.07	**0.48**	**0.84**
4	76	−0.09	**0.05**	**0.09**	0.19	0.00	**0.20**	0.01
5	54	−0.34	**0.20**	−0.23	**0.86**	**0.73**	**0.25**	−0.26
6	34	−0.47	−0.87	**0.01**	−0.58	−0.53	−0.56	−0.17
7	26	−0.80	−0.71	−0.53	−0.22	**0.65**	−0.32	−0.43
	Anova (eta)	0.087[3]	0.092	0.086	0.110	0.113	0.076	0.149

[1]SPre, social preference; Pop, perceived popularity; Sym, shows sympathy; Cool, is cool, well know; Agg, is aggressive; Ath, is a good athlete; Tries, tries hard at school.
[2]Means in bold are significantly different from means that are underlined. Means not in bold and underlined means are not significantly ($p < 0.05$) different from one another.
[3]All cluster effects had a probability < 0.001.

income significantly less than the state and national average), the educational attainment of the adult male population was different (i.e., persons 25 years and older). This was the result of the differences in educational attainment among minority populations. The ethnic/racial composition of the county in which Group B schools were located was predominantly White, while counties in which Group A schools were located had a much higher percentage of minority adults (about one-third of the population). The percentage of minority children in the public schools was even larger in Group A schools, constituting about 50% of the public-school population. The children in Group B schools who live in an environment comprised a more educated adult population might value different behavior characteristics than those in the Group A schools, where educational attainment among the adult population is more limited. This social environmental difference might create difference in the types of children who are viewed as most influential by their peers. To investigate this notion, the total influence scores of children were submitted to a multifactor ANOVA in which temperament cluster and school group were conceptualized as independent variables and the total influence score as the dependent variable. The results are reported in Table 6. This analysis resulted in a significant main effect for cluster ($F = 9.67$; $p < 0.001$), no main effect for School Group ($F = 0.57$; $p = 0.45$), but there was a significant Interaction ($F = 3.53$; $p = 0.002$). To determine if there were significant differences within profiles, a one-way ANOVA across school groups for each profile was calculated and summarized in Table 6. This resulted in a significant effect for Clusters 2 and 3, with children exhibiting this temperamental profile in school group B (i.e., more educated adult environment) having more influence on the peers than children exhibiting this profile in school group A (i.e., less educated adult environment). These children exhibited a status profile in which trying hard in school was an important factor along being sympathetic toward others and being likeable (having a high social preference score). Children in Cluster 5 (Active, distractible, and negatively emotional) did not have a significantly different influence score in the two school settings, although their total influence score was more than twice as high in the School A group (lower levels of adult education) than in School B (more educated adult population). Thus, it appears that the macro-environment in which the two groups of schools were situated had an effect on whether dominance had the greatest effect on peer influence (school group A) or prestige-related methods had the greatest effect on influence (school group B). To further analyze the differences between the two school groups, a similar analysis was conducted on each of the five areas of influence. This was done separately for Cluster 3 children who had the most status in School Group B, and Cluster 5 children that had high status in both school groups. As summarized in Table 7,

TABLE 6 Effects of profile and school group on total influence on peers.

Profile	School group A			School group B			*p*	etasq
	M	SD	*N*	*M*	SD	*N*		
1	−0.01	(0.90)	177	−0.15	(0.86)	145	ns	0.006
2	−0.35	(0.75)	84	−0.02	(0.93)	62	0.03	0.032
3	−0.04	(0.89)	72	0.53	(1.11)	27	0.01	0.066
4	0.15	(0.88)	38	0.28	(0.92)	40	ns	0.006
5	1.25	(1.53)	34	0.56	(1.45)	22	ns	0.051
6	−0.74	(0.53)	19	−0.67	(0.53)	29	ns	0.005
7	−0.17	(0.75)	17	0.03	(1.16)	20	ns	0.011
Total			441			345		

TABLE 7 Comparison of influence of group 3 and group 5 on specific types of influence.

Influence type	Cluster	School group A			School group B			*p*	etasq
		M	SD	*N*	*M*	SD	*N*		
Good grade and homework									
	3	0.28	(1.17)	72	1.03	(1.44)	27	0.009	0.069
	5	0.56	(1.14)	34	−0.07	(0.90)	22	0.032	0.082
Sport									
	3	0.11	(1.04)	72	0.57	(1.26)	27	ns	0.034
	5	0.83	(1.45)	34	0.34	(1.12)	22	ns	0.032
Cultural Trends (hair style; clothes; music)									
	3	−0.12	(0.85)	72	0.35	(1.09)	27	0.026	0.050
	5	1.10	(1.54)	34	0.49	(1.50)	22	ns	0.038
Inappropriate behavior in the classroom									
	3	−0.30	(0.71)	72	−0.28	(0.43)	27	ns	0.000
	5	1.34	(0.34)	34	1.30	(2.05)	22	ns	0.000
Games									
	3	−0.01	(1.10)	72	0.13	(0.95)	27	ns	0.003
	5	0.95	(1.37)	34	0.27	(1.15)	22	0.050	0.066

Cluster 3 children had significantly more influence on academic issues (getting good grades, doing the homework) in school group B. But they also had more influence on youth culture in school group B than in school group A. Cluster 5 children had more influence on academics in school group A (less educated adult population), and also on the imaginary games children play.

Discussion

Temperamental traits are important to psychological theory and in the practice of helping parents, teachers, and children because these traits can be observed very early in life and have been shown to relate to important outcomes for children throughout their developing years and even throughout the live span. These traits also have been shown to relate to various levels of the biology of the child (genes, the biochemistry of the nervous system, etc.). In the early stages of development of temperament theory, the biological underpinnings, particularly genetic influences, were viewed as one of the most important defining aspects of temperamental traits. As genetic research and its relationship to behavior and personality has progressed, it has become clear that almost all personality traits and behavioral responses have a genetic foundation (Shiner and Caspi, 2012; Plomin, 2018). Research on these traits would not have continued to grow as it has if the various traits typically thought of as being temperamental had not been demonstrated to be relatively stable (stability increasing with maturity; see Martin et al., 2020 for a review) and had they not been found to relate to behavior problems in childhood, diagnosed psychopathology, academic achievement, educational attainment in adulthood, and other important outcomes. But the focus on these guidepost outcomes in human life has not elucidated many of the social processes occurring in the life of the child that led to these outcomes. This is nowhere clearer than in the application of temperamental differences to children in schools, where the majority of research is on achievement and behavior problems. The research reported in this paper was designed to begin to fill one gap in our understanding of schooling; specifically, the influence students have on one another. Parents and teachers are aware that children who attend the same school have an influence on one another. The multi-billion-dollar industry of private schooling is to some extent built on this awareness. The awareness that children influence one another does not tell us which children are particularly influential, it does not tell us what areas of schooling are most impacted by peer influence (e.g., peer status, academic achievement, and inappropriate behavior in the classroom), and it does not address what individual differences of children lead to being influential. The research reported here is based on the hypothesis that individual differences in six temperamental traits has a substantial impact on influence processes in the classroom. This research is also based on the assumption that it is the configuration of these six traits considered together, rather than individual traits that will best illuminate how temperamental traits are related to peer influence in school. This assumption is based on research indicating that temperamental traits are correlated in complex and interactive ways. Research has demonstrated that temperamental traits are not highly stable. Correlations across 2-year periods, for example, typically vary from 0.40 to 0.70, but decline somewhat when longer retest intervals are used. Further, the impact of temperament in different social environments may be different. Thus, in the current context, it is important to determine what environmental factors affect change in how temperamental profiles are related to peer influence.

In this study of approximately 800 rural public-school children in 4th and 5th grades, it was determined that one group of children (Cluster 5) was perceived by peers as having the most influence. Of the seven clusters of children defined empirically by their temperament profiles (assessed by teachers), a relatively small group of children (7.3%) was found to have the most influence on their peers. Children in this cluster were viewed by their teachers as highly active, with above-average ratings on sociability, but exhibited high levels of negative emotionality and low levels of positive emotionality. They were also above average in distractibility. This group can be conceptualized as having low levels of self-regulation of emotion and attention. Notably, this cluster was also rated as being among the least inhibited and fearful of all temperament clusters. We investigated what areas of peer interaction this temperament group (Cluster 5) had most influence. They were among the most influential of all profiles in peer cultural trends (hair style, music preference, and peer language), and in what games were played with peers. They also had particularly strong influence on inappropriate behavior in the classroom (e.g., fooling around when the teacher left the room, talking back to the teacher). Their high activity level and distractibility, as well as their low level of fearfulness probably played an important role in their inappropriate behavior in the classroom. In addition to investigating which group of children was most influential, one aspect of this research investigated how temperamental profiles and influence was related to indicators of social status as assessed by peers. Peers perceived the children in Cluster 5 to be 'cool' more often than any other clusters and they had high scores on aggression. They were mildly above average in popularity and athletic skill. The influence of this group seemed to be based in part on their athleticism, on being socially aggressive, but also on their lack of inhibition and fearfulness. Perhaps most of all, they seem to be viewed as charismatic as indicated by being nominated frequently as 'cool'. Thus, they can be thought of as using both domination and prestige forms of influence. Children who were perceived by peers as least influential across all five areas of school life were those belonging to Cluster 6 (6% of the sample). Their temperament profile was characterized by low activity level, low sociability, low levels of negative emotionality, and high inhibition/fearfulness. They had below-average scores on peer perceptions of likeability, popularity, trying hard at school, having sympathy for others, being cool, acting aggressively, and having athletic skill. Their lack of influence on others seemed to be a function of their withdrawal from social

activities and being perceived as less skillful in sports. The two largest clusters (Clusters 1, 41.2%, and 2, 18.4%) were average on all temperamental characteristics, with Cluster 2 being viewed as of more negative mood Cluster 1. They also had near average scores on all types of influence based on peer nominations. Further, peer nominations of status-related characteristics were all in the average range as well, with Cluster 2 children being perceived as having moderately higher status than Cluster 1. One of the most important findings from this research was that the social milieu of the school had a significant effect on the influence exercised by the most influential groups of children. The aspect of the broader social environment that we focused on was the educational attainment of the adult population of the counties in which the children resided. Children in temperament Cluster 3 (happy, social, active, and, well self-regulated) were viewed as the second most influential group. When they lived in a county with higher adult educational attainment (particularly among adult males) they had more influence on academic behaviors (e.g., trying hard in school) than Cluster 3 who lived in rural counties with lower educational attainment. The reverse was true of children in Clusters 5. For these children, they had more influence when they lived in the counties with lower educational attainment.

Theoretical implications

Temperament researchers, spurred on by findings of significant stability of temperament traits, as well as long-term significant prediction of adult behavior from measures obtained in early childhood, have made major strides in the understanding of child behavior. However, they have not paid much attention to environmental factors that may alter the expression of temperamental traits. The major exception to the rule is the role of parenting on temperamental characteristics (Bridgett et al., 2015; Bornstein et al., 2018). All temperament theorists and researchers posit that temperament is not static. While most behavioral characteristics understood as being rooted in temperament have been shown to have moderate stability, all data available indicate some children are very stable, most children exhibit some change, and a few children exhibit major changes in their trait level scores. What is less clear are the mechanisms and social forces that influence these changes. There is another type of change that is even less well understood; that is, how do children with the same temperamental profile alter their social behavior to meet changing environmental demands. The research reported here did not study change over time, but it does open the door to thinking about this question. We found that children with the same temperamental profile who live in different social environments engage that environment in different ways. Stated another way, those children who are influential in one environment are less influential in another. These findings remind temperament researchers that human beings are social animals and that temperamental characteristics may have a different impact in different social circumstances.

Strengths, limitations, and future research

The research reported here utilizes measures of individual differences that have been shown to appear in the first few years of life (i.e., temperamental differences) to explore questions about which children have the most influence in the peer group in late elementary school. Temperamental individual differences were measured as individual traits based on teacher's perceptions of their students. One of the strengths of this study is that temperament profiles have rarely been empirically developed based on teacher perception. These profiles were then used to investigate influence patterns that occur among peers in schools. A second strength of this research is that this is one of the first attempts to relate empirically derived temperament profiles to peer influence in a school setting. Further, the status characteristics of children as viewed by other children were studied in the context of temperament profiles, revealing that children with different temperament profiles manifest their influence through different sets of status-related characteristics (e.g., popularity) and behavior (e.g., showing sympathy). These associations will help researchers in the area social processes understand some links between individual differences, status, and influence. Finally, the research demonstrated that the broader social context in which children live is related to how and by whom peer influence is exhibited. These findings were strengthened by having independent measures of behavior from teachers and students. A strong point of the research is that each type of measurement (teacher rated temperament, student perceptions of influence, and student perceptions of social status-related behavior) were all measured in detail as well as globally. That is, six dimensions of temperament were assessed, influence was assessed in five areas of school life, and status was measured through global indices (e.g., perceived popularity) as well as specific behaviors related to related to likeability and social stature. The availability of these more specific aspects of influence and status allowed for the determination of what type of status and influence was most affected by temperamental differences. Finally, the sample size was large enough to allow for an application of a modeling technique that requires relatively large samples (latent profile analysis) and to allow for a model of seven different profile types ($n = 797$). Having a sample of this size in conjunction with a detailed assessment of student social lives from two perspectives (teacher and student) is very rare in the temperament literature. Despite these strengths, the research had several limitations. The data analyzed in the current study were obtained from teachers and children during one development period, and on one occasion. Thus, temperament, the timing of effects of temperament on both social status and temperament remain unclear. Further, temperament was assessed from the point of view of a one teacher in each classroom. The research would have been strengthened if more than one teacher assessed the temperament of each student. Parental assessment would have also enhanced the temperament assessment. In addition, there was a confound between the

interpretation of the social environment, described at the county level, and the minority status of the participants and their families. This occurred because ethnicity/race and school group were entangled to some extent. The Group B schools were less diverse than the Group A schools. The findings would have been stronger if the diversity of the two school systems were similar. This type of design would have clarified the effects of educational attainment independent of other cultural factors that are associated with rural southern culture. A further weakness of this study was the reliance on county-level educational attainment data. The results would have been much clearer if the educational attainment of each individual family had been assessed. The findings reported here clearly indicate the need for a longitudinal approach in which temperamental traits are measured at several time periods in different environments to determine effects of the environment (a) on the measurements of traits over time, (b) on the association of temperament with social status phenomena, and (c) the effects of environments and developmental level on social influence patterns. To enhance the understand of temperamental effects on peer influence in different environment, special care to measure the environments as precisely as possible is critical.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The dataset was collected by the co-author and is still being analyzed for various publication. It is not available to the public. Requests to access these datasets should be directed to mlease@uga.edu.

Ethics statement

The studies involving human participants were reviewed and approved by University of Georgia Ethics Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 10 November 2022
DOI 10.3389/fpsyg.2022.1011095

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 03 August 2022
ACCEPTED 14 October 2022
PUBLISHED 10 November 2022

CITATION
Smith MR, Parrish KH, Shimomaeda L, Zalewski M, Rosen ML, Rodman A, Kasparek S, Mayes M, Meltzoff AN, McLaughlin KA and Lengua LJ (2022) Early-childhood temperament moderates the prospective associations of coping with adolescent internalizing and externalizing symptoms.
Front. Psychol. 13:1011095.
doi: 10.3389/fpsyg.2022.1011095

Early-childhood temperament moderates the prospective associations of coping with adolescent internalizing and externalizing symptoms

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While appraisal and coping are known to impact adolescent psychopathology, more vulnerable or resilient responses to stress may depend on individual temperament. This study examined early life temperament as a moderator of the prospective relations of pre-adolescent appraisal and coping with adolescent psychopathology. The sample included 226 (62% female, 14–15years) adolescents with assessments starting at 3years of age. Adolescents were predominately White (12% Black 9% Asian, 11% Latinx, 4% Multiracial, and 65% White). Observed early-childhood temperament (fear, frustration, executive control, and delay ability) were tested as moderators of pre-adolescent coping (active and avoidant) and appraisal (threat, positive) on internalizing and externalizing symptoms during the pandemic. Interaction effects were tested using regression in *R*. Sex and family context of stress were covariates. Early-childhood temperament was correlated with pre-adolescent symptoms, however, pre-adolescent appraisal and coping but not temperament predicted adolescent psychopathology. Frustration moderated the relations of active and avoidant coping and positive appraisal to symptoms such that coping and appraisal related to lower symptoms only for those low in frustration. Executive control moderated the associations of avoidant coping with symptoms such that avoidance reduced the likelihood of symptoms for youth low in executive control. Findings underscore the role of emotionality and self-regulation in youth adjustment, with the impact of coping differing with temperament. These findings suggest that equipping youth with a flexible assortment of coping skills may serve to reduce negative mental health outcomes.

KEYWORDS

temperament, coping, adolescence, internalizing and externalizing behavior, COVID-19, early childhood, stress

Introduction

Adolescence is a time when youth experience increases in psychopathology (Kessler et al., 2009; Costello et al., 2011), and early onset of psychopathology is associated with a more persistent course (Moffitt et al., 2007; Costello et al., 2016). For youth who have experienced adverse life events, rates of psychopathology are 2–4 times those of other youth (McLaughlin et al., 2012). Temperament (Nigg, 2006; Rothbart and Posner, 2006) and appraisal and coping (Compas et al., 2017), that is, the assessment and effortful management of a stressor, have also been shown to contribute to youth psychopathology above the effects of experiences of stress or adversity (Wadsworth and Berger, 2006; Pitzer et al., 2011; Rabinowitz et al., 2016; Chung et al., 2019). In fact, the effectiveness of appraisal and coping behaviors in reducing psychopathology may vary based on individual differences in temperament. This study examined how temperament might alter the effects of youth coping with stress on their mental health symptoms. This combination of characterological and intentional emotion regulation efforts was expected to predict adolescent psychopathology in response to stress. We examined early-childhood temperament as a moderator of the prospective effects of pre-adolescent appraisal and coping on adolescent psychopathology while accounting for past and concurrent contexts of adversity and stress (see Figure 1).

Temperament is a consistent and robust predictor of psychopathology (e.g., Nigg, 2006) and may operate through its interactions with other risk factors (e.g., Rothbart and Bates, 2006). Temperament is conceptualized as biologically based individual differences in patterns of reactivity and self-regulation that are relatively stable over time but may be influenced by experience (Rothbart and Bates, 2006; Rothbart, 2007). There are multiple facets of temperament. Fear reactivity (negative emotion related to anticipation of threat or distress) and frustration (negative emotion regarding goal blocking or interruption of goals or tasks) are prominent facets of temperament negative emotionality (Rothbart, 2007). Fear reactivity arises from activation of the behavioral inhibition system, associated with responsiveness to cues of threat or punishment and freezing or passive avoidance responses, while frustration reactivity arises from initiation of the behavioral activation system which is associated with responsiveness to reward cues, frustration in non-reward contexts, active avoidance of punishment, as well as the fight-flight system responsible for defensive aggression (McNaughton and Gray, 2000; Rothbart et al., 2014). Effortful control, comprised both executive control and delay ability, refers to individual differences in executive regulation of attention and inhibitory control of thoughts and behaviors (Rothbart and Bates, 2006). Executive Control (EC) is the non-emotional cognitive component that involves shifting and focusing attention and the inhibition and activation of behavior, whereas Delay Ability (DA) refers to the motivational component that involves delaying an immediate reward for a larger reward later (Rothbart et al., 2000; Rothbart and Bates, 2006; Kim et al., 2013).

Both negative emotionality and effortful control have been associated with internalizing and externalizing problems in youth (e.g., Eisenberg et al., 2005; Lengua, 2006). Indeed, youth high in negative emotionality are at risk for both internalizing and externalizing problems (e.g., Eisenberg et al., 2005). Independently, fear and frustration have been related to adjustment. Fear is a consistent predictor of higher internalizing, while frustration has been associated with both internalizing and externalizing problems (see De Pauw and Mervielde, 2010 for review; Rothbart, 2007). Executive control is consistently associated with both positive and negative indicators of adjustment, including internalizing and externalizing problems (Lengua et al., 2015; Kim-Spoon et al., 2019), while lower delay ability has been related increased externalizing symptoms in children (Gusdorf et al., 2011; Lengua et al., 2015). Little evidence supports a connection between delay ability and internalizing symptoms. However, one study suggested that low reward sensitivity (a facet of delay inability) was related to increase internalizing psychopathology in adolescents (Forbes et al., 2017).

The vulnerability model of temperament, however, suggests that particular temperament profiles may be associated with poor adjustment through their interaction with other factors (Nigg, 2006). In a review of the role of temperament in adolescent psychopathology, a vulnerability model emerged most consistently (Tackett, 2006). This diathesis-stress approach suggests that temperament may create risk or resilience to psychopathology under high or low risk conditions. That is, temperament may moderate environmental risk or behavior to influence adjustment (Ingram and Luxton, 2005; Nigg, 2006; Ingram and Price, 2010). Indeed, there is considerable evidence to suggest this process (Roisman et al., 2012; Rioux et al., 2016). In addition to temperament, appraisal and coping styles may be critical factors in youth responses to stressors, but their effectiveness might depend on temperament.

Appraisal and coping reflect cognitive approach and volitional regulation processes regarding individual perception and response to a stressor (Folkman, 1984; Compas et al., 2001). Appraisals refer to the assessment of an event as stressful or not, and whether one has the resources to deal with the stressful event. Appraisals can be characterized as positive and threat appraisals. Positive appraisals include challenge (evaluation of the potential for gain or positive outcomes) and resource (evaluation that one has the resources to deal with the event) appraisals. Threat appraisals, on the other hand, are an assessment of harm or future loss. Positive appraisals have been related to fewer adjustment problems whereas threat appraisals have been associated with greater adjustment problems (Sheets et al., 1996; Lengua et al., 1999; Jackson and Warren, 2000; Lengua and Long, 2002; Raver et al., 2016).

Coping traditionally describes specific, volitional, and intentional self-regulatory strategies employed when faced with stress that has been appraised as exceeding one's resources (Compas et al., 2001, 2017). Coping is commonly operationalized as active or avoidant. Active coping strategies involve directing

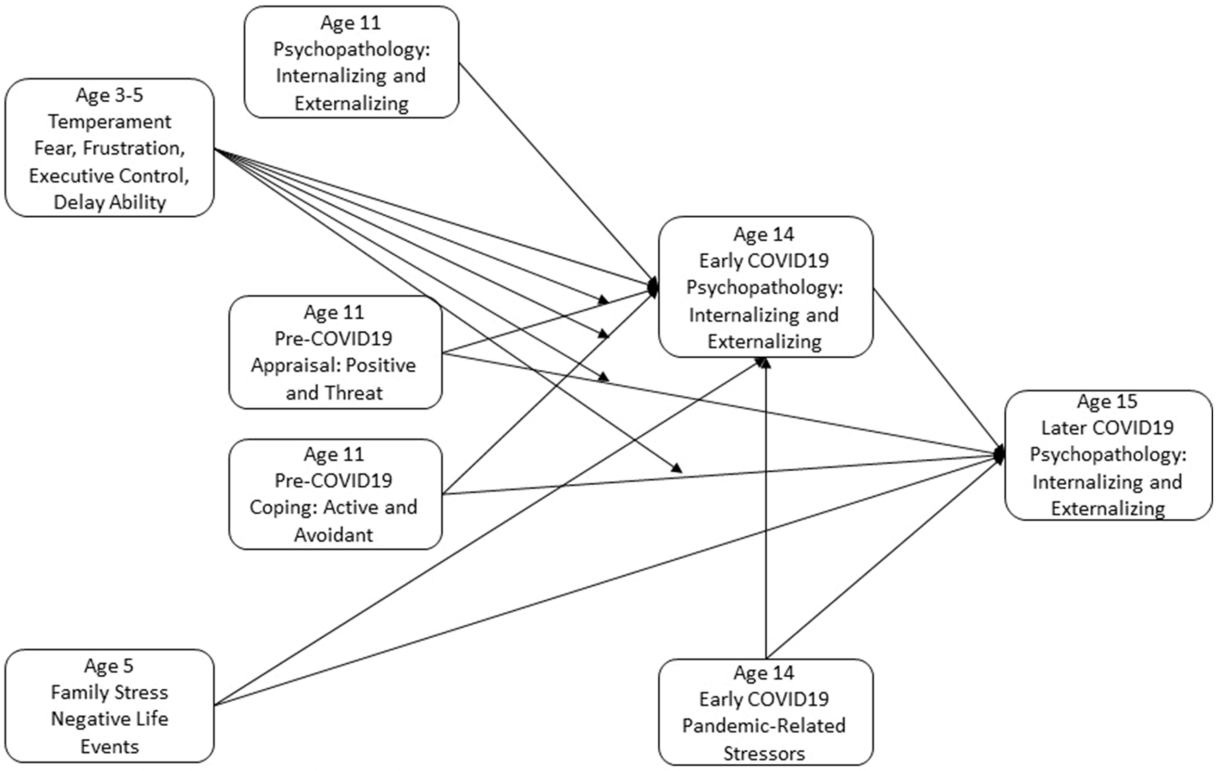

FIGURE 1
Conceptual model of early childhood temperament moderating the associations of appraisal and coping styles with levels of and changes in psychopathology in response to the context of stress posed by the COVID19 pandemic.

oneself towards/dealing with the problem or related emotions, whereas avoidant coping strategies involve removing oneself/withdrawing from the stressful situation and associated emotions. A large body of research has examined processes of dealing with stress in youth and has identified specific coping strategies that are differentially associated with emotional and behavioral adjustment (Compas et al., 2017).

As children age, temperament may aid or hinder propitious appraisal and coping. In their theoretical differential-choice effectiveness model, Bolger and Zuckerman (1995) found that individual personality may be related to differences in the effectiveness of coping strategies on psychopathology. A small body of more recent research has supported this phenomenon in youth (Blair et al., 2004; Muris, 2006; Miller et al., 2009). For example, using parent-reported measures, researchers found that active coping strategies moderated the association between negative emotionality and internalizing symptoms in a sample of youth with cancer (Miller et al., 2009). In another study, children's self-regulation, assessed as approach-flexibility, moderated coping, such that at higher levels of self-regulation, active coping was related to lower anxiety and avoidant coping was unrelated to anxiety (Lengua and Sandler, 1996). Such interaction effects indicate that, over and above direct effects of temperament, appraisal, and coping on psychopathology, their interactions are relevant. In particular, higher negative emotionality and lower effortful control might render active coping efforts less effective and might exacerbate the negative effects of avoidant coping.

These effects might be even more pronounced as youth have navigated the substantial stress and disruptions associated with the COVID-19 pandemic. The pandemic has been largely associated with increased adjustment problems in youth (Barendse et al., 2021; Samji et al., 2021; Chadi et al., 2022). In particular, avoidant coping before and during the pandemic was related to worse mental health outcomes (Liang et al., 2020; Tyra et al., 2021), while active coping strategies were related to better outcomes (Arbel et al., 2020). Moreover, in studies prior to the pandemic, temperament, appraisal, and coping were shown to contribute to youth psychopathology above the effects of experiences of stress or adversity (Pitzer et al., 2011; Rabinowitz et al., 2016). Given that appraisal and coping styles are moderately stable in preadolescence and adolescence (e.g., Thompson et al., 2016), they may be relevant prospective predictors of how youth respond to stressors such as those related to the pandemic.

It is essential to understand how temperament, appraisal, and coping styles inform adolescent adjustment in contexts of stress and adversity. This study is unique in prospectively testing the combined effects of temperament, appraisal, and coping on psychopathology across developmental periods. We examined early-childhood temperament as a moderator of the prospective effects of appraisal and coping styles on levels and changes in

youth adjustment during the COVID-19 pandemic, while accounting for the context of stress both before and during the pandemic. We expected that appraisal and coping styles prior to the pandemic would predict levels of psychopathology early in the pandemic, as well as changes across 6 months of the pandemic. However, we expected the associations of prospective associations of appraisal and coping with youth adjustment during the pandemic would be dependent on temperament. Specifically, high fear and frustration and low effortful control (composed of executive control and delay ability) were hypothesized as risk factors, increasing the negative impact of threat appraisal or avoidant coping on psychopathology, while reducing the positive impact of positive appraisal and active coping.

Materials and methods

Participants

The study used a sample of adolescents from a larger community-based sample of 306 children and their mothers who were assessed at multiple time-points across childhood. The subset of 226 participants participated in an age-12 assessment, capturing adjustment before the pandemic. Participants from the parent study were excluded from age-12 assessments based on the following criteria: moved out-of-area, IQ < 80, active substance dependence, psychosis, or the presence of pervasive developmental disorder. All subjects who participated in the age-12 assessment were invited to complete COVID-19 surveys. Of those, 143 adolescents (63%, 62 female, mean age = 14.33, *SD* = 0.48) and a caregiver completed online questionnaires between April and May of 2020, early in the COVID-19 pandemic (spring 2020), and 152 youth (67%, 72 female, mean age 14.87, SD = 0.49), and a caregiver completed questionnaires online between November 2020 and January 2021 (winter 2020–21). Some participants completing the second survey had not completed the first one, and vice versa, resulting in a total of 161 survey respondents across the two surveys. Of those participants, 105 (65%) identified as White, 19 (12%) as Black, 17 (11%) as Latinx, 14 (9%) as Asian, and 6 (4%) as another race or ethnicity.

Missingness analyses

Participants completing both the spring 2020 and winter 2020–21 COVID-19 surveys were compared with those who did not complete either of the surveys. We compared variables across participants missing and not missing COVID-19 survey by examining the magnitude and significance of point biserial correlations with missingness coded as 0 for no missing data, and 1 for missing either COVID-19 survey. Families who did not complete the COVID-19 surveys did not differ significantly from the families who completed the survey on T1-4 temperament variables, T4 negative life events, T5 (age-12) income-to-needs, appraisal, and coping or child internalizing or externalizing problems. The magnitude of missingness effects were small ($r = |0.009–0.129|$), indicating that it was unlikely that missing data introduced bias in the model estimates, and missing data would likely have minimal impact on parameter estimates (Collins et al., 2001; Dong and Peng, 2013). Full-information maximum likelihood estimation (FIMLE) was considered appropriate under these conditions and consistently produces less biased parameter estimates and greater statistical power (e.g., Enders and Bandalos, 2001).

Procedure

This study is part of a longitudinal study examining the development of self-regulation, in the context of early-childhood experiences of low income and its associated adversity. Parents and children granted consent and assent in advance of data collection. For Time 1–Time 4 assessments, mothers and children completed tasks and questionnaires in a university lab setting. Families received compensation at each visit. Beginning when the youth were roughly 36-month old, the first four time-points were separated by 9 months (T1 child age *M* = 3.06 years, *SD* = 0.07, T4 child age *M* = 5.35 years, *SD* = 0.28). The fifth time-point (T5) was approximately 6 years after T4 when youth were age 10–13 years (*M* = 11.00, *SD* = 0.59), and approximately 3 years later at T6, (M = 14.33, *SD* = 0.48) COVID-19 experiences and adjustment symptoms were assessed using youth and parent report on an online survey conducted in April/May 2020 coinciding with stay home orders. Identical surveys were administered again in November 2020–January 2021 (T7, *M* = 14.87, *SD* = 0.49). The university Institutional Review Board approved all procedures for this study.

Measures

Demographics

At Time 1, mothers reported demographic characteristics including family income and child sex. Mothers reported on household income from all sources on a 14-point Likert scale that provided a fine-grained breakdown of income at the lower levels facilitating identification of families at the federal poverty cutoff using an income-to-needs ratio (e.g., *1* = $14,570 or less, *2* = $14,571–$18,310, *3* = $18,311–22,050, etc.). Families were recruited into the original study to equally represent the full range of income, and as a result, family income and the income-to-needs ratio were highly correlated ($r = 0.92$). Therefore, the 14-point variable representing the full range of income was used for analyses [*M* = 8.75 (≈$38–$39 K), *SD* = 3.93, *Range* = 1.00 ($14,570 or less)–14.00 (above $150 K)]. Correlations among T1–T4 income ranged from 0.80 to 0.88. Given the high stability in income, only T4 income was analyzed.

T4 negative life events

Mother-report on the General Life Events Schedule for Children (Sandler et al., 1986) assessed negative life events. Mothers reported whether the 28 moderate-to-major negative life events occurred during the previous year, and the total score was the summed number of events.

T1–T4 temperament

Temperament was assessed with behavioral observations at the first four timepoints when children were 3–5 years old. For this study, temperament measures were the average of task scores across the four timepoints. Observed measures of children's fear and frustration were adapted from the Laboratory Temperament Assessment Battery: Preschool Version (Goldsmith et al., 1993).

Fear

Fear reactivity was measured by the child's response to a toy spider. After a toy spider was presented, the child received three cues to touch it. Fear was assessed on the intensity (0–2, no response to strong response) of behaviors by (1) how long it took to touch the spider, (2) physical response, (3) facial response, and (4) verbal response; scores were aggregated across behavior to comprise a fear score for each cue. Total fear reactivity score was calculated based on an average across the three cues, ICC = 0.78–0.97.

Frustration

The Transparent Box task assessed child frustration. In this task, children were faced with a toy locked inside a clear, impenetrable box. Children received the keys to the box and were asked to remove the toy; however, these were the wrong keys and did not open the box. For a 2-min period, the child worked alone to open the box. Frustration was assessed though the intensity (0–2; no response to strong response) of physical, facial, and verbal response, alongside expressed annoyance with the research assistant. The task was coded in 30-s intervals, and intervals were averaged to create a total frustration score, ICC = 0.72–0.79.

Executive control

Executive control was assessed as a composite of six tasks. The *NEPSY Inhibition* subtest assesses a child's ability to inhibit a dominant response in order to enact a novel response. The *NEPSY Auditory Attention* subtest is a continuous performance test that assesses the ability to be vigilant and to maintain and shift selective auditory set. Total scores for both scales were the proportion of correct responses across the task.

Behavioral inhibitory control was assessed using the *Bear-Dragon task* (Kochanska et al., 1996; Li-Grining, 2007), which requires the child to perform actions when a directive is given by a bear puppet, but not when given by a dragon puppet. Children's actions were scored as performing no movement, a wrong movement, a partial movement, or a complete movement, with scores ranging from 0 to 3. Total scores were the proportion of the score across both bear and dragon items to the total possible score.

Cognitive inhibitory control was assessed using the *Day-Night task* (Gerstadt et al., 1994), which requires the child to say "day" when shown a picture of moon and stars and "night" when shown a picture of the sun. Children's actions were scored 1 for correctly providing the non-dominant response or 0 for providing the dominant response. Total scores were the proportion of correct responses.

The *Dimensional Change Card Sort* (Zelazo et al., 2003) assesses cognitive inhibitory control, attention focusing, and set shifting. In this task, children were introduced to two black recipe boxes with slots cut in the top. Target cards were attached to the front of each box. The target cards consisted of a silhouetted figure on a colored background (star on blue background and truck on red background). Children were instructed to sort cards according to either the shape or color properties on the target cards, first according to shape (six trials), then according to color (six trials). The experimenter stated the sorting rule before each trial, and then presented a card and labeled it according to the current dimension (e.g., on a shape trial, "Here's a truck. Where does it go?"). If children correctly sorted >50% of cards, they advanced to the next level in which the target cards integrated the sorting properties. Target cards consisted of a colored figure on a white background (blue star and red truck), and children were again instructed to sort according to shape (six trials) and then color (six trials). If they correctly sorted >50% of the cards, children advanced to the next level in which they were instructed to sort by one dimension (color) if the card had a border on it and by the other dimension (shape) if the card lacked the border (12 trials). The score was the proportion of correct trials out of the total possible of 36 trials.

The *Head, Toes, Knees, Shoulders* (HTKS) task also integrates attention regulation and inhibitory control (Ponitz et al., 2008). Children are asked to follow the instructions of the experimenter, but to enact the opposite of what the experimenter directs (e.g., touch toes when asked to touch head). Behaviors were coded as 0 points if the child touched the directed body part, 1 point if the child self-corrected his/her behavior, and 2 points if the child only touched the opposite body part. Total scores were the proportion of the score across items to the total possible score. Twenty percent of all executive control tasks were independently re-scored to assess inter-rater reliability. ICCs on individual tasks ranged from 0.72 to 0.98. Consistent with previous research, an overall executive control score was computed as the mean of the proportion scores of the individual tasks. Internal consistency of the composite executive control measure was $\alpha = 0.67$, and the ICC for the composite was 0.83, $\alpha = 0.67$–0.74.

Delay ability

The ability to delay gratification was assessed using the gift delay task (Kochanska et al., 1996). During the gift delay task, the child was told that s/he would receive a present, but that the experimenter wanted to wrap it. The child was instructed to sit facing the opposite direction and to not peek while the experimenter noisily wrapped the gift. Children's peeking behavior

(frequency, degree, latency to peek, and latency to turn around) and difficulty with the delay (fidgeting, tensing, getting out of seat, grimacing, and talking) were rated. Latencies and behavior scores were converted to proportions of total possible times/scores and averaged, with higher delay scores reflecting greater ability to delay gratification. An overall delay ability score was computed as the mean of the proportion scores for the individual delay indicators. Internal consistency of the composite delay ability measure was $\alpha = 0.71–0.77$, and the ICC was.91.

T5 threat and positive appraisal

Appraisal styles were assessed using youth responses on the What I Felt Scale (Sheets et al., 1996), in which they were prompted to think about three of the "biggest problems" they had during the past month and rate on a Likert-type scale from "0 = not at all" to "3 = most of the time" how much they tended to think each of the thoughts related to those problems or problems like those. *Threat appraisal* included six dimensions of negative thoughts about life events: negative self-evaluations, negative evaluation by others, rejection, criticism of others, harm to others, and loss of desired objects or activities. *Positive appraisal* was assessed by combining the challenge appraisal subscale (seven items, e.g., "You thought that you would be able to figure the problem out") and the resource appraisal subscale (six items, e.g., "You thought about all the people and things in your life that could help with the situation"). The threat and positive appraisal scales had good internal consistency $\alpha = 0.83–0.88$ and.83–0.89, respectively.

T5 active and avoidant coping

Using the Children's Coping Strategies Checklist (Ayers et al., 1996), youth rated (0, not at all to 3, most of the time) how often they used each coping behavior when they had problems during the previous month. They were prompted to think about problems like the ones identified for the appraisal measure above. *Active coping* included various strategies: cognitive decision making, control, direct problem solving, positive cognitive restructuring, optimism, and seeking understanding strategies. *Avoidant coping* included the strategies: cognitive avoidance, avoidant actions, and wishful thinking. The active and avoidant coping scales had good internal consistency $\alpha = 0.88–0.93$ and.76–0.86, respectively.

T5, T6, and T7 psychopathology

Both mother and youth reported on psychopathology and combined to create cross-reporter measures of adjustment at T5, T6, and T7. Multi-method measures of adjustment were sought to partially address the effects of shared method variance and reporter bias on the observed associations. Relying on only one method of assessment for a construct can lead to ambiguous interpretation of the validity of a measure (Marsh and Grayson, 1995), and combining reporters has been suggested to capture differing perspectives of adjustment (e.g., Hinshaw and Park, 1999). At T5, pre-adolescent psychopathology was assessed by youth report on the Youth Self-Report (YSR) and parent report on the Child Behavior Checklist (CBCL; Achenbach, 1991; Achenbach et al., 2003). At the T6 and T7 assessments adolescents and parents completed the 25-item Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001), selected to reduce participant burden, as it has substantially fewer items than the YSR and CBCL. The SDQ has good reliability and validity (Dickey and Blumberg, 2004; Goodman et al., 2010) and correlates strongly with the CBCL/YSR (Goodman and Scott, 1999).

Analytic plan

All analyses were conducted in *R* 4.1.3 (R Core Team, 2022). Descriptive statistics and correlations between variables were estimated for each sample. We tested our hypotheses using *R*'s *lavaan* package, version 0.6–11 (Rosseel, 2012) with FIML estimation to account for missing data. We examined a series of two-step nested multivariate multiple linear regression models to examine the contributions of early-childhood temperament (T1–T4), coping and appraisal (T5), and their interactions in predicting adolescent symptoms of psychopathology early in the pandemic (T6), indicating changes from earlier levels of psychopathology likely related to the initial stressors introduced by the pandemic. We also examined temperament, appraisal, and coping styles as predictors of psychopathology several months after the start of the pandemic (T7) to assess the extent to which temperament, appraisal, and coping styles contributed to adolescent psychopathology in response to the persistent stress of the pandemic. These effects were tested as contributing to changes in youth psychopathology above the effects of early negative life events (T4) and concurrent pandemic-specific stressors (T6). Sex, early-childhood family income (all T4), and pre-adolescent symptoms (T5) were also included as covariates. To test for main effects, the first step of each model included internalizing and externalizing symptoms jointly regressed onto each facet of temperament, one coping or appraisal style variable (active coping, avoidant coping, positive appraisal, and threat appraisal), and covariates to better account for shared variance across outcomes and permit more direct comparisons of coefficients (Tabachnick and Fidell, 2013). Next, we added interactions between temperament and coping/appraisal in the second step to test interaction effects. Predictors were mean centered prior to multiplication to avoid nonessential multicollinearity (Cohen et al., 2013). Significant interactions were probed at 1 and 2 SDs above/below and at the mean of temperament consistent with procedures outlined by Aiken and West (1991).

Results

T6 pandemic-related stressors

Parent and youth reported on pandemic-related stressors including, financial, health, school, social, and physical

environment stressors that occurred within the month prior to the first COVID-19 assessment (Weissman et al., 2021). Seven of the stressors were related to the health of participants or close others (e.g., contracting COVID-19); four were related to financial impacts of COVID-19 (e.g., parent lost a job); four were related to disruptions to social life related to social distancing, remote school, and suspended activities; and three related to household noise and crowding. Scores were the count of risk factors endorsed. Adolescent and parent reports were correlated $r = 0.59$ and were averaged to capture both perspectives. Scores ranged from 0 to 18. Although not included in this study, pandemic-related stressors were also measured at T7, with T6 and T7 measures correlated.50. $p < 0.001$, suggesting moderate stability of stressors during the pandemic.

Descriptive statistics and correlations

We present descriptive statistics in Table 1. Overall, levels of internalizing ($M_{T6} = 4.19$; $M_{T7} = 4.99$) and externalizing ($M_{T6} = 5.03$; $M_{T7} = 5.40$) were slightly elevated based on published norms (youthinmind.com/SDQ norms).

Income was negatively correlated with age 11/12 psychopathology (T5) but not with levels of psychopathology during the pandemic (T6 or T7). Income was positively correlated with early-childhood executive control and delay ability, and negatively correlated with frustration (T1–T4). Early-childhood executive control and delay ability were significantly correlated with age 11/12 psychopathology (T5), but generally not with psychopathology during the pandemic (T6 or T7), suggesting that early-childhood effortful control was related to level of psychopathology but not their changes in response to pandemic-related stressors. Early-childhood fear was related to higher internalizing at the start of the pandemic (T6), and frustration was correlated with T5 and T6 externalizing. Psychopathology during the pandemic (T6 and T7) had moderate, positive correlations with pandemic-related stressors, while correlations with pre-adolescent negative life events were smaller and less consistent. Positive appraisal and active coping at age 11/12 (T5) were negatively correlated with both internalizing and externalizing psychopathology during the pandemic at T7. Correlations are presented in Table 2.

TABLE 1 Descriptive statistics for sample demographics and all study variables.

Sex	62% Female	
Race/ethnicity	Asian American	9%
	Black	12%
	Latinx	11%
	White	65%
	Multiracial or otherwise defined	4%
		M (SD)
Child Age	*T4*	5.35(0.28)
	T5	11.00 (0.59)
	T6	14.33 (0.48)
	T7	14.87 (0.49)
T4 Income		9.31 (3.83)
T4 Negative Life Events		5.22 (2.78)
T6 Pandemic-related Stressors		2.32 (1.75)
T1-4 Fear		0.41 (0.23)
T1-4 Frustration		0.24 (0.09)
T1-4 Executive Control		0.56 (0.14)
T1-4 Delay		0.73 (0.17)
T5 Threat Appraisal		5.76 (5.86)
T5 Positive Appraisal		18.63 (6.89)
T5 Active Coping		31.92 (12.99)
T5 Avoidant Coping		14.28 (6.66)
T5 Internalizing		9.28 (5.88)
T5 Externalizing		7.05 (4.59)
T6 Internalizing		4.19 (2.89)
T6 Externalizing		5.03 (2.74)
T7 Internalizing		4.99 (3.30)
T7 Externalizing		5.40 (3.11)

M and SD are used to represent mean and standard deviation, respectively.

Regression analyses

Direct associations

In initial models, positive ($\beta = -0.29$) and threat ($\beta = 0.23$) appraisal and active ($\beta = -0.30$) but not avoidant ($\beta = -0.14$, $p = 0.09$) coping were moderate predictors of changes in internalizing symptoms across the pandemic (T7) in the expected directions, whereas neither appraisal nor coping predicted adolescent symptoms early in the pandemic (T6). Frustration significantly predicted T6 externalizing problems early in the pandemic, depending on which appraisal or coping variable was included in the regression (β's = 0.15–0.17), but apart from that, there were no main effects of early-childhood temperament on adolescent psychopathology above the effects of other variables and covariates. Concurrent pandemic-related stress (β's = 0.20–0.40) but not age 11/12 (T5) stress predicted T6 adolescent symptoms. Of the covariates, only previous symptoms (β's = 0.26–0.65) were consistent predictors of psychopathology (standardized regression coefficients, standard errors, p-values, and 95% confidence intervals from the final models presented in Tables 3–6).

Temperament moderating coping

Final models including interaction effects are reported in Tables 3–6.

Fear

There were no significant interactions between fear and coping or appraisal. There were only trends toward interaction

TABLE 2 Correlations among study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Sex																	
2. Income	−0.05																
3. Negative Life Events	−0.07	−0.09															
4. Pandemic-related Stressors	−0.09	−0.03	0.08														
5. Fear	−0.08	−0.10	−0.04	0.03													
6. Frustration	0.15*	−0.13*	−0.00	0.06	0.09												
7. Executive Control	−0.14*	0.32**	0.05	−0.09	−0.14*	−0.15*											
8. Delay	−0.22**	0.18**	−0.01	−0.03	−0.08	−0.26**	0.43**										
9. Threat Appraisal	0.03	−0.02	−0.02	0.05	0.19**	0.09	−0.03	−0.08									
10. Positive Appraisal	−0.10	0.08	−0.01	−0.04	−0.13	−0.11	−0.00	0.07	−0.32**								
11. Active Coping	−0.10	0.07	−0.05	−0.10	−0.16*	−0.09	−0.02	0.06	−0.23**	0.77**							
12. Avoidant Coping	−0.02	−0.06	0.02	−0.06	−0.06	0.01	−0.12	−0.05	0.20**	0.26**	0.44**						
13. T5 Internalizing	0.04	−0.21**	0.18**	0.08	0.04	0.09	−0.15*	−0.07	0.27**	−0.26**	−0.18*	0.21**					
14. T5 Externalizing	0.19**	−0.34**	0.31**	0.11	0.03	0.21**	−0.15*	−0.19**	0.20**	−0.19**	−0.16*	0.08	0.50**				
15. T6 Internalizing	−0.25**	−0.03	0.09	0.46**	0.17*	0.05	−0.06	−0.02	0.16	−0.15	−0.13	0.07	0.38**	0.17*			
16. T6 Externalizing	0.10	−0.09	0.17*	0.25**	0.11	0.22**	−0.14	−0.10	0.16	−0.11	−0.17	0.07	0.28**	0.33**	0.41**		
17. T7 Internalizing	−0.31**	0.04	0.18*	0.26**	0.11	0.01	0.07	0.07	0.21*	−0.34**	−0.34**	−0.15	0.27**	0.20*	0.59**	0.28**	
18. T7 Externalizing	0.09	−0.11	0.22**	0.26**	−0.02	0.11	−0.07	−0.13	0.18	−0.22*	−0.26**	−0.07	0.27**	0.40**	0.26**	0.69**	0.47**

* indicates $p < 0.05$. ** indicates $p < 0.01$.

10.3389/fpsyg.2022.1011095

TABLE 3 Standardized regression coefficients, standard errors, and confidence intervals from regressions predicting adolescent psychopathology from temperament and active coping.

Parameter	*Est.*	*SE*	*p*	95% CI	*Est.*	*SE*	*p*	95% CI
	T6 Internalizing				T6 Externalizing			
Intercept	−0.01	0.06	0.881	[−0.13, 0.11]	−0.01	0.07	0.888	[−0.14, 0.12]
Sex	−0.26	0.06	< 0.001	[−0.38, −0.13]	0.02	0.07	0.776	[−0.12, 0.16]
Income	0.07	0.07	0.299	[−0.06, 0.20]	0.05	0.08	0.496	[−0.10, 0.20]
Neg. Life Events	−0.02	0.07	0.742	[−0.16, 0.12]	0.08	0.08	0.322	[−0.08, 0.24]
Pandemic-related Stressors	0.42	0.06	< 0.001	[0.29, 0.54]	0.16	0.07	0.027	[0.02, 0.31]
T5 Psychopathol.	0.40	0.06	< 0.001	[0.28, 0.53]	0.31	0.08	< 0.001	[0.15, 0.46]
Fear	0.08	0.06	0.222	[−0.05, 0.20]	0.07	0.07	0.323	[−0.07, 0.22]
Frustration	0.03	0.07	0.678	[−0.10, 0.16]	0.12	0.08	0.131	[−0.04, 0.27]
Executive Control	0.01	0.07	0.894	[−0.13, 0.15]	−0.05	0.08	0.510	[−0.21, 0.10]
Delay	−0.02	0.07	0.817	[−0.15, 0.12]	0.03	0.08	0.697	[−0.12, 0.18]
Active Coping	0.00	0.06	0.958	[−0.12, 0.13]	−0.11	0.07	0.136	[−0.25, 0.04]
Fear × Act. Coping	−0.04	0.07	0.561	[−0.18, 0.10]	0.14	0.08	0.097	[−0.03, 0.30]
Frustration × Act. Coping	0.16	0.08	0.038	[0.01, 0.32]	0.22	0.09	0.016	[0.04, 0.41]
Exec. Control × Act. Coping	0.02	0.07	0.757	[−0.12, 0.17]	0.10	0.09	0.267	[−0.07, 0.27]
Delay × Act. Coping	−0.06	0.07	0.417	[−0.21, 0.09]	0.11	0.09	0.195	[−0.06, 0.28]
	T7 Internalizing				T7 Externalizing			
Intercept	0.01	0.06	0.837	[−0.11, 0.14]	−0.03	0.06	0.613	[−0.15, 0.09]
Sex	−0.14	0.07	0.035	[−0.28, −0.01]	0.03	0.06	0.633	[−0.09, 0.16]
Income	−0.00	0.07	0.984	[−0.14, 0.14]	−0.05	0.07	0.482	[−0.18, 0.08]
Neg. Life Events	0.09	0.07	0.236	[−0.06, 0.23]	0.09	0.07	0.187	[−0.04, 0.23]
Pandemic-related Stressors	−0.07	0.08	0.362	[−0.22, 0.08]	0.07	0.07	0.339	[−0.07, 0.21]
T5 Psychopathology	0.55	0.07	< 0.001	[0.41, 0.69]	0.63	0.06	<0.001	[0.50, 0.76]
Fear	0.03	0.07	0.667	[−0.10, 0.16]	−0.10	0.06	0.135	[−0.22, 0.03]
Frustration	0.01	0.07	0.839	[−0.13, 0.16]	−0.03	0.07	0.688	[−0.16, 0.11]
Executive Control	0.07	0.07	0.343	[−0.07, 0.22]	0.02	0.07	0.824	[−0.12, 0.15]
Delay	0.12	0.07	0.113	[−0.03, 0.26]	−0.02	0.07	0.763	[−0.16, 0.12]
Active Coping	−0.30	0.07	< 0.001	[−0.44, −0.17]	−0.04	0.07	0.594	[−0.17, 0.10]
Fear × Act. Coping	0.10	0.08	0.210	[−0.06, 0.25]	−0.03	0.08	0.691	[−0.18, 0.12]
Frustration × Act. Coping	0.09	0.10	0.368	[−0.11, 0.29]	0.14	0.11	0.194	[−0.07, 0.34]
Exec. Control × Act. Coping	0.07	0.07	0.328	[−0.07, 0.22]	−0.02	0.07	0.779	[−0.17, 0.12]
Delay × Act. Coping	−0.14	0.08	0.096	[−0.30, 0.03]	−0.19	0.08	0.026	[−0.35, −0.02]

effects for fear x active (β = 0.14, $p = 0.10$) and avoidant (β = 0.17, $p = 0.06$) coping predicting T6 externalizing symptoms.

Frustration

The interaction between frustration and active coping predicted T6 adolescent internalizing (β = 0.16, $p = 0.038$) and externalizing (β = 0.22, $p = 0.016$) symptoms. Frustration also interacted with positive appraisal to predict T6 externalizing (β = 0.32, $p = 0.003$) but not internalizing symptoms. In addition, frustration moderated the association between avoidant coping and T7 internalizing symptoms (β = 0.25, $p = 0.024$).

For T6 internalizing symptoms, although the interaction is significant, the simple slopes for frustration were not significant, indicating that slopes were significantly different from each other, but it remains unclear what levels of frustration the association between internalizing symptoms and active coping were significant. However, at lower levels of frustration, active coping was negatively related to internalizing, whereas at higher levels of frustration it was positively related (Figure 2A). For externalizing, at low levels of frustration, active coping (Figure 2B) was negatively related to externalizing symptoms whereas at mean and higher levels of frustration, active coping was not significantly associated with externalizing. Positive appraisal was negatively

TABLE 4 Standardized regression coefficients, standard errors, and confidence intervals from regressions predicting adolescent psychopathology from temperament and avoidant coping.

Parameter	*Est.*	*SE*	*p*	95% CI	*Est.*	*SE*	*p*	95% CI
	T6 Internalizing				T6 Externalizing			
Intercept	−0.01	0.06	0.859	[−0.13, 0.11]	−0.01	0.07	0.863	[−0.15, 0.12]
Sex	−0.27	0.06	< 0.001	[−0.39, −0.15]	0.03	0.07	0.671	[−0.11, 0.17]
Income	0.06	0.07	0.369	[−0.07, 0.19]	0.04	0.08	0.630	[−0.12, 0.19]
Neg. Life Events	−0.02	0.07	0.748	[−0.16, 0.12]	0.06	0.08	0.469	[−0.10, 0.22]
Pandemic-related Stressors	0.42	0.06	< 0.001	[0.30, 0.54]	0.21	0.07	0.004	[0.07, 0.35]
T5 Psychopathol.	0.39	0.06	< 0.001	[0.26, 0.52]	0.33	0.08	< 0.001	[0.17, 0.48]
Fear	0.07	0.06	0.273	[−0.06, 0.20]	0.07	0.07	0.337	[−0.07, 0.22]
Frustration	0.06	0.07	0.404	[−0.08, 0.19]	0.17	0.08	0.036	[0.01, 0.33]
Executive Control	0.02	0.07	0.734	[−0.11, 0.16]	−0.04	0.08	0.577	[−0.20, 0.11]
Delay	−0.02	0.07	0.727	[−0.16, 0.11]	−0.00	0.08	0.972	[−0.15, 0.15]
Avoidant Coping	0.00	0.07	0.945	[−0.13, 0.14]	0.06	0.08	0.495	[−0.10, 0.21]
Fear × Avo. Coping	−0.01	0.08	0.922	[−0.16, 0.14]	0.17	0.09	0.060	[−0.01, 0.36]
Frustration × Avo. Coping	−0.09	0.08	0.242	[−0.24, 0.06]	0.08	0.09	0.413	[−0.11, 0.26]
Exec. Control × Avo. Coping	0.17	0.07	0.020	[0.03, 0.31]	0.27	0.09	0.002	[0.10, 0.44]
Delay × Avo. Coping	−0.15	0.07	0.042	[−0.29, −0.00]	0.08	0.08	0.353	[−0.09, 0.25]
	T7 Internalizing				T7 Externalizing			
Intercept	−0.01	0.07	0.853	[−0.14, 0.12]	−0.04	0.06	0.530	[−0.16, 0.09]
Sex	−0.08	0.07	0.275	[−0.22, 0.06]	0.04	0.07	0.589	[−0.09, 0.16]
Income	−0.03	0.07	0.711	[−0.17, 0.12]	−0.09	0.07	0.208	[−0.22, 0.05]
Neg. Life Events	0.10	0.08	0.197	[−0.05, 0.26]	0.11	0.07	0.124	[−0.03, 0.26]
Pandemic-related Stressors	−0.06	0.08	0.455	[−0.22, 0.10]	0.06	0.07	0.402	[−0.08, 0.20]
T5 Psychopathology	0.64	0.08	< 0.001	[0.48, 0.80]	0.63	0.07	< 0.001	[0.50, 0.76]
Fear	0.09	0.07	0.204	[−0.05, 0.24]	−0.06	0.07	0.350	[−0.20, 0.07]
Frustration	−0.02	0.08	0.791	[−0.17, 0.13]	−0.04	0.07	0.557	[−0.19, 0.10]
Executive Control	0.11	0.08	0.152	[−0.04, 0.26]	0.07	0.07	0.354	[−0.07, 0.21]
Delay	0.06	0.08	0.394	[−0.09, 0.22]	−0.05	0.07	0.458	[−0.19, 0.09]
Avoidant Coping	−0.13	0.08	0.116	[−0.29, 0.03]	−0.05	0.08	0.520	[−0.22, 0.11]
Fear × Avo. Coping	0.03	0.10	0.793	[−0.18, 0.23]	−0.00	0.11	0.988	[−0.22, 0.22]
Frustration × Avo. Coping	0.25	0.11	0.024	[0.03, 0.47]	0.07	0.12	0.574	[−0.17, 0.32]
Exec. Control × Avo. Coping	−0.05	0.08	0.542	[−0.21, 0.11]	0.02	0.09	0.788	[−0.14, 0.19]
Delay × Avo. Coping	0.04	0.09	0.670	[−0.14, 0.22]	0.01	0.09	0.946	[−0.17, 0.18]

associated with externalizing symptoms at lower levels of frustration, but it was also associated with higher externalizing symptoms at higher levels of frustration (Figure 2C). Avoidant coping was negatively related to T7 internalizing symptoms at low levels of frustration, but unrelated to internalizing at mean and higher levels of frustration (Figure 2D).

Executive control

Executive control moderated the association of avoidant coping with both T6 internalizing ($\beta = 0.17$, $p = 0.020$) and externalizing symptoms ($\beta = 0.27$, $p = 0.002$). Probing this interaction revealed that avoidant coping was negatively associated with internalizing and externalizing symptoms at low levels of executive control, whereas at high levels of executive control, avoidant coping was positively related to internalizing and externalizing at T6 (Figures 3A,B). Given this pattern of finding was inconsistent with our hypotheses, we examined mean levels of internalizing and externalizing at low and high levels of executive control and avoidant coping to contextualize the results. For adolescents who were low in executive control, as the level of use of avoidant coping increased, level of internalizing decreased. However, youth with lower executive control and higher avoidant coping had the highest levels of internalizing ($M = 4.61$, $SD = 3.11$) compared to others ($M = 4.00$ $SD = 2.90$). Similarly, for adolescents who were low in executive control, as use of avoidant coping increased, levels of externalizing decreased. However, youth with higher executive control and lower avoidant coping had the lowest mean levels of externalizing ($M = 4.42$, $SD = 2.68$) compared to all others ($M = 5.31$, $SD = 2.75$).

TABLE 5 Standardized regression coefficients, standard errors, and confidence intervals from regressions predicting adolescent psychopathology from temperament and positive appraisal.

Parameter	*Est.*	*SE*	*p*	95% CI	*Est.*	*SE*	*p*	95% CI
	T6 Internalizing				T6 Externalizing			
Intercept	−0.01	0.06	0.894	[−0.13, 0.11]	−0.02	0.07	0.785	[−0.16, 0.12]
Sex	−0.27	0.06	< 0.001	[−0.40, −0.15]	0.03	0.07	0.677	[−0.11, 0.17]
Income	0.07	0.07	0.254	[−0.05, 0.20]	0.08	0.08	0.328	[−0.08, 0.23]
Neg. Life Events	−0.03	0.07	0.645	[−0.17, 0.11]	0.07	0.08	0.363	[−0.09, 0.24]
Pandemic-related Stressors	0.42	0.06	< 0.001	[0.29, 0.54]	0.20	0.07	0.006	[0.06, 0.34]
T5 Psychopathol.	0.40	0.07	< 0.001	[0.26, 0.52]	0.27	0.08	< 0.001	[0.12, 0.42]
Fear	0.08	0.06	0.218	[−0.05, 0.20]	0.08	0.07	0.268	[−0.06, 0.22]
Frustration	0.04	0.07	0.604	[−0.10, 0.17]	0.13	0.08	0.098	[−0.02, 0.28]
Executive Control	0.03	0.07	0.702	[−0.11, 0.16]	−0.05	0.08	0.521	[−0.21, 0.10]
Delay	−0.03	0.07	0.626	[−0.17, 0.10]	0.01	0.08	0.908	[−0.15, 0.16]
Positive Appraisal	−0.04	0.07	0.592	[−0.18, 0.10]	−0.09	0.08	0.274	[−0.24, 0.07]
Fear × Pos. Appraisal	0.00	0.07	0.951	[−0.14, 0.15]	0.09	0.08	0.266	[−0.07, 0.26]
Frustration × Pos. Appraisal	0.14	0.10	0.143	[−0.05, 0.32]	0.32	0.11	0.003	[0.11, 0.52]
Exec. Control × Pos. Appraisal	−0.01	0.08	0.849	[−0.16, 0.14]	0.01	0.09	0.945	[−0.16, 0.18]
Delay × Pos. Appraisal	−0.00	0.08	0.960	[−0.16, 0.15]	0.10	0.09	0.261	[−0.07, 0.27]
	T7 Internalizing				T7 Externalizing			
Intercept	0.01	0.06	0.876	[−0.12, 0.14]	−0.03	0.06	0.620	[−0.15, 0.09]
Sex	−0.14	0.07	0.045	[−0.28, −0.00]	0.03	0.06	0.668	[−0.10, 0.15]
Income	0.01	0.07	0.913	[−0.13, 0.14]	−0.07	0.07	0.312	[−0.20, 0.06]
Neg. Life Events	0.10	0.07	0.191	[−0.05, 0.25]	0.09	0.07	0.189	[−0.05, 0.23]
Pandemic-related Stressors	−0.04	0.07	0.596	[−0.19, 0.11]	0.06	0.07	0.398	[−0.08, 0.20]
T5 Psychopathology	0.51	0.07	< 0.001	[0.37, 0.65]	0.62	0.07	< 0.001	[0.49, 0.75]
Fear	0.07	0.07	0.323	[−0.07, 0.20]	−0.08	0.06	0.246	[−0.20, 0.05]
Frustration	0.01	0.07	0.923	[−0.13, 0.15]	−0.04	0.07	0.589	[−0.17, 0.10]
Executive Control	0.10	0.07	0.172	[−0.04, 0.24]	0.05	0.07	0.513	[−0.09, 0.18]
Delay	0.09	0.08	0.228	[−0.06, 0.24]	−0.02	0.07	0.821	[−0.16, 0.13]
Positive Appraisal	−0.28	0.07	< 0.001	[−0.42, −0.14]	−0.05	0.07	0.502	[−0.20, 0.10]
Fear × Pos. Appraisal	0.05	0.08	0.539	[−0.11, 0.20]	0.00	0.08	0.971	[−0.16, 0.17]
Frustration × Pos. Appraisal	0.18	0.12	0.132	[−0.05, 0.41]	0.12	0.14	0.418	[−0.16, 0.39]
Exec. Control × Pos. Appraisal	0.05	0.07	0.487	[−0.09, 0.20]	−0.02	0.08	0.767	[−0.17, 0.13]
Delay × Pos. Appraisal	−0.06	0.08	0.442	[−0.23, 0.10]	−0.12	0.09	0.206	[−0.29, 0.06]

Delay ability

Delay and avoidant coping interacted to predict T6 internalizing symptoms ($\beta = -0.15$, $p = 0.042$). Simple slopes were not significant, again indicating that the slopes were different than each other, but it is unclear at what level of delay the associations of avoidant coping with internalizing might be significant (Figure 4A). For those low in delay ability, avoidant coping was positively related to internalizing, whereas for those high in delay ability, it was negatively related to internalizing. In addition, delay ability and active coping interacted to predict T7 externalizing symptoms ($\beta = -0.19$, $p = 0.026$), and probes of simple slopes indicated that at high levels of delay ability, active coping was associated with lower T7 externalizing (Figure 4B).

Discussion

Child temperament, early life stress, and appraisal and coping styles may serve as factors of risk and resilience in children and

TABLE 6 Standardized regression coefficients, standard errors, and confidence intervals from regressions predicting adolescent psychopathology from temperament and threat appraisal.

Parameter	*Est.*	*SE*	*p*	95% CI	*Est.*	*SE*	*p*	95% CI
		T6 Internalizing				T6 Externalizing		
Intercept	0.01	0.06	0.877	[−0.11, 0.13]	−0.02	0.07	0.810	[−0.15, 0.12]
Sex	−0.26	0.06	< 0.001	[−0.39,-0.14]	0.06	0.07	0.450	[−0.09, 0.20]
Income	0.08	0.07	0.207	[−0.05, 0.21]	0.10	0.08	0.216	[−0.06, 0.25]
Neg. Life Events	−0.04	0.07	0.585	[−0.18, 0.10]	0.07	0.08	0.392	[−0.09, 0.23]
Pandemic-related Stressors	0.42	0.06	< 0.001	[0.29, 0.54]	0.21	0.07	0.003	[0.07, 0.36]
T5 Psychopathology	0.42	0.07	< 0.001	[0.29, 0.55]	0.26	0.08	0.001	[0.11, 0.42]
Fear	0.09	0.06	0.164	[−0.04, 0.22]	0.09	0.07	0.229	[−0.06, 0.24]
Frustration	0.05	0.07	0.422	[−0.08, 0.19]	0.15	0.08	0.049	[0.00, 0.31]
Executive Control	0.03	0.07	0.673	[−0.11, 0.17]	−0.04	0.08	0.646	[−0.20, 0.12]
Delay	−0.03	0.07	0.697	[−0.16, 0.11]	0.04	0.08	0.660	[−0.12, 0.19]
Threat Appraisal	−0.03	0.07	0.732	[−0.17, 0.12]	0.09	0.09	0.316	[−0.08, 0.26]
Fear × Threat Appraisal	0.08	0.09	0.369	[−0.09, 0.25]	0.05	0.10	0.611	[−0.15, 0.26]
Frustration × Threat Appraisal	−0.08	0.09	0.350	[−0.25, 0.09]	−0.15	0.11	0.167	[−0.35, 0.06]
Exec. Control × Threat Appraisal	0.09	0.08	0.252	[−0.06, 0.25]	−0.02	0.10	0.861	[−0.21, 0.17]
Delay × Threat Appraisal	0.02	0.07	0.792	[−0.13, 0.17]	0.10	0.09	0.267	[−0.07, 0.27]
		T7 Internalizing				T7 Externalizing		
Intercept	−0.01	0.07	0.921	[−0.14, 0.12]	−0.03	0.06	0.652	[−0.16, 0.10]
Sex	−0.11	0.07	0.121	[−0.25, 0.03]	0.03	0.07	0.678	[−0.10, 0.16]
Income	−0.02	0.07	0.784	[−0.17, 0.12]	−0.08	0.07	0.291	[−0.22, 0.06]
Neg. Life Events	0.11	0.08	0.175	[−0.05, 0.26]	0.11	0.07	0.123	[−0.03, 0.26]
Pandemic-related Stressors	−0.02	0.08	0.784	[−0.18, 0.13]	0.07	0.07	0.367	[−0.08, 0.22]
T5 Psychopathology	0.56	0.07	< 0.001	[0.42, 0.70]	0.62	0.08	< 0.001	[0.47, 0.77]
Fear	0.07	0.07	0.331	[−0.07, 0.21]	−0.08	0.07	0.256	[−0.21, 0.06]
Frustration	−0.02	0.07	0.820	[−0.16, 0.13]	−0.06	0.07	0.417	[−0.20, 0.08]
Executive Control	0.13	0.08	0.075	[−0.01, 0.28]	0.07	0.07	0.354	[−0.07, 0.21]
Delay	0.04	0.08	0.566	[−0.11, 0.20]	−0.06	0.07	0.383	[−0.21, 0.08]
Threat Appraisal	0.17	0.09	0.050	[−0.00, 0.35]	0.07	0.10	0.459	[−0.12, 0.26]
Fear × Threat Appraisal	−0.00	0.11	0.980	[−0.22, 0.21]	−0.05	0.12	0.701	[−0.29, 0.19]
Frustration × Threat Appraisal	−0.06	0.13	0.631	[−0.31, 0.19]	−0.09	0.15	0.546	[−0.38, 0.20]
Exec. Control × Threat Appraisal	−0.18	0.10	0.077	[−0.37, 0.02]	0.03	0.11	0.803	[−0.19, 0.24]
Delay × Threat Appraisal	0.02	0.09	0.806	[−0.15, 0.19]	−0.04	0.09	0.708	[−0.22, 0.15]

adolescents. Their interaction may reflect combined characterological and intentional emotion regulation efforts in contexts of stress, and the combination may be particularly relevant in understanding the development of psychopathology. In this study, we examined whether appraisal and coping styles were more or less effective in preventing symptoms of psychopathology given different temperament characteristics. We did so by examining the extent to which temperament altered the associations of appraisal and coping with changes in internalizing and externalizing symptoms in adolescents during the COVID-19 pandemic, accounting for experiences of stress. The COVID-19 pandemic presented a situation that introduced new stressors or exacerbated existing ones for many adolescents and their families, providing an opportunity to examine the prospective effects of interactions of temperament with appraisal and coping, over and above the previously existing context of stress. We found that all facets of temperament except fear moderated coping or appraisal in predicting adolescent symptoms of psychopathology. In particular, the impacts of both active and avoidant coping, as well as positive appraisal varied with temperament. However, the patterns of interactions were not all consistent with the hypothesized effects, as we discuss below.

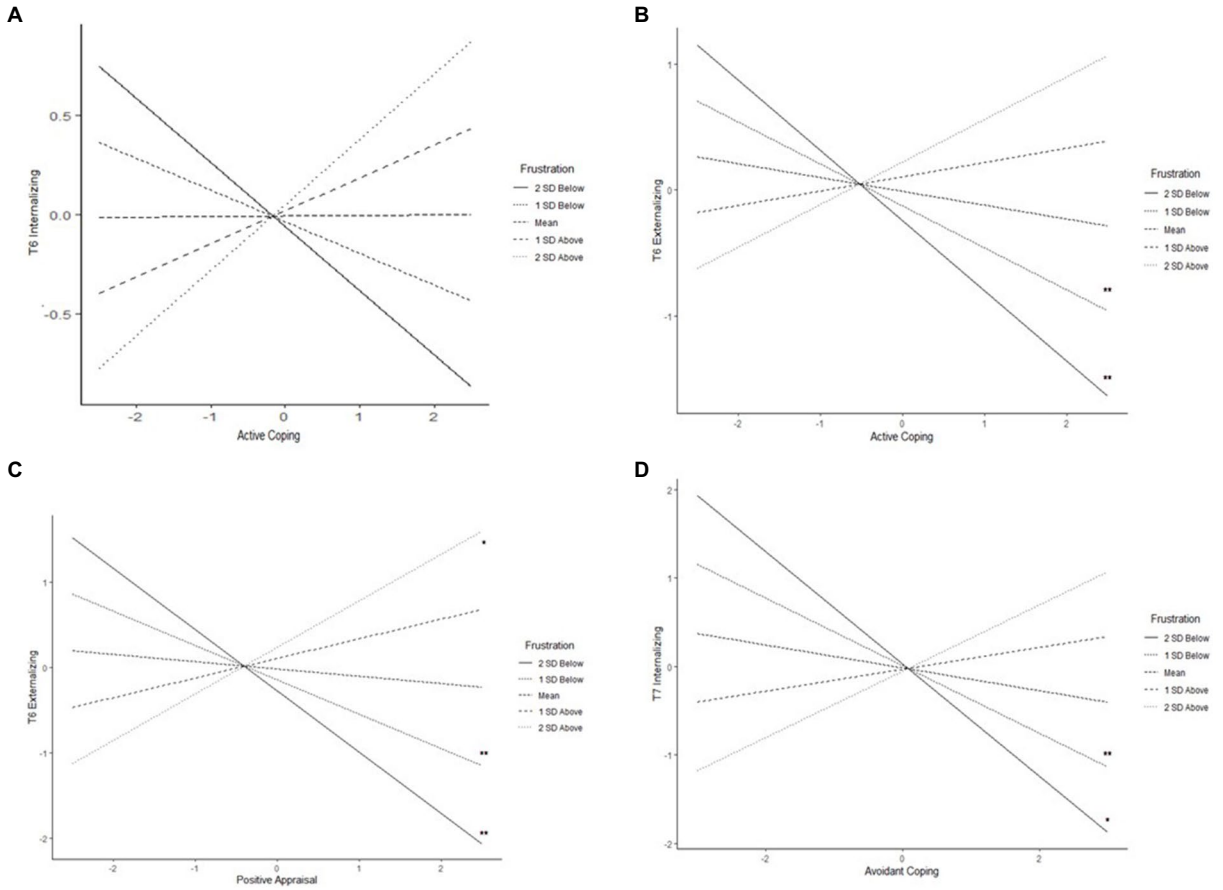

FIGURE 2
Frustration moderating the associations of **(A)** active coping with T6 internalizing, **(B)** active coping with T6 externalizing, **(C)** positive appraisal with T6 externalizing, and **(D)** avoidant coping with T7 internalizing (* p <0.05, ** p <0.01).

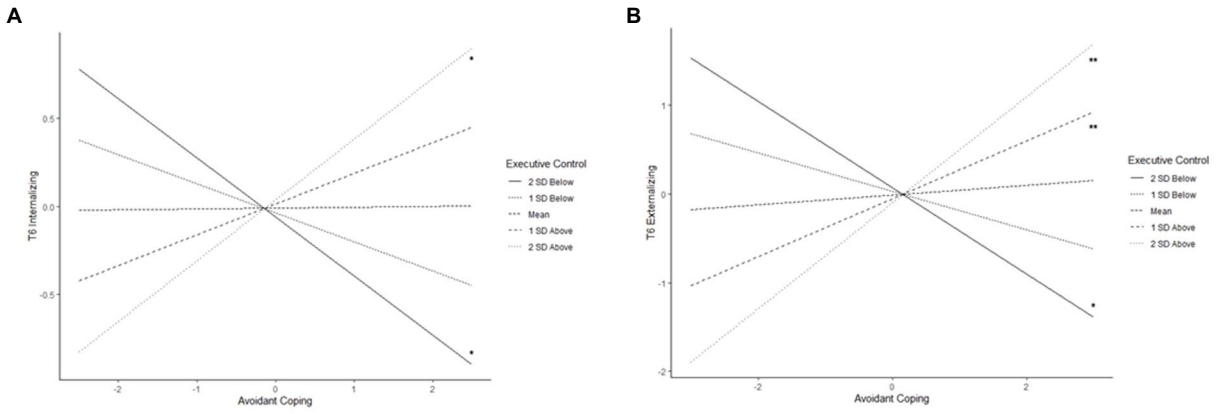

FIGURE 3
Executive control moderating the associations of **(A)** avoidant coping with T6 internalizing and **(B)** avoidant coping with T6 externalizing (* p <0.05, ** p < 0.01).

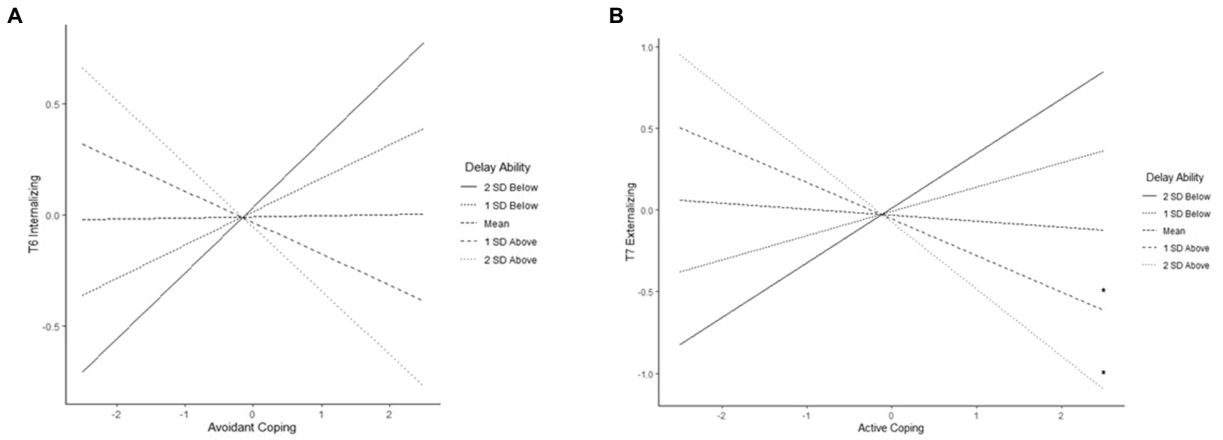

FIGURE 4
Delay ability moderating the associations of **(A)** avoidant coping with T6 internalizing and **(B)** active coping with T7 externalizing (*p <0.05, **p <.0.01).

Thus, the hypothesized vulnerability model was not consistently supported.

We note that there were few significant interactions among the many tested. There were also relatively few direct effects, with direct effects of prior levels of psychopathology and pandemic-related stressors being the most consistent predictors of both initial pandemic levels of psychopathology and changes across the pandemic. Importantly, levels of psychopathology prior to the pandemic were correlated with the family's income and experiences of stress. Taken together, the findings suggest that it is critical to account for the context of stress in understanding the potential roles of temperament, appraisal and coping in children's psychopathology. Given this, it may be understandable that there were relatively few interaction effects and fewer direct effects of temperament, appraisal, and coping once the substantial effects of context and prior psychopathology were accounted.

We hypothesized that high fear and frustration, and low effortful control would confer risk for increased adolescent psychopathology in the context of ostensible adaptive or maladaptive appraisal and coping, while low fear and frustration and high effortful control may serve as protective factors. In partial support for this, we found that active coping and positive appraisal were related to decreases in externalizing problems at low levels of frustration. The association of active coping with internalizing was similar. However, positive appraisals were related to increase externalizing at high levels of frustration. These results indicate that frustration, positive appraisal, and active coping prior to the pandemic interacted to contribute to relative changes in psychopathology early in the pandemic. After several months of the pandemic, temperamental frustration and pre-pandemic styles of coping also predicted changes in psychopathology. At the T7 follow-up, avoidant coping was associated with lower internalizing symptoms at low frustration, and active coping was related to lower externalizing symptoms at high levels of delay. These patterns were aligned with expectations and a vulnerability model. In contrast to expectations, low executive control did not exacerbate the impact of avoidant coping, nor was high executive control protective. In fact, avoidant coping was related to decreases in internalizing and externalizing only at low levels of EC, while at high levels of executive control avoidant coping was related to increases in internalizing and externalizing symptoms, suggesting that avoidant coping was a helpful coping strategy for some children. This finding reflects that children who had a style of avoidant coping combined with low levels of executive control had the highest levels of psychopathology compared to those lower in avoidance or higher in executive control. In addition, both avoidant coping and lower executive control were related to higher levels of psychopathology prior to the pandemic, which was the most robust predictor of psychopathology in response to the pandemic.

There is ample evidence of direct effects of temperament on psychopathology, and we observed significant correlations of frustration, executive control, and delay ability with pre-pandemic levels of psychopathology. However, we did not find direct effects of early-childhood temperament on changes in adolescent symptoms, other than the association of frustration with increases in externalizing, in response to the pandemic. Rather, the findings suggest that early-childhood temperament might contribute to later psychopathology by influencing levels of psychopathology established in childhood, and it might contribute to changes in adolescent adjustment through its moderation of the effectiveness of appraisal and coping strategies employed. Few prior studies have examined temperament as a moderator of the associations of appraisal and coping with child psychopathology. However, those studies have tended to show that appraisal and coping operate differently depending on child temperament. For example, the impact of active coping on youth internalizing symptoms depended on level of negative emotionality (Sugimura et al., 2014). In another study, self-regulation altered the associations of active and avoidant coping with child anxiety

(Lengua and Sandler, 1996). These findings underscore the role of individual emotionality and self-regulation in youth adjustment. Beyond direct effects, temperament contributes to psychopathology through its interplay with other risk and protective factors (Nigg, 2006), in this case, coping. Moreover, we found these effects above and beyond the impact of negative life events and pandemic-related stressors. Across all models, while pandemic-related stress was related to COVID-19 psychopathology, its impact did not subsume the effects of temperament interactions with appraisal and coping. These results suggest that while temperament predicted children's level of psychopathology, appraisal and coping were more relevant predictors of their responses to their current context of stress.

Though both appraisal and coping were examined, coping emerged as particularly relevant to adolescents' adjustment in response to the stressors experienced during the pandemic. Since coping is theorized to arise as a result of appraisal that may be characterized by strong negative affect, coping strategies must be responsive not only to initial appraisals, but also to thoughts and feelings that emerge in the process (Folkman and Moskowitz, 2004). This ongoing and responsive role of coping may be more sensitive to contexts, and thus may account for the significant impact seen here. Appraisal style predicted youth mental health but was less often modulated by early temperament, suggesting that specific coping behaviors may be a more important factor in managing mental health during difficult times.

Active coping and positive appraisal

Frustration appears to play a key role in increases in the development of psychopathology, as a consistent moderator of both coping and appraisal to predict adjustment. Frustration has been theoretically and empirically associated with externalizing and social problems (Eisenberg et al., 2001; Dodge and Pettit, 2003; Muris and Ollendick, 2005; Muris et al., 2007; Nigg, 2017). This relation is theorized to emerge partly because frustrative feelings often engender aggressive behavior (Berkowitz, 1993), and frustration is theorized to emerge due to a blocked goal or reward in the activation of the behavioral activation system (BAS), theorized to underlie approach behaviors and reward sensitivity (Gray, 1982; McNaughton and Gray, 2000). In our results, active coping and positive appraisal predicted decreased externalizing symptoms only at low levels of frustration, but failed to do so in youth with higher levels of frustration, consistent with a vulnerability model. Low irritability and reactivity to blocked goals may create an ideal environment for appraisal and coping strategies characterized by engagement and anticipation of success. On the other hand, evidence suggests that high sensitivity to reward and frustration is more related to the use of disengagement strategies (Melegari et al., 2021). High frustration was indeed a vulnerability in that it interacted with positive appraisal to predict higher levels of externalizing symptoms. Positive appraisals reflect expectations for goal attainment or a positive outcome and sufficient resources to achieve that (Lengua and Long, 2002). But as high frustration is associated with proneness to anger, irritability, and sensitivity to blocked goals, barriers to acting on positive appraisals may result in frustrated attempts at resolution or emotion regulation (Kuppens and Van Mechelen, 2007). Moreover, in this case, positive appraisals may indicate a potential undervaluation of challenge or overevaluation of effective adequate resources. Other research has found that stress appraisals underestimating challenge were associated with increased externalizing symptoms in adolescence (Conway et al., 2016).

Delay ability is thought to stem from reward-sensitive systems, and to also reflect sensitivity to blocked goals. Delay ability moderated the impact of coping on adolescent psychopathology. For those who were higher in delay ability, active coping was associated with lower levels of externalizing, whereas those low in delay ability trended toward higher externalizing at higher levels of active coping, again, consistent with a vulnerability model. This suggests that delay ability supported more effective use of active coping, and being low in delay ability rendered active coping ineffective. The motivational and regulatory skills in emotionally heightened contexts that underlie delay ability may aid in navigating affect (Mischel et al., 2011), particularly in the context of situationally appropriate coping strategies.

Avoidant coping

The pattern of interactions of temperament with avoidance were not in the hypothesized direction, and were not consistent with a vulnerability model. Controllability is an important factor to consider in the context of coping. Less controllability has been associated with likelihood of youth engaging in more avoidant coping styles (Zimmer-Gembeck et al., 2016), and avoidant coping styles have been associated with better outcomes for children who faced less controllable, acute stressors (Aldridge and Roesch, 2007). Proactive avoidance, identifying, assessing, and taking steps to minimize or avoid threat impact (LeDoux and Gorman, 2001; Hofmann and Hay, 2018), may also be a useful framework for considering how adolescents are engaging in avoidance during the time of the pandemic. A number of studies early in the pandemic found avoidant coping to be positively related to distress among adults (Dawson and Golijani-Moghaddam, 2020; Rettie and Daniels, 2020; Wang et al., 2020). Other research has found that avoidant/disengagement coping was similarly associated with lower general distress (Hsieh et al., 2021) or not at all related to mood (Wang et al., 2021) in adolescents. As these interactions predicted T7 internalizing several months into the pandemic, it suggests that avoidance might have been particularly relevant at a time in which teens identified many stressors as beyond their control and took steps to avoid their impact.

In the case of internalizing symptoms, avoidant coping was related to lower problems for those with low executive control and low frustration. Previous research has found avoidant style coping

to be related to lower externalizing among young boys (Blair et al., 2004). On the other hand, executive control has been implicated as a protective factor in the development of psychopathology. Specifically, low executive control has been linked to higher internalizing and externalizing problems (Razza et al., 2010; Nigg, 2017). This association is thought to be partially accounted for by an inability to regulate attention to stimuli evoking negative emotion, as well as difficulty executing cognitive coping strategies (e.g., cognitive reappraisal) and regulating appropriate behavioral responses to dysphoria (Nigg, 2017). In this context, avoidant coping may result in less distress and fewer adjustment problems as alternative coping strategies, particularly those that might require attentional flexibility or shifting such as cognitive reappraisal, are less available or less effective for youth with lower executive control. In addition, avoidant coping may avert exacerbation of symptoms through experiences of failure in executing active strategies, which require more cognitive control and planning. Avoidant coping might be a compensatory emotion regulation strategy that is effective in reducing distress when someone is temperamentally more prone to distress due to high frustration or low effortful control. However, as noted above, this pattern of interaction also reflected that lower executive control and a style of avoidant coping were each related to higher levels of psychopathology prior to the pandemic, and that youth both high in avoidance and low in effortful control had the highest, albeit decreasing, levels of psychopathology during the pandemic, pointing to a potential ceiling effect.

Frustration has been associated with internalizing symptoms as well, specifically depression (Oldehinkel et al., 2004; Nigg, 2006). While high frustration may be related to increased dysphoria when goals are blocked, low frustration may also be related to lower motivation and approach of goal receipt. Avoidance may be more tenable in the context of low approach related to low frustration, and avoidance may also mitigate increased dysphoria from unmotivated or unsuccessful attempts at active coping. Moreover, the observed frustration used in this study may obscure other aspects of frustrative temperament. Zalewski et al. (2011) identified different patterns of frustrative profiles in children comprised observed, physiological indicators (heart rate), and self-reported frustration. The profile of moderate to low observed frustration but higher physiological and self-reported measures was positively associated with depressive symptoms (Zalewski et al., 2011). It is possible that avoidant strategies ameliorate the mood impact of these other frustrative characteristics. Overall, our findings suggest that low levels of frustration may indeed be protective across coping and appraisal strategies.

While this study's use of behavioral measures provided more objective indication of individual temperament, these measures might not capture patterns of regulation and reactivity across time and situations (e.g., Hubbard et al., 2010). This may explain the lack of direct or interactive effects with fear and adjustment. However, observations across four assessments that spanned two and half years were aggregated, capturing the consistency of the observations across time. In addition, the use of early-childhood observational measures of temperament reduced concerns about the potential mutual influences of temperament with stress, appraisal, and coping shaping temperament over time. The assessments occurred prior to assessments of appraisal, coping, stress, and psychopathology. Given prior evidence that has shown potential associations among these variables over time (e.g., Thompson et al., 2014, 2016), the early-childhood assessments captured children's temperament characteristics prior to substantial collinearity. Nonetheless, our results suggest that early life negative emotionality and effortful control may interact with coping strategies to impact the development of internalizing and externalizing symptoms in adolescence.

Strengths and Limitations

This study had several strengths. A key strength of this study was its developmental framework in which we were able to leverage longitudinal data from multiple-reporters, observational data, and an economically diverse sample across seven timepoints during childhood and adolescence. There were limitations of the study as well. While it was economically diverse, the sample used in this study was less diverse than the original sample, limiting our ability better generalize the findings. Our measure of coping and appraisal asked individuals to independently generate problems for coping and appraisal which may have led to differential responses. We also used broad categories of coping rather than narrowing in on specific strategies, limiting the specificity with which our results can speak to interventions.

Future directions and implications

Future directions in this work include examining both more specific and momentary reports (rather than global self-report) of coping strategy use. Physiological measures of regulation would also deepen our understanding of these associations. Facets of temperament are known to interact (e.g., Muris et al., 2007; Halvorson et al., 2022), thus three-way interactions may help probe emotionality and regulatory transactions with appraisal and coping. Additional considerations, such as the differential impacts of parent-level factors such as parental mental health and self-regulation, may be fruitful additions to this work. Parental self-regulation, emotionality, and mental health may all play a role in youth coping and outcomes in contexts of stress.

The results of this study underscore the role of individual emotionality and self-regulation in youth adjustment. Early individual differences in negative emotionality and self-regulation continue to contribute to psychopathology into adolescence by altering the effectiveness of coping efforts. These effects were observed over and above the effects of the context of stress, emphasizing the contribution of temperament to youth stress

responses and adjustment. These findings generally suggest that equipping youth with active coping skills may serve to reduce negative mental health outcomes. Indeed, a recent meta-analysis (Eadeh et al., 2021) reported that programs to improve adolescent emotion regulation were generally effective for both clinical and community samples by either increasing active or decreasing avoidant strategies. Although this effect did not differ based on sex or age, important factors like temperament were not explored as moderators. Our results suggest that, for some youth, particularly those high in frustration and low in executive control, additional or alternative emotion regulation strategies might be needed to support effective coping. Interventions might incorporate compensatory strategies or training to enhance inhibitory control (e.g., Rossignoli-Palomeque et al., 2019) or mindfulness practices (e.g., Long et al., 2021) to complement cognitive-behavioral coping strategies. Consideration of individual temperament differences in the delivery of coping enhancement or clinical intervention can support better emotion regulation and mental health.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to LL, liliana@uw.edu.

Ethics statement

The studies involving human participants were reviewed and approved by the University of Washington Institutional Review Board and Harvard University Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

LL, LS, and MS contributed to conception and design of the study. LL, KM, MR, AR, and AM contributed to conception and design of the parent studies from which the data were drawn. KP, MZ, MR, AR, SK, and MM were responsible for managing data collection and organization. MS and LL performed the statistical analysis. MS wrote the initial draft of the manuscript. KP, LS, LL, and MS wrote sections of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This work was supported by the National Institute of Child Health and Human Development (R01 HD054465 to LL), National Institute of Mental Health (R01 MH106482 to KM), and the Bezos Family Foundation (to AM).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 10 November 2022
DOI 10.3389/fpsyg.2022.992292

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 12 July 2022
ACCEPTED 07 October 2022
PUBLISHED 10 November 2022

CITATION
Susa-Erdogan G, Benga O, Albu-Răduleț M and Macovei T (2022) Child temperament and child-teacher relationship quality: Implications for children's emotional functioning during preschool period.
Front. Psychol. 13:992292.
doi: 10.3389/fpsyg.2022.992292

Child temperament and child-teacher relationship quality: Implications for children's emotional functioning during preschool period

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Although, in the last years several studies have moved beyond analyzing the role of mother–child relationship in the association between child temperament and child emotional functioning, our knowledge is still limited about which fine-grained temperamental components of child reactivity and self-regulation are associated with child-teacher relationship quality. Also, fewer studies have looked at the moderating role of child-teacher relationship in the association between child temperament and child internalizing/externalizing problems during early childhood. The present study examined the relation between components of child temperamental Negative Affectivity, Surgency, and Effortful Control and child-teacher relationship quality (i.e., closeness, conflict) in preschool children. In addition, our aim was to test the moderating effect of the child-teacher relationship on the association between temperament and internalizing and externalizing problems. One hundred Romanian preschoolers (55 boys, mean age=4.04years) participated in this study. Mothers assessed their child's temperament by completing the Children's Behavior Questionnaire and externalizing and internalizing problems with the Child Behavior Checklist. Child-teacher relationship quality was evaluated by children's teachers using the Student-Teacher Relationship Scale. Our results revealed that teachers rated their relationship as less conflictual with children who were assessed by their mothers as better in shifting and focusing attention, enjoying situations involving low stimulus intensity and displaying higher levels of Shyness, Sadness and Activity Level. Moreover, higher levels of Discomfort were associated with more conflict and less closeness while emotional reactivity such as Sadness, Fearfulness, and Activity Level were positively associated with closeness. Teacher-child closeness was associated with three temperamental self-regulation factors in the expected direction, except inhibitory control. Furthermore, results revealed a statistically significant interaction between child temperamental Shyness and child-teacher closeness in the prediction of child internalizing problems. Thus, when child-teacher closeness was low, there was a significant and positive relationship between child temperamental Shyness and child internalizing problems. Results highlight the importance of child-teacher

relationship quality in relation to child temperament and social–emotional development during preschool period.

KEYWORDS

preschoolers, child temperament, internalizing and externalizing problems, child-teacher conflict, child-teacher closeness

Introduction

The perception teachers have of their relationship with their students plays an important role for children's emotional and academic functioning (Sabol and Pianta, 2012; McCormick and O'Connor, 2015; Horn et al., 2021; Li et al., 2022). More specifically, teachers' perception regarding relationship quality with their students (e.g., the degree of closeness and conflict) can affect the nature of child-teacher interaction within the classroom (e.g., engagement, communication) which can further impact children's emotional experiences. An extensive body of research supports this view, many studies demonstrating that children who have a relationship with their teacher characterized by high levels of closeness (conceptualized as open, warmth and secure) experience fewer emotional and behavioral problems (Zatto and Hoglund, 2019; Bulotsky-Shearer et al., 2020; Harvey et al., 2022). Given the impact of teacher-student relationship quality on child emotional and behavioral functioning, it is critical to identify the factors related to higher levels of closeness and less conflict in the relationship between children and their teachers. Individual differences in child behavior in the form of temperamental characteristics is an important child-related factor that may influence teacher closeness and conflict. Child temperament, defined as individual differences that are observed in reactivity and self-regulation manifested on emotional, attentional and motor levels (Rothbart and Bates, 2006), is considered to influence the quality of child-teacher relationship. Rothbart's multidimensional model of temperament (Putnam and Rothbart, 2006; Rothbart et al., 2007) considers that temperament encompasses two broad dimensions: reactivity and self-regulation. Reactivity includes Negative Affectivity which refers to individual differences in the propensity to experience and express negative emotions (i.e., Sadness, Fear, Anger/Frustration), as well as Surgency which is associated with expressions of positive emotions, high activity level, and reward seeking. Self-regulation, or Effortful Control, encompasses active and voluntary recruitment of higher-order cognitive processes, such as inhibitory control, high perceptual sensitivity, and attentional mechanisms that modulate reactivity.

When addressing temperamental reactivity, the large body of previous studies looked at Shyness as part of Surgency/Extraversion factor (Justice et al., 2008; Rudasill and Rimm-Kaufman, 2009; Arbeau et al., 2010; Bassett et al., 2017; Sette et al., 2019; Chen et al., 2021). Several cross-sectional studies found that children who displayed higher levels of Shyness have lowered teacher ratings of closeness (Justice et al., 2008; Sette et al., 2019) while longitudinal data showed that higher levels of child Shyness lead to less closeness in child-teacher relation over time (Arbeau et al., 2010; Rudasill, 2011). Moreover, in a recent study, Chen et al. (2021) analyzed the cultural differences between samples of Dutch and Chinese school-aged children regarding the role of children Shyness on child-teacher relationship. In this study, children reported on their own levels of Shyness and both teachers and children reported on the quality of their relationship. Results demonstrated that Shyness was associated with less closeness and more conflict as reported by children in both countries, but these associations were higher for the Chinese sample. Regarding teachers' perception, only closeness was associated in both countries with children Shyness, namely higher Shyness was associated with less teacher-reported closeness. One possible explanation for this pattern of results regarding child Shyness and child-teacher closeness comes from ecological systems (Bronfenbrenner and Morris, 2007) and socialization theories (Grusec and Davidov, 2010), according to which children's behaviors can shape the way caregivers, including teachers, respond and interact with them. As such, temperamental shy children who are inclined to show fearfulness and inhibited approach in the face of other people or novel situations (Rothbart and Bates, 2006) seek less comfort and support from their teachers and engage less positively with them. Therefore, teachers may subsequently perceive less closeness with these children. Since most cultures place value on autonomy, self-reliance, and sociability nowadays, due to globalization, shyness may often be regarded as a non-desirable trait and is discouraged by adults (Hofstede et al., 2010). Thus, shy children are more likely to be perceived negatively by teachers and hence may have fewer quality relations with them compared to non-shy children (Chen, 2019). Although, previous studies did not measure how teachers interpret children shyness, the study conducted by Rudasill and Rimm-Kaufman (2009) showed that Shyness was negatively related to child-teacher closeness indirectly through less frequent child-initiated interactions between teachers and children.

Other possible explanations for the relationship between Shyness and child-teacher relations can be grounded in the transactional model of development (Sameroff, 1975; Sameroff and Chandler, 1975) and temperamental theories (Rothbart, 2011). The transactional model of development considers that child Shyness and child-teacher relations can mutually influence

each other. This theoretical perspective postulates that biologically based traits like temperament can be shaped by social context. While this hypothesis has not been studied compared to child-driven models, the few longitudinal child-teacher data reported in the literature are in line with the child-driven model, given that child Shyness predicted child-teacher closeness (Arbeau et al., 2010; Rudasill, 2011).

Fewer studies (e.g., Eisenberg et al., 2010; Diaz et al., 2017; Hernández et al., 2017; White et al., 2021) have investigated the impact of self-regulatory dimensions of temperament on child-teacher relationship. As such, Effortful Control has often been associated with more closeness and less conflict in the child-teacher relation (Eisenberg et al., 2010; Acar et al., 2021). Longitudinal evidence demonstrated that higher levels of Effortful Control, measured in kindergarten, positively predicted teacher-student closeness and strongly, negatively predicted teacher-student conflict 1 year later (Hernández et al., 2017). Other studies obtained the same results when also controlling for different child variables, such as SES and verbal intelligence (Valiente et al., 2012) or gender (Rudasill and Rimm-Kaufman, 2009). These results were interpreted mostly in terms of child-driven effects, namely that children with better self-regulatory abilities are easier to manage and they are able to interact more positively with others, which may contribute to higher quality relationship with their teachers (Nurmi, 2012).

From an attachment theory perspective, (Sroufe et al., 1999) higher quality of child-teacher relationship (warm and close) may enhance the development of self-regulation by supporting children to feel secure. In line with attachment theory, a recent study by Acar et al. (2021) showed that child-teacher closeness was positively associated with children's self-regulation, whereas child-teacher conflict was negatively associated with children's self-regulation. Moreover, the longitudinal study conducted by Goble et al. (2019) demonstrated that teachers' emotional support across 1 year predicted gains in children's inhibitory control development. In addition, teacher's level of initial support in the beginning of the academic year moderated the relation between improvements in teachers' emotional support and development of inhibitory control in children.

The research mentioned above concerning the relation between child temperament and child-teacher relationship has two major shortcomings. First, they have considered few temperamental traits with the majority of studies (for an exception, see Acar et al. (2021); White et al., 2021) looking at Shyness and Effortful Control. Looking at Shyness is reasonable given that this temperamental trait can place young children at risk for concurrent and long-term social- emotional challenges. However, there are other important dimensions of temperamental reactivity (e.g., Anger, Sadness, Activity Level) that are conceptually and empirically different from Shyness (Gartstein et al., 2012), which can impact child-teacher relationship. Equally, temperamental Effortful Control as a broader factor encompasses several abilities that can modulate reactivity: the ability to focus and shift attention, the ability to inhibit dominant responses and perform subdominant actions, the capacity to enjoy situations involving low stimulus intensity and to manifest positive emotions such as smiling or laughter. Because some individual differences in these fine-grained components of Effortful Control can have greater impact on the child-teacher relation (e.g., how much a child is able to enjoy activities with low stimulus intensity and flexibly shift attention when needed might be more applicable for learning contexts), analyzing the impact of these components of Effortful Control becomes relevant. Second, majority of this past research has been conducted with school-aged children and few studies addressed the preschool period (Zatto and Hoglund, 2019; Bulotsky-Shearer et al., 2020; Horn et al., 2021). However, preschool period is an important developmental stage for the experience of emotional difficulties, such as internalizing and externalizing problems. Preschool teachers represent key relational figures for children's emotional and behavioral adjustment given that they interact with children several hours per day. Moreover, especially during early development, children's temperamental dispositions may interact with features of environment, including the teacher relation context, to further predict children's emotional functioning (Rothbart and Bates, 2006).

According to temperament theories (Rothbart and Bates, 2006) the consequences of child-teacher interaction on children's emotional functioning may depend on children's individual differences in temperamental reactivity and self-regulation. As such, the same type of interaction will be processed differently by children with different temperamental profiles. For instance, a shy child might be more likely to be affected by a less warm and close relation with their teachers while a supportive child-teacher interaction may protect against the negative impact of Shyness on child emotional functioning (Bulotsky-Shearer et al., 2020). Thus, temperamental models (Rothbart and Bates, 2006; Chess and Thomas, 2013) emphasize the moderating role of the environment that may support or hamper children's adjustment.

A majority of previous research has analyzed the moderating role of family and in particular of mother–child relationship in the association between child temperament and child emotional functioning, while few studies have looked at child-teacher relational factors (Arbeau et al., 2010; Roubinov et al., 2017; Bulotsky-Shearer et al., 2020; White et al., 2021; Harvey et al., 2022). Roubinov et al. (2017) demonstrated that preschool children characterized by an overcontrolled temperamental profile (higher levels of Negative Affectivity and Effortful Control) produced more cortisol when they were at kindergarten only if their teachers reported less emotional and motivational support. Moreover, a recent study conducted by Harvey et al. (2022) found that low levels of Surgency were associated with fewer internalizing problems only for children that had a close relationship with their teachers while the longitudinal data obtained by Arbeau et al. (2010) demonstrated that for school-aged children shyness was significantly associated with anxiety and school avoidance only for children that had a child-teacher relationship characterized by low levels of closeness. In conclusion, previous studies have supported the prediction that child-teacher relationship can moderate the association between child temperament and child emotional functioning. However, these studies measured few

fine-grained components of child temperament that may confer risk for internalizing and externalizing problems.

Present study

Going beyond previous research, the present study examined the relation between fine-grained components of child temperamental Negative Affectivity, Surgency, and Effortful Control and child-teacher relationship quality (i.e., closeness, conflict) in preschool children. Further, our aim was to test the moderating effect of the child-teacher relationship quality on the association between temperament and internalizing and externalizing problems.

In order to advance the knowledge in this domain, first we conceptualized temperament based on fine-grained components of the two broad temperamental factors, namely reactivity and self-regulation (Rothbart, 2011). Second, we focused on preschool period, given that is the context in which many children experience the formation of a primary relation (i.e., child-teacher relation) outside the family environment for the first time. Third, we used different informants for the measurement of child-teacher relationship and child temperament. Based on previous data (Hernández et al., 2017; Acar et al., 2021), ecological systems (Bronfenbrenner and Morris, 2007), and socialization theories (Grusec and Davidov, 2010), we hypothesized that (a) fine-grained components of child Effortful Control would be associated with higher levels of closeness and less conflict in child-teacher relationship, while fine-grained components of child Negative Affectivity would be associated with lower levels of closeness and higher conflict. Regarding fine-grained components of Surgency, we expect positive associations between Smiling/Laughter and child-teacher closeness, while between Shyness, Activity Level, Impulsivity, High Intensity Pleasure, and closeness negative associations are anticipated. Regarding child-teacher conflict, we expect Impulsivity and High Intensity Pleasure to be associated with higher levels of child-teacher conflict, while Shyness and Smiling are expected to be associated with lower levels of child-teacher conflict. Based on temperamental theories postulating that children's temperamental dispositions may interact with features of environment, we hypothesized that child-teacher relationship quality would moderate the association between children's temperament and internalizing/externalizing problems. Developmental models of psychopathology (Nigg, 2006; Pérez-Edgar, 2019) and robust past research (Putnam and Stifter, 2005; Gartstein et al., 2017; Buss et al., 2018; Lin et al., 2018) have been postulated and have demonstrated that temperamental traits may be differentially associated with internalizing and externalizing problems. For example, higher levels of fearfulness, sadness, and shyness have been delineated as critical temperamental risk factors for internalizing problems, while higher levels of impulsivity, activity level, and anger have been identified for externalizing problems. Based on these theoretical models and empirical evidence, we expect that child-teacher closeness would decrease the strength of the association between temperamental risk (i.e., Fearfulness, Sadness and Shyness) on internalizing problems and between temperamental risk (i.e., Impulsivity, Activity Level, and High Intensity Pleasure) on externalizing problems. In contrast, conflict with teachers would increase the risk for experiencing internalizing problems and externalizing problems for children with higher levels in these temperamental traits.

Participants

A total of 100 children (average age = 4.04 years, SD = 0.088, range = 2–5, 55 boys and 45 girls) and their primary caregivers, all mothers (average age = 34.12 years; SD = 5.39, range 26–50 years), participated in this study. A community-based sample was involved, the participants having been recruited *via* flyers distributed in local kindergartens. Mothers came from a middle- and upper-class backgrounds and their education level was diverse (on a scale ranging from 1, primary education, to 11, graduate studies), with 56% having a bachelor's degree, 27% of them having a high school diploma, and the rest completed middle school and post-secondary education.

Procedure

The procedure of the study was reviewed and approved by the Ethics Committee of Babeș-Bolyai University. At the beginning of the school year, parents were given informed consent forms; those who returned them were further offered the Children's Behavior Questionnaire (CBQ) and the questionnaire pertaining to socio-demographic information. Parents filled in the questionnaires at home. In the middle of the school year (after 5–6 months), the primary teachers (those the child spent the most time with) also completed the Student-Teacher Relationship Scale (STRS), whereas the mothers additionally completed the Child Behavior Checklist (CBCL).

Instruments

The children's behavior questionnaire, standard form (CBQ)

For measuring child temperamental reactivity and emotion regulation, we used The Children's Behavior Questionnaire, Standard Form (CBQ; Rothbart et al., 1994; Benga, 2004). The CBQ is a caregiver-report measure that assesses three major temperamental dimensions: Negative Affectivity, Effortful Control, and Surgency/Extraversion. The CBQ was developed for 3–7-year-old children and it features a total of 195 items and 15 subscales. Responses to the items are rated on a 7-point Likert scale, ranging from "extremely untrue of your child" (1) to "extremely true of your child"; additionally, the CBQ provides a "not applicable" alternative for items that do not apply to the child in question.

In regards to the current study, we used the child Negative Affectivity, Effortful Control, and Surgency dimensions. Negative Affectivity includes the following scales: Discomfort, Sadness, Fear, Anger/Frustration, and Soothability. Effortful Control contains Attentional Focusing, Inhibitory Control, Low Intensity Pleasure, and Perceptual Sensitivity. Surgency is defined by the following scales: Impulsivity, High Intensity Pleasure, Activity Level, and Shyness. Positive Anticipation and Smiling/Laughter also contribute to this factor.

According to Rothbart et al. (2001), Discomfort refers to negative affectivity related to the sensorial qualities of a stimulus, including intensity, rate, complexity, etc. (e.g., 'Is not very bothered by pain'), Sadness refers to "negative affectivity and lowered mood and energy" due to the "exposure to suffering, disappointment, and object loss" (e.g., 'Cries sadly when a favorite toy gets lost or broken'), and Fear covers "negative affectivity, including unease, worry, or nervousness, which is related to anticipated pain" (e.g., 'Is not afraid of large dogs and/or other animals'). Anger/Frustration covers "negative affectivity related to interruption of ongoing tasks or goal blocking" (e.g., 'Has temper tantrums when s(he) does not get what s(he) wants') and Soothability refers to "the rate of recovery from peak distress, excitement, or general arousal" ('Has a hard time setting down for a nap').

Regarding the Effortful Control dimension, Attentional Focusing refers to "the capacity to maintain attentional focus on task-related channels" ('When picking up toys or other jobs, usually keeps at the task until it's done'), Inhibitory Control measures "the capacity to plan and to suppress inappropriate approach responses under instructions or novel or uncertain situations" (e.g., 'Can lower his/her voice when asked to do so'), and Low Intensity Pleasure refers to pleasure or enjoyment derived from "situations involving low stimulus intensity" (e.g., 'Rarely enjoys just being talked to'). Perceptual Sensitivity covers "the detection of slight, low-intensity stimuli from the external environment" (e.g., 'Notices the smoothness or roughness of objects s(he) touches') and Smiling/ Laughter measures the positive emotions in regards to changes in the intensity of a stimulus (e.g., 'Laughs a lot at jokes and silly happenings').

Impulsivity stands for the speed with which a response is initiated (e.g., 'Usually rushes into an activity without thinking about it') and High Intensity Pleasure refers to pleasure or enjoyment derived from "situations involving high stimulus intensity" (e.g., 'Likes going down high slides or other adventurous activities'). Activity Level refers to the level of "gross motor activity, including rate and extent of locomotion" (e.g., 'Seems always in a big hurry to get from one place to another') and Shyness stands for "slow or inhibited … speed of approach and discomfort" in social interactions (e.g., 'Often prefers to watch rather than join other children playing'). Additionally, Positive Anticipation refers to "the amount of excitement for expected pleasurable activities" (e.g., 'Gets so worked up before an exciting event that s(he) has trouble sitting still').

The CBQ has appropriate psychometric properties, with test–retest reliability and internal consistency ranging from.56 to.86, as obtained from the Romanian population. For the current sample, we also obtained appropriate reliability for the Effortful Control dimension ($\alpha = 0.71$), for the Surgency dimension ($\alpha = 0.75$), and for the Negative Affectivity dimension ($\alpha = 0.70$). Internal consistency for fine-grained components of child temperamental Negative Affectivity was acceptable for Fear ($\alpha = 0.74$), Anger ($\alpha = 0.88$), Sadness ($\alpha = 0.76$) but relatively low for Discomfort ($\alpha = 0.66$). For Surgency, except for the Impulsivity ($\alpha = 0.50$) the other subscales had good reliability (Shyness $\alpha = 0.79$; Smiling $\alpha = 0.75$, Activity Level $\alpha = 0.71$, Approach $\alpha = 0.86$, and High Intensity Pleasure $\alpha = 0.75$). Finally, for fine-grained components of Effortful Control dimension was good for Inhibitory Control ($\alpha = 0.83$) and Low Intensity Pleasure ($\alpha = 0.70$) but relatively low for Perceptual Sensitivity ($\alpha = 0.68$), Attentional Focusing ($\alpha = 0.58$) and Attentional Shifting ($\alpha = 0.60$). Although the reliability for some reactive and regulatory temperament variable appears low in the current study, this is similar with previous studies using CBQ in different samples (Putnam and Rothbart, 2006; White et al., 2011; Acar et al., 2021).

Student-teacher relationship scale

For evaluating the child-teacher quality of interaction, we used The Student-Teacher Relationship Scale, Short Form (Pianta, 2001). The STRS is a self-report instrument that measures the teacher's relationship with individual children in their classroom (Pianta, 2001). It contains 15 items that are rated on a 5-point scale, with responses ranging from 1 ("definitely does not apply") to 5 ("definitely applies"). The STRS covers two main dimensions, closeness and conflict. According to Pianta (2001), closeness refers to the degree to which the child-teacher relationship is characterized by warmth and positive affect, according to the teacher (e.g., 'I share an affectionate, warm relationship with this child'), and conflict evaluates the degree to which teachers view interactions with the child as negative or disagreeable (e.g., 'This child and I always seem to be struggling with each other').

The STRS features good psychometric properties, with internal consistency ranging from.86 to.89 (Pianta and Steinberg, 1992) and good predictive and concurrent validity. For example, the questionnaire shows correlations with present and future academic skills (Hamre and Pianta, 2001), behavioral adjustment, and peer relations (Birch and Ladd, 1998). In the current study, the closeness dimension rendered good reliability ($\alpha = 0.81$), whereas the conflict dimension featured very good reliability ($\alpha = 0.94$).

The child behavior checklist 1½–5 years (CBCL 1½–5 years)

For measuring externalizing and internalizing problems, we used the caregiver version of the CBCL 1½–5 years (Achenbach and Rescorla, 2000). For the present study we calculated the total score for Internalizing dimension which includes the following subscales: Emotionally Reactive (e.g., 'Disturbed by any change in routine'), Anxious/Depressed (e.g., 'Nervous, high-strung, or tense'), Somatic Complaints (e.g., 'Nausea, feels sick'), and Withdrawn (e.g., 'Avoids looking

others in the eye'). The Externalizing problems were measured with Attention Problems (e.g., 'Cannot concentrate, cannot pay attention for long') and Aggressive Behavior subscales (e.g., 'Destroys things belonging to his/her family or other children'). Items are scored on a 3-point Likert scale (0 = false; 1 = somewhat true or sometimes true; 2 = very true or often true). The CBCL features good psychometric properties. The CBCL has shown good psychometric properties on the Romanian population as well, with high levels of test-rest reliability (Dobrean, 2009; Ştefan and Miclea, 2017) and internal consistency ranging from.85 to.94 (Ivanova et al., 2007a,b; Ştefan and Miclea, 2017). For the current study we obtained a very good reliability for the Internalizing ($\alpha = 0.91$) and Externalizing ($\alpha = 0.94$) dimensions.

TABLE 1 Descriptive statistics for study variables.

Variable	*M*	*SD*	Range
Temperament (CBQ)			
Negative affectivity	4.44	0.51	3.79–5.53
Effortful control	4.78	0.43	3.95–5.66
Surgency	4.43	0.28	3.67–5.23
Internalizing problems (CBCL)	1.34	0.97	0–3.39
Externalizing problems (CBCL)	0.94	0.70	0–2.26
Child-teacher relationship (STRS)			
Child-teacher conflict	1.50	0.80	1–3.86
Child-teacher closeness	4.38	0.52	2.75–5

CBQ, Children's Behavior Questionnaire; CBCL, Child Behavior Checklist; STRS, Student-Teacher Relationship Scale.

Results

Descriptive statistics for the study variables are presented in Table 1. Moreover, bivariate correlations between fine-grained components of child temperamental Negative Affectivity, Surgency, Effortful control, and child-teacher relationship are presented in Tables 2–4. The data yielded several statistically significant correlations of importance. Significant negative correlations were obtained between child-teacher conflict and fine-grained components of Effortful Control, namely, Low Intensity Pleasure, Inhibitory Control and a marginally significant negative correlation with Attentional Shifting, (r (98) = −0.19, $p = 0.061$). In addition, child-teacher conflict was also significantly and negatively correlated with the fine-grained component of Surgency, namely Shyness. Moreover, a significant positive correlation was found between child-teacher closeness and Activity Level as part of Surgency.

Child temperament and child-teacher relationship

In order to examine the relation between components of child temperamental Negative Affectivity, Surgency, and Effortful Control and child-teacher relationship quality two hierarchical regression analyzes (one with child-teacher conflict and one with child-teacher closeness as an outcome variable) were conducted (Tables 5, 6). The model predicting child-teacher conflict (Table 5) revealed statistical significance, F (5, 85) = 5, 27, $p = 0.000$ and explained 27% of the

TABLE 2 Correlations for study variables (negative affectivity).

Variable	*n*	1	2	3	4	5	6	7
1. Child_Teacher_Conflict	100	—						
2. Child_Teacher_Closeness	100	−0.64**	—					
3. Discomfort	100	0.02	−0.11	—				
4. Fear	100	0.06	0.12	0.55**	—			
5. Anger/frustration	100	0.13	−0.02	0.65**	0.39**	—		
6. Sadness	100	0.03	−0.02	0.78**	0.18	0.72**	—	
7. Soothability	100	−0.12	−0.01	−0.33**	0.09	−0.33**	−0.39**	—

**$p < 0.01$.

TABLE 3 Correlations for study variables (effortful control).

Variable	*n*	1	2	3	4	5	6	7
1. Child_Teacher_Conflict	100	—						
2. Child_Teacher_Closeness	100	−0.64**	—					
3. Attentional focusing	100	−0.11	0.01	—				
4. Inhibitory control	100	−0.19*	0.02	0.67**	—			
5. Low Intensity pleasure	100	−0.20*	−0.03	0.27**	0.38**	—		
6. Perceptual sensitivity	100	0.10	0.10	0.11	0.18	−0.20*	—	
7. Attentional shifting	100	−0.19	−0.07	0.30**	0.49**	−0.12	0.39**	—

*$p < 0.05$; **$p < 0.01$.

TABLE 4 Correlations for study variables (surgency).

Variable	*n*	1	2	3	4	5	6	7	8
1. Child_Teacher_Conflict	100	—							
2. Child_Teacher_Closeness	100	−0.64**	—						
3. Activity Level	100	0.01	0.26**	—					
4. Impulsivity	100	0.10	−0.07	0.39**	—				
5. High Intensity Pleasure	100	−0.12	0.12	0.41**	0.51**	—			
6. Shyness	100	−0.22*	−0.01	−0.20	−0.46**	−0.57**	—		
7. Approach	100	0.08	0.08	0.56**	0.55**	0.37**	−0.02	—	
8. Smiling/ Laughter	100	0.12	0.14	0.59**	0.29**	−0.12	−0.10	0.53**	—

*$p < 0.05$; **$p < 0.01$.

TABLE 5 Hierarchical regression coefficients for child temperament and child-teacher conflict.

Variable	Model 1			*t*-value	*p*-value
	B	*SE*	*β*		
Constant	0.85	0.37		2.28	0.025
Discomfort	1.18	0.43	1.14	2.71	0.008
Fear	−0.30	0.22	−0.37	−1.33	0.188
Anger	−0.00	0.19	−0.00	−0.00	0.997
Sadness	−1.01	0.38	−0.84	−2.62	0.010
Shyness	−0.28	0.12	−0.25	−2.39	0.019
Smiling	1.81	0.59	1.03	3.08	0.003
High intensity pleasure	0.40	0.30	0.37	1.35	0.179
Impulsivity	0.38	0.36	0.21	1.04	0.302
Activity level	−0.60	0.55	−0.99	−2.91	0.005
Inhibitory control	0.12	0.14	0.11	0.83	0.406
Low intensity pleasure	−0.40	0.15	−0.30	−2.62	0.010
Attentional shifting	−0.37	0.18	−0.24	−2.04	0.044
Attentional focusing	−0.57	0.23	−0.44	−2.43	0.017
Perceptual sensitivity	0.02	0.28	0.01	0.07	0.942

SE, standard error; Dependent variable: Child_Teacher_Conflict.

variance of conflict. Regarding fine-grained components of the Negative Affectivity, Discomfort was statistically significant and positively associated with conflict ($\beta = 1.14$, $p = 0.008$) while Sadness was statistically significant and negatively associated with conflict ($\beta = -0.84$, $p = 0.010$). Shyness and Activity Level, as part of Surgency, were negatively associated with conflict ($\beta = -0.25$, $p = 0.019$, $\beta = -0.99$ $p = 0.005$, respectively) and Smiling was positively associated with conflict ($\beta = 1.03$, $p = 0.003$). Low Intensity Pleasure, Attentional Shifting and Attentional Focusing were statistically significant and negatively associated with conflict ($\beta = -0.30$, $p = 0.010$, $\beta = -0.24$, $p = 0.044$, $\beta = -0.44$, $p = 0.017$, respectively). The second hierarchical regression model with child-closeness as an outcome (Table 6) was statistically significant, F (5, 85) = 2, 81, $p = 0.021$, and explained 20% of the variance of closeness. From Negative Affectivity, Discomfort significantly and negatively predicted closeness ($\beta = -0.1.59$, $p = 0.001$) while Fearfulness and Sadness were positively associated with closeness ($\beta = 0.65$, $p = 0.028$, $\beta = 1.49$, $p = 0.000$). For Surgency factor, only Activity Level predicted closeness ($\beta = 0.73$, $p = 0.044$). Attentional Focusing and Low Intensity Pleasure as part of Effortful Control were positively associated with closeness ($\beta = 0.37$, $p = 0.054$, $\beta = 0.49$, $p = 0.046$). In contrast, Inhibitory Control was negatively associated with closeness ($\beta = -0.86$, $p = 0.045$).

The moderating role of child-teacher relationship on child temperament and internalizing/externalizing problems

Several regression analyzes were carried out using PROCESS for SPSS software (Preacher and Hayes, 2008) in order to analyze the moderating role of child-teacher relationship on child temperament and child internalizing and externalizing problems. In order to test our hypothesis that child-teacher closeness and conflict would moderate the association between children's Impulsivity, Activity Level, High Intensity Pleasure and externalizing problems we run separate models to test these interaction effects. No interaction model was significantly associated with children's externalizing problems ($b = -0.02$, $p = 0.91$ for Impulsivity x closeness,

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TABLE 6 Hierarchical regression coefficients for child temperament and child-teacher closeness.

Variable	Model 1			*t*-value	*p*-value
	B	*SE*	*β*		
Constant	−0.70	1.66		−0.42	0.675
Discomfort	−1.07	0.29	−1.59	−3.60	0.001
Fear	0.34	0.15	0.65	2.23	0.028
Anger	−0.25	0.13	−0.41	−1.86	0.065
Sadness	1.17	0.26	1.49	4.47	0.000
Shyness	0.27	0.14	0.37	1.87	0.064
Smiling	−0.36	0.40	−0.31	−0.88	0.377
High intensity pleasure	−0.13	0.20	−0.18	−0.65	0.517
Impulsivity	−0.01	0.24	−0.01	−0.05	0.960
Activity level	0.77	0.37	0.73	2.04	0.044
Inhibitory control	−0.58	0.29	−0.86	−2.03	0.045
Low intensity pleasure	0.42	0.20	0.49	2.02	0.046
Attentional shifting	0.29	0.24	0.29	1.21	0.227
Attentional focusing	0.31	0.16	0.37	1.95	0.054
Perceptual sensitivity	0.13	0.19	0.13	0.65	0.517

SE, standard error; Dependent variable: Child_Teacher_Closeness.

TABLE 7 Hierarchical regression analysis for variables predicting child internalizing problems.

Variable	Estimate	*SE*	95% CI for B		*t*-value	*p*-value
			LL	*UL*		
CBQ_Shyness	0.22	0.14	−0.07	0.49	1.51	0.133
Child_Teacher_Closeness	−0.08	0.25	−0.58	0.43	−0.30	0.763
Child_Teacher_Conflict	−0.06	0.16	−0.39	0.26	−0.41	0.682
CBQ_Shyness × Child_Teacher_Closeness	−0.73	0.32	−1.36	−0.09	−2.28	0.024

SE, standard error; CI, confidence interval; LL, lower limit; UL, upper limit.

$b = -0.03$, $p = 0.92$ for Impulsivity x conflict, $b = 0.12$, $p = 0.74$ for Activity Level x closeness, $b = -0.09$, $p = 0.66$ for Activity Level x conflict, $b = 0.19$, $p = 0.34$ for High Intensity Pleasure x closeness, and $b = -0.03$, $p = 0.77$ for High Intensity Pleasure x conflict).

To test our hypothesis that child-teacher closeness and conflict would moderate the association between children's Fearfulness, Shyness, Sadness and internalizing problems we also run separate models to test these interaction effects (Table 7). Only the model with children's Shyness and child-teacher closeness as an interaction term significantly moderated the association between temperamental risk and internalizing problems ($b = -0.73$, $p = 0.024$).

As can be seen in Figure 1, the effect of child-teacher closeness was probed at low (−1 SD from mean), average, and high (+1 SD from mean) levels of child Shyness. When child-teacher closeness was low a significant and positive relationship between child Shyness and child internalizing problems was found ($b = 0.60$, $SE = 0.23$, $t = 2.55$, $p = 0.012$). However, when child-teacher closeness was high and medium, no statistically significant effect

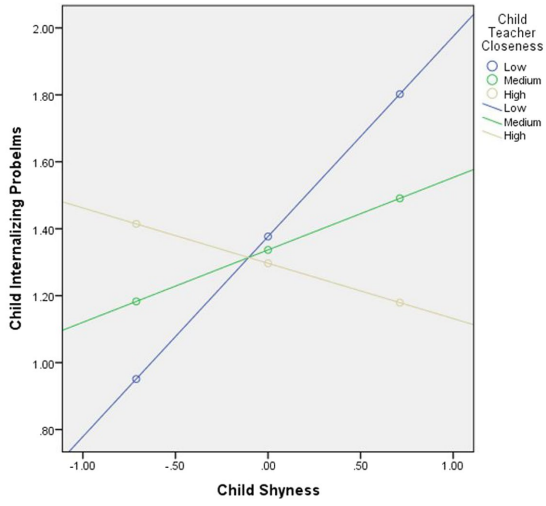

FIGURE 1
Interaction between child shyness and child-teacher closeness in predicting child internalizing problems.

was found ($b = -0.16$, $SE = 0.20$, $p = 0.42$, $b = 0.22$, $SE = 0.14$, $p = 0.13$, respectively).

Discussion

The present study aimed to examine child temperamental factors that are related to higher levels of closeness and less conflict in the relationship between children and their teachers during preschool period. In addition, we tested the moderating role of child-teacher interaction quality in the association between child temperamental risk and child internalizing/externalizing problems.

The results of the hierarchical regression analysis revealed that, three fine-grained components of child temperamental Effortful Control were significantly associated with child-teacher conflict. Specifically, children's Low Intensity Pleasure, Attentional Shifting, and Attentional Focusing were associated with lower levels of conflict in the child-teacher relation. In addition, Shyness and Activity Level as reactive temperamental factors of Surgency dimension were associated with lower levels of child-teacher conflict, while Smiling as also part of Surgency was associated with higher levels of conflict. With respect to fine-grained components of negative affectivity we found that Discomfort was associated with higher conflict and Sadness with lower conflict. Child-teacher closeness was inversely associated with Discomfort and positively associated with Sadness, Fearfulness, and Activity Level. In addition, teacher-child closeness was associated with three temperamental self-regulation factors in the expected direction, except inhibitory control. That is, inhibitory control was inversely associated with closeness while Attentional Focusing and Low Intensity Pleasure were positively associated.

Another goal of the present study was to investigate the interactive role of child temperament and child-teacher relationship quality on child internalizing and externalizing problems. Regarding this goal, our study demonstrated a significant interaction effect between child Shyness and child-teacher closeness. Specifically, temperamental Shyness predicted higher levels of internalizing problems only when child-teacher closeness was low. However, temperamental Shyness did not predict internalizing problems when child-teacher closeness was high or medium.

Knowledge is limited about which fine-grained components of child temperamental reactivity and self-regulation explain more from the variance in child-teacher relationship during preschool. Our study addresses this shortcoming by showing that teachers rated their relationship as less conflictual with children who were assessed by their mothers as better in shifting and focusing attention, and enjoying situations involving low stimulus intensity. This result is in line with our hypothesis and confirms previous data demonstrating that higher temperamental self-regulation in children is linked with less conflict and more closeness in the child-teacher relation (Valiente et al., 2012; Hernández et al., 2017; White et al., 2021). Thus, young children's attentional abilities, as well as their capacity to enjoy situations that are not highly arousing, such as being talked to, are critical for the establishment of a close and supportive relationship with their teachers. The reason these self-regulatory abilities are important for child-teacher relationship stems from the relevance these traits have in the learning context of the kindergarten. Specifically, much of the learning activities in kindergarten are teacher directed and conducted in groups in Romanian kindergartens. Therefore, children's ability to shift attention toward teachers when needed, to inhibit inappropriate responses in order to follow teachers' directions, and to be able to focus on tasks that involve low stimulus intensity, such as staying at a table and draw something, are traits that are highly appreciated and valued by teachers given their impact on the kindergarten learning environment. Contrary to our expectation we did not find a direct association between Shyness and child-teacher closeness but we found that teachers reported less conflict with children that were perceived by their mothers as having higher levels of Shyness. With respect to child-teacher conflict previous findings were inconsistent. For example, the meta-analysis conducted by Nurmi (2012) found that children shyness was not significantly associated with conflict. However, some studies found a positive association between child Shyness and conflict (Rudasill and Rimm-Kaufman, 2009; Sette et al., 2014; Chen et al., 2021) while others found a negative association (Rudasill, 2011). Thus, our results show that shy children were less likely to have conflictual relationships with teachers. This effect might be due to the fact that these children are initiating less interactions with their teachers. However, having less conflictual relationship with teachers may help preschool shy children to adapt to kindergarten environment. Not in line with our expectation we found that children who have higher levels of positive affect (Smiling) in response to changes in stimulus intensity, rate, complexity, and incongruity were more likely to be perceived by their teachers as being conflictual. One explanation for this result could be that teachers may perceive these children behavior as disturbing the learning environment given that they may act more exuberant during lessons. Moreover, although, our expectation was that higher Negative Reactivity would be associated with more child-teacher conflict our results demonstrate a more nuanced picture, depending on the type of negative emotional reactivity. That is, children with higher negative affect related to sensory stimulation (Discomfort) have less positive relationship with their teachers (i.e., higher conflict and lower closeness) while children with higher fearfulness have higher closeness and those with higher sadness have both less conflict and more closeness. This results can be interpret in the light of social functionalist theory of emotions (Campos et al., 1994; Keltner et al., 2022) which considers that each emotion motivates the behavior of others in a different way. For example, sadness and fear signal to others that support is needed, in contrast with discomfort that has a less clear message for the social environment. As such young children who are predispose to manifest fearfulness and sadness activates teacher's comforting responses which in turn may increase child-teacher relationship quality.

Also, not in line with our expectation was the finding that teachers reported more closeness in relationships with children displaying higher levels of Activity Level as part of the Surgency dimension. In addition, children with higher inhibitory control had less closeness with their teachers. Regarding the relation between Activity Level and closeness it is possible that children

who are active and move a lot from one place to another are more likely to also initiate more interactions with their teachers and to make more bids for attention from them, which may facilitate the formation of positive child-teacher relationships given that close relationships require frequent interactions. In line with this argument, the study conducted by Rudasill and Rimm-Kaufman (2009) showed that less shy children initiated more interactions with teachers compared to shy ones. Although the relation between inhibitory control and closeness detected in the present study needs to be replicated in future research, it is possible that young children who are better in controlling their behavior receive less attention and contact from their teachers.

Regarding the moderating role of child-teacher interaction quality in the association between child temperament and child internalizing/externalizing problems, our hypothesis was partially supported since only child-teacher closeness acted as a moderator of the relationship between Shyness and internalizing problems. Specifically, when teachers reported having less closeness, children presenting higher levels of Shyness experienced more internalizing problems. This result is similar with other studies that demonstrated the protective role of high levels of closeness in child-teacher relation for shy children that have difficulties approaching people and new situations (Arbeau et al., 2010; Harvey et al., 2022), and with temperamental theories that postulate an interaction between temperamental traits and context (Rothbart and Bates, 2006; Chess and Thomas, 2013). However, no moderating effect was observed between other temperamental components and closeness in the prediction of internalizing or externalizing problems. In addition, conflict was not identified as a moderator of the relationship between temperament and internalizing or externalizing problems. In our sample, teachers rated overall low levels of conflict in their relationship with children, which can explain this null result regarding conflict. Moreover, the finding that no direct or interactive effects were found between child temperament, child-teacher relation (both conflict and closeness), and externalizing problems can be explained by the low levels of externalizing problems reported by parents in this community-based sample. It might be that parents are less accurate in reporting children externalizing problems, as compared to internalizing problems, and future studies should also include teachers' reports. Our results are in contrast with previous data reported by Harvey et al. (2022) in school-aged children, where a direct effect was found between temperament and externalizing problems but no moderation from child-teacher relationship quality. However, compared to our study, those children were presenting higher levels of externalizing problems at study entry (t-scores corresponding to the cutoff for high risk).

Strengths and limitations

This study has several contributions for the research focused on identifying child factors associated with teacher-student relationship quality during early development. First, it looks at which fine-grained components of child temperamental reactivity and self-regulation have greater impact on child-teacher relationship during preschool. Second, we focused on the preschool period given that young children's adaptation to the kindergarten environment is a challenging developmental task that can be facilitated by the relationship children form with their teachers. Third, we analyzed joint effects between child temperament and child-teacher interaction quality in predicting internalizing and externalizing problems in children. Limitations include: the lack of multiple measurement time-points for child temperament and child-teacher relationship quality, which did not allow us to test the direction of influences, as well as stability and change within child-teacher relationships as a function of child temperament; the lack of a direct observational measure of child-teacher interactions, given that teachers might report less conflict with children due to social desirability; the use of one respondent (i.e., the mother) for the assessment of internalizing and externalizing problems.

Conclusion

The present study highlights the unique contribution of several fine-grained components of child temperament on the establishment and maintenance of a less conflictual and closer relationship with their teachers. In addition, our study underscores the importance of the quality of child-teacher relationship for shy children. This result is especially relevant for school psychologists or other mental health professional who would like to provide support for teachers in order to facilitate their ability to support children experiencing higher levels of shyness. These children may require extra support to engage in the kindergarten environment which can challenge teachers and as a consequence may hinder the formation of a positive relationships with them.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Babeş-Bolyai University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

GS-E contributed to study design, processing, statistical analysis, interpretation, paper writing, and review. OB and TM contributed to paper writing and review. MA-R contributed to

data collection. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 24 November 2022
DOI 10.3389/fpsyg.2022.1004082

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 26 July 2022
ACCEPTED 31 October 2022
PUBLISHED 24 November 2022

CITATION
Pham C, Desmarais E, Jones V, French BF, Wang Z, Putnam S, Casalin S, Linhares MBM, Lecannelier F, Tuovinen S, Heinonen K, Raikkonen K, Montirosso R, Giusti L, Park S-Y, Han S-Y, Lee EG, Huitron B, de Weerth C, Beijers R, Majdandžić M, Gonzalez-Salinas C, Acar I, Slobodskaya H, Kozlova E, Ahmetoglu E, Benga O and Gartstein MA (2022) Relations between bedtime parenting behaviors and temperament across 14 cultures. *Front. Psychol.* 13:1004082. doi: 10.3389/fpsyg.2022.1004082

Relations between bedtime parenting behaviors and temperament across 14 cultures

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Objectives: The present study examined parental sleep-supporting practices during toddlerhood in relation to temperament across 14 cultures. We hypothesized that passive sleep-supporting techniques (e.g., talking, cuddling), but not active techniques (e.g., walking, doing an activity together), would be associated with less challenging temperament profiles: higher Surgency (SUR) and Effortful Control (EC) and lower Negative Emotionality (NE), with fine-grained dimensions exhibiting relationships consistent with their overarching factors (e.g., parallel passive sleep-supporting approach effects for dimensions of NE).

Methods: Caregivers (N =841) across 14 cultures (M=61 families per site) reported toddler (between 17 and 40months of age; 52% male) temperament and sleep-supporting activities. Utilizing linear multilevel regression models and group-mean centering procedures, we assessed the role of between- and within-cultural variance in sleep-supporting practices in relation to temperament.

Results: Both within-and between-culture differences in passive sleep-supporting techniques were associated with temperament attributes, (e.g., lower NE at the between-culture level; higher within-culture EC). For active

techniques only within-culture effects were significant (e.g., demonstrating a positive association with NE). Adding sleep-supporting behaviors to the regression models accounted for significantly more between-culture temperament variance than child age and gender alone.

Conclusion: Hypotheses were largely supported. Findings suggest parental sleep practices could be potential targets for interventions to mitigate risk posed by challenging temperament profiles (e.g., reducing active techniques that are associated with greater distress proneness and NE).

KEYWORDS

sleep, parenting behaviors, temperament, cross-cultural comparisons, toddlerhood

Introduction

The importance of cultural context in child development has been long recognized, with related topics the subject of theoretical and empirical efforts. The "Developmental Niche" conceptual model, proposed by Super and Harkness (1986) has been particularly influential in framing links between culturally influenced parenting, sleep, and temperament development. This developmental socioecological framework construes the ecological context in which a child develops as three integrated subsystems: (1) the physical and social settings where the child resides/spends time; (2) cultural norms of parenting; and (3) parental psychology and practices (e.g., caregiver values/priorities and parenting behaviors; Super and Harkness, 1986; Harkness and Super, 1994). Through reciprocal effects, these subsystems work in tandem to shape the sociocultural interface between the child's development and their environment, with components examined across a variety of cultures from Malaysia to Kenya to Bangladesh to the United States (for review see Harkness and Super, 1994). According to this conceptual framework, it is critical to examine factors that support healthy development, such as the role caregivers play in shaping sleep during early childhood, discerning their culturally based underpinnings.

The significance of sleep across childhood has been extensively documented, including effects on brain maturation (Scher, 2005; Sadeh, 2007; Touchette et al., 2007; Sadeh et al., 2014; El-Sheikh et al., 2017). Compromised sleep appears to be detrimental for neurobehavioral functioning, emotional reactivity and regulation, as well as risk for future psychopathology (Sadeh et al., 2014). Sleep patterns and temperament have been consistently linked (Sadeh and Anders, 1993; Jian and Teti, 2016). For instance, Negative Affectivity, an aspect of temperament, and its dimensions have been associated with sleep development and problems such as night waking from 6 to 12 months of age (Morales-Munoz et al., 2020). Child temperament, defined in terms of individual differences in self-regulation and reactivity (Rothbart and Derryberry, 1981; Rothbart et al., 1994), is important to study in its own right and because of implications for trajectories marked either by behavioral–emotional health and wellbeing or risk for symptoms/disorders. For example, temperament components of impulsivity and anger were related to externalizing problems, whereas fear linked to internalizing difficulties in 36-month-olds (Karreman et al., 2010). Furthermore, the associations between "difficult" temperament (e.g., negative mood, low adaptability, high intensity) and clinically significant externalizing behavior problems has been demonstrated in 3- to 7-year-old and 8- to 12-year-old children (Maziade et al., 1990; for a review of further connections see Sanson et al., 2004), showing stability throughout development. It is important to expand the existing literature by examining parenting factors (especially sleep-supporting behaviors, which can be altered or adjusted) and their links to temperament development across cultures, as understanding parental contributions provide targets for potential preventative efforts.

Children receive an extensive amount of exposure to their caregiver during bedtime (Sadeh et al., 2010) that gradually decreases with age. Studies examining the interaction between infant sleep and parenting sleep-related practices have shown that infants whose parents were present when they fell asleep were more likely to experience night waking compared to those who slept independently (Adair et al., 1991), and that co-sleeping in response to night waking also increased difficulties (Karraker, 2008). On the other hand, regularity of bedtime routines across the first year of life decreases sleeping issues overall (Sadeh et al., 2010), with lasting protective effects particularly at a higher "dose" of routine (i.e., with increased frequency; Mindell et al., 2015). Patrick et al. (2016) reported that more consistent bedtime routines were associated with better sleep outcomes for children from three to 5 years of age. More frequent night waking was correlated with parental presence and active soothing techniques, such as breastfeeding back to sleep, that varied significantly between cultures (Mindell et al., 2010). Maternal reliance on active soothing techniques has also been correlated with maintenance of sleep issues for children (Morrell, 1999), and parental beliefs regarding supporting child sleep were shown to vary cross-culturally (Mindell et al., 2010). Furthermore, cross-cultural differences in parental bedtime behaviors/practices during infancy and childhood (Giannotti and Cortesi, 2009; Mindell et al., 2010; Sadeh et al., 2010) have been reported and likely contribute to cross-cultural variability in toddler temperament. For example,

Dutch parents have been described as emphasizing sleep promotion and structuring daily activities in a manner that provides maximum support for regular sleep patterns (e.g., Super et al., 1996).

Though various aspects of sleep have been studied widely with regard to temperament in early childhood, including sleep problems (Atkinson et al., 1995; Molfese et al., 2015; Baukiene and Jusiene, 2016), sleep/wake regulation (Scher et al., 1998), sleep duration (Berger et al., 2018), bedtime resistance (Wilson et al., 2015), and sleeping arrangements (Hayes et al., 2002), relations between parental efforts to support sleep and temperament have been studied less often, with mixed results (Halpern et al., 1994; Kelmanson, 1999), and not considering cultural influences/differences. This gap in the field is especially notable given established cross-cultural differences in both temperament (e.g., Gartstein et al., 2003, 2006, 2010; Montirosso et al., 2011; Gaias et al., 2012; Cozzi et al., 2013; Krassner et al., 2017; Desmarais et al., 2019) and parental sleep-supporting practices (e.g., Jenni and O'Connor, 2005; Mindell et al., 2010, 2013; Gartstein and Putnam, 2018). South Korean toddlers, for example, scored significantly higher on the temperament dimension of Effortful Control compared to United States toddlers, yet lower on Surgency (Krassner et al., 2017). When examining differences in sleep practices between these cultural groups, 57% of the predominantly Caucasian group promoted independent sleep for their infants, whereas in the predominantly Asian group this percentage dropped to 4% (Mindell et al., 2010). Furthermore, findings from the Joint Effort Toddler Temperament Consortium (JETTC) indicate that varying sleep-supporting techniques across cultures differentially correlated with child temperament (Gartstein and Putnam, 2018). Specifically, active sleep-supporting behaviors (e.g., walking, car ride, special activity) were associated with higher ratings of Surgency, Effortful Control, and Negative Emotionality whereas passive sleep-supporting techniques (e.g., talking, cuddling) were linked with higher Surgency and Effortful Control, but lower Negative Emotionality. Given these differences, it is crucial to study the interplay between sleep practices and temperament through a cross-cultural lens as this knowledge may inform culturally sensitive interventions aimed to mitigate developmental risk.

To operationalize temperament, the psychobiological construct is defined by three overarching factors across childhood: (1) Surgency (SUR), reflecting positive affect such as smiling and laughter, approach tendencies, activity, and enthusiasm, (2) Negative Emotionality (NE), capturing overall distress proneness, including in situations eliciting fear, anger, sadness, and discomfort, and (3) Effortful Control (EC), involving attention-based regulatory skills and enjoyment of calm activities (Rothbart et al., 2001; Gartstein and Rothbart, 2003; Putnam et al., 2006). Each of these factors independently contributes to predicting behavioral, achievement, and interpersonal outcomes, such as behavior problems, social competence, and academic performance (Lengua, 2006; Rothbart and Bates, 2006; Gartstein et al., 2012, 2016), and fine-grained dimensions (i.e., subscales) that make up the overall dimension should be considered in their own right. For example, fine-grained dimensions have demonstrated developmental trajectories that differed from those of their overarching factors (Gartstein and Hancock, 2019), and uniquely contribute to temperament profile/types (Garstein et al., 2017). Perhaps most importantly, fine-grained dimensions were shown to have distinctive relations with behaviors, such as sleep, critical to children's health and development (e.g., Gartstein et al., 2014; Jian and Teti, 2016; Morales-Munoz et al., 2020). Specifically, Gartstein et al. (2014) found vocal reactivity and sleep problems to be negatively correlated, and Jian and Teti (2016) reported that smiling/laughter and vocal reactivity moderated relations between mother's bedtime emotional availability and infant sleep time variation: infants demonstrating higher levels of these fine-grained attributes experienced more sleep time than others if their mothers were emotionally available at bedtime. Morales-Munoz et al. (2020) found that higher fear, a fine-grained dimension of Negative Affectivity, was independently related to more night waking in 12-month-olds.

Our study examines parental sleep-supporting practices during the transitional period of a sleep routine consolidation for toddlers (Sadeh and Anders, 1993; Iglowstein et al., 2003; Staples et al., 2015) in relation to temperament across 14 cultures using the JETTC dataset. The "Developmental Niche" model indicates that culturally influenced parenting promotes certain developmental tendencies. Thus, the present study advances previous work by utilizing multilevel models (MLM) to elucidate the effects of both between-and within-cultural differences in parental sleep techniques (i.e., active and passive) in relation to toddler temperament. That is, we assessed the effects of both culture-level mean differences in the use of active and passive sleep-supporting techniques as well as the effects of individual variation in sleep practices within cultures. We hypothesized that passive sleep-supporting techniques, but not active techniques, would be associated with higher SUR and EC as well as lower NE. Fine-grained temperament dimensions, not previously examined, were expected to exhibit patterns of relationships consistent with their overarching factors (e.g., parallel passive sleep-supporting approach effects for dimensions of NE). Because previous research has indicated both between-and within-culture effects for other aspects of development (e.g., Deater-Deckard et al., 2018) we anticipate obtaining support for both herein. This study further expands on the work reported by Gartstein and Putnam (2018) by examining cross-cultural differences through a more optimal analytic lens, and considering these relations at the critical fine-grained dimension level.

Materials and methods

Participants

Data for this project was collected from 2015 to 2017. JETTC sites were selected to capture a wide range of geographic regions

with meaningful variability in cultural orientation (e.g., individualism versus collectivism) and culturally driven parenting practices. These were also sites where investigators were using Rothbart temperament instruments, thus translation efforts had already been undertaken and relationships required for data collection established (for further details on the JETTC sites please see Chapter 2 Putnam et al. (2018)). Across the JETTC sites (i.e., Belgium, Brazil, Chile, China, Finland, Italy, Mexico, Netherlands, Romania, Russia, Spain, South Korea, Turkey, United States), mean enrollment was 61 families, ranging from a low of 49 families in Chile to a high of 119 families in the Netherlands (Table 1). Of the 865 families who completed the study, 841 of them responded to the Daily Activities Questionnaire (DAQ; Gartstein and Putnam, 2018), which was the sample size for final models. These were families of children between 17 and 40 months of age ($M = 26.88$ months, SD = 5.65 months), approximately equal in representation of child gender (52% male). For all but two of the JETTC cultures, data were collected at a single site, and for the two cultures (the Netherlands and US) where data were collected from two locations, there were no significant differences ($p > 0.05$) between sites on the variables used in this study. As is common with cross-cultural research (Keller et al., 2006), recruitment strategies varied across sites and depended on the cultural viability of methods. In general, approaches included social media, websites for new parents, flyers distributed at child-care centers and pediatric medical offices, as well as in person efforts by research assistants (e.g., at Saturday Market). Families in this study primarily reflected middle socioeconomic status (Revised Duncan Sociometric Index, RDSI; Stevens and Featherman, 1981) and were considered to be representative of their respective communities. However, it is important to keep in mind that these JETTC families may not necessarily be representative of their respective cultures as a whole. The study was approved by the institutional review boards/ethics committees overseeing the research at each of the sites involved.

Measures

Temperament was measured using the Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006), based on the psychobiological temperament framework (Rothbart et al., 1994). This measure includes 201 items, comprising 18 fine-grained scales, in turn forming three overarching factors. These items are rated on a 7-point rating scale with responses that range from "1-Never" to "7-Always." In general, higher scores reflect a greater quantity of the particular attribute, as observed by the parent. The first factor, labeled Surgency (SUR), consists of five subscales: impulsivity, activity level, high-intensity pleasure, sociability, and positive anticipation. The second factor, Negative Emotionality (NE), consists of eight subscales: discomfort, fear, motor activation, sadness, perceptual sensitivity, shyness, soothability, and frustration. The third and final factor, labeled Effortful Control (EC) consists of five subscales: inhibitory control, attention shifting, low-intensity pleasure, cuddliness, and attention focusing. For each JETTC site, translation of the ECBQ was carried out by the respective principal investigators with an author of the original ECBQ providing feedback on back-translated items. The ECBQ was originally designed for children 18-to 36-months of age, yet mild expansion of age range is typical

TABLE 1 Sample demographics by culture.

Culture	Child gender		Child age (in months)			Family socio-economic status (RDSI)[1]			Marital status (in percent)[2]				Maternal education (in years)			Maternal age (in years)			# of children in the household		
	F	M	Range	*M*	SD	Range	*M*	SD	Ma	Lt	Di	Si	Range	*M*	SD	Range	*M*	SD	Range	*M*	SD
US	49	39	17–36	25.6	5.8	10–97	50.3	26.2	92	7	1	0	9–24	17.2	2.3	23–46	33.1	4.47	1–6	1.7	1
Belgium	21	27	17–41	25.7	5.3	10–97	63.8	21.1	56	38	12	4	10–32	18.0	2.9	27–38	32.26	2.67	1–5	1.9	1
Brazil	23	28	18–38	29.4	5.6	15–96	56.9	24.2	82	12	0	6	11–37	18.3	4.9	22–43	32.90	4.55	1–3	1.4	1
Chile	21	28	17–41	27.3	7.2	10–97	49.7	28.3	62	15	2	21	12–28	18.1	4.9	17–41	28.54	7.11	1–4	1.8	1
China	30	24	19–36	26.4	4.7	15–97	58.7	29.9	87	13	0	0	8–23	15.6	3.6	21–40	30.11	3.99	1–2	1.2	1
Finland	24	31	18–40	27.6	5.7	10–97	61.6	20.8	62	30	2	6	12–26	17.7	2.6	24–41	33.57	3.87	1–4	1.5	1
Italy	24	28	17–36	26.6	4.9	15–97	61.9	20.6	77	23	0	0	11–25	17.2	3.1	30–48	37.15	3.72	1–5	1.7	1
Mexico	25	29	18–36	26.4	5.6	10–97	38.3	29.8	69	24	6	1	9–25	16.8	3.8	17–43	32.35	5.89	1–5	1.6	1
Netherlands	55	64	16–40	26.6	5.8	10–87	56.6	22.3	53	40	2	5	5–25	17.7	3.7	20–41	31.99	4.27	1–3	1.6	1
Romania	30	28	17–38	21.2	6.4	15–97	72.4	19.4	98	2	0	0	12–29	18.1	6.4	23–41	32.91	3.93	1–3	1.4	1
Russia	26	25	17–36	27.0	5.6	15–93	62.8	19.0	77	21	2	0	10–22	14.9	2.1	21–43	29.37	5.20	1–8	1.6	1
Spain	27	35	18–35	26.1	5.1	10–97	58.2	27.3	74	18	1	7	8–21	15.6	4.2	29–43	35.88	3.55	1–4	1.8	1
S. Korea	26	27	17–35	28.0	4.8	15–96	51.6	24.5	100	0	0	0	7–18	15.3	2.2	29–44	34.58	3.45	1–3	1.9	1
Turkey	25	34	16–36	27.7	5.6	10–97	50.5	26.1	92	7	1	0	9–24	14.4	3.9	19–46	31.78	5.46	1–4	1.4	1

[1]RDSI: Revised Duncan Sociometric Index—an occupation based measure of social prestige, based on maternal occupations (Stevens and Featherman, 1981).
[2]Ma, married; Lt, living together; Di, divorced; and Si, single.
Table adapted from Gartstein et al. (2018), with permission from Routledge.

for childhood temperament instruments, given that items remain developmentally appropriate (Putnam et al., 2014). Therefore, a subset of children between 15- and 18-months ($n = 22$) and 37- to 40-months ($n = 13$) were included in the study.

According to the ECBQ development paper (Putnam et al., 2006), this measure demonstrated moderate interrater reliability, longitudinal stability at a moderate to large level from the ages of six to 36 months, and adequate internal consistency. Regarding construct validity, studies have consistently found relations between ECBQ indicators and temperament scores obtained in infancy and childhood (Putnam et al., 2018), as well as behavior problems (Gartstein et al., 2012), including in countries other than the United States (Gonzalez-Salinas et al., 2018). A study examining the Japanese version of the ECBQ further demonstrated that the measure showed internal consistency across its 18 scales and remained consistent across time (i.e., 18–36 months; Sukigara et al., 2015).

Over 20 papers document effective cross-cultural use of the ECBQ in the past 5 years, relating toddler temperament to constructs ranging from personality variables (Putnam and Gartstein, 2017) to parenting techniques (e.g., overprotective parenting; Jones et al., 2021) to developmental disorders (e.g., autism spectrum disorder, Vlaeminck et al., 2020; ADHD/ODD, Sánchez-Pérez et al., 2020). For each culture in this study, internal consistency reliability for all scores was examined, and items were subsequently dropped one-by-one across cultures to maximize the number of scales with $\alpha > 0.60$ (Putnam et al., 2018). As a result, three items were eliminated from activity level, two were deleted from both attention focusing and impulsivity, and one item each was removed from attention shifting, low-intensity pleasure, and shyness. These deletions did not disrupt the content balance of the scale. Though internal consistency reliability for impulsivity remained below 0.60 in eight countries and did not improve with item deletion, the items resulting in the most optimal internal consistency were utilized to compute the Surgency overarching score. Overarching domain scores had good internal consistency reliability across all 14 countries (Desmarais et al., 2021a, b).

The Daily Activities Questionnaire (DAQ; Gartstein and Putnam, 2018), a parent-report questionnaire designed to ascertain how often parents of toddlers currently engaged in caregiving practices and other behaviors intended to maintain the household and support child-rearing was used to measure various aspects of daily routine, including sleep-supporting parenting techniques. The DAQ is composed of 46 items, rated on a 6-point rating scale with responses that range from "0-Never" to "5-Very Often." For the purpose of our study, we examined the section of the DAQ that asked about parental techniques used to assist children in falling asleep. Based on an exploratory factor analysis, these techniques were further categorized into active sleep-supporting techniques (i.e., walking in the stroller, going for a car ride, walking while holding, doing a special play activity) and passive sleep-supporting techniques (i.e., talking softly, reading stories, cuddling, and singing), following a "data-driven" approach (for more details see Putnam et al., 2018). The resulting 4-item scale reflecting active sleep techniques generated alphas > 0.60 in 9 of 14 countries, and the 4-item passive sleep techniques scale alphas were > 0.60 in 6 countries. The DAQ was developed for use by the parent JETTC project (Gartstein and Putnam, 2018), with preliminary analyses supporting cross-cultural applicability of this instrument (Kirchhoff et al., 2014). The measure has also been used in other studies examining child temperament (Huitron et al., 2017), television exposure and behavioral/emotional dysregulation (Desmarais et al., 2021a), and mothers' socialization goals and ethnotheories (Majdandzic et al., 2017), based on the parent JETTC project.

Analytic strategy

We utilized a linear MLM approach to examine between-and within-cultural differences in parental sleep techniques (i.e., active and passive) in relation to toddler temperament. Child age and gender were included as covariates because they have been previously linked to temperament (Gartstein and Rothbart, 2003; Else-Quest et al., 2006; Putnam et al., 2006; Casalin et al., 2012) and to maintain consistency with prior cross-cultural studies (e.g., Montirosso et al., 2011; Cozzi et al., 2013; Slobodskaya et al., 2013). Data for active and passive sleep practices were group-mean centered, meaning that the arithmetic mean rating for sleep practices in each culture was subtracted from the individual ratings of all subjects within a culture for both sleep scales (Enders and Tofighi, 2007). This procedure allows for assessment of both between-and within-group effects. That is, the mean for each culture (i.e., level 2 variables) and individual-level group-mean centered values (i.e., level 1 variables) were included in all models to assess not only the culture-level effect of sleep practices (represented by the cultural mean), but also the effects of differing from normative practices within one's culture (represented by group-mean centered values). Although parents with the same cultural backgrounds vary somewhat with respect to sleep-related practices, there are also strong culture-wide prescriptions regarding sleep for young children, which caregivers typically follow closely. Thus, we sought to understand the unique influence of both normative cultural practices and individual differences within culture.

Models were constructed in three phases, starting with a Null Model that partitioned within-and between-level variance and provided an unconditional intraclass correlation coefficient estimate for comparing subsequent models. Model 1 added age and gender covariates. The Final Model introduced group-mean centered sleep practices (i.e., level 1 variables) as well as group-mean values (i.e., level 2 variables) in order to account for within- and between-culture variance, respectively. This final model can be noted as

$$\begin{aligned}\text{Temperament}_{ij} = {} & \gamma_{00} + \gamma_{01}\left(\text{Age}_{ij}\right) + \gamma_{02}\left(\text{Gender}_{ij}\right) + \\ & \gamma_{03}\left(\text{Active}_{i-j}\right) + +\gamma_{04}\left(\text{Passive}_{i-j}\right) + \\ & \gamma_{10}\left(\text{Active}_{j}\right) + \gamma_{20}\left(\text{Passive}_{j}\right) + \mu_{0j} + r_{ij}. \quad (1)\end{aligned}$$

where Temperament_{ij} represents an individual's rating on a specific temperament variable, $\gamma_{01}(\text{Age}_{ij})$ indicates the coefficient associated with a subject's age in months, γ_{02} (Gender_{ij}) indicates the coefficient associated with a subject's gender. The parameters γ_{03} (Active_{i-j}) and γ_{04} (Passive_{i-j}) indicate the coefficients associated with the difference between the culture-mean and subject's reported use of active or passive techniques (i.e., level 1/individual-level variables), respectively, and γ_{10} (Active_j) and γ_{20} (Passive_j) indicate the coefficients associated with the culture-level mean (i.e., group mean) for active and passive techniques, respectively.

Significant effects for cultural means (i.e., represented by both γ_{10} and γ_{20}) indicate that the average frequency of use of a specific parental sleeping technique (i.e., active or passive) within a culture predicts individual differences in temperament. Significant group-mean centered effects (i.e., represented by γ_{03} and γ_{04}) indicate that the degree to which an individual differs from the cultural average accounts for variance in temperament.

Models were compared *via* various fit indices [i.e., Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Chi-square]. Models were estimated using restricted maximum likelihood (REML) to accommodate the relatively low number of level-2 groups (i.e., cultures, $J = 14$). Models were also estimated using full information maximum likelihood for the purposes of the chi-square difference test based on the deviance statistic. Models were also assessed in terms of variance accounted for by sleep practices. The intraclass correlation (ICC) reflects the proportion of variance occurring at the culture-level in comparison to the total model variance. Similarly, models were also compared based upon reduction of between-and within-culture variance explained by sleep practices in comparison to models with only age and gender covariates utilizing equation 1 as described by Hox et al. (2017):

$$\Delta R^2 = \left(\text{Model 1 Estimate} - \text{Final Model Estimate}\right) / \left(\text{Model 1 Estimate}\right). \quad (2)$$

Importantly, ΔR^2 reflects the relative (i.e., proportional) difference in between- or within-level variance statistic. That is, we can look at change in each level of variance. Thus, the change in R^2 values discussed herein reflect the percentage reduction in between-and within-culture variance when adding sleep practice variables to the previous model, which included only age and gender covariates.

Results

Table 2 provides summary statistics for final models, including changes in ICC, variance accounted for, and coefficients and standard effect sizes for individual- and culture-level sleep technique variables. Importantly, effect sizes are interpreted in the metric of the standard deviation and the term "effect" is used in the statistical sense of the word, not to imply causality. For example, a one standard deviation increase in the group-mean of passive sleep practices was associated with a 0.417 unit decrease in ratings of temperament discomfort. All models demonstrated better fit with regard to change in AIC, BIC, and chi-square deviance statistics ($\chi^2 > 9.49$, $p < 0.05$). Detailed models including covariates are presented in the supplementary results (Supplementary Tables 1–20), however, as the effect of age and gender were not a focus of this study, they will not be further discussed.

The ICC and change in R^2 are the most common metrics for comparing models in terms of variance and practical significance. Reductions in the ICC represent a decrease in the ratio of between- to within-culture variance. The interpretation of R^2 is more nuanced in that it differs in MLM relative to standard multiple regressions. In MLM, R^2 reflects the relative (i.e., proportional) difference in variance statistic between models. Thus, the change in R^2 values presented in Table 2 reflect the percentage reduction in between- and within-culture variance when adding sleep practice variables to the previous model, which included only age and gender covariates.

For example, the Null Model ICC for models assessing NE was ~20.88%, meaning that ~20.88% of the total variance in NE occurred at the cultural level. In other words, if two random individuals were sampled from a given culture, we expect their NE scores to be correlated at 0.21. Adding age and gender covariates reduced the ICC to ~20.46%. The addition of sleep practice variables resulted in an ICC of ~8.92%, meaning only ~8.92% of all the remaining variance in NE occurred at the cultural level after accounting for the effects of sleep practices. In terms of change in R^2, the addition of sleep practice variables explained ~62.07% of the between-culture variance and ~0.88% of the within-culture variance remaining after controlling for the effects of age and gender. In other words, after accounting for age and gender covariates, over half of the remaining variance in culture-level ratings of NE was explained by sleep practice variables. In contrast, very little individual-level variance in NE ratings was explained by sleep practice variables after accounting for age and gender. All other models summarized in Table 2 can be interpreted in the same manner.

Given the multiple statistical significance tests, the Benjamini–Hochberg procedure (Benjamini and Hochberg, 1995) to control the false discovery rate was employed and a conservative $p > 0.001$ was utilized to assess significance. Statistically significant results are presented in the text and Table 2. Greater use of passive sleep practices at the cultural level were significantly associated with higher sociability and soothability, and lower NE, discomfort, fear, and perceptual sensitivity. Effects for culture-level active sleep practices did not reach significance ($p > 0.001$). Regarding the effects of individual variations within cultures (i.e., deviations from the group mean predicting changes in the individual temperament ratings), passive sleep practices were positively associated with EC, perceptual sensitivity, cuddliness, and low-intensity pleasure. At the individual level, active sleep techniques were positively associated with NE, discomfort, and motor activity.

TABLE 2 Summary statistics for final models.

Factor/Scale	Null ICC	Model 1 ICC	Final Model ICC	ΔR^2 Between[1]	ΔR^2 Within[2]	Passive (Individual)		Active (Individual)		Passive (Culture)		Active (Culture)	
	(%)	(%)	(%)	(%)	(%)	γ	δ	γ	δ	γ	δ	γ	δ
Surgency	8.09	7.93	5.73	26.09	0.00	0.035	0.049	0.047	0.063	0.295	0.180	0.058	0.034
Activity level	1.69	1.92	2.48	0.00	0.00	0.008	0.007	0.104	0.087	−0.016	−0.006	−0.080	−0.029
High-intensity pleasure	13.20	13.11	8.28	39.80	0.00	0.024	0.021	0.060	0.050	−0.130	−0.050	0.659	0.242
Positive anticipation	10.44	10.21	9.72	4.48	0.00	0.099	0.091	0.017	0.015	−0.118	−0.047	0.354	0.137
Sociability	11.11	11.41	4.50	63.27	0.00	0.071	0.058	0.059	0.046	0.752***	0.267	0.196	0.067
Negative emotionality	20.88	20.46	8.92	62.07	0.88	−0.011	−0.016	0.107***	0.145	−0.568***	−0.351	0.228	0.136
Discomfort	28.30	27.69	9.77	72.02	1.23	0.039	0.033	0.174***	0.139	−1.149***	−0.417	0.477	0.167
Fear	19.12	18.89	8.31	60.61	0.00	−0.009	−0.008	0.093	0.081	−0.811***	−0.320	0.427	0.162
Frustration	8.06	7.99	8.91	0.00	0.00	0.019	0.017	0.122	0.105	0.088	0.034	0.157	0.059
Sadness	6.98	6.81	4.23	40.43	0.00	−0.043	−0.039	0.140	0.123	−0.454	−0.181	−0.002	−0.001
Shyness	3.99	3.92	3.13	20.59	0.00	−0.006	−0.005	0.012	0.009	−0.347	−0.123	−0.017	−0.006
Motor activity	11.53	12.88	11.34	14.52	0.95	−0.022	−0.024	0.145***	0.151	−0.339	−0.161	0.235	0.107
Perceptual sensitivity	13.45	12.72	6.03	56.20	0.11	0.165***	0.119	0.086	0.059	−0.833***	−0.262	0.348	0.105
Soothability	12.14	11.79	5.80	54.22	0.00	0.057	0.051	−0.088	−0.076	0.683***	0.267	−0.193	−0.073
Effortful control	3.23	3.45	2.51	33.33	1.22	0.123***	0.177	0.001	0.001	0.094	0.059	0.161	0.097
Attention focusing	1.67	1.37	0.46	33.33	0.00	0.065	0.058	−0.014	−0.012	−0.260	−0.100	0.098	0.036
Attention shifting	6.53	6.42	3.95	42.31	0.00	0.050	0.059	0.039	0.044	0.016	0.008	0.341	0.168
Cuddliness	8.03	8.06	7.04	13.27	0.00	0.146***	0.137	−0.023	−0.021	0.289	0.118	0.203	0.080
Inhibition	7.89	8.58	9.95	0.00	0.00	0.124	0.101	−0.027	−0.021	0.006	0.002	0.109	0.037
Low-intensity pleasure	6.74	6.94	4.43	40.00	4.69	0.234***	0.234	0.028	0.027	0.411	0.178	0.106	0.044

[1]Between-culture variance (ΔR^2 Between) reflects reduction in between-level variance attributed to sleep practices while controlling for age and gender covariates.
[2]Within-culture variance (ΔR^2 Within) reflects reduction in within-level variance attributed to sleep practices while controlling for age and gender covariates.
γ, unstandardized coefficient; δ, standardized coefficient; and ICC, interclass correlation. ***$p < 0.001$.
"Model 1" reflects ICC for models with age and gender covariates.
"Model 2" reflects the ICC after including sleep practices.

Rank-ordering the extent to which a culture's sample endorsed using passive techniques (Supplementary Figure 1), we find that the United States, Finland, and Netherlands top the list and South Korea, Turkey, and China are at the bottom of this distribution. In contrast, rank-ordering for active techniques (Supplementary Figure 2), we find that Romania, Spain, and Chile top the list while Turkey, Italy, and Belgium are at the bottom of the distribution.

Discussion

The present study examined parental sleep-supporting practices during toddlerhood in relation to temperament across 14 cultures. Overall, the addition of sleep practice variables to our null models explained from 0.00–72.02% of between-culture temperament variance and 0.00–4.69% of within-culture temperament variance, after controlling for the effects of age and gender. Thus, sleep practices appeared to account for variance more consistently at the between-culture level, and these effects were generally proportionally larger than the ones that emerged at the within-culture level. The size of between-culture effects suggests that parental sleep-supporting practices make substantial contributions to cross-cultural differences in child temperament. Overall, passive sleep-supporting techniques (e.g., cuddling) were associated with temperament outcomes at the culture level (e.g., higher levels of sociability, lower NE) and at the individual level (e.g., higher levels of EC), whereas active sleep-supporting techniques (e.g., doing an activity together) were associated with temperament outcomes at an individual level only (e.g., higher NE), largely supporting hypotheses.

Culture-level associations between passive sleep-supporting techniques and temperament are consistent with previous findings indicating countries where parents reported frequent reliance on passive techniques also had toddlers with higher levels of SUR and lower levels of NE (Gartstein and Putnam, 2018). Results in Supplementary Figure 1 demonstrate that cultures categorized as "individualistic," or more Western in their orientation, rather than "collectivistic" tend to use more passive approaches to soothe their child. These results appear to be in line with those reported by Sadeh et al. (2011) who found that parents from predominantly Caucasian (PC) cultures were less likely than those from predominantly Asian (PA) cultures to describe their children as struggling with sleep issues (linked with more active sleep-supporting techniques, e.g., Morrell and Cortina-Borja, 2002). Prior studies demonstrating a combination of fewer child sleep

issues (Sadeh et al., 2011) and a tendency toward less involved parenting behaviors related to sleep (e.g., waiting for the child to independently fall asleep; Mindell et al., 2010) can be viewed as consistent with the present findings suggesting that parents in countries with frequent endorsement of passive sleep-inducing techniques report lower NE in their children and higher positive affectivity. However, results for usage of active techniques per culture (Supplementary Figure 2) do not show a consistent pattern based on a cultural endorsement of individualism. This pattern of results seems to indicate that not only are active sleep-supporting techniques used less frequently by parents relative to passive ones overall, but that there may be less of a cultural effect on the active set of sleep-supporting behaviors.

The substantial variability in the percentage of each temperament dimension accounted for by sleep practices at a between-culture level could reflect differences in cultural values/priorities. It may also be that other factors (e.g., customary bedtime and sleep beliefs, presence of other relatives, physical sleep arrangements, electronic device usage before bedtime) influenced by culture take precedence over parental sleep-related interventions for some manifestations of temperament but not others—possibilities that should be considered in future cross-cultural investigations. Cultural norms regarding how much parents attend to child sleep patterns have been linked with caregivers' appraisals of other areas of child functioning, including temperament (Jenni and O'Connor, 2005; Giannotti and Cortesi, 2009; Mindell et al., 2010), and may be differentially related to various attributes.

Higher proportions of variance accounted for by parenting practices across fine-grained dimensions and overall NE suggest that this contextual factor (i.e., parental sleep-supporting practices) has stronger connections with distress proneness relative to SUR or EC at the between culture level, that is, in terms of distinguishing among cultures rather than individuals. In contrast to other dimensions of NE and the overarching factor itself, soothability was positively related to passive techniques, which is not surprising given that this scale loads negatively onto the NE factor. Passive sleep induction techniques likely assist infants in developing self-soothing and regulation (Öztürk Dönmez and Bayik Temel, 2019), in turn leading to greater soothability in non-sleep contexts. At the fine-grained level, discomfort, fear, perceptual sensitivity and soothability demonstrated the strongest relations with respect to between culture effects, thus may be more closely linked with cultural differences in sleep relative to other aspects of NE.

Although significant results were not observed for overall SUR, there was a significant between culture effect for passive sleep induction techniques and sociability—countries with greater reliance on passive strategies had toddlers with higher sociability scores. Sociability may be unique among members of the SUR constellation, with greater cross-cultural variability related to sleep and parental approach to supporting sleep in toddlers. This may be due to its role in the development of social competence, which has been associated with sleep consolidation (Mindell et al., 2017), duration, and onset (Tomisaki et al., 2018) in infancy and toddlerhood.

There is a considerable amount of research examining the association between parent sleep-soothing techniques and child sleep difficulties (at the individual, but not cultural level) as well as linking temperament to sleep difficulties, yet limited efforts have addressed the association between parent sleep-soothing techniques and child temperament. A previous study found that fussy-difficult temperament in 14–16-month-old infants was positively correlated with physical comforting—characterized by cuddling or settling in the parent's bed, rocking in the parent's arms, or giving food/drink to assist with settling the child to sleep (Morrell and Steele, 2003). Similarly, parents with temperamentally difficult 12- to 19-month-old children used more physical comforting strategies (e.g., cuddling, rocking, giving them food/drink) than parents with temperamentally easy children (Morrell and Cortina-Borja, 2002). Earlier measures were less differentiated than the assessment tools used in this study, and our results extend prior findings by suggesting that active techniques that involve removing the child from bed to walk, drive or play with them are related specifically to greater distress proneness. This extension further supports the idea that clinicians suggest passive sleep-supporting techniques to parents to interrupt the pattern of active techniques perpetuating temperament-related sleep difficulties.

Negative emotionality, which operationally overlaps with fussy-difficult temperament examined in previous studies, was significantly correlated with active sleep techniques but not passive strategies on an individual level. A previous study investigating the relationship between parents' comforting techniques and child sleep behavior indicated that mothers who used active strategies (e.g., rocking, rubbing the child's back) reported problematic child sleep patterns (the child had to be comforted/resettled) and frequent nighttime waking in preschoolers (Coulombe and Reid, 2014). Sleep disturbances (e.g., delayed sleep onset, nightmares, and restless sleep) were positively correlated with children's (mean age 5.7 years) temperamental emotionality, conceptually similar to the NE factor on the ECBQ (Owens-Stively et al., 1997). Furthermore, Ward et al. (2008) reported temperament differences in preschoolers based on napping behavior. Those who were "problem nappers" (e.g., children who struggled to settle down or exhibited disruptive behavior) had lower effortful control (EC) and higher NE scores. Overall, this pattern of results indicates that active sleep-supporting parenting strategies are associated with greater child NE, consistently linked with sleep difficulties in existing studies. Mindell and Williamson's, 2018 recent review on cross-cultural prevalence of bedtime behaviors has pointed out that some aspects of previously adaptive behaviors may become non-adaptive with development, also varying in effectiveness depending on the child (e.g., "adaptive" singing being too overstimulating for some children). Thus, it may be that active sleep supporting practices interfere with sleep quality particularly for children with higher NE but not others. On a related note, child temperament may exert some influence on parental sleep-supporting behaviors, so

that child NE contributes to active techniques, perhaps eliciting stimulating responses from caregivers starting in infancy. Future research should examine this direction of effects, also considering the role of sleep problems linked to emotional/behavioral problems and to higher NE in this context (e.g., emotional reactivity as a risk factor for sleep problems, Baukienė and Jusienė, 2021; infants of Caesarean deliveries having elevated sleep problems as well as internalizing difficulties, Kelmanson, 2003). Future research should extend the present investigation by also considering sleep difficulties across cultures, utilizing actigraphy along with parent-report to examine difficulty patterns that may be specific to culture and better inform sleep-targeted interventions.

It should be noted that the NE dimension of perceptual sensitivity was positively associated with passive soothing techniques, whereas positive associations for discomfort and motor activation were observed with active strategies. Perceptual sensitivity involves children's ability to flexibly participate in quiet activities and toddlers' awareness of mild, low-intensity stimuli (Putnam et al., 2006), which may explain its links to passive sleep-soothing techniques, which tend to be quiet, gentle, and less stimulating. More active techniques were associated with greater discomfort and motor activation within cultures, in line with between-culture results indicating passive techniques tend to be conducive to lower NE overall.

Overall EC as well as fine-grained dimensions of cuddliness and low-intensity pleasure were positively related to passive techniques at an individual level. As passive techniques consist of talking softly, reading stories, cuddling, and singing, they may directly promote behavioral manifestations of these narrowly defined attributes (i.e., enjoying closeness and activities offering less complexity and stimulation), explaining the overall EC within-culture effect. It should be noted that smaller amounts of within-culture temperament variance (0.00–4.69%) accounted for with the addition of sleep variables to our null models could be indicative of other factors contributing to individual differences. This pattern of results may reflect relative importance of other contextual factors within cultures, for example overall quality of caregiving (e.g., sensitivity/responsiveness; Gartstein et al., 2008; Leclère et al., 2014), which should be examined in future research.

This study has several limitations. First, internal consistency of the active and passive sleep techniques measure was lower than optimal in several cultures. Utility of the DAQ is evident given a number of hypothesized effects that emerged herein; however, this measure will benefit from further study and possible refinement. For example, future research should consider if DAQ sleep-supporting techniques scales account for variance in temperament outcomes similar to more comprehensive and lengthy instruments such as the Parental Interactive Bedtime Behavior Scale (PIBBS; Morrell and Cortina-Borja, 2002). A second limitation of the study results from the DAQ and ECBQ being parent-report questionnaires. In future research, observational measure of temperament and sleep-supporting techniques should be considered to increase the confidence in the pattern of results observe herein. A third limitation has to do with the cross-sectional nature of the study, which does not permit us to make causal interpretations. Longitudinal investigations are needed to discern whether infants with more challenging temperament profiles (i.e., higher NE) elicit more active sleep-supporting techniques from the caregivers and to consider bi-directional effects. These studies should also track sleep problems discerning potential effects with respect to NE, as well as sleep-supporting parenting behaviors. Finally, though 14 cultures were compared in this study, this is a relatively small number and is limiting in terms of power using MLM. Future work examining the relationship between sleep practices and temperament outcomes should aim to collect data from a larger number of cultures to increase statistical power and afford further generalizability.

This study addresses the gap in the developmental sleep literature by exploring cross-cultural differences in the effects of sleep-supporting techniques on toddler temperament across 14 cultures. By examining associations from the overall temperament factor level and the fine-grained dimension level, this study links parental sleep-supporting techniques with specific dimensions that have been connected to developmental outcomes such as adjustment problems (e.g., low fear exacerbating maladjustment to stress for preschool-age children in high-risk contexts; Moran et al., 2017). Our findings indicate that both within-and between-culture differences in passive sleep-supporting techniques are associated with temperament attributes, and within-culture active techniques effects were also noted. Overall results highlight the importance of links between parental sleep practices and early temperament development, indicating that passive techniques are associated with more adaptive temperament profiles (e.g., lower NE, higher levels of sociability, and higher levels of EC). Notably, a greater amount of between-culture level variance was explained relative to the within-culture level. Implications include potentially targeting sleep-related parenting practices to support temperament development, facilitating positive adjustment/behavioral health across cultures. Future research will need to further support current findings and examine potential benefits of such applications, extending the present investigation.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors upon reasonable request.

Ethics statement

The studies involving human participants were reviewed and approved by Washington State University Institutional Review

Boards. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MG and SP contributed to the conception and design of the study. ZW, SP, SC, ML, FL, ST, KH, KR, RM, LG, S-YP, S-YH, EL, BH, CW, RB, MM, CG-S, IA, HS, EK, EA, OB, and MG collected the data and managed sites in each respective location. ED and BF performed the statistical analyses. CP wrote the first draft of the manuscript. CP, ED, and VJ wrote sections of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This project was supported by Washington State University College of Arts and Sciences Berry Family Faculty Excellence Award awarded to MG.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1004082/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 22 December 2022
DOI 10.3389/fpsyg.2022.975110

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 21 June 2022
ACCEPTED 05 December 2022
PUBLISHED 22 December 2022

CITATION
Vaughan HS and Teglasi H (2022) Preschoolers' temperament and social functioning in novel and routine contexts. *Front. Psychol.* 13:975110. doi: 10.3389/fpsyg.2022.975110

Preschoolers' temperament and social functioning in novel and routine contexts

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Introduction: The centrality of social competence to children's short and long-term well-being has sparked interest in the factors that contribute to its development, including temperament, a set of biologically based dispositions. A large body of work documents two types of temperamental dispositions associated with young children's social functioning: reactivity and regulation. There is consensus about the detrimental effects of negative reactive tendencies, called negative affective reactivity (NA), and about the beneficial effects of regulatory tendencies, called effortful control (EC), on social functioning. Another reactive component of temperament, Extraversion/Surgency (E/S) is less consistent in its relation with social functioning. Although NA is exacerbated by lack of familiarity, its contribution to social functioning in novel and routine contexts has not been systematically addressed.

Methods: To test this study's hypotheses, we devised a structured interview of adaptive responsiveness in context (ARC) which was completed by parents of preschoolers along with a comprehensive temperament questionnaire. Additionally, children completed an individually administered task measuring emotion-situation knowledge (N=92) and their teachers completed a standard social competence questionnaire.

Results and Discussion: A path analysis that controlled for variance shared across contexts and temperamental traits showed that NA was the only unique predictor of social functioning in the Novel context, that EC was the only unique predictor of social functioning in the Routine context and that E/S was not a unique predictor of social functioning in either context. Bivariate analyses, conducted without controlling for context overlap, showed all reactive emotional traits (subsumed within NA and E/S) to correlate exclusively with ARC in the Novel contexts. However, regulatory traits showed a mixed pattern. Inhibitory Control correlated with ARC in both contexts but more highly in the Routine context, and Perceptual Sensitivity correlated with ARC in the Novel context.

KEYWORDS

temperament, negative emotion, positive emotion, effortful control, context, children

Introduction

The centrality of young children's social competence to their well-being, both in the short-and long-terms has sparked interest in research to understand factors contributing to effective social functioning, including temperament. Conceptualized as a set of biologically based dispositional traits, temperament is thought to remain

relatively stable over time and situation, though amenable to influence by experience (see Rothbart and Bates, 2006). A large body of work documents relations between temperament and children's social competence (SC) as rated by adult informants in various settings (i.e., home, school, or peer group; Denham et al., 2001; Denham, 2006). However, the measures of SC are context free.

Contexts vary in their requirements for children to adjust to novel or intense stimuli, to size up subtle cues, or to restrain their behavior. An important determinant of social competence is the appropriateness of the child's behavior in the context (Rose-Krasnor, 1997) and, it is not unusual for the same child to be rated as socially competent in one setting but not another (Teglasi et al., 2017). In this vein, discrepancies between adult informants, particularly those observing children in different settings, such as home and school, are commonly found, and increasingly attributed to differences in those contexts (Dirks et al., 2012; Teglasi et al., 2015). However, treating these settings broadly as proxies for context leaves gaps in our understanding of what aspects of situations may be challenging for children with particular temperamental dispositions. Temperamental individuality influences what children notice in their surroundings, how they react, and how they elicit responses from others, thereby influencing their transactions, hence the ratings of informants, in context-specific ways.

Temperament and social functioning

Rothbart proposed two overarching processes of reactivity and regulation that subsume various temperament traits (Rothbart, 1989). Reactivity includes affective, motoric, and sensory responses to internal and external stimuli, and regulation includes attentional and inhibitory responses to modulate reactivity. This framework is supported by the three-factor structure characterizing the Rothbart family of questionnaires (see Rothbart et al., 2001; Teglasi et al., 2015), which includes one regulatory component, Effortful Control (EC) and two reactive components, Negative Affectivity (NA) and Extraversion/Surgency (E/S).

The Negative Affectivity (NA) component of temperament encompasses dispositional tendencies to experience and to remain in unpleasant emotional states (Anger, Fear, Sadness, Discomfort and Falling Reactivity). Inverse associations between NA and children's social competence (SC) are consistently documented (for a review, see Fabes et al., 2008; Eggum-Wilkens et al., 2016), even among preschoolers (see Denham et al., 2001; Kolak et al., 2013).

Effortful Control (EC), the regulatory component of temperament, includes four subscales that, when composited, evidence consistent positive relations with socially effective behaviors (Eggum-Wilkens et al., 2016). In aggregate, EC is thought to play a role in moderating the intensity of NA (e.g., Denham et al., 2001; Gartstein et al., 2012) and in mitigating the adverse impact of NA on social functioning (Eisenberg et al., 2004; Acar et al., 2015; Eggum-Wilkens et al., 2016). Overall, EC is thought to enable the individual to refrain from a 'ready' response and to resist distraction in order to maintain attention on a task (Rothbart and Putnam, 2002). When EC subscales are disaggregated, positive associations with SC are consistently demonstrated with Attentional Focus and Inhibitory Control (Eisenberg et al., 2016). The two other subscales, Perceptual Sensitivity and Low Intensity Pleasure, are relatively understudied in relation to SC.

The Extraversion/Surgency (E/S) component of temperament encompasses tendencies to experience positive emotions (Smiling/laughter) and to engage in behaviors described as exuberant (Activity, Approach, Low Shyness, Impulsivity). Although the relation between Extraversion/Surgency (E/S) and social behavior has been studied, the majority of the research has focused on Negative Affectivity (NA) and Effortful Control (EC). Overall, E/S appears less predictive than NA of children's social outcomes (Sanson et al., 2004; Slagt et al., 2016). When the E/S subscales are disaggregated, there is evidence that, in young children, Smiling is linked with higher social competence and that Shyness is associated with lower social competence (e.g., Teglasi et al., 2015).

Context-specificity

Pre-schoolers often encounter new experiences that ordinarily become routine over time and face unanticipated departures from routines or expectations. Uncertainties inherent in unfamiliar or unexpectedly changing situations increase feelings of fear or discomfort (Morriss et al., 2022), particularly in individuals who are prone to higher NA reactivity, and may also heighten other negative emotions such as sadness or anger (Bar-Anan et al., 2009). Hence, the disruptive effects of NA on functioning are particularly apparent in the face of novelty or departures from expectations (Kagan, 1997). These disruptive effects extend to the influence of NA on how children process information in their surroundings (e.g., Pérez-Edgar et al., 2011). When children are gripped by intense negative emotions, concerns about their emotional states may interfere with the strategic deployment of EC to attune information processing and behavior to the requirements of the context (e.g., Taylor et al., 2014; Bonmassar et al., 2020). Children with higher NA may direct their EC toward processing the immediate cues in the surroundings in an attempt to tamp down affective reactivity, but detracting from the pursuit of social goals. Hence, when facing novel or unexpectedly changing conditions, children with higher NA may show behaviors that appear less flexible and therefore less likely to be rated as socially competent.

As the context becomes more familiar, pre-existing understandings contribute to changes in emotions elicited and put children in a better position to direct their EC toward purposeful actions that are responsive to the context and are observable to

others. In the novel context, higher EC may not compensate directly for the adverse effects of NA on social functioning, but may work indirectly by enabling children to gain social–emotional understandings that reduce uncertainty with increasing familiarity (e.g., Verron and Teglasi, 2018). Children who are less able to maintain their negative emotional reactivity within a tolerable range may need more time to gain or to access the social emotional understandings that underlie effective social behaviors. For these reasons, the independent contribution of EC to social functioning, documented in the literature, may be undermined in the novel context, whereas the independent contribution of NA, documented in the literature, may be mitigated in the routine context.

As a reactive component of temperament, E/S seems particularly salient to functioning in novel contexts. Even so, the extent of its contribution is unclear when the effect of NA or EC is controlled. Research and theory suggests that both high and low levels of E/S detract from behavior deemed socially competent, albeit in different ways. Children who are low in surgency tend to be apprehensive when faced with new experiences, hence to be cautious, inhibited, or avoidant in such situations (Hipson and Séguin, 2015). However, given substantial evidence that NA contributes to socially inhibited/avoidant behaviors in the face of novelty, we expect that controlling for NA would mitigate the unique contribution of E/S to adaptive functioning in novel contexts. On the other hand, children who are high in surgency tend to be exuberant (highly active in exploring their surroundings) in their responses to novelty, but may sometimes behave in ways that disregard rules and standards for appropriate behaviors (Sallquist et al., 2009; Dollar and Stifter, 2012). For these reasons, we do not expect the E/S composite to uniquely predict ARC in the Novel context. However, we anticipate that at least two of its subscales, Shyness and Smiling, will correlate with ARC in the Novel context.

Current study

Parents and educators are well-positioned to observe young children's social functioning in a wide range of situations, but questionnaires to assess social competence do not incorporate context. Although associations of NA and EC with social functioning are extensively documented, little is known about the independent contribution of each to functioning in novel and routine contexts. To pursue the aim of this study, we devised a structured parent-interview to measure children's adaptive responsiveness in novel and routine social contexts (Adaptive Responsiveness in Context; ARC).

The context sets the requirements for effective responding to which temperamental reactivity and regulation may be differentially salient. At about age four, stable individual differences begin to emerge in both regulation and reactivity (Kochanska et al., 2000). For preschoolers, the transformation of an unfamiliar encounter to a familiar one is commonplace. With increasing experience, some aspects of new situations may become predictable, whereas some aspects of familiar situations remain uncertain. Features of unfamiliar contexts that increase predictability (i.e., structure, rules, clear expectations) may reduce uncertainty whereas certain features of familiar contexts (i.e., ambiguities of peer interactions) may heighten uncertainty. For these reasons, preschoolers' functioning in novel and routine contexts are likely distinct, but also related.

Hypotheses and data analyses

Validation of the adaptive responsiveness in context

To develop the ARC as a measure of adaptive responsiveness in context, we conducted pilot interviews with parents of preschoolers and generated 18 items to measure aspects of functioning that are salient in contexts that are familiar/routine (e.g., understanding implicit rules, following clear instructions) and in contexts that include elements of novelty or ambiguity (e.g., unexpected change, peer interactions). We investigated the properties of this measure to ascertain its validity as a tool for this study, Principal components analyses (including examination of the scree plot and parallel analyses; Bryant and Yarnold, 1995) supported a two-factor solution distinguishing between adaptive responses in Novel and Routine social contexts. Subsequently, we examined the feasibility of using Novel and Routine contexts as subscales of the ARC. We hypothesized that the scales would be internally consistent and that they would correlate differentially with relevant variables. Since preschool teachers emphasize routines, we expected that Social Competence, which captures conventional prosocial behaviors, would correlate with ARC in the Routine but not in the Novel context and that Internalizing behaviors, which are rooted in negative affectivity, would correlate with ARC in the Novel, but not Routine context. In view of the importance of social cognitions as shaping children's observable behaviors, we expected that scores on the ARC would correlate with children's emotion-situation knowledge, measured with the Emotion Comprehension Test (ECT; see Verron and Teglasi, 2018). However, since the ECT samples conventional situations, we expected correlations to reach significance in the Routine, but not in the Novel, context.

Relations of temperament with social functioning

Studies relating temperament with social functioning often aggregate scales subsumed within the three broader temperament factors. We relied on these factors as well to test our central hypothesis. However, we also examined the bivariate relations between each of the 15 subscales of the Child Behavior Questionnaire (CBQ; Rothbart et al., 2001; Putnam and Rothbart, 2006) with ARC in the Novel and Routine contexts. Assuming that the requirements of novel and routine contexts are distinct but somewhat overlapping, we tested an exploratory path model that includes AR in Novel and in Routine contexts as the outcome variables and temperament traits

as predictor variables. The inclusion of both contexts in the model was intended to control for any existing overlaps between them to highlight the unique, context-specific relations of reactive and regulatory temperamental dispositions with ARC.

We hypothesized that effortful control (EC) is a unique predictor of adaptive social responding (AR) in routine contexts and that negative affectivity (NA) is a unique predictor of AR in novel contexts. Although we expected reactive tendencies, including those subsumed within the E/S composite to be more salient to adaptive responding in Novel than in Routine contexts, we did not expect that the E/S composite would make a unique contribution beyond NA and EC. By virtue of controlling for other variables, the partial correlations in the path model are distinct from the bivariate relations of each temperament subscale with ARC. Missing data were addressed by using full information maximum likelihood (FIML) which is the default setting in MPLUS. Using FIML assumes that data are missing at random and creates a covariance matrix taking into account the information in both complete and incomplete cases.

Materials and methods

Participants

Participants included children between 3 and 6 years of age ($N = 92$), enrolled in a private preschool on the campus of a large, public university in the Mid-Atlantic region of the United States as well as their parents and teachers. This pre-school is supportive of research conducted on campus and has established procedures for the conduct of studies. The sample comprised 54% European Americans, 13% African Americans, 13% Asian Americans, and 17% "other." The mean age of participating children was 55.97 months (SD = 9.97), and girls made up 50 percent of the sample. Based on parental reports about their current employment, no one indicated having a position that would require only a high school level education, 24.6 percent reported having positions that require at least a 4 year college degree, and 29.6 percent reported positions that require a professional or graduate level degree. About half the participants, 45.8 percent, chose not to report this information.

Procedures

In accord with procedures established by the IRB, parents gave informed consent and children gave their assent when picked up from class. No child declined to participate. At the time of data analysis, participants are identifiable only by number. To recruit participants, researchers made a presentation during back to school night. Subsequently, informed consent forms were sent home with students in six classrooms. Parents who consented to the study were provided with packets that included questionnaires with instructions for how to return completed forms to researchers. Packets were distributed to teachers of children in six classrooms whose parents gave consent. Trained graduate students conducted interviews, either in person or on the phone, with parents, primarily mothers and also administered the ECT individually to each participating child.

Measures

Children's behavior questionnaire

The CBQ was designed as a highly differentiated and comprehensive measure of temperament based on the conceptualization of temperament as individual differences in reactivity and regulation (Rothbart et al., 2001). The Short Form of the CBQ (Putnam and Rothbart, 2006) includes 94 items rated on seven-point Likert rating scales with response options ranging from 1 (extremely untrue of your child) to 7 (extremely true of your child). Parents are also provided with a Not Applicable response option. Each of the 15 subscales demonstrated adequate internal consistency in the current study, including Activity Level ($\alpha = 0.69$), Anger/Frustration ($\alpha = 0.80$), Approach/Positive Anticipation ($\alpha = 0.68$), Attentional Control ($\alpha = 0.78$), Discomfort ($\alpha = 0.86$), Falling Reactivity/Soothability ($\alpha = 0.79$), Fear ($\alpha = 0.74$), High Intensity Pleasure ($\alpha = 0.74$), Impulsivity ($\alpha = 0.73$), Inhibitory Control ($\alpha = 0.65$), Low Intensity Pleasure ($\alpha = 0.70$), Perceptual Sensitivity ($\alpha = 0.76$), Sadness ($\alpha = 0.65$), Smiling and Laughter ($\alpha = 0.61$), and Shyness ($\alpha = 0.86$). There is considerable consensus that these subscales fall into three higher order factors, the regulatory factor of Effortful Control, and the reactive factors Negative Affectivity and Extraversion/Surgency (Rothbart et al., 2001). Composite scores were created by averaging applicable item scores.

Emotion comprehension test

The ECT (see Verron and Teglasi, 2018) was designed as an adaptation of the Affect Knowledge Test and the Assessment of Children's Emotion Skills (ACES) for preschoolers. The ECT consists of three parts but only one is used in the current study, the Emotion-Situation Knowledge task (ESK), comprising 15 vignettes that are read and acted out by the researcher using two puppets. Participants are asked what the person in the story might be feeling. One example of a vignette is the following: "Green let Red play with Green's favorite toy. Red plays with the toy and then it breaks. Do you think Green feels happy, sad, mad, scared, or no feeling?" To score the measure, two points are awarded for the correct answer and correct valence of emotion, one point is awarded for the incorrect answer but correct valence of emotion, and 0 points for answers with an incorrect emotion and incorrect valence. For 3 of the 15 scenarios, including the one described above, both sad and mad were given full credit. The "correctness" of the responses was determined in two ways: (a) consensus among the panel of 5 psychology doctoral students and a faculty member; and (b) a pilot test with preschoolers who were also asked to tell why the puppet would feel that way. With respect to three vignettes, the authors determined that both sad and mad

would be appropriate given the discussion with the panel and children's interpretation (e.g., sad when toy broke by accident or mad when on purpose). This rationale was supported by the finding of a bimodal distribution for these scenarios with sad and mad chosen most often and with relatively equal frequency.

The total score was calculated by adding the points awarded to individual items ($M = 35.12$, SD = 5.99). No significant differences were found between girls' and boys' scores. Internal consistency was adequate ($\alpha = 0.80$). On average, administration time for the ECT was roughly 30 min.

Social competence and behavior evaluation

The SCBE (Preschool Edition; LaFreniere and Dumas, 1996; Anthony et al., 2005) is a teacher report questionnaire that describes a child's functioning within a preschool classroom. Its 80 items measure overall emotional expression, social interactions with peers, and interactions with teachers on a 6-point scale from 1 (almost never occurs) to 6 (almost always occurs). Content of items ranges from asking about negotiating solutions to conflicts with other children to asking about bullying behaviors.

Teachers completed the entire SCBE questionnaire, but to test our hypotheses we utilized two of the three scales, the Internalizing scale (which measures depressive, anxious, or isolative behaviors) and the Social Competence scale (which measures prosocial behaviors). Studies investigating the psychometric properties of the SCBE have found the internal consistencies of these subscales to be high, with the internal consistency of all 80 items at $\alpha = 0.95$ and the Externalizing scale ($\alpha = 0.94$), Internalizing scale ($\alpha = 0.86$) and the Social Competence scale ($\alpha = 0.94$) each having high internal consistencies as well (Anthony et al., 2005).

Adaptive responsiveness to context scale

Parents are well-positioned to observe children's social functioning in a wide range of encounters, but parent-report questionnaires to assess preschoolers' social competence do not incorporate context. To pursue this study's aims, we devised the Adaptive Responsiveness to Context (ARC) Scale to measure aspects of functioning that are salient in contexts that are familiar/routine (e.g., understanding implicit rules, following clear instructions) and unfamiliar, including elements that are novel, unexpected, or changing (e.g., emotional expression when faced with change, peer interactions). Based on pilot interviews with parents of preschoolers, we generated 18 items that seemed to differ in their implications for functioning in routine and novel contexts. This conceptualization was supported by the emergence of two internally consistent factors demonstrating theoretically meaningful relations with external correlates (see Results section). An example of a question that loaded on the Novel factor is "How does the child react to the postponement of a planned positive trip?" with response options on a Likert scale from "1. Distress, disappointment, and insistence on sticking with the plan" to "5. Takes it in stride, accepts it easily."

Adaptive responses, including those captured by items on the ARC, are inherently self-regulated. Hence, it is reasonable to examine conceptual and item overlaps between the ARC and EC, the regulatory component of temperament. Three of the four EC scales involve basic regulatory processes that support, but do not directly capture, socially adaptive responses (*attentional focus*, *perceptual sensitivity*, and *enjoyment of low intensity* stimuli). One of the scales (*inhibitory control*), which emphasizes the capacity to suppress inappropriate behavior, does get at regulation in ways that directly relate to adaptive social responses, but does so more narrowly than does the ARC. This difference in conceptual scope is mirrored at the item level, with EC items describing specific behaviors (e.g., *can wait before entering a new activity when asked to do so; can easily stop an activity when told no*) and ARC items describing broad tendencies (e.g., *follows implicit rules*).

Results

The adaptive responsiveness to context scale

The ARC was developed in the current study as a way to measure adaptive responding (AR) to familiar and unfamiliar contexts. As part of its development, we conducted a factor analysis, including parallel analysis (see Table 1). We also examined its relations with teacher reported social competence and internalizing behavior (SCBE), and with child performance on the emotion-situation-knowledge (ECT).

Factor analysis

PCAs of the ARC showed two internally consistent factors, the Novel ($\alpha = 0.69$) and the Routine ($\alpha = 0.83$), which included 7 and 11 respective items (see Table 1). When internal consistency for the Novel subscale was adjusted to account for a low number of items with the Spearman-Brown Prophecy Formula for an 8-item scale, it was found to be acceptable at $\alpha = 0.71$. AR across the two categories of contexts were moderately correlated, hence distinct but related ($r = 0.369$, $p < 0.001$).

As anticipated, there was a significant difference ($t = 4.65$, $p < 0.001$, df = 178) between mean ratings for the Routine (3.61; SD = 0.56) and for the Novel subscales (3.31; SD = 0.55) with Routine being higher. The mean parent rating on the Novel subscale was 3.24 (SD = 0.5439) for boys and 3.37 (SD =0.557) for girls. For the Routine subscale, the mean score for boys was 3.56 (SD = 0.599) and for girls the mean score was 3.65 (SD =0.509). Parent ratings were not significantly different between boys and girls for either subscale.

Scores from the Routine Adaptive Responsiveness subscale correlated significantly with age in months ($r = -0.22$, $p < 0.05$). Hence, subsequent analyses with this variable controlled for age.

External correlates

Bivariate correlational analyses showed context-specific patterns in keeping with expectations (see Table 2). In conducting these correlational analyses with teacher rated SCBE scales, we did

TABLE 1 Factor loadings for exploratory factor analysis with varimax rotation for ARC scale.

ARC item	Routine	Novel
Item 98: Organized/planned vs. haphazard/unplanned behavior	**0.758**	
Item 110: Understands rules vs. requires external limits	**0.735**	
Item 97: Anticipates others' reactions vs. surprised by reactions of others	**0.721**	
Item 109: Follows rules and standards vs. immediate wish	**0.708**	
Item 101: Following implicit rules without being told	**0.645**	
Item 100: Following clear instructions	**0.643**	
Item 107: Handles routine demands at home	**0.521**	0.368
Item 111: Acting without prior thought vs. careful forethought	**0.477**	−0.393
Item 99: Size up demands of new task or change in routine	**0.456**	
Item 112: Likelihood of planning ahead	**0.437**	
Item 106: Handles routine demands at school	**0.424**	0.365
Item 104: Responds to changes in situation		**0.745**
Item 103: Reacts to departure from expectations		**0.727**
Item 102: Responds to postponement of positive events		**0.602**
Item 47: Appropriateness of negative emotions		**0.501**
Item 46: Appropriateness of positive emotions		**0.479**
Item 105: Reacts to unexpectedly difficult activity		**0.365**
Item 108: Handles routine demands of peers		**0.359**
Eigenvalue	4.824	2.330
Cumulative percent of variance	26.800	39.743
Internal consistency	0.831	0.688 (*0.716*)
Number of items in subscale	11	7

Extraction method = principal components analysis; rotation method = Varimax with Kaiser Normalization (rotation converged in three iterations). Highest factor loadings are indicated in bold. Internal consistency estimates in italics were adjusted to a scale length of eight items using the Spearman-Brown Prophecy Formula; ARC = Adaptive Responsiveness in Context Scale.

not control for rater effects, which, after controlling for age in months, were small (ranging from 0 to 0.04) and non-significant.

As anticipated, children's ARC scores in Routine contexts correlated with ESK scores as measured by the ECT ($r = 0.43$, $p < 0.01$), which presents commonly occurring scenarios. A Fisher's z test showed that the correlation between the ESK and the Routine subscale was significantly different from the correlation between ESK and the Novel subscale scores ($r = 0.16$, $z = 2.21$, $p < 0.05$).

Social competence scores correlated with ARC in the Routine context ($r = 0.27$, $p < 0.05$) but not with ARC in the Novel context. A Fisher's z test indicated that this difference was significant ($z = 1.57$, $p < 0.05$). This pattern was as expected, given that pre-school teachers emphasize classroom routines. Also in line with expectations, scores on the Internalizing Problems subscale of the SCBE, which captures affective dysregulation, correlated with ARC in the Novel ($r = 0.26$, $p < 0.05$) but not in the Routine context. However, the difference between these correlations was not statistically significant.

Taken together, these correlational patterns support the use of the ARC to test the context-specific hypotheses about the contribution of temperament to AR.

Bivariate relations of temperament with adaptive responding in novel and routine context

Bivariate correlations of the 15 CBQ subscales with parent rated ARC in Routine and Novel contexts are seen in Table 3. All of the NA subscales correlated with ARC in the Novel context but none correlated with ARC in the routine contexts. Fear and Sadness were negatively associated with ARC, whereas Anger and Falling Reactivity were positively associated. Two of the E/S subscales that aligned with emotion, hence with reactivity, Shyness and Smiling, correlated with AR in Novel but not Routine contexts, the former negatively and the latter positively. With respect to the EC subscales, context specific the patterns were not consistent. Two subscales, Attentional Focusing and Low Intensity Pleasure did not correlate with AR in either context. Inhibitory Control correlated with AR in both Routine and Novel contexts, but the relation was higher in the routine context ($z = 1.68$, $p < 0.05$). Finally, Perceptual Sensitivity was associated with AR in the Novel but not in the Routine context, and relations differed significantly ($z = 2.45$, $p < 0.01$).

TABLE 2 Correlations between adaptive responsiveness in context subscales, ECT subscales, and SCBE subscales.

Measures	Routine	Novel
Situations (ECT)	0.434**	0.162
Social competence scaled score (SCBE)	0.273*	0.045
Externalizing problems (SCBE)	0.157	0.113
Internalizing problems (SCBE)	0.188	0.260*

**$p < 0.01$ and *$p < 0.05$.

Path analysis

To test the primary hypothesis, we conducted an exploratory path analysis, controlling for overlaps between the two contexts. Incorporating both Novel and Routine ARC in the model accounted for overlaps in responses between the two contexts, hence highlight context-specific and unique contributions of each predictor. The model included temperament composites as the predictor variables and adaptive responsiveness (AR) in Novel and Routine contexts as the outcome variables utilizing the software program MPLUS (Muthén and Muthén, 2017).

Variable selection

To reduce the number of variables in the path analyses, we were guided by the three-factor conceptualization of the subscales that has emerged from higher order factor analyses (Rothbart et al., 2001; Teglasi et al., 2015). Three of four predictors were composites of CBQ subscales that aligned with positive emotional reactivity (E/S), negative emotional reactivity (NA) and regulation (EC). The fourth predictor, Falling Reactivity, is a subscale that loads inversely on NA, but is distinct from the others in that it does not have a positive or negative valence. However, as an aspect of NA, we hypothesized that it would be particularly relevant to ARC in the Novel context.

Negative Affect (NA) Composite ($\alpha = 0.86$) represents an individual's susceptibility to experiencing negative emotions (Rothbart et al., 2001). This composite was calculated as the mean of items on four subscales that load on this factor: Fear, Sadness, Discomfort and Anger. In order to explore its potentially unique effects, we entered the Falling Reactivity subscale ($\alpha = 0.79$) separately.

Extraversion/Surgency Composite ($\alpha = 0.68$), sometimes described as measuring levels of exuberance or excitability (Rothbart et al., 2001), is captured in the following subscales: High Intensity Pleasure, Impulsivity, and Activity Level. E/S also incorporates aspects of positive emotional reactivity captured in two subscales: Approach and Smiling. The E/S score was calculated as the mean of items on these two subscales.

Effortful Control Composite ($\alpha = 0.78$), comprising the self-regulatory component of temperament (Rothbart, 2007), was calculated as the mean of all the items on subscales that load on this factor: Attentional Focus, Inhibitory Control, Perceptual Sensitivity, and Low Intensity Pleasure.

TABLE 3 Correlations between ARC subscales, CBQ subscales, and composites.

CBQ factor	CBQ subscale	AR routine	AR novel
Effortful control		**0.394****	**0.386****
	Attentional focus	−0.014	0.195
	Inhibitory	**0.567****	**0.372****
	Control*		
	Perceptual	0.028	**0.376****
	Sensitivity		
	Low-Intensity	−0.171	0.157
	Pleasure		
Negative Affectivity		0.139	**0.497****
	Anger	−0.054	**0.592****
	Fear	0.142	**−0.335***
	Discomfort	0.072	−0.113
	Sadness	0.084	**−0.359****
	Falling reactivity	−0.058	**0.551****
Surgency/Extraversion		0.095	. 0.120
	Activity Level	−0.032	0.181
	Shyness	0.023	**−0.325****
	High Intensity Pleasure	−0.044	−0.071
	Smiling	0.106	**0.264***
	Impulsivity	0.039	−0.015
	Approach	−0.032	−0.072
	ARC Routine	-	0.369***
ARC Subscales			
	ARC novel	0.369***	-

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.
Note: A Fischer's Z Test demonstrated that the ARC correlates to Inhibitory Control were significantly different ($z = 1.68$, $p < 0.05$); ARC, Adaptive Responsiveness to Context Scale; CBQ, Child Behavior Questionnaire.

Results of the path analysis (see Figure 1) revealed that the Effortful Control Composite ($b = 0.38$, β=0.37, $p < 0.001$), was a unique (positive) predictor of Routine Adaptive Responsiveness and that the Negative Affectivity Composite ($b = -0.27$, $\beta = -0.45$, $p < 0.05$) was a unique (negative) predictor of Novel Adaptive Responsiveness. As suggested by Kenny et al. (2015) fit indices are not reported for this model due to the small number of degrees of freedom (df = 0). In cases where degrees of freedom are small, fit indices can be misleading unless the sample size is large. The relations in the model explain 17 percent of the variance in Routine Adaptive Responsiveness ($R^2 = 0.17$, $p < 0.05$) and 41 percent of the variance in Novel Adaptive Responsiveness ($R^2 = 0.41$, $p < 0.001$). Overall, temperament as measured by parent reported CBQ is more predictive of functioning in novel than routine contexts.

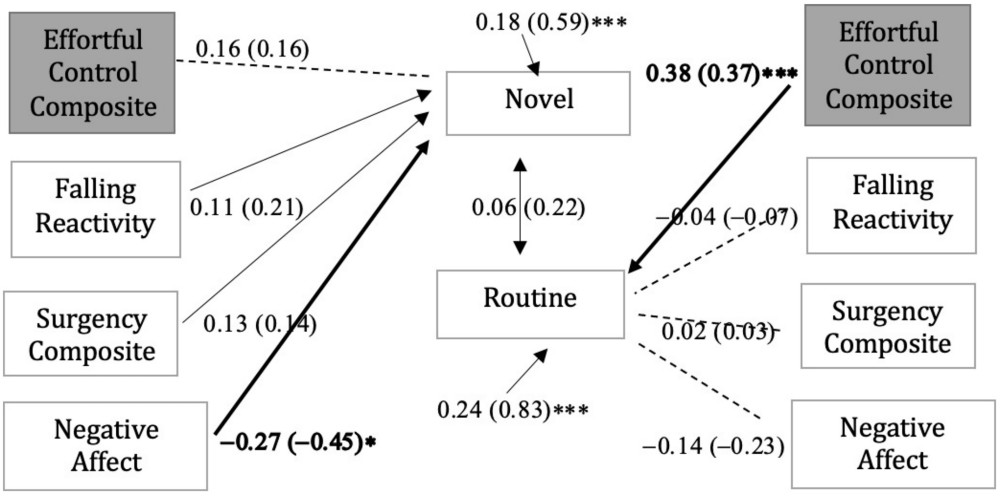

FIGURE 1
Structural model with traits measured by the Child Behavior Questionnaire. Each coefficient is followed by the standardized coefficient () in parentheses. The error variance indicates the amount of unexplained variance in Novel and Routine Adaptive Responsiveness. Solid lines indicate which relationships were hypothesized to be statistically significant, and bold arrows indicate the relationship was found to be statistically significant. No hypotheses were offered for relations indicated by the dotted lines. *p<0.05, **p<0.01, ***p<0.001.

Discussion

A substantial body of work has shown that young children's temperamental individuality is related to their social competence, but has not given systematic consideration to context. Yet, distinct patterns observed in children's responses to novelty are explained by temperament theorists and researchers as a function of early appearing, reactive tendencies. In this study we re-examine previously established relations between temperament and social functioning in both Novel and Routine contexts. To pursue the aims of the study, we devised and validated a structured parent interview as a tool to measure young children's adaptive responses in contexts (ARC) that are Novel and Routine. After establishing the validity of the ARC for the purposes of this study, we tested context-specific hypotheses about relations between preschoolers' temperament and social functioning.

Feelings of uncertainty, evoked in contexts that are unfamiliar, ambiguous, or depart from expectations, are associated with negative emotional states, particularly fear/anxiety but also with other negative emotions, including being upset, angry, frustrated, sad or confused (see Morriss et al., 2022). Consistent with the emotion eliciting nature of Novel contexts, the temperament variables entered in the path model explained more variance in ARC in the Novel (41%) than the Routine context (17%). Moreover, parent rated ARC was higher in the Routine than in the Novel context, suggesting that a certain degree of wariness in new situations may be typical in a community sample of preschoolers. Although participants in this study do not represent extremes in temperamental reactivity, those with higher NA appear to be more vulnerable to uncertainties inherent in Novel contexts. As would be expected, there was some overlap in ARC across Novel and Routine contexts, evident in the moderate correlation (0.37) between them. Hence, we tested our primary hypothesis with an exploratory path model that controlled for variance shared across contexts and across temperamental dispositions.

Convincing evidence points to the adverse effect of negative affective reactivity (NA) and to the beneficial effect of effortful control (EC) on children's social functioning using context-free methods (e.g., Eggum-Wilkens et al., 2016). However, relatively few studies have examined linkages between Extraversion/Surgency and social competence. Using path analysis, we revisited relations between temperament and adaptive social responses in Novel and Routine contexts. As anticipated, higher NA uniquely predicted lower ARC in the Novel context but did not contribute uniquely to ARC in the Routine context and, higher EC uniquely predicted higher ARC, in the Routine context but did not contribute uniquely to ARC in the Novel context. The finding that E/S did not emerge as a unique predictor of ARC was consistent with expectations based on the argument that various aspects and levels of E/S relate to social responses in different ways. Bivariate analyses provide insight into context-specific relations between ARC and individual scale subsumed within the composites.

Bivariate analyses

Reactivity

Children's initial responses to novel experiences range from *inhibited* (negative emotions; withdrawal) and linked to higher NA to *exuberant* (positive excitement, increased motoric activity, approach) and linked to higher E/S. These contrasting tendencies

have been linked to physiological reactivity as well as to subsequent mental health outcomes (e.g., Dollar et al., 2017). In this study, whether the direction was positive or negative, all significant bivariate correlations between reactive traits (whether loading on NA or on E/S) and ARC were exclusive to the Novel context. With the exception of Anger, higher scores on negative emotions, were associated with lower ARC in the Novel context. This pattern is consistent with the finding of the path model wherein NA, in aggregate, contributed uniquely to ARC in the Novel but not Routine context. Although the E/S composite did not contribute uniquely to ARC in the Novel context, two of its subscales (Smiling and Shyness) did correlate with ARC in the Novel, but not in the Routine, context.

Higher scores on Anger, Falling reactivity and Smiling, all reactive aspects of temperament, were associated with higher ARC in the Novel context. The unexpected association of Anger with higher ARC in the Novel context may be explained in terms of a potential link with positive emotionality. Positive emotions in the face of novelty motivate children's engagement (Stifter et al., 2008), which expands opportunities to gain social competence (Dollar et al., 2017). Again, in this study, the association of Smiling/Positive Emotions and of Anger with higher AR held only in the Novel context. Children with greater interest in novel experiences may be more likely to express anger/frustration when their approaches are limited by adults. Anger, as measured with the CBQ, taps into a child's tendency to resist limits and to express frustration with thwarted goals. The functional perspective on emotions posits that each emotion motivates a particular goal and is associated with a certain way of thinking and acting (see Lench et al., 2015). Perhaps some degree of protest to adult limits (Anger/Frustration) by preschoolers is adaptive. As such, there may be important conceptual distinctions between certain emotions subsumed within NA, such as anger, sadness, and fear that are not well captured by the aggregate.

Effortful control

Children's EC, thought to play a central role in self-regulation, is highlighted as key to children's social–emotional development (e.g., Eisenberg et al., 2010; Rueda, 2012). With controls for context and trait overlaps, the composite EC score made a unique positive contribution to AR, but only in the Routine context. However, bivariate correlations between AR and the individual scales that make up this composite were not specific to the Routine context. Two of the four scales comprising EC, Inhibitory Control and Attentional Focus, have been far more extensively studied in relation to social functioning (e.g., Eisenberg et al., 2016) than the others, Perceptual Sensitivity and Low Intensity Pleasure. Perhaps the most understudied is Perceptual Sensitivity, which refers to the tendency to be receptive to low key stimuli and to notice subtle cues in the surroundings (Evans and Rothbart, 2007).

Inhibitory Control refers to children's capacity to deliberately suppress a 'ready' response in favor of a more appropriate alternative, which requires the child to understand the difference. Other processes subsumed within the EC rubric, Attentional Focus, Low Intensity Pleasure, and Perceptual Sensitivity, refer to children's capacity to process information that enables them to discern the need to suppress a 'ready' response. In this study, Attentional Focus and Low Intensity Pleasure did not correlate significantly with AR in either context. Inhibitory Control and Perceptual Sensitivity showed the expected positive correlations with AR but in different contexts. Inhibitory Control correlated with AR in both contexts, but more strongly in the Routine context, consistent with the path analysis. Among preschoolers, it is not the particular behavior, such as the expression of anger, that is troubling, but its inappropriateness to the context (Locke et al., 2015). The understandings that underlie effective exercise of Inhibitory Control are available in familiar contexts and, perhaps to a lesser degree, in novel contexts that include familiar elements.

Perceptual Sensitivity correlated with AR in the Novel but not the Routine context. Perceptual Sensitivity bears similarities to concepts described by others as having potential to play a role in social functioning: *novelty awareness*, (see Evans et al., 2012) and *sensitivity to subtleties* (see Aron and Aron, 1997). Children who are more aware of nuances would seem better positioned to detect social cues in novel contexts.

Overall, context played a key role in the link between temperament and social functioning. Eight of the 15 CBQ scales correlated with AR, but only one, Inhibitory Control, correlated in both contexts, but more strongly in Routine. Findings with respect to reactivity showed that, regardless of controls for context and trait overlaps, reactive traits are associated with AR in Novel but not Routine contexts. With respect to EC, when overlaps are controlled, the EC composite contributed uniquely to AR in the Routine but not Novel context. However, when disaggregated and tested without controls for overlaps, Perceptual Sensitivity correlated with AR in the Novel but not in the Routine context, whereas Inhibitory Control correlated with AR in both, but more strongly in the Routine context.

Limitations

This study has several shortcomings that may be addressed by future research. Specifically, the measure of AR in Novel and Routine contexts, though adequate to test the hypotheses, has not been extensively researched. In addition, although this study's participants were ethnically/racially diverse, they were recruited from a single school.

Support for the hypothesized associations of the ARC with selective, theoretically relevant variables was taken as evidence for its valid use in this study. The Routine but not the Novel subscale correlated (positively) with conventional social skills and with conventional situation-emotion knowledge, whereas the Novel but not the Routine subscale correlated (inversely) with internalizing problems. Future efforts to devise context-specific questionnaires of children's social functioning must grapple with complexities, including basic questions about how to conceptualize context. Our

focus in this study was on context familiarity, given its relevance to temperamental reactivity. The essence of novelty is in not knowing what to expect, which elicits feelings of uncertainty that are magnified by NA. Temperamental reactivity is thought to be influential in the peer context because peer interactions involve constantly changing social cues and challenges that evoke emotions (Coplan and Bullock, 2012). Hence, even with familiar peers, interactions include some unknowns. Accordingly, the item on the ARC referring to "routine peer interactions" loaded on the Novel factor.

Implications for intervention

Children vary not only in their initial reactions to the uncertainties inherent to novel, changing, or unexpected conditions but also in how readily they acclimate, Perhaps it is the difficulty in making the transition from novelty to increasing familiarity, not the initial reactivity, that is problematic and should be targeted for intervention. For example, high reactivity in low threat contexts, reported by parents during toddlerhood, suggests difficulties acclimating, and is a more specific marker of risk for subsequent behavioral inhibition (see Buss et al., 2018).

Increasing familiarity with a context that once was new tends to reduce uncertainty as an elicitor of reactivity and may alter a child's social functioning in that context. Moreover, gains in understanding that come with experience may enable the child to discern familiar elements in subsequently new encounters. For children with higher NA, this process of getting used to new experiences may take longer or may require more support. The challenge for interventionists is to unpack the processes that interfere with the child's ability to gain a sense of predictability and agency with increasing familiarity.

The transactional view of child development provides an influential framework for early intervention/prevention programs for parents, caregivers, and educators of young children. Transactional models posit that development is shaped by the reciprocal dynamic between children and their surroundings and that temperament comprises the child's contribution. Accordingly, the aims of temperament-informed interventions is to improve the match, or *goodness-of-fit*, between the adaptive demands of the context and the child's temperament (Chess and Thomas, 1991).

From this transactional developmental perspective, strategies to improve fit would require unpacking the multiple interacting factors contributing to mismatches between the child's behavior and others' expectations in a given context. Consider a 5 year old who arrives with a parent at a busy and loud birthday party in a novel setting and immediately wants to leave, but the parent insists otherwise. Although this child gets along well with the pre-school peers attending the party, in this context the child is feeling overwhelmed. The parent, concerned with the child's behavior, dismisses the child's distress. For this child, the mismatch is the product of high reactivity, which makes it difficult to handle the adaptive requirements posed by (a) the *stimuli in the setting* and by (b) *others' behavioral expectations*. Understanding the temperamental roots of the child's behavior opens avenues for parents to consider both sources of mismatch.

Programs to promote children's prosocial behaviors are often implemented as a vehicle to improve the fit between children and their peers. However, as in the above example, the child's reason for wanting to leave the party had more to do with difficulty moderating reactivity in the setting than with the quality of peer relationships or of prosocial skills. In this vein, it has been suggested that social competence programs may benefit by considering the factors that underlie social behaviors, including variations in the motives, goals, and social strategies (see Kutnick et al., 2007; Garcia-Fernandez et al., 2022).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board University of Maryland. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

HV: conceptualization, data analysis, and initial writing. HT: conceptualization, development and validation of the ARC, methodology, editing, and re-writing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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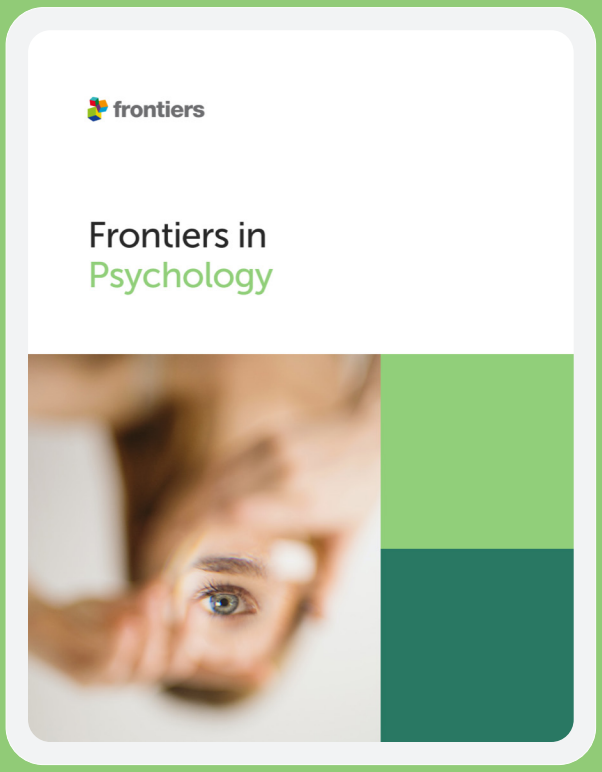

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