IMAGINING CULTURE SCIENCE: NEW DIRECTIONS AND PROVOCATIONS

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IMAGINING CULTURE SCIENCE: NEW DIRECTIONS AND PROVOCATIONS

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REVIEW
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Cultures and Persons: Characterizing National and Other Types of Cultural Difference Can Also Aid Our Understanding and Prediction of Individual Variability

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Valid understanding of the relationship between cultures and persons requires an adequate conceptualization of the many contexts within which individuals work and live. These contexts include the more distal features of the individual's birth ecology and ethno-national group history. These features converge more proximally upon individual experience as "process" variables, through the institutional–normative constraints and affordances encountered through socialization into a diverse set of cultural groupings. This enculturation is then revealed in the individual's response profile of values, beliefs, choices, and behaviors at any given time. Cross-cultural psychologists have typically compared these encultured responses cross-nationally by averaging the scores of equivalent groups of persons across national groups, terming these average differences "cultural differences." This procedure has generated considerable resistance, primarily due to careless over-generalization of results to all members of a given cultural group. Critics of nation-based characterizations have challenged their methodological and conceptual inadequacies, but we now know better how to address the measurement-related aspects of culture-level "psychological" variables, such as individualism–collectivism. In challenging the accuracy of these measures, critics have also neglected to acknowledge the continuing predictive and discriminant validity of these dimensions of national culture. We here review the utility of more recent measurements. We then show how nation-level comparisons can be used by psychologists to improve our understanding of individual, rather than group, outcomes. Nations are heterogeneous amalgams of ethnicities, social classes, organizations, school systems, and families. Individuals' socialization into these groups affects their functioning at any given point in life. These enculturations are further dependent on their gender, age, and education. Assessment of culture's relation with individual functioning requires adequate measurement of both personality and normative aspects of situations in which behavior is enacted. Once this integration of cultural influences is achieved, the logic and methodology for integrating national culture into psychological models of individual behavior can be applied within any nation where research focuses on how

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within-nation cultural variation affects individual functioning. Culture, conceptualized as normative group constraints, becomes more widely amenable to study, and the hard lessons learned from cross-national research can be used to guide the practice of more locally sensitive research.

Keywords: enculturation, person and situation, levels of analysis, individualism – collectivism, eco-cultural

INTRODUCTION

> *"Two primary goals of psychological science should be to understand what aspects of human psychology are universal and the way that context and culture produce variability. This requires that we take into account the importance of culture and context in the way that we write our papers and in the types of populations that we sample."*
>
> *-Rad et al., 2018, p. 1.*

We argue in this paper that a valid understanding of the relation between persons and cultures requires an adequate conceptualization of the many different contexts within which individuals work and live. In particular, we explore the interrelation between the attributes of large cultural groups and the factors acting upon the specific experiences of individuals located within such groups. Relevant contexts include the more distal features of the individual's birth ecology and ethno-national group history that are treated as "background" variables in Berry's (2018) eco-cultural framework. These distal features give impetus over time toward individual experience through the constraints and affordances encountered by each individual during his or her socialization into membership of multiple cultural groupings. These extend across the lifespan from one's family, varyingly constituted and embedded within a local community of caregivers (Keller, 2007), through schooling to various levels and associated peer group influences (Harris, 1995), to occupational settings (Lodi-Smith and Roberts, 2007), and vocational groupings (Pozzebon et al., 2010).

Over the course of this developmental process, the individual becomes less dependent on others for survival and better able to exercise greater agency in choosing his or her proximal cultural groupings and the micro-cultures of relationships within these proximal cultures (Bandura, 2001). This general process is individualized and sorted (Fowler et al., 2011) at each stage by the genetic profile of temperaments, intelligence, proclivities, and skills with which each person is endowed at birth (Thomas and Chess, 1977; Deary et al., 2010). These genetic givens are then infused into the normative cultural realities of the specific cultural groupings encountered by the individual. Successive enculturation experiences then channel the individual's genetic profile into a behavioral repertoire which interacts with the fortuities of life (Bandura, 1998) to further refine the individual's motivations and beliefs about the perceived world (Sasaki and Kim, 2017). These emergent structures finally channel individual choices and skill enhancements, leading to individual personality developments compatible with the constraints and affordances of the proximal cultural systems encountered as embedded within the distal birth culture of each individual.

This progressive "fitting in" across the life course may thus be construed in terms of a Bronfenbrennerian bio-ecological model of development across the lifespan (Bronfenbrenner and Ceci, 1994). This model recognizes the importance of individual genetic heritage and the epigenesis of interaction between the genetic "stuff" an individual brings into the world and the enculturation environments progressively faced by the individual throughout the life course. To understand and predict an individual's responses at any stage in his or her life story or drama-in-the-world requires an appreciation of the cultural contexts with which he or she is interfacing.

What are these cultural contexts, and how can they best be conceptualized and measured? How are social scientists to deal with the interweaving of cultural contexts at different levels of immediacy to the living person (Bronfenbrenner and Morris, 2006)? How to incorporate the emerging polyculturalism of the individual (Morris et al., 2015a) across the lifespan into our models for behavior? What follows is our attempt to address these questions regarding culture. We first revisit conceptualizations and measurements of cultural variation. In subsequent sections we propose how such analyses of culture can be integrated with research on personality in ways that can explain the range of individual behavior more fully. Our lofty intent is to explain why an individual does what he or she does in a given cultural context at a given stage of life. Such precision of understanding and prediction is not currently available, but we hope to set an agenda for such studies.

CULTURAL VARIATIONS

In developing a conceptual framework for the study of culture, psychologists have faced a series of problems. Firstly, the traditional focus of psychology has been upon understanding the behavior of individuals, and the behavior of these individuals has mostly been studied in a highly restricted set of national–cultural circumstances (Henrich et al., 2010). Consequently, it is perhaps understandable that initial attempts to understand the differences between groups of individuals from different parts of the world was often undertaken by drawing on concepts of personality (Piker, 1998). In order to move beyond such a perspective, it was necessary to take note of the way in which a given group is not only an aggregation of individuals but also a shared context moderating the manner in which a range of individual dispositions becomes expressed. A major step in this direction was accomplished by Hofstede (1980), when he proposed that variation between nations could best be summarized by defining nations as distinctive units, based on the way that they varied *from one another*, and discounting the variation between individuals within each nation. As we shall see, this procedure is not without limitations, but the recognition that

in order to study culture and persons we need to differentiate levels of analysis was a critical achievement.

A second problem that has had to be faced is the question of how culture is to be defined. Everyday observation reveals a diversity of values, attitudes, beliefs, and behaviors between different groups. Each of these attributes has been included in some or all of the more than 300 definitions of culture that have been proposed (Faulkner et al., 2006). A major challenge in choosing how one can best define culture is to find a way that does not entail circularity. If variations in values or behaviors are to be considered as consequent upon cultural differences, then those same values and behaviors cannot also contribute to a definition of culture as a cause of such variations.

Two perspectives have helped toward a resolution of this conundrum. Firstly, Triandis (1995) proposed that cultural differences be examined in terms of syndromes. This concept refers to the way that cultures may be characterized not just along some single dimension, but along a series of interrelated dimensions reflecting different aspects of the social context. He differentiated five aspects of the much-discussed cultural dimension of individualism–collectivism: beliefs, attitudes, norms, roles, and values. Thus, his focus was less upon causal relationships between these attributes and more upon observing the way in which they correlated and interacted with one another at a given point in time.

A second helpful perspective is complementary to that of Triandis. Researchers have increasingly sought out variables whose measurement can contribute to the understanding of ways in which cultures evolve over time. These are the "distal" eco-social variables referred to in Berry's (2018) model of cultural evolution, for instance measures of climate, environmental hazard, health risks, and so forth. If indices of such variables can be shown to precede contemporary expressions of cultural variations in ways that can be plausibly argued to have influenced their evolution over time, then we can begin to escape the problems of circular definition. In the following sections, we first examine the classic studies of culture-level variation, and then consider the extent to which more recent studies have overcome the criticisms that have been made of the classic studies.

The Classic Studies of Cultural Variation

The classic studies of cultural differences have all focused upon comparisons between national cultures. As we insist, cultural differences can be studied at all levels of analysis. It is for purely pragmatic reasons that national differences have been highlighted: survey data from individuals are frequently summarized by averaging the within-nation individual responses to produce nation-level indices, and other forms of data, such as indices of wealth and inequality, are also readily available for use as tests of concurrent validity.

The three classic studies of cultural dimensions (Hofstede, 1980; Schwartz, 1994, 2009; House et al., 2004) each employed broadly similar methods. Individual-level survey items were administered to samples from a broad range of nations, with the mean score for each item then being aggregated for each nation sampled. Sample-level means were then factor analyzed, yielding a set of dimensions summarizing culture-level variation in national means. In further analyses, controls are introduced to guard against the effects of cultural variations in survey response style (Smith, 2004), and to determine the independence of the identified dimensions from variations in national wealth.

The question for consideration is what these dimension scores mean. They are based on individual-level scores, but they do not represent individuals. The scores for nations from different studies are drawn from different types of sample and have been collected at different times over the past few decades, but scores on conceptually related dimensions (for instance, individualism–collectivism and autonomy–embeddedness) are nonetheless shown to correlate substantially with one another (Smith et al., 2013). Nation-level scores have been argued to represent a collectively shared perspective on ways in which social relationships and personality are understood in a given cultural context. Thus, for instance, nations scoring high or low on power distance as a relational dynamic or on power as a value could be thought to be characterized by a particular shared understanding of the nature of hierarchy and authority (Fiske, 1991; Bond, 1996).

However, this view has become increasingly difficult to sustain. Analyses of the Schwartz database have shown that variation in values between individuals is very much greater than variation between national samples (Fischer and Schwartz, 2011), with nation-level variance for individual value-types ranging from 6 to 26%. A similar contrast between individual variance and nation-level variance is found for personality dimensions (Poortinga and van Hemert, 2001). Schwartz (2014) has addressed these results most directly, arguing that:

> *"Societal culture is a latent hypothetical construct. It cannot be observed directly, but can be inferred from its manifestations. The rich complex of meanings, beliefs, practices, symbols, norms and values prevalent among people in a society are among the manifestations of the underlying culture. They are not culture itself." (p. 6).*

Thus, nation-level scores can better be considered as an indicator of an underlying structure that will have been molded over time by multiple factors, and which may entail institutional structures, such as family relations, schooling, work organizations, laws, and languages spoken. They do not necessarily require value consensus. The strongest argument for retaining an interest in nation-level dimension scores is that they are found to consistently predict relevant nation-level indices derived from independent sources. The meta-analysis of relevant studies by Taras et al. (2010) found 87 significant nation-level effects for individualism–collectivism with a mean effect size of 0.46. In a similar way, Schwartz (2009) has summarized significant independent correlates of each of his dimensions. These results help to clarify what can be usefully derived from nation-level scores and what cannot. Dimension scores can give approximations of particular cultural contexts. Dimension scores do not enable predictions about the behaviors of individuals within a given sample. By adhering to this distinction, we can avoid the ecological fallacy (Robinson, 1950; Hofstede, 1980) of assuming that relations between variables at one level of analysis will be the same at a different level of analysis.

If we accept the coherence and predictive utility of some of the dimensions identified in the classic cross-national surveys, there remain numerous questions as to whether and how more recent studies can add value to what we already have. We consider first whether researchers have devised better measures and whether these have identified additional dimensions of variance.

Improved and More Diverse Measures of Cultural Variation

The dimensions of nation-level variation that have been most fully explored are those that stem from Hofstede's (1980) pioneering study, particularly individualism–collectivism and its associated correlate, power distance. The items used to define his dimensions were not selected on the basis of explicit theory but rather opportunistically, using an in-house morale survey conducted at IBM in the 1960s; there can be no certainty that they define the most important dimensions of variance. The classic studies have also focused principally though not exclusively on defining dimensions on the basis of items measuring personal values. Given the emphasis of Triandis (1995) on cultural variations as complex entities, there is a need to tap other syndrome components.

Using a more specifically targeted design, Owe et al. (2013) developed a measure of contextualism explicitly intended to measure the belief component of individualism–collectivism. Contextualism is defined as a belief that one can understand an individual through a knowledge of his or her context. Data from adults in 35 nations yielded contextualism scores on a six-item scale with metric invariance across national samples. Their nation-level scores were positively correlated with nation-level measures of collectivism based on values, but nation-level contextualism could also explain variance in dependent measures that was additional to that explained by values, suggesting the incremental validity of contextualism.

In a related study using the same dataset of adults from 35 nations, Vignoles et al. (2016) identified sample-level dimensions that were based on new and improved individual-level measures of self-construal. The intention of this study was to overcome the methodological weaknesses of earlier measures of self-construal and to differentiate the varying components of the global concept of collectivism. Aggregated to the sample-level, factoring of the means for self-construal items yielded seven dimensions referred to as "cultures of self," which also achieved metric invariance. Four of these dimensions correlated significantly with earlier measures of collectivism, but the other three did not. These results underline the limitations of earlier stereotyping of Western nations as individualistic and Eastern nations as collectivistic.

Another aspect of cultural syndromes, namely the existence of cultural norms has been addressed by several projects. Some authors have tested for the prevalence of specific norms across samples. For example, Matsumoto et al. (2008) surveyed norms regulating emotional expressiveness across 32 nations. Recognizing that the relevance of norms may be context-specific, Gelfand et al. (2011) examined instead the extent to which norms in general were tightly enforced within a given cultural group. Across students in 33 nations, their six-item measure of perceived tightness–looseness was found to correlate modestly with individualism–collectivism, but to also predict aspects of cultural difference (for instance a history of social conflict) that are unrelated to collectivism. The items in the measure of Gelfand et al. (2011) emphasize perceptions of how people *should* behave, and thus provide a measure of injunctive rather than descriptive norms (Cialdini et al., 1991). A measure of the tightness–looseness of 68 nations based on descriptive norms has been created by Uz (2015). This was constructed by summarizing the variance in response to each item across a set of items drawn from the World Values Survey[1]. This index shows similar correlations with dependent measures to those obtained by Gelfand et al. (2011). Both descriptive and injunctive indices of tightness–looseness norms have potential in broadening the predictive potential of nation-level measures of cultural difference, taking the study of national culture beyond the thrall of individualism–collectivism.

The inclusion of an increasingly large number of nations within successive waves of the World Values Survey has also provided the basis for identification of further dimensions of variation. Nation-level factor analysis of selected attitude items initially identified two dimensions of variation named as rational–legal authority versus traditional authority and well-being versus survival (Inglehart and Baker, 2000). Scores on both of these dimensions were found to correlate at an average of 0.66 with Hofstede's scores for individualism–collectivism and Schwartz's (2009) scores for autonomy–embeddedness (Inglehart and Oyserman, 2004). Bond and Lun (2014) drew on survey items concerning the values that parents consider that their children should learn, which have been included in more recent waves of the World Values Survey. Across 55 nations, these goals were found to vary in terms of emphasis on self-directedness versus other-directedness and civility versus practicality in socializing children. The first of these dimensions was also strongly correlated with Schwartz's (2009) dimension of autonomy–embeddedness, while the second was related to his dimension of hierarchy versus egalitarianism.

Most recently, Minkov et al. (2017) have designed survey items intended to provide a new measure of individualism–collectivism, sampling adults within 56 nations, and using a three-point response format intended to obviate variations in response style. The seven items used to define their new measure of collectivism included value statements and self-descriptions. Means were found to correlate between 0.70 and 0.89 with earlier measures. Minkov et al. (2018) have used further data from the same 56 nation survey to propose a revised conceptualization of the cultural dimension previously defined by Hofstede (2001) as long-term orientation. Minkov et al. (2018) used seven survey items to rename this dimension as monumentalism versus flexibility. Scores on this dimension of national culture correlate at no >0.32 with individualism–collectivism but correlate strongly with Hofstede's (2001) measure of long-term orientation and with nation-level indices of school mathematics

[1] www.worldvaluessurvey.org

achievement. Again, national-level cultural variation extends beyond individualism–collectivism.

The more recent studies detailed in this section are notable for substantial improvements in the use of theory-driven item selection, controls for measurement error, and the sophistication of the analyses used to test for measurement equivalence. They provide some diversification away from the prior emphasis on values as the sole basis for identifying dimensions of variance. However, they continue for the most part to examine variance that is related to individualism–collectivism. Where evidence is obtained for nation-level variance along more than this single dimension, possibilities are opened up for an examination of their interactive relation to relevant dependent measures. For instance, Smith (2017) showed that across 49 nations the relationship between autonomy–embeddedness values and levels of prosocial behaviors was stronger in nations with a loose rather than a tight culture, both when using the measure of Gelfand et al. (2011) and that of Uz (2015). These types of moderation effect can be examined more thoroughly when individual-level variability is also taken into account, as we argue in detail later in this paper.

The Search for Causal Relations

The studies outlined in the preceding section have revealed a substantial consistency in the dimensions along which nations vary, even despite variations in the measures used and the types and range of samples that have been examined. We now consider evidence of what might explain these consistencies. There are two ways in which this issue can be addressed. Firstly, if we can identify ecological circumstances that are correlated with cultural differences, but which existed prior to the emergence of these cultural differences, we shall know that it is much more plausible that the circumstances influenced the emergence of the cultural differences than vice versa (Talhelm and Oishi, 2019). Secondly, if we can detect contemporary changes in cultural differences, we can seek out circumstances that preceded those changes and are plausibly linked to them.

An example of a circumstance preceding the development of cultural differences is provided by the pathogen prevalence theory of Fincher et al. (2008) and Fincher and Thornhill (2012). These authors provided evidence that life-threatening pathogens are more frequent in some regions of the world. They reasoned that groups who developed a collective culture would be better able to survive, as they could reduce the risk of infections due to contacts with out-groups. Nations that are more collectivistic are indeed found in the hotter regions of the world where pathogens are more numerous and more dangerous.

Climate is another pre-existing circumstance, which will influence the adaptation of human populations in numerous ways, including levels of mobility and the facilitation of different types of agriculture. Talhelm et al. (2014) compared inhabitants of rice growing regions and of wheat-growing regions in China. Rice growing requires much greater hours of labor and more coordinated activity for success than does wheat growing. These authors selected samples for comparison that were closely adjacent, in order to discount regional variations. Respondents from rice-growing areas described themselves and their relations with others in more collectivistic ways.

A more complex eco-cultural theory has been advanced by Van de Vliert (2009, 2013), who reasoned that the climatic challenges posed to populations living in different regions could be moderated by the wealth that is available to contain these challenges. Levels of wealth would initially be dependent on available natural resources. Van de Vliert postulated that populations in climates with a mean annual temperature of 22°C experienced optimal "liveability." Those living in climates that were hotter or colder than this baseline would experience increasing challenges unless these could be offset by the availability of wealth. Comparing mean scores for 15 Chinese provinces, van de Vliert et al. (2013) found collectivist responses to a survey to be correlated with level of climatic challenge. Using a similar method, involving data from more than 100 nations, Van de Vliert (2011) found three separate indicators of collectivism to be associated with climatic challenge.

Gelfand et al. (2011) were also able to provide evidence of environmental precursors across nations for the development of their dimension of tightness–looseness. They found support for their predictions that the frequencies of risks such as earthquakes, floods, food shortages, and population density during historical periods would favor the development of tight cultures. Their hypotheses were also supported on the basis of comparisons between states within the United States (Harrington and Gelfand, 2014).

Several eco-cultural explanations for the causes of cultural differences have thus been advanced. Where samples overlap to a sufficient degree, their predictions can be tested competitively against one another. For instance, Van de Vliert and Postmes (2012) showed that climate challenge predicted collectivism even after pathogen prevalence had been controlled, whereas pathogen prevalence was no longer predictive of collectivism after climatic challenge had been controlled. Thus, we can determine which are the most basic causes of cultural differences and which are more peripheral.

The second way to test for causal effects is to examine changes in scores on cultural dimensions over time. The World Values Survey has provided extensive opportunities to do so, due to repeated administrations of relevant survey items over the past several decades. A model of global cultural change was first proposed by Inglehart (1990) and has been further developed by Inglehart and Welzel (2005) and by Welzel and Inglehart (2010). We here consider the most recent formulation (Welzel, 2013). Cultural change within any particular national culture is seen as following a sequential series of stages. The first stage is cognitive mobilization, which entails an increase in availability of information and participation in educational opportunities, which can open up understandings of the ways in which culture members can utilize available resources. The experience of cognitive mobilization is predicted to lead to the development of emancipative values. These are values that favor equality, liberty, autonomy, and voice. They are measured within Welzel's analysis by 14 value items which are factor analyzed at the individual level and then aggregated to the nation level. Where these values are experienced as fulfilled, levels of life satisfaction are predicted to become more focused on intrinsic well-being and less on material circumstances.

Welzel's (2013) analyses showed increasing levels of emancipative values over time in almost all nations sampled. However, the rate of increase varies, with it being highest in knowledge economies and lowest in traditional economies; Li and Bond's (2010) analysis of World Values Survey data found a similar moderation of increase in secular values by a nation's Human Development Index (HDI) with nations at lower HDI levels showing slower increases over time. The number of nations sampled in the World Values Survey has increased greatly over time, so that for many nations data are not available for the earlier waves. By extrapolating the rates of change for a given nation for the periods where data are available to the earlier periods where it is not, Welzel was able to create scores for each nation for value change for some of the periods where data were absent. With this input accomplished, across 49 nations, he was able to test the relationship between increases in national wealth and increases in emancipative values. Controlling for wealth at Time 1, wealth at Time 2 predicts increase in emancipative values. However, controlling for values at Time 1, values at Time 2 predict increased national wealth. Thus, Welzel finds evidence for a reciprocal influence between wealth and emancipative values. Increased wealth facilitates cognitive mobilization which elicits a move to emancipative values. Enactment of emancipative values facilitates economic growth.

In a subsequent analysis, Beugelsdijk and Welzel (2018) have used World Values Survey data from 68 nations to define three dimensions of national level variance: (individualism–collectivism; duty versus joy; trust versus distrust). They judge these dimensions to be equivalent to Hofstede et al.'s (2010) dimensions of individualism–collectivism, restraint versus indulgence, and uncertainty avoidance, respectively. For these dimensions also, Beugelsdijk and Welzel (2018) found evidence for mutual influence between change in wealth and value change over time. Schwartz (2007, 2009) has conducted similar analyses, in which he shows reciprocal relations between increased national wealth and increased autonomy values, across a 10-year interval. These analyses all reinforce the conclusion that nation-level cultural values can be both a cause and a consequence of the social contexts in which they are embedded.

How Can We Explain Nation-Level Effects?

In the preceding sections we have shown that there is some convergence in the knowledge of how the cultures of nations can usefully be described, and that there is evidence of the network of causal effects in which they may be involved. However, we have left to one side the question of just how such effects may occur. Early discussions of national culture favored defining it as a unitary state, for instance in the phrase coined by Hofstede (1980), a "collective programming of the mind." Such definitions are no longer tenable, in light of the finding that variance in values between individuals is much greater than between nations (Fischer and Schwartz, 2011) and that there is a substantial global consensus as to which values are the most desirable (Schwartz and Bardi, 2001; Hanel et al., 2019). Furthermore, most nations comprise numerous self-evident subcultures, defined by region, religion, social class, occupation, and so forth. We need to think more clearly about the factors that may mediate nation-level effects.

Welzel (2013) proposes that while individual values denote preferences, nation-level measures indicate the relative prevalence of different values. On this view, nation-level effects are a simple averaging of individual-level effects. However, simple averaging takes no account of social inequalities within nations. Higher status individuals and groups within nations are characterized by different values from those of lower status (Kohn et al., 1990; Miyamoto et al., 2018). The greater influence of higher status groups in a nation makes it likely that their values will be better able than simple averages for the whole nation to predict nation-level effects.

We noted earlier Schwartz's (2014) contrasting view that nation-level effects are not directly due to the prevalence of values but are due to the procedures and norms of the institutional structures embodied within nations, of which values are a reflection. An instance of such a structure that would be salient in most nations is the language used in everyday use. Kashima and Kashima (1998) found that languages used in nations that are individualistic more frequently require the use of the personal pronoun "I." Verbs are used more frequently in collectivist nations, while nouns and adjectives are used more frequently in individualist nations (Kashima et al., 2006; Maass et al., 2006). Nouns and adjectives less frequently imply a relationship with the speaker (e.g., "He is a friendly person"), whereas verbs more often do so (e.g., "I like him"). Thus, language use may repeatedly prime individuals to think in ways that are more individualistic or more collectivistic.

A second possible way in which nation-level effects may occur is that they may be mediated by one's day-to-day involvement in organizations, whose cultures may parallel that of the nation in which they are located. We lack sufficient studies that have concurrently sampled both national culture and organizational culture. One project in which such measures were included was the GLOBE project of House et al. (2004). The organizations from which managers provided data were within the electronics, food processing, and financial services industries. Brodbeck et al. (2004) found strong associations between national culture and organizational culture in the data from the electronics and food processing industries. However, within financial services there was stronger evidence for a global organizational culture that was unrelated to national context. Thus, there is some evidence for the view that nation-level cultural effects may be achieved by their replication within specific organizational cultures. However, in some circumstances, there is no such replication, in this case no doubt due to the international nature of the financial services sector. We also have indicative evidence that the culture of families varies in relation to national culture (Georgas et al., 2006; Kağıtçıbaşı, 2007; Keller, 2007).

Dimensions Need to Be Understood as Dynamic Systems

In this section, we have discussed evidence relating to nation-level variability. In doing so we have retained the usage pioneered by

Hofstede (1980) that refers to this variability in terms of stable value dimensions. We shall continue to do so in later sections of this paper, but in moving to the levels of analysis examined in the succeeding sections, it is important to acknowledge that we now know much more about the processes of social cognition than was the case a few decades ago. Throughout the day of an average individual, events will occur that cause a person to think of him or herself as a member of various social groups and entities, but sometimes also as an autonomous individual (e.g., Turner et al., 1987). Except in rare circumstances, they will not often think of themselves as a member of a nation. Each of these momentary identifications are likely to influence the individual's perceptions and actions, thus creating and recreating various types of cultural influence, some of them dependent on relevant values, others more dependent on relevant norms applicable to the role they are instantiating (McAuley et al., 2002) or other features of the situation they are encountering (Reis, 2008). Recent studies have illustrated the way in which these momentary identifications can be manipulated experimentally (Hong et al., 2000; Leung and Morris, 2015; Morris et al., 2015b). Our focus here is on the way in which everyday life can prime one's identifications in a similar manner. In this respect, the distinction between norms and values is not critical: awareness of the values endorsed by one's peers can provide the basis for knowledge of descriptive norms (e.g., House et al., 2004; Wan et al., 2007a). Equally, the injunctive norms that characterize major institutions are likely to be reflective of the values endorsed by key groups within those institutions. National culture can be thought of as a fluid amalgam of innumerable momentary events, constantly open to change but sustained by the continuities of everyday life events in particular contexts. We seek next to tease apart some of its components.

RECLAIMING THE INDIVIDUAL

How Does Culture Relate to Its Members' Individual Functioning?

As shown in the previous section, any functioning group of relating humans – dyads, families, classrooms, school districts, universities, professional associations, companies, types of organizations, ethnic communities, nations, supra-national bodies, and so forth – "has" a culture. Any group culture defines and regulates the interactions of it group members by systematizing and legitimating member exchanges to coordinate their actions for group survival and flourishing within the scope of ambient constraints and affordances. These groupings vary in their immediacy to the individual actor in daily life and may be characterized in a varying number of ways. So, for example, Lee et al. (2012) defined a family's relationship culture using a single dimension, termed concord; Bond and Ng (2004) defined a team's culture in terms of two dimensions of member interaction dynamics, viz., task focus and shared exchange; Hofstede et al. (1993) defined organizational practices as perceived by their members across six dimensions, like professionalism, hostility, trust, and so forth. Over the course of time, different constructs have been identified for each type of culture grouping, often without linking one set of such constructs to others previously researched in the same type of culture grouping. In consequence, the field of "culturology" is beset by a plethora of unrelated constructs.

These dimensionalizations of functioning groups constitute an unpackaging of the culture characterizing that type of grouping. So, a social scientist studying family culture may be called a "familyologist," exploring the nomological network surrounding the cultural dimension of families being examined, as with the construct and measure of concord (Lee et al., 2012). Similarly, a social scientist may be described as a "teamologist," an "organizationologist," a "nationologist," and so forth, as long as their analysis remains focused on that particular type of social grouping.

But, if social scientists wish to study individuals as individuals, how shall the researcher include the individual person's embeddedness within an on-going cultural group in the analysis? That agenda is, after all, the fundamental role for a cross-cultural psychologist to assume. We propose here, as elsewhere (Bond, 2004, 2013) that culture may be productively treated as the *context for action* in any group setting, however large the group and however distal the cultural group's influence on the individual. So, the personality–social psychologist could be trying to explain the behavioral response of an individual in a dyadic role relationship as defined in terms of its associated norms (McAuley et al., 2002), in an organizational setting as defined in terms of its norms of practice (Hofstede et al., 1990), or the behavioral response of an individual member of a nation as defined in terms of its norms of value or belief (see e.g., Wan et al., 2007a).

Context is thus defined as the normative structure for the group in which the individual is embedded and is acting in conjunction with other members of that group. Using these norms rather than the individual's personal norms can yield better prediction of certain outcomes (Wan et al., 2007b). Using a person–context interaction to model behavior, we can deploy constructs and their associated measures that combine group norms in relation to the individual's personality dispositions. A fuller understanding and prediction of individual behavior may be achieved in consequence.

A Closer Look at Norms

Norms are statements about behavioral regularities or social expectations for desirable or proscribed behaviors, i.e., norms are either descriptive, comprising statements about what happens, or injunctive, comprising statements about what should happen (Cialdini et al., 1991; Morris et al., 2015b). Injunctive norms may refer either to behaviors that are to be done or are not to be done. The behavior in question may be concrete and specific, as in closing one's eyes when being addressed by one's boss, or general and wide-ranging, as in cooperation with others.

As usual in social science, norms may be specified by referring to statistical averages of the relevant constructs as reported by a sample of respondents, e.g., a value, an emotion complex, a general belief, a cognitive style, or a behavior. This average is then treated as the cultural-group descriptive norm. Alternatively, a subjective norm may be measured at the individual level by asking each individual to report his or her perception of the

norm characterizing the cultural group in question. Whether and how either or both these types of norm are used will depend on the model for behavioral response being proposed by the researcher – it may be a group-level, individual-level, or cross-level model. At the group level, we have evidence that subjective norms aggregated to the nation level can account for differences in effects as well as or better than measures based on personal values (Fischer et al., 2009; Shteynberg et al., 2009). In the present case, we will discuss cross-level models where group-level norms can be related to an individual's response across many cultural groups. In order to address this issue cross-culturally, we first examine the literature concerning personality and situation more generally.

Situations as Normative Contexts

Given the preceding, it becomes apparent just how complex, scattered, and difficult-to-integrate is the literature on norms. The challenge is how best to include the concept of norms-as-context within a social–personality psychology that attempts to understand and predict individual responding. One approach is to acknowledge that individual responses are always situated, i.e., they apply to situations of varying specificity or generality. For instance, we may consider when a father is at home conversing with his son, or when one is in public settings with unfamiliar fellow citizens, respectively (for a cross-national example, see Matsumoto et al., 2008). Similarly, one could consider the normative constraints induced by different types of group tasks and other types of activities (Kerr, 2017). The difficulty to be addressed with this approach is that any use of norms as constructs for describing such contexts for individual responses needs to indicate both the specificity of the behaviors in question and the nature or type of situations or tasks in which each behavior is being enacted or inhibited.

Concerning situations, Lewin (1936) proposed the general formula, Behavior = f(Personality.Situation), i.e., B = f(P.S), for integrating personality factors with situational features in predicting an individual's behavior. Norms exercise their force upon an individual's situated behavior by suggesting or specifying the reinforcement contingencies likely to be applied should the individual behave or not behave in a normatively prescribed or proscribed way. So, some situations may be characterized as strong, others as weak depending on the intensity of reward and punishments regarded by the individual as likely to arise given certain behaviors (Kammrath et al., 2005). These reward and punishments could be applied intra-psychically or socially, alone or face-to-face (Clark et al., 2018), and be more or less effective depending on the personality of the situated individual whose response is to be understood.

The power of situations has been a longstanding assumption in social psychology based on many of the field's dramatic early demonstrations of human responsiveness to unusual interpersonal arrangements, such as the classic Asch study on distortion of line judgments (Funder and Ozer, 1983). Using the Lewinian framework, researchers moved on to demonstrate the joint action of both personality *and* situation but made an *ad hoc* selection of specific situations to demonstrate the impact of both personality and situation in predicting individual responding (e.g., Funder and Colvin, 1991). Calls were eventually raised for a more analytic approach to distinguishing among situations as factors influencing behavior, especially in drawing a clear distinction between personality and situations as predictors in the response equation [see Reis (2008) for a historical summary].

An early taxonomy for analyzing social–interpersonal situations was provided by Mischel and Shoda (1995) with their CAPS system, which grouped situations from the perspective of the individual, based upon the individual's cognitive–affective reactions to the situation encountered. The problem with this system was that the situation was defined by the intra-psychic responses of the individual actor and made no reference to the nature of the social situation independent of the actor's response to that situation. A situation-referenced typology of situations independent of the individual perceiver was needed (Funder, 2009).

That gap was filled by Rauthmann et al. (2014) who developed a variety of typologies, e.g., the DIAMONDS taxonomy, which they have striven to integrate with other situation typologies in order to identify cross-study commonalities (Rauthmann and Sherman, 2018). Ziegler et al. (2019) have shown that one of these typologies, the Situation Five, shows considerable independence from a Big Five measure of personality. This enables the separation of personality measures from those of the situation, and provides evidence that the situation measures add predictive power to personality measures, supporting the original Lewinian distinction between P and S (Funder, 2006).

Situations as Interpersonal Interdependencies

Clark et al. (2018) have argued that relationships and the relational context within which any cognition, emotion, attitude, or behavior occurs is of fundamental importance in social–personality psychology:

> "... pursuing understandings of human behavior without taking its relationship context into account runs the risk of omitting a central – if not the most central – determinant of that behavior and one that interacts in important ways with other determinants of that behavior (like personality) ... of all the situational factors that might be considered in helping us to understand psychological phenomena, the relational context in which a person finds him- or herself is not only one of the most important contexts, it is probably *the* most important context." (pp. 1–2, brackets added).

These authors proceed to make their case by examining the research data supporting the importance of variations in relationship type, relational character, and the developmental history of a relationship for their impact on a wide range of psychological outcomes – "prosocial behavior, social influence, person perception, self-concept, self-regulation, and judgments of pain, taste, beauty, and risk." (ibid, p. 27). They conclude their review by claiming that, "... relationship contexts are one of the most powerful and pervasive situational influences fundamentally shaping human behavior." (ibid, p. 1).

Clark et al. (2018) point out, however, that the studies in their analysis "have contrasted what occurs within close, intimate, safe, relational contexts relative to other types of relational contexts." (p. 28). They note that other dimensions of relationship, like

power differentials, are needed to supplement any analysis of relationship context. Such a broadening of relationship typology has been provided by Gerpott et al. (2018), who focused their analysis upon the interdependencies that actors perceive to vary across the breadth of various interpersonal interactions. These researchers isolated five dimensions that US and Dutch respondents use to make sense of their interpersonal interactions: "We find that people (*in situ* and *ex situ*) can reliably differentiate situations according to 5 . . . dimensions of interdependence: (a) mutual dependence, (b) power, (c) conflict, (d) future interdependence, and (e) information certainty." (p. 716).

In predicting individual cooperation, Gerpott et al. (2018) showed that two of their dimensions of perceived interdependency had significant effects. The situation dimension of mutual dependence and the situation dimension of conflict increased variance explained over and above that provided by the HEXACO model of personality (Lee and Ashton, 2006) and the DIAMONDS typology for profiling situations. In future studies, other broad interpersonal outcomes, such as associative and dissociative behaviors or superordinate–subordinate behaviors, could be explored to extend this type of analysis; so, too, could more narrowly focused outcomes, like specific emotions, attributional judgments of character, or imitation of a model's behavior. Whatever the psychological outcome of interest, using a model of perceived situational interdependency holds promise in extending research in social psychology beyond its intra-psychic, personality focus.

Cultures as Recurring Types of Interpersonal Situations

Having identified a general line of approach, we can now explore how it could find application to the study of cultural differences. As Clark et al. (2018) claim, "Understanding how relational contexts themselves vary by culture and influence psychological phenomena is itself an important issue to address." (p. 6). Given that cultures are systems for organizing human interaction within and between groups of interacting persons, it seems sensible to conclude that, "culture often influences individuals through the nature of their connections with others in that culture." (ibid, p. 6). In this light, the Gerpott et al. (2018) analysis of social situations seems especially apt for comparing the norms of cultural groups concerning the management of member interdependencies. These researchers provide the following definitions of their five dimensions of interdependency:

> Mutual dependence: "Degree of how much each person's outcomes are determined by how each person behaves in that situation.". . .
>
> Power: "Degree to which an individual determines their own and others' outcomes, while others do not influence their own outcome.". . .
>
> Conflict: "Degree to which the behavior that results in the best outcome for one individual results in the worst outcome for the other.". . .
>
> Future interdependence: "Degree to which own and others' behavior in the present situation can affect own and others behavior and outcomes in future interactions.". . .
>
> Information certainty: "Degree to which a person knows their partner's preferred outcomes and how each person's actions influence each other's outcomes." (p. 718).

We suggest that these dimensions of social–interpersonal interdependency can be linked in suggestive ways with the dimensions of variation in national culture that we discussed in preceding sections. For instance, within collectivistic cultural contexts there are likely to be stronger perceptions of mutual dependence, less perceived personal power, and greater perceived future interdependence. Within tight cultures there is likely to be greater perceived information certainty. However, there is no reason to expect that all contexts within a given nation will replicate the characteristics of the nation as a whole. Other dimensions will become relevant, as Gerpott et al. (2018) have illustrated.

These speculations on cultural systems and their associated logics for interdependency management need to be tested empirically. They may provide a way to integrate situational analysis into cross-cultural comparisons of social and interpersonal behavior.

The Contribution of Individual Personality

What might be the role of personality in the Lewinian model $B = f(P.S)$ for explaining individual behaviors across cultural groupings? There are a few points worth considering in this regard: Firstly, whatever effect personality might exercise on the individuals involved in a cross-cultural study of behavior will be dependent upon the specific lens of the personality measure used in that study. These measures vary across a spectrum of dimensionality – from the single, as in general self-esteem (Schwarzer and Jerusalem, 1995); the double, as in proactive and prevention focus (Higgins, 1997), the triple, as in the dark and light triads (Kaufman et al., 2019); the quartet, as in McClelland's (1987) Power, Achievement, Affiliation, and Intimacy; the Big Five (e.g., McCrae and Costa, 1989); the six of HEXACO (Ashton et al., 2014); the Great Eight Competencies (Bartram, 2005); the Implicit Motive Scale's nine (Schönbrodt and Gerstenberg, 2012), and beyond. The choice of scale type will change depending on the model for behavioral response being used by the researcher. There is a welter of possibilities to consider.

Secondly, the personality measure used is usually completed by the respondent but could and should have been rated about the respondent by others and included in an actor–observer model of social processes (e.g., Lun and Bond, 2006). If interpersonal or social behaviors are the focus, then mutual perceptions by the actors of one another's personalities become an element in the equation predicting the actor's response[2]. These perceptions of the other signal to the actor holding those perceptions the likely responses by that other to the actor's possible actions. Under certain relational considerations, perceptions of the actor held by

[2]http://www.persoc.net/

others may be more decisive than self-perceptions in determining the actor's outcomes in the exchange, especially over extended periods (Clark et al., 2018).

Perceptions of the actor held by the other or others can of course be considered part of the situation confronting the actor, i.e., the "real" interpersonal context. Furthermore, actors themselves differ in the accuracy of judging these perceptions held about themselves by others (Kwan et al., 2004), and perhaps more importantly, in their attentiveness to the other or the others in the equation underpinning their behavior, as research on need for closure has shown (Kruglanski and Webster, 1996). So, other-attentiveness may be considered a feature of personality, and the more objective measures of the situation mentioned above can be used in conjunction with personality to model actor behavior in group settings.

Thirdly, participants in our research endeavors enter our measurement process at different stages of their lives. By the time of a given study, their initial genetic endowment has been acted upon by the circumstances of their various socialization environments to yield the personality profile of the individual before us (Bouchard, 2004). A meta-analytic study of self-report studies of personality concluded that, "... 40% of individual differences in personality were due to genetic, while 60% are due to environmental influences." (Vukasovic and Bratko, 2015). Environmental influences in this context would be all those factors impacting on the individual to date and not the immediate situational features considered above. Genetic information about the actor may, however, provide additional predictive power over and above the standard personality measures used in predicting behavior in free-response situations; research has shown that persons with certain genetic profiles seek out particular kinds of social situations and may be more responsive in these situations than others lacking these genetic profiles (see e.g., Dick et al., 2015; Salvatore and Dick, 2016). The extension of this work on genetic influence into the cross-cultural domain is in its infancy but promising in its capacity to add further predictive power to our standard measures of personality (Sasaki and Kim, 2017).

Finally, the Lewinian equation joining personality (P) with situation (S) to predict behavior (B) does not specify the way in which P and S, however operationalized, are to be combined – the researcher might specify and test for an additive or an interactive relationship between the two. Both approaches are possible, depending on how narrowly "the situation" is defined and whether there are "layers" of situational influence to consider in the analysis, as elaborated next.

Culture as an Encompassing Superordinate Construct

Considering culture as a normative situational context would enable researchers to proceed in applying the Lewinian formula, $B = f(P.S)$ to their behavioral response of interest. To do so, they must hypothesize the personality factors involved, the normative considerations related to the situated behavior, and any P.S interactions, and then test their model. The challenge, however, is to specify the norms applicable for the behaviors being examined. The usual procedure in cross-cultural studies is to measure an actor's *typical* behaviors, in effect summarizing across the actor's life to date. In that case, "the situation" in question is absorbed into the personality measure which summarizes the many, varied situations encompassing an actor's life to date.

Such a simplifying process has been the typical approach in cross-national research. But, what if one is doing cross-ethnic, cross-state (or province), cross-organizational, cross-team, or cross-family research across national cultures where variations of ethnicity, provinces or states, organizations, teams, and families are embedded within nations? In this case, cultural influences on social psychological processes would "seep down" to the situational–relational level through many potential layers of culture, varying in their immediacy to the actor. A multi-layered, multi-level model of influence then becomes necessary to disentangle the complexity of possible cultural influences in play.

How Does Culture Exercise Its Effect on Individual Social–Psychological Outcomes?

Our approach outlined above is consistent with Brady et al.'s (2018) assertion that, "Fully understanding human behavior necessitates understanding the cultural influences *on individuals in a given context*." (p. 11,407, italics added). If researchers are to use the Lewinian formula for behavior as a guide, then behavior, B, can be the result of variation in individuals' personality, P, variation in the immediate normative situation, S, and variation in their interaction, (P.S). When researching across cultures, culture then becomes a superordinate construct in which the $B = f(P.S)$ model is embedded, a higher-level summary of the individual's situations encountered across a lifetime.

A number of possible effects may emerge from this multi-cultural, cross-level analysis:

(1) P may exercise a main effect across all cultural groups, positioning the "average behavior" of members from any cultural group differently from that of other cultural groups.
(2) S may exercise a main effect across all cultural groups, positioning that average behavior of members from any cultural group differently from that of other cultural groups.
(3) The P.S interaction may exercise a main effect across all cultural groups, positioning that average behavior of members from any cultural group differently from that of other cultural groups. Leung and Bond (1989) refer to these three possible effects as "cultural positioning effects," where culture is the superordinate context for action and S the immediate situation confronting the individual actor.

These types of analysis require multi-level modeling (Raudenbush and Bryk, 2002; Nezlek, 2011). We have emphasized throughout this paper the importance of distinguishing between levels of analysis, and of not assuming that the relations between variables are the same at different levels of analysis. Multi-level modeling provides the best currently available procedure for detecting these probable differences in

relationships. To be effective, an adequate number of samples is required to estimate the relations between variables at each level of analysis. This requirement is typically most challenging for higher-order samples such as nations. While multi-level models containing no more than 10 higher order samples may be tested, the likelihood that hypotheses can be validly tested is greatly enhanced where 30 or more samples have been included.

As an example of this approach, consider the work of Becker et al. (2012). These authors asked adolescents in 21 nations to provide 10 answers to the question, "Who are you"? Respondents were then asked to rate each attribute of themselves on a series of dimensions, including how much the attribute provided distinctiveness and how much it was important to defining who they were. Individual-level analysis showed that distinctiveness was important in all samples. However, multi-level modeling showed that in more individualistic samples distinctiveness was associated with seeing oneself as separate and different, whereas in collectivistic samples distinctiveness was associated with membership of distinctive groups. Thus, there were main effects both for persons (P), for cultural contexts (S), but Becker et al. (2012) also found significant P.S interactions.

This study lacked individual-level measures of S, but where these are also included we may anticipate that a variety of cross-level moderation effects will emerge. So, culture, however operationalized, might interact with P, with S, with P.S, or with any combination of factors to influence individual behavior, B. These cross-level moderations are referred to by Bond and van de Vijver (2011) as "cultural salience effects," such that the cultural background of an individual results in that individual's position on P, S, or P.S being relatively more or less powerful in predicting his or her behavior than for an individual from another culture.

"Cultural salience effect" is a descriptive phrase only, requiring a persuasive logic for explaining why this way of unpackaging culture results in greater or lesser weight being attached to P, to S, or to P.S in affecting B. An *a priori* argument, well grounded in the literature involving this type of cultural grouping – nation, organization, team, family, role dyad – would be needed to provide a persuasive argument for conducting such a study. As always, methodological rigor and statistical appropriateness are required to prove one's case. Since results do not always support the researcher's hypotheses, so a sensible, fair-minded interpretation of the findings would provide a necessary conclusion to the research exercise (Bond, 2019).

When designed using the Lewinian formula described above, cross-cultural research can improve psychologists' interpretive power. "When psychologists leverage interpretive power, they can use cultural differences to build theories that explain a greater range of phenomena with greater nuance." (Brady et al., 2018, p. 11,408). Carefully planned, executed, analyzed, and interpreted cross-cultural studies will enable researchers to "... go beyond simply documenting cross-cultural differences; (instead) they use their understanding of how culture shapes cognition, motivation, and emotion to build theories that explain why, how, and when psychological processes manifest differently in diverse cultural contexts." (ibid., p. 11,407, brackets added). That increase in precision and generalizability should be our goal as *cross-cultural* psychologists.

INTO THE FUTURE

We have argued that the culture of any type of group may be defined as the norms characterizing that type of group in situated interaction with the personalities of its members to yield each member's response. This conceptualization of the cross-level relationship between culture and the psychology of its members opens up a host of possibilities for modeling individual behavior. Our vision has been one of a possible future. Few studies exist that have analyzed effects that included individual-level variance in terms of social context other than that defined by nation-level dimensions. We conclude by identifying three studies that indicate the variance that remains to be explored through more detailed investigation.

Diener and Diener (1995) examined the correlation between self-esteem and life satisfaction among students in each of 31 nations. The strength of the correlations was uniformly positive but varied in magnitude. Diener and Diener (1995) found that the strength of the correlation within each sample was significantly predicted by indices of individualism–collectivism. However, the measures of individualism–collectivism were not provided by the student respondents. Direct measurements would give a stronger test of their conclusions. Similar results were reported by Schmitt and Allik (2005) who sampled students from 53 nations. Self-esteem was found to correlate positively with extraversion and negatively with neuroticism in almost all samples, but the magnitude of the relationships varied, and this magnitude was in some instances predicted by scores on Hofstede's cultural dimensions.

A more recent study did involve direct sample-level measurement of cultural differences. Lun and Bond (2016) examined the strength of the linkage between trust of one's ingroup members and satisfaction with life in 65,021 representatively sampled individuals from 50 nations. These nations were conceptualized as differing from one another along two dimensions of socialization goals for children, viz., Self- versus Other-directedness and Civility versus Practicality. Although these dimensions are derived from individuals' recorded preferences, they were identified through sample-level factor analyses that discount individual-level variance, and are thus true estimates of sample-level variability. These dimensions would be considered as process features of culture in Berry's (2018) eco-cultural model of ecological features of the nation. Using Berry's terms, these measures of national socialization also relate to "psychological" features of each nation, for instance the norm for equality that characterizes its citizens (Bond and Lun, 2014).

Moving from the national level of analysis to the individual level, Lun and Bond (2016) found that trust of ingroup members was a predictor of life satisfaction pan-nationally but was a *stronger* predictor in nations higher in Self-directedness and in Civility. The socialization context for children characterizing one's national culture thus has relevance to the life satisfaction of individual citizens. However, because this study also reported results nation by nation, they were able to show that trusting one's ingroup did not predict life satisfaction significantly in *all* 50 nations, even if those nations were high

in either Self-directedness or Civility. In fact, for Ethiopians the relationship was negative, albeit not significantly so. Why?

Of course, the specific result for Ethiopia may be an anomaly due to measurement error. However, to understand the results obtained more fully, we should need to move closer to the type of research design outlined in the preceding section. Rather than using a measure of generalized trust as the predictor, we should require measures of personality dimensions and measures of the perceived attributes of different interaction contexts. The World Values Survey already includes a very brief measure of personality but measures more akin to those proposed by Gerpott et al. (2018) would also be required.

Here, then are opportunities for a more "nuanced" understanding of the social–psychological phenomenon in question, albeit one that raises provocative questions of generalizability, begging the question of why a variable that predicts life satisfaction in most national cultures does not do so in a few. Such provocation is surely a reason for conducting studies as culturally comprehensive as that of Lun and Bond (2016), despite its relatively limited focus on culture just as national context. After all, each individual in these 50 nations is embedded within a family of origin (or family of creation), which is itself embedded within a linguistic–ethnic cultural group within a provincial or state cultural group. Each of these levels of culture may exercise further moderating effects upon the strength of linkage between ingroup trust and life satisfaction. Assessing these further "nuancings" of the outcome requires careful theorizing to justify their examination, not to mention considerable statistical sophistication in their application. But, is not such nuancing in the interests of generalizability the purpose of doing psychology cross-culturally? We agree with Brady et al. (2018) in asserting that it is.

"Everything should be made as simple as possible, but no simpler."
-Albert Einstein

AUTHOR CONTRIBUTIONS

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

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A Contextual Behavioral Account of Culture: Example Implementation of a Functional Behavioral Approach to the Study of Cultural Differences in Social Anxiety

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The current article proposes integrating a functional behavior approach to the study of culture. After describing culture from a contextual behavioral science framework, we outline a three-step process to perform a functional behavior analysis of culture: (1) identifying potential contingencies, (2) determining functional relationships, and (3) gathering supporting evidence. As an example, we present each of the three steps through a re-analysis of data related to cultural differences in social anxiety between Japanese and European Americans as well as describe a hypothetical experiment. The results demonstrate how implementing an alternative framework that focuses on the relationship between behavioral function and environmental adaptability leads to different conclusions compared to implementing frameworks that emphasize the form or degree of a behavior or belief in one group compared to another. For this particular example, in contrast to viewing social anxiety in Japanese as something stemming from innate beliefs about themselves and others (e.g., self-construal), the current study suggests that displaying social anxiety in some situations within a Japanese context is more functionally adaptive (e.g., more likely leads to desirable outcomes) than within a European American context.

Keywords: culture, functional behavioral assessment, contextual behavior science, social anxiety, cross-cultural differences

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INTRODUCTION

Contextual Behavior Science (CBS) is the functional analysis of behavioral variation, selection, and retention within a given context across various dimensions (Hayes et al., 2012, 2017; Zettle et al., 2016). One important contextual dimension is culture. Culture has been defined by cultural psychologists as a set of shared values, beliefs, and practices that are influenced by the environment and transmitted to others (Kitayama and Cohen, 2007; Markus and Hamedani, 2007). According to this widely agreed-upon definition, culture characterizes both an individual's private thoughts (i.e., values and beliefs) and public behaviors (i.e., practices) *if* they

are (1) influenced by salient features of the physical or social ecology, (2) shared by a specific group, and (3) transmitted by the group to new culture members.

Contextual Behavior Science focuses on predicting and influencing both public behavior (practices) as well as private internal behavioral events (thoughts, feelings, and values), and provides a compelling account for how these behaviors are shaped by contextual factors. Specifically, CBS addresses (1) how the features of the environment create the contingencies that promote or obstruct a behavior from occurring (e.g., behavioral antecedents), (2) how social learning can occur so that individuals in close proximity share similar private and public behavior (e.g., behavioral imitation, Epstein, 1984; Boyd and Richerson, 1985), and (3) how behavioral repertoires are transmitted to others via the processes of associative and operant learning (e.g., behavioral consequences). Taken together, CBS aims to functionally relate organisms' behaviors with features of the environment.

Many contributions to the study of culture emphasize the form, frequency, or intensity of a certain groups' behavior relative to other groups. Unfortunately, the relation between that groups' behavior and the environment in which they are situated is often relegated to the discussion section of a manuscript if addressed at all (Ryder and Chentsova-Dutton, 2015). In contrast, CBS emphasizes function over form, highlighting the role of environmental contingencies (i.e., antecedents and consequences). To a behaviorist, the question is not limited to just "how much more frequent does this behavior need to occur to be representative of a given culture?" but rather "is this behavior being differentially reinforced by even a subsection of the population?" (Tourinho and Vichi, 2012; Glenn et al., 2016; Baum, 2017). If it is, that alone creates a sufficient basis for cultural inquiry.

The current study provides a brief CBS account of culture, as well as re-analyzes the results of a recent study on Japanese and European American differences in social anxiety (Krieg, 2018) from a CBS perspective. In doing so, we hope to provide a theoretical framework for the contextual influence of culture on individual behavior as well as expound a CBS-approach for future studies to examine and compare cultures beyond the form and frequency of cultural practices or beliefs such as "individualism and collectivism."

Contextual Behavioral Science

Contextual Behavior Science claims academic heritage from Charles Darwin, B. F. Skinner, and Murray Sidman, all of whom emphasized the role of environment × organism interactions in the variation, selection, and retention of a given behavioral repertoire (Hayes et al., 2017). Rooted the philosophy of functional contextualism, CBS emphasizes the centrality of situated action and sets a pragmatic truth criterion, attempting to answer the question "what works in this context" (Hayes et al., 2012). It utilizes various behavior analysis methodology to develop a basic behavioral account for complex organism behavior (Blackledge, 2003).

Behavior variation occurs somewhat randomly (Hayes et al., 2017), with the environment simply setting constraints on what behavior is possible in a certain context (e.g., singing is impossible for humans to perform underwater). From a pool of possible behaviors, the environment influences the selection and retention of behavior either by generalizing a behavioral response across a variety of stimuli through associations (i.e., classical conditioning; Pavlov, 1902) or through providing appetitive or aversive outcomes toward a behavior exhibited in a certain context (i.e., operant conditioning; Skinner, 1938, 1963).

Several interventions were developed from CBS and have shown a high degree of clinical utility across a broad range of affective and behavioral concerns. For example, Acceptance Commitment Therapy (ACT) is a modern, process-based contextual behavior therapy that has demonstrated effectiveness in treating a wide range of psychological phenomena all over the world (Hayes et al., 2006; Powers et al., 2009; A-tjak et al., 2015). Similarly, Applied Behavior Analysis (ABA) is the gold standard treatment for treating children with developmental disabilities worldwide (e.g., Austin and Carr, 2000; Hayes and Bissett, 2000). Making use of its sensitivity to subtle idiographic factors impacting an individual's behavior in a specific context, several attempts have been made to capitalize on the potential for cultural sensitivity it offers (Hayes et al., 2011; Pasillas and Masuda, 2014; Sabucedo, 2017). These approaches to working with psychological and behavioral concerns have become invaluable tools within the modern clinical psychologist's toolbox.

Contextual Behavioral Ideas in Cultural Psychology

A lesser-known fact among non-behaviorists is that Skinner's treatment of human behavior inherently stressed the importance of social and cultural variables (Skinner, 1981). This idea is so central to a behavioral understanding of culture that Skinner (1953) even defined culture as contingencies "arranged by other people" (p. 419). Specifically, Skinner (Skinner, 1953; Ferster and Skinner, 1957) hypothesized that an individual's behavior often constitutes a significant portion of the controlling environment for the behavior of other individuals and defined social behavior on the basis of these "interlocking behavioral contingencies" (IBCs). According to the theory, IBCs may give rise to cultural practices when the behaviors involved are learned by other individuals and maintained by similar contingencies (Muchon de Melo and de Rose, 2013). Taken together, the behavior of other group members provides the antecedents and consequences of cultural practices.

The idea of understanding culture in terms of its antecedents and consequences is not new to the field of cultural psychology. Although a simplification, it could be said that traditional culture-comparative research defined culture as a collection of antecedent conditions that shaped behavior. If some difference in behavior was observed between two groups there should be an antecedent variable that is able to account for this. The presumption of invariant antecedent-behavior relationships across human populations in all cultures was reflected by the notion of universalism, a prevalent belief at the time (Triandis, 2007).

However, as the assumption of the universality of humankind gave way to the apt criticism offered by the indigenous and cultural psychology traditions (Stigler et al., 1990; Sinha, 1997),

this approach fell out of favor and more mentalistic concepts such as individualism and collectivism (Triandis, 1995) and self-construal (Markus and Kitayama, 1991) became increasingly popular. Although these concepts demonstrated some utility in certain explanatory models, there are certain philosophical challenges associated with "invisible" mentalistic concepts. As outlined by Ryle (1984), logical problems occur when "categories of behavior" are conflated with the behaviors themselves. In his famous example of 'team spirit,' we can observe teammates shouting, patting, and hugging each other after winning a sporting event, but there is no "ghostly team spirit" running around the field or possessing each of the players (Baum, 2017). Perhaps unsurprisingly, methodological limitations followed this shift toward mentalistic concepts, as cultural scientists struggled to define, measure, and support cultural validity/equivalence for these new mentalistic constructs (e.g., Levine et al., 2003). The current paper's author is reminded of an interaction he witnessed at the International Association of Cross-Cultural Psychology's (IACCP) 2016 Conference in Nagoya, Japan where a prominent cultural psychologist asked a room full of conference attendees "No, really, we talk about self-construal, but do we even know what a 'self' is?" The room went silent.

It is possible that the de-emphasis of behavioral antecedents and consequences from the study of cultural psychology was a little premature. Recent developments in both CBS as well as evolutionary branches of cultural psychology may have made a way for more promising collaborations between the two fields. Whereas the methodological behaviorism of the 1960's–1980's offered a less than convincing account of verbal behavior as well as individuals' internal thoughts or feelings (Chomsky, 1959; Winton, 1986), advances in theories such as Relational Frame Theory (RFT; Hayes et al., 2001) have opened up verbal behavior and "private internal behavioral events" (i.e., thoughts and feelings) as not only legitimate but fruitful topics of inquiry using modern behavioral methodology. Likewise, in cultural psychology, there seems to be a resurgence of the notion that the physical and social environment can profoundly affect the phylogenic development of people groups both on genetic and cultural levels (Cole and Hatano, 2007; Konner, 2007; Newson et al., 2007; Keller, 2008).

Recent research on gene-culture coevolution (e.g., Boyd and Richerson, 1985; Laland et al., 2010) and cultural neuroscience (e.g., Chiao et al., 2008, 2013; Han and Humphreys, 2016) has supported the integration of natural and cultural science and emphasized the dynamic organism × environment interactions on both the individual and culture group levels (Kashima, 2014, 2016). Likewise, the modern CBS approach has increasingly integrated within a larger framework of evolutionary science (Hayes et al., 2012, 2017; Wilson et al., 2018), and wholeheartedly agrees with these propositions.

A CBS Approach to Examining Culture

As discussed in previous sections, a functional behavioral approach to culture emphasizes identifying and understanding the contingencies of a given behavior rather than overly focusing on the behavior itself. The goal is to understand the resulting function of a given behavior and how it impacts the individual or the individual's environment. This is usually described as the ABC's of behavior analysis (Sturmey, 1996; Iwata, 2000), where behaviors are defined by their functions in the following format.

> [Behavior] functions to [Consequence] when/among/during [Antecedent]
>
> *Example:* [Nodding one's head] functions to [keep a speaker talking] during [conversation.]

In order to identify the components necessary to complete the above conclusion, the current paper recommends the following three-step process: (1) identifying potential contingencies, (2) determining functional relationships, and (3) gathering supporting evidence. These three steps are discussed in turn in the sections below.

Step 1: Identifying Potential Contingencies

In order to develop a list of potential contingencies that may account for a specific behavior, researchers can ask questions related to the behavior's variation, selection, and retention to better elucidate these exact mechanisms. **Table 1** outlines a non-exhaustive list of possible questions. The first set of questions relates to defining the research question and behavior of interest in concrete behavioral terms. This is in order to avoid the difficult task of attempting to use environmental contingencies to predict an entirely mentalistic concept. Next, it is recommended that the researcher takes a moment to identify alternatives to their behavior of interest. If other behaviors are *not* occurring in this context or some do at much lower base rates, this information is likely beneficial in forming hypotheses about possible antecedents and consequences.

From there, the remaining questions work to generate a list of potential antecedents and consequences that would contribute to both the selection of a certain behavior (over and above potential alternatives) as well as the retention of that behavior. Among the list of sample questions in **Table 1**, many fall under the theme of identifying common environmental features occurring in different cultural contexts where similar behaviors are observed. There has been some evidence to suggest that similar contextual contingencies result in similar behaviors across large geographic divides (Henry, 2014). This is likely due to the fact that nowhere in Markus and Hamedani's (2007) definition of culture is geographic location an essential feature. Culture is multidimensional and spans geographic region through other common features such as religion, socio-economic status, and generation (Cohen, 2014). For example, the exploration of cultural themes of honor in Middle East and southern United States has demonstrated a high degree of similarities as oppose to differences (at least with this particular cultural value; Cohen et al., 1996; Mosquera et al., 2007; Uskul et al., 2015). Examining these particular commonalities may help generate possible antecedents and consequences that work to select and retain this particular cultural value as well as the practices surrounding it.

Likewise, given our understanding of interlocking behavioral contingencies (IBS), it is important to consider *who* or what subgroup of the population is a primary reinforcer of the behavior

TABLE 1 | Questions to facilitate the identification of potential cultural contingencies on behavior.

Process	Question
Behavioral definition	How would one define the current object of study in behavioral terms?
	Is it possible to divide this behavior into smaller units?
Variation	What alternative behaviors are possible?
	What relevant behaviors are occurring at a lower base rate?
	What relevant behaviors are not occurring at all?
Selection antecedents	In what social/physical ecology does this occur?
	Are there social/physical ecologies in which this does not occur?
	Does this social/physical ecology occur in other culture groups' set of social/physical ecologies? If so, do similar behaviors emerge?
	Are there any features in the social/physical ecology that are sufficiently salient to be a potential stimulus control variable?
	Can the antecedents of the behavior of interest be manipulated to change the frequency of the behavior?
Selection consequences	What possible ways does the social/physical ecology reinforce or punish this behavior?
	Does the strength and reinforcement schedule reflect the frequency of the observed behavior?
	Does this type of reinforcement occur in other cultural contexts or geographical settings? If so, do similar behaviors emerge?
	Does the influence of the physical or social ecology outweigh a given individual's unshared learning history?
	Can the consequences of the behavior of interest be manipulated to change the rate or frequency of the behavior?
Retention antecedents	What would need to change about the physical/social ecology that would precede changes to the behavioral repertoire?
	What features of the social/physical environment preceding the behavior would have to change for the frequency of the behavior to also change?
Retention consequences	What is the adaptive cost of behavior change in the social/physical ecology?
	What consequences of the social/physical environment following the behavior would have to change for the frequency of the behavior to also change?

of interest. What do they gain from reinforcing these behaviors? What other behaviors might they also be motivated to reinforce? It is also possible that some form of mutual reinforcement is involved. Is the person or group of people reinforcing a certain behavior in turn reinforced for their reinforcing behavior? What can this interaction or meta-reinforcement inform us of potential consequences? What other consequences would happen if people within the group stop reinforcing the behavior of interest? Through these near infinite questions, the researcher can begin to develop a list of identified antecedents and consequences that potentially relate to the behavior of interest.

Step 2: Determining Functional Relationships

Determining functional relationships between a behavior and its possible contingencies for a cultural group would likely be a similar process as it is for an individual. Essentially, researchers would be looking for a mathematical relationship that would resemble a Bayesian analysis more than a Pearson correlation. Three pieces of information are needed: (1) an overall base rate of a behavior (i.e., cultural practice) occurring in a non-specified setting under non-specified reinforcement contingencies, (2) a list of potential antecedents or consequences occurring in proximity to the behavior (as generated in Step 1), and (3) the probabilities of the behavior occurring before or after a consequence or antecedent, respectively. By comparing the relative base rates of a behavior within a contextual contingency to its overall base rate, a functional relationship can be derived (Sturmey, 1996; Iwata, 2000; Baum, 2017).

For example, imagine that people in both Culture A and Culture B perform Behavior X 25% of the time across all antecedent conditions. However, people in Culture A perform it 85% of the time in situation Y or 100% of the time after experiencing Consequence Z, whereas members of Culture B continue to perform Behavior X at around 25% of the time even in these conditions. This would be an example of a functional relationship between antecedents/consequences and a behavior that varies between culture group. In the case of identifying a differential functional relationship like the one described above, culture membership becomes an additional antecedent condition. There are many statistical methods that could be used to calculate this. A researcher could compare effect sizes, odds ratios, complete a non-parametric analysis, or perform a formal Bayesian analysis.

Step 3: Gathering Supporting Evidence

As in a traditional functional behavioral assessment, testing out predictions made by the model in novel situation as well as examining the change in behavior frequency when manipulating the contingencies are essential to supporting the ABC explanation. If the extant evidence has shown that the behavior of interest occurs within one particular context over another, not only should this be replicable within the same culture group, but individuals in other culture groups should perform similarly if the underlying contingencies are manipulated. Likewise, the removal of the specific contingencies that form the functional relationships should reduce the degree to which the behavior is performed within a variety of contexts. Although a wide variety of methodology can be implemented, experimental studies provide an excellent avenue for further elucidating the exact mechanism of reinforcement as well as antecedent-sensitivity.

Examining Cultural Differences in Social Anxiety Between Japanese and European Americans

In order to provide a case example of this approach, the current set of two studies re-analyze and re-interpret data from the current author's research program examining cultural differences in social anxiety among people of East Asian Heritage and European Heritage. A brief summary of this field will precede engaging in the three steps outlined above.

Over the past 30 years, the extant research has shown that individuals of East Asian cultural heritage relative to European Americans or European Canadians report higher social anxiety

symptoms with remarkable consistency (for meta-analyses see Krieg and Xu, 2015; Woody et al., 2015), with a moderate average effect size of Cohen's d = 0.36 (95%, CI:0.27, 0.44; Krieg and Xu, 2015). Furthermore, follow-up study by Krieg et al. (2018) showed that this cultural difference in social anxiety was not an artifact of non-equivalent measurement properties between the two groups by testing for measurement invariance across common social anxiety measures.

Following the trends in cultural psychology, independent and interdependent self-construal were posited as mediators (Okazaki, 1997; Krieg and Xu, 2015, 2018), where viewing oneself as separate or independent from social others led to reduced social anxiety and viewing oneself as interconnected with social others as either increasing (Okazaki, 1997; Krieg and Xu, 2018) or unrelated to social anxiety (Krieg and Xu, 2015). Employing a cultural neuroscience perspective, self-construal was understood act as a framework for a variety of cognitive functions (Han and Humphreys, 2016), including determining the emotional saliency and relevance to the self, and "threat appraisal" was added to the model (Krieg and Xu, 2018). As originally suggested by Okazaki (1997, 2000), Krieg and Xu (2018) demonstrated that patterns of interdependence (and relatively less independence) transform the perception of a variety of social situations as "high stakes" situations for members of one group more than the other. The results of this process likely contribute to the detection of social threat and subsequent phenomenological experience of social anxiety. An additional study currently in preparation expands the examination of social threat by examining its role as a mediator in a behavior-based, and quasi-experimental study across multiple culture groups.

Although several important questions have already been answered by the extant literature, some compelling questions remain. For instance, what situations are considered 'socially threatening?' Do people of East Asian-heritage consider the same situations socially threatening as European-heritage people, or are the two groups responding to different situations? Is expressing social anxiety more adaptive in one context than another? Do differences in the level of adaptability explain cultural group differences in social anxiety? Each of these questions contain elements of a functional relationship between social anxiety and its antecedents (e.g., the situations where it occurs) as well as its consequences (e.g., whether the outcomes are desirable or "adaptive"). Thus, the incorporation of a functional behavioral approach may help in answering these questions.

An important first step of a functional behavioral approach is examining the potential consequences of a certain behavior in general before investigating its function in a particular context. Researchers studying the behavioral ecological ramifications of emotional displays among primates from an evolutionary perspective context that displays of fear or anxiety can function to convey the readiness to submit (Fridlund, 1994), communicate the intention to avoid threat (Keltner, 2003), and request assistance and support from social others (Eisenberg et al., 1989). Taken together, one of the key general functions of displaying social anxiety is to garner social support and sympathy. Although a general function is not always helpful when it comes to understanding a behavior's function within a specific context, it can be a good place to begin one's investigation.

There is some supporting evidence for the viability of this universal function in helping explain differences in the expression of social anxiety between groups of Japanese and European Americans. In a recently published preprint that examined Japanese and European American responses to a vignette of someone suffering from social anxiety, the Japanese responses were more positive and neutral, whereas the European American responses were more negative and judgmental (Krieg et al., 2019). The authors concluded displaying social anxiety facilitated a more positive and even sympathetic reaction among Japanese participants, who used words such as "sensitive," "victimized by own thoughts," and "tendency to care too much" to describe the character in the vignette as compared to European Americans who used words such as "awkward" and "insecure." Therefore, it is plausible that social anxiety functions to facilitate social support in a social situation.

Current Studies

In a contextual behavioral account of culture, social anxiety would not be something "felt," but rather behaviorally signaled to others. This might be in the form of a fearful expression, stuttered speech, averted eye-gaze, behavioral avoidance, or an endorsement of social anxiety on a questionnaire. All of these signals (among many more) are explicit behavioral attempts to convey social anxiety by the participant to others in their environment. Following the three steps outlined above, we aim to identify potential contingencies, determine functional relationships, and gather supporting evidence to better understand how signaling social anxiety functions between groups of Japanese participants and European-American participants.

Krieg et al. (2018) originally used the self-construal model to explain differences in threat appraisal that would then predict social anxiety. They hypothesized that viewing oneself as less independent and more interdependent from social others would increase the degree to which ambiguous social situations would be perceived as threatening, thereby increasing social anxiety. In contrast, Study 1 re-analyzes situation data collected as a part of Krieg et al. (2018) in order to identify contexts in which social anxiety was signaled differentially by one group over and above the typical culture group differences in social anxiety. We hypothesize that Japanese and European American participants will both be able to generate a number of diverse situations in which they experience social anxiety. We also hypothesize that the two culture groups will respond differently to some situations over and above the patterns of responding identified across the pool of situations. These situations may be able to be organized by the theme of social-support seeking in uncomfortable situations.

Following the results of Study 1, Study 2 simulates experiment data based on descriptive statistics collected from Krieg (2018) and Okazaki et al. (2002) in order to test the tentative conclusions drawn from Study 1. The simulated data will mirror prior findings as well as conform to typical experimental protocols to make it as realistic as possible. All in all, both of the studies

are designed to examine the predictive utility of the following functional statement: Signaling social anxiety functions to garner social support or assistance when in a particular situation among Japanese culture group members relative to European-American culture group members.

STUDY 1 METHODS

Participants

The sample from Krieg (2018) Study 1 was used to examine social anxiety across antecedent conditions. This sample consisted of 212 Japanese (116 females; M_{age} = 20.88; *SD* = 2.23) and 249 European Americans (180 females; M_{age} = 21.14; *SD* = 5.01). All participants signed an informed consent, and this study was approved by the University of Hawai'i at Mānoa's Human Studies Program (CHS #22337). For more information, please see the original publication.

Procedure

In order to produce a repository of participant-generated social-anxiety provoking situations (e.g., antecedent conditions), we incorporated a situation sampling approach (Kitayama et al., 1997; Morling et al., 2002). First, a pilot study was first conducted to identify social situations that were perceived by individuals of Japanese and European-American heritage as anxiety provoking. The pilot study recruited 30 Japanese nationals and 30 European Americans. To generate a pool of situations that are relatively salient to members of the three cultural groups in provoking their social anxiety, participants responded to an open-ended question online, "For the following categories, please create brief, specific situations where someone would feel socially anxious," and generated a total of 610 unique social situations; 313 by Japanese participants and 297 by European American participants.

In accordance with the situation sampling method, each participant in the current sample answered a unique set of randomly selected situations. We randomly selected 30 situations, 15 generated from each cultural group and asked the current participants to rate the degree to which they would experience social anxiety in this situation ("How anxious would you feel if this situation happened to you?"; 1 = None, 5 = Extremely Anxious). Please see Krieg (2018) for a detailed description of situation preparation, cleaning, and redistribution procedures.

STUDY 1 RESULTS

Step 1: Identifying Potential Contingencies

In order to generate a list of antecedent conditions that would provoke social anxiety among members of each culture group, we used the first part of the situation sampling procedure [described as 'pilot study' in Krieg's (2018) Study 1 "Methods" section]. The results of the pilot study were 610 social situations (297 from Europeans American and 313 from Japanese participants).

Step 2: Determining Functional Relationships

In order to establish a base rate of culture group differences in endorsed social anxiety, we calculated a Cohen's *d* effect size for the anxiety scores overall, irrespective of each situation. The base rate for the culture group differences in social anxiety was Cohen's *d* = 0.194 (95% CI: 0.152, 0.236). From this point, we calculated the effect sizes for culture group differences in social anxiety for each situation. The confidence intervals of these effect sizes were compared in order to identify if any situation antecedents produced a culture group difference in social anxiety over and above the base rate. Among all 610 situations, only three situations were associated with effect sizes that were either statistically significantly above or below the base rate and not overlapping with 0 (no effect). These six situations were *being with a boss/colleague* (*d* = 3.24; 95% CI = 0.77, 5.70), *admitting a fault* (*d* = 1.65; 95% CI = 0.30, 3.00), and *being called names* (*d* = −1.59; 95% CI = −2.99, −0.19). All of these situations were made by European-American participants (see **Figure 1**).

STUDY 1 DISCUSSION

When all of the variance from situations were collapsed into a single global category, a small-to-moderate culture group difference in social anxiety endorsements emerged, with Japanese participants scoring higher than European American participants. This particular effect size corresponds with the findings from prior meta-analyses (Krieg and Xu, 2015; Woody et al., 2015). As identified and disseminated in the original Krieg (2018) manuscript, both Japanese and European Americans generated approximately the same number of socially anxiety provoking situations in the first part of the situation sampling analysis. This result suggests that the saliency of social anxiety-provoking situations is approximately the same between the two culture groups. That said, the specific types of situations identified varied widely, with standardized culture group differences in social anxiety varying as a function of these situations. From a contextual behavioral perspective, it seems that the antecedents for social anxiety differ between the two groups, with some antecedents holding more influence on whether social anxiety will be endorsed.

Most situations had effect sizes that were unable to be differentiated from the overall effect, with only three situations being identified as "above and beyond" the base rate. These three situations had effect sizes showing Japanese participants endorsing more social anxiety than European Americans (*n* = 2) and vice versa (*n* = 1). When examining these situations for themes, it became apparent that in the two situations where Japanese participants expressed more social anxiety than European Americans contained elements of "having made a mistake in an official situation" (e.g., admitting a fault and being in a workplace setting). In contrast, the situation where European Americans endorsed more social anxiety when being verbally attacked by another person. By examining the patterns of effect sizes in these "over and above situations," we gained some preliminary evidence supporting the help-seeking function

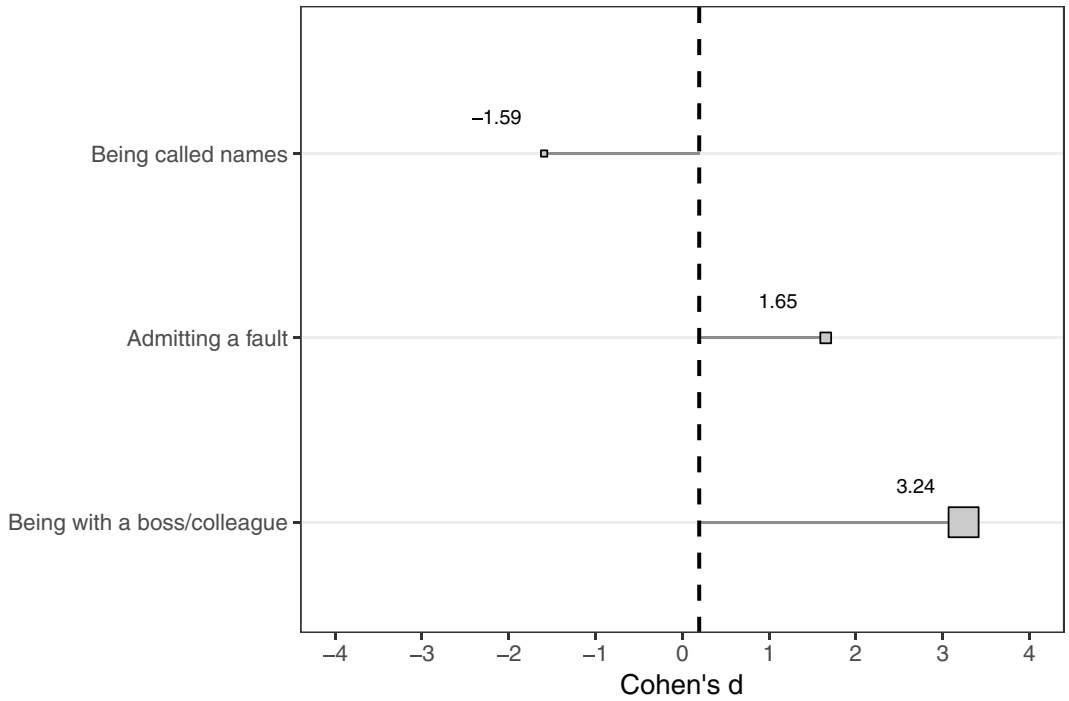

FIGURE 1 | Cohen's *d* effect sizes of culture group differences in social anxiety under three antecedent conditions relative to overall base rate effect size.

of social anxiety. Thus, we can generate a functional statement as follows:

> Displaying social anxiety [behavior] *functions to* garner social support or assistance [consequence] *when* having made a mistake in an official situation [antecedent] *among* Japanese relative to European Americans.

HYPOTHETICAL STUDY 2

In order to gather supporting evidence (Step 3) of our proposed functional statement, we conducted a quasi-experiment that directly tests the hypothesis through manipulating antecedent conditions. If the main difference between the two groups in terms of the functional consequences of social anxiety is its amenability to garner social support or assistance when having made a mistake in an official situation, then the degree of social anxiety expressed should vary in conditions were social support is potentially available as compared to social situations where it is less available. Study 2 is comprised of a hypothetical experiment of a speech task designed to elucidate the necessary antecedent conditions for the desired consequences of social anxiety among Japanese as compared to European Americans.

STUDY 2 METHODS

Participants

The simulated sample included 200 participants, 100 Japanese (50 female) and 100 European Americans (50 female). The mean age for these participants was 22.95 ($SD = 2.10$) and 21.82 ($SD = 1.73$) for each culture group, respectively.

Procedure

Participants were tasked with giving a 5-min speech in which they admit to a recent mistake they made at their workplace. After receiving 5 min to prepare, half of the participants were randomly assigned to give their speech in front of a video camera (camera condition) while viewing a video of stock footage of a small classroom listening to a speech projected on a nearby wall. No one else was in the room while the speech was being video recorded. The other half gave their speech in the presence of seven confederates (research assistants matched to the participant's cultural background). In the audience condition, the speech was also video recorded. Upon completing the speech, participants were escorted to a separate room where they completed questionnaires that measured social performance anxiety and perceived social support. Given that the study's hypotheses and experimental conditions were concealed at the beginning of the study in order to reduce the impact of response bias. Participants were debriefed of the study's hypothesis and conditions following the completion of the speech task by the principal investigator.

Measures

Social Performance Anxiety

The Social Phobia Scale Six-Item Version (SPS-6; Peters et al., 2011) is a short version of Mattick and Clarke's (1998) Social Phobia Scale, and measures social performance anxiety on a

5-point Likert scale (0 = not at all characteristic or true of me; 4 = extremely characteristic or true of me). The six-item version was created by selecting items with the best psychometric properties using Item Response Theory. As a result, the SPS-6 has excellent reliability, validity, and sensitivity to change properties (Peters et al., 2011). Krieg et al. (2019) found that the SPS-6 was scalar invariant between Japanese and European American samples, allowing means to be compared. The inter-item reliability within the current sample is 0.88 for Japanese and 0.93 for European Americans.

Perceived Social Support

In addition to measuring self-reported social anxiety, we administered a single-item question to participants asking, "how often did you feel that your audience was supporting you as you made your speech." Responses were on a 5-point Likert scale with 0 representing "not at all" and 4 representing "all the time."

Social Anxiety Displays

Three bilingual research assistants (two Japanese and one European American) who were blind to experimental conditions assigned to participants, rated each participant's behavioral displays of anxiety from the video recordings. Specifically, the research assistants used the Behavioral Assessment of Speech Anxiety (BASA; Mulac and Sherman, 1974), a standardized behavioral assessment scale, to rate specific behaviors associated with social anxiety. The BASA examined eighteen specific behaviors, e.g., fidgeting, swallowing, breathing heavy, and each were coded using a 7-point Likert scale (1 = not at all, 7 = strong). Each rater coded all of the videos and inter-rater reliability was calculated as an intra-class correlation of 0.91 (CI: 0.88, 0.94). Final scores consisted of the rounded average. All eighteen ratings were summed together to generate a final behavioral score (alpha = 0.83). The BASA has demonstrated evidence of internal consistency, inter-rater reliability, and concurrent validity with expert ratings of speech performance in prior Western studies (Mulac and Sherman, 1974; Heeren et al., 2012). Simulated means and standard deviations for each group can be found in **Table 2**.

TABLE 2 | Means and standard deviations of simulated SPS-6, social support, and BASA data for each culture group and condition.

		Japanese (n = 100)		European Americans (n = 100)	
Variable	**Condition**	**Mean**	***SD***	**Mean**	***SD***
SPS-6	Camera	3.33	0.76	2.98	0.89
	Audience	3.48	0.66	2.69	0.85
	Overall	3.41	0.71	2.84	0.88
Social support	Camera	1.90	0.57	1.97	0.51
	Audience	2.33	0.39	0.205	0.33
	Overall	2.12	0.54	2.01	0.42
BASA	Camera	32.28	6.74	34.11	6.05
	Audience	37.53	5.53	34.86	6.41
	Overall	34.90	6.68	34.49	6.21

SPS-6, Social Phobia Scale – Six item version; BASA, Behavioral Assessment of Speech Anxiety.

STUDY 2 RESULTS

Step 3: Gathering Supporting Evidence

Mean Differences

In order to gather additional support hypothesis that increased displays (endorsements) of social anxiety functioned primarily in situations where having made a mistake in an important situation, we first explored mean differences between culture groups and experimental conditions. To this end, we implemented a multivariate general linear model that regressed social performance anxiety, perceived social support, and social anxiety displays on culture group, experimental condition, and the interaction between the two.

For social performance anxiety, as measured by the SPS-6, our analysis revealed a statistically significant main effect for culture group (B = 0.34, p = 0.033), with Japanese participants reporting experiencing more social anxiety. There was no effect found for experimental condition (B = −0.29, p = 0.72), and the results of the interaction effect were also statistical significance (B = 0.45, p = 0.049).

For perceived social support, our results demonstrated no main effect for culture group (B = −0.07, p = 0.442), or experimental condition (B = 0.08, p = 383). However, the culture group x experimental condition interaction effect was also statistically significant (B = 0.35, $p < 0.01$), with Japanese participants scoring higher overall, but especially in the live audience condition.

Finally, for social anxiety displays, as measured by the BASA, our analysis revealed no main effect for either group (B = −1.83, p = 0.140) or experimental condition (B = 0.74, p = 0.550). However, the results did demonstrate a statistically significant interaction effect for culture group × experimental condition (B = 4.50, p = 0.011), with Japanese participants scoring higher in the live audience condition (see **Figure 2**).

Mediation Modeling

Given that the pattern of mean differences suggested that the experimental condition may predict social anxiety displays and perceived social support among Japanese but not necessarily European Americans, we used structural equation modeling (SEM) to examine the potential mediating effect of social anxiety displays in the relationship between experimental condition and perceived social support.

Specifically, we constructed two path models, one for Japanese participants and one for European American participants. We specified direct paths from experimental condition (1 = live audience) and perceived social support, as well as between perceived social support and anxiety displays. Social performance anxiety was included as social anxiety display's covariate. Each model was estimated using the maximum likelihood estimator implemented with the 'lavaan' package (Rosseel, 2012) with R (R Core Team, 2014).

The results of our analyses revealed that among Japanese participants, social anxiety displays fully mediated the

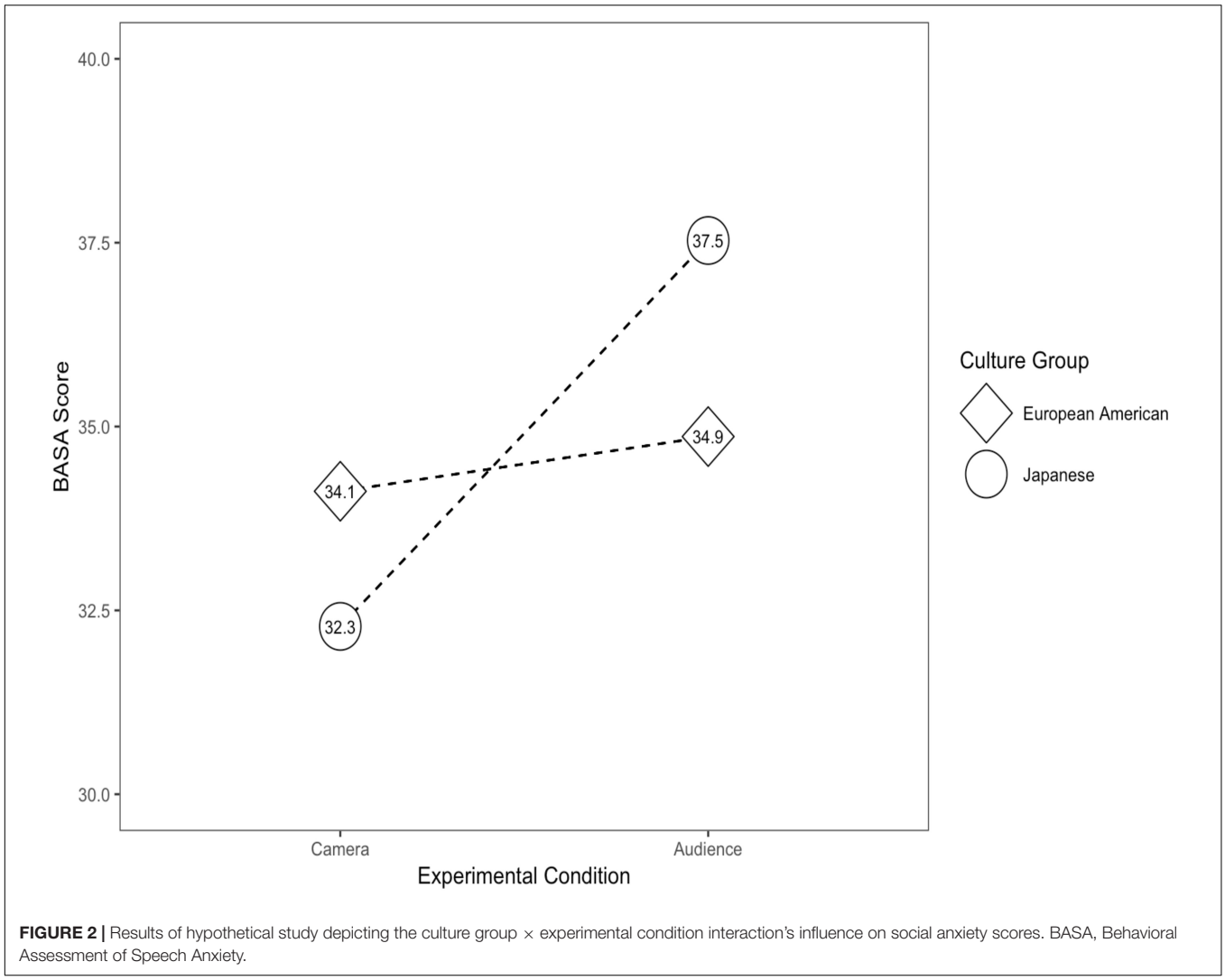

FIGURE 2 | Results of hypothetical study depicting the culture group × experimental condition interaction's influence on social anxiety scores. BASA, Behavioral Assessment of Speech Anxiety.

relationship between experiment condition and perceived social support (CFI: 0.999, TLI: 0.998, RMSEA: 0.036, and SRMR: 0.023). However, for European Americans, neither path coefficient was statistically significant, and model fit was low (CFI: 0.818, TLI: 0.453, RMSEA: 0.421, and SRMR: 0.192). See **Figure 3** for a depiction of the model as well as specific details on path coefficients.

STUDY 2 DISCUSSION

The results of Study 2 demonstrate the impact of the antecedent situation on the cultural group differences in social anxiety. By changing one aspect of the antecedent (i.e., camera vs. live audience) the behavioral expression changed based on its intended function. Assuming that the hypothetical experiment replicates with real experimental data, Study 2 would also provide the additional evidence needed to support the functional statement derived from Study 1. We would have provided support for the functional statement, "displaying social anxiety functions to garner social support or assistance when having made a mistake in an official situation among Japanese relative to European Americans." However, it is also important to note that behavior can have multiple functions within the same context. Because anxiety displays can function to foster social support in one group does not necessarily mean that it cannot also be a reaction to the threat of being scrutinized or criticized by peers as concluded in Okazaki (1997) and Krieg et al. (2018).

That being said, this functional statement is fundamentally different than statements previously made in the literature that associated social anxiety behavior with mentalistic constructs like independent and interdependent self-construal in that each aspect can be directly observed and requires no further explanation (e.g., "where does self-construal come from," "where is it located," "is it malleable across the lifespan," and "what predicts self-construal," etc.). It also positions culture in a larger context that is not limited to geography or nationality. For instance, if social anxiety functions to facilitate social support among Japanese people, are there other groups that seek social support in a similar way? What about a different way? Would

the different group's social support seeking strategies also work in a Japanese context? If not, what alternative consequences are generated instead? Have social support seeking strategies changed over time? Does this align with changing contingencies in the environment or simply a product of behavioral variation (e.g., cultural drift)? Many of these questions can be asked and answered within single sample studies.

Furthermore, examining social anxiety through a CBS lens centers the examination on adaptability rather than pathology, reducing the stigma of certain behaviors in certain groups by explicitly stating how the behavior is reinforced by desirable consequences (or avoiding undesirable consequences.). This hypothetical study would posit a new conclusion is that social anxiety is more adaptive in a Japanese context than an European American context in terms of garnering social support, which is a very different conclusion than suggesting that people of Japanese heritage being intrinsically more anxious than European Americans. The concept of differential adaptability is necessarily focused on the environment, rather than the person or group of people responding to it.

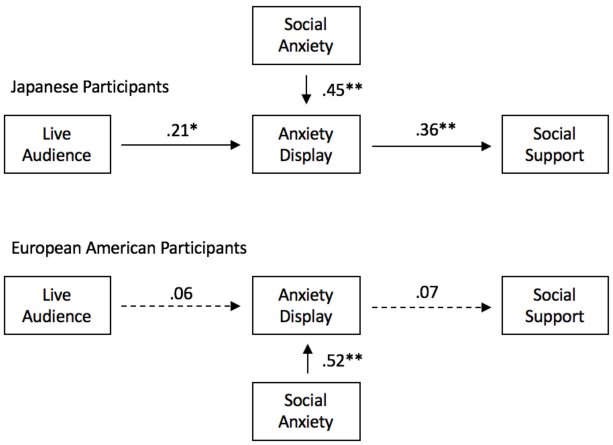

FIGURE 3 | Hypothetical path model and standardized coefficients for each cultural group. *$p < 0.05$ and **$p < 0.01$.

GENERAL DISCUSSION

In the current studies, we attempted to provide a simple example of implementing functional behavioral methodology in an established program of culture research. First, we generated a list of antecedent conditions and proposed functional consequences from the extant literature (Step 1). Then we determined functional relationships by examining differences in the effect sizes of a behavior among different antecedents relative to its overall base rate (Step 2). We then used a functional statement to generate testable hypotheses and explicitly sought evidence to support the statement (Step 3).

It is important to note that there are already many cultural psychologists doing work that would be proposed by this model, though maybe under a different name. For instance, the socioecological framework also emphasizes antecedent conditions within a social ecology to predict differences in cultural practices (Talhelm and Oishi, 2019). For instance, Gelfand et al. (2011) examined the degree to which tight situational constraints in modern cultures could be explained by historical population density. Arguing that historical population density created a survival pressure in these cultures, their study showed a strong correlation between ecological antecedents and cultural behaviors. Their conclusion, however, is more of an explanatory statement (answering "why") than a functional statement (answering "what for").

Some advantages of a CBS perspective include the emphasis on adapting to one's context (de-pathologization), focus on directly measurable behaviors (observable behavioral outcomes), and the amenability to intervention development. By describing how certain behaviors "work" in a certain context, but not necessarily others, the emphasis shifts from pathology to adaptability. The idea of differential adaptability is especially important in potentially explaining functional differences in behavior or a behavioral syndrome between groups in a non-stigmatizing manner.

Likewise, by having behavioral definitions for each construct of interest, we reduce the challenges associated with relying on mentalistic concepts (Ryle, 1984; Baum, 2017). Given that the main objective of CBS is to predict behavior and successfully intervene based on its function, once we have established and supported a functional statement, further hypotheses abound. We could expand the statement to include multiple consequences or a series of antecedents in order to better predict behavior in context as well as design effective interventions.

Adapting culture-group findings to individual clients is not terribly difficult. With this type of analysis already in place, updating the model to include information related to a client's idiographic learning history is entirely plausible. A clinician can examine the degree to which known contingencies associated with a given behavior apply to their client and can structure questions and in-session activities to gather further evidence. Sharing functional analyses with clients can also be helpful in facilitating a new understanding on how concerning behavior is reinforced and may have been initially or occasionally adaptive.

No approach is without its limitations, however, and one important limitation is that behavior analysis itself is a culture (Ruiz and Roche, 2007), and using behavioral language evokes a set of Western values associated with action, causation, health, and wellbeing. By emphasizing these constructs, there is the possibility of missing important information that doesn't necessarily conform to a behavioral framework. Likewise, although in clinical practice, behavior analysts are focused on the ideographic saliency of a reinforcer for each client, that nuance seems to be lost when using the same model to compare behaviors among different culture groups. To this point, there is evidence to suggest that, in general, European Americans find contingencies related to enhancing one's influence on others more salient, whereas Japanese participants were more focused on contingencies that highlighted adjustment to others (Morling et al., 2002). Not every antecedent or consequence can be readily

compared. Keeping these potential limitations in mind, cultural scientists or culture-clinical researchers can evoke the strengths of this approach to better understand culture's influence on behavior in context.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Hawaii Human Studies Program. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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A World Unto Itself: Human Communication as Active Inference

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Recent theoretical work in developmental psychology suggests that humans are predisposed to align their mental states with those of other individuals. One way this manifests is in *cooperative communication*; that is, intentional communication aimed at aligning individuals' mental states with respect to events in their shared environment. This idea has received strong empirical support. The purpose of this paper is to extend this account by proposing an integrative model of the biobehavioral dynamics of cooperative communication. Our formulation is based on *active inference*. Active inference suggests that action-perception cycles operate to minimize uncertainty and optimize an individual's internal model of the world. We propose that humans are characterized by an evolved *adaptive prior belief* that their mental states are aligned with, or similar to, those of conspecifics (i.e., that 'we are the same sort of creature, inhabiting the same sort of niche'). The use of cooperative communication emerges as the principal means to gather evidence for this belief, allowing for the development of a shared narrative that is used to disambiguate interactants' (hidden and inferred) mental states. Thus, by using cooperative communication, individuals effectively attune to a hermeneutic niche composed, in part, of others' mental states; and, reciprocally, attune the niche to their own ends via epistemic niche construction. This means that niche construction enables features of the niche to encode precise, reliable cues about the *deontic* or *shared value* of certain action policies (e.g., the utility of using communicative constructions to disambiguate mental states, given expectations about shared prior beliefs). In turn, the alignment of mental states (prior beliefs) enables the emergence of a novel, contextualizing scale of *cultural* dynamics that encompasses the actions and mental states of the ensemble of interactants and their shared environment. The dynamics of this contextualizing layer of cultural organization feedback, across scales, to constrain the variability of the prior expectations of the individuals who constitute it. Our theory additionally builds upon the active inference literature by introducing a new set of neurobiologically plausible computational hypotheses for cooperative communication. We conclude with directions for future research.

Keywords: cooperative communication, mental state alignment, evolution, development, active inference, adaptive prior, free energy, circular causality

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"*The point we emphasize is strong confidence in our original nature*,"

Suzuki (1970/2014, p. 35)

INTRODUCTION

An influential body of recent work on human communication describes it as *cooperative communication*. Cooperative communication is defined as intentional communication aimed at the alignment of mental states between conspecifics (reviewed in Tomasello, 2008, 2014, 2019). This is thought to be one particularly important behavioral manifestation of a broader, species-typical motivation to align mental states with those of others (Tomasello et al., 2005). Some have hypothesized that this motivation is the result of selective pressures acting on human evolution in the context of interdependent collaborative foraging (Tomasello et al., 2012; Whiten and Erdal, 2012). In scenarios where individuals in a group must forage together for resources (food, water, information, etc.), the alignment of multiple individuals' goals, intentions, and attentional processes is necessary for success (e.g., Liebenberg, 2006). This view has been useful for empirical investigation in developmental and comparative psychology (reviewed in Call, 2009; Carpenter and Liebal, 2011; MacLean, 2016).

The purpose of this narrative review is to extend the approach to cooperative communication introduced above by leveraging a recent *active inference formulation* in theoretical neuroscience and biology (Friston, 2012, 2013; Friston and Ao, 2012). This formulation of living systems provides a formal account of the dynamics of belief-guided, embodied action from first principles of biological self-organization (e.g., Friston et al., 2014; Sengupta et al., 2016). A formal account is arguably important, because it forces one to make explicit one's theoretical predictions in experimental and modeling work that investigates the usage, development, and cultural evolution of human communication (e.g., Christiansen and Kirby, 2003; McCauley and Christiansen, 2014). Furthermore, and although this is not the primary focus of this work, by proposing an active inference formulation of cooperative communication, we pave the way for a set of well specified predictions about the neurocomputational dynamics underwriting cooperative communication (Friston, 2010; e.g., Bastos et al., 2012; Adams et al., 2013; Parr and Friston, 2017, 2018). This is important, as precisely formulated neuroscientific hypotheses are largely absent from extant work on cooperative communication.

In brief, active inference is a mathematical formulation of the tendency of living systems to maintain themselves in a restricted set of states (i.e., their phenotypic states) while embedded in a fluctuating, partially observed environment (Friston, 2012, 2013). More precisely, active inference formalizes the structure of exchanges between organisms (individuals and groups) and their environment by explaining how the structure and function of organisms and their ecological niches become *attuned* to, or predictive of, each other (Bruineberg et al., 2018a). In short, active inference suggests that every organism optimizes its internal (generative) model of the world via circular or self-fulfilling action-perception cycles that minimize an upper bound on biophysical surprise (i.e., variational free-energy). In turn, the environment becomes attuned to the organisms that inhabit it (Constant et al., 2019). We will see later that this is formally equivalent to maximizing the evidence for internal or generative models of the world – and that when the world (e.g., the cultural niche) is 'shared,' then the generative models of its denizens become committed to a (reliably) shared narrative.

Following a recent hypothesis of the embodied human brain derived from active inference, called the hierarchically mechanistic mind (Badcock et al., 2019a,b), our proposal combines active inference with substantive research in psychology and allied disciplines that captures the specific evolutionary, developmental, and real-time dynamics that underlie the human capacity for cooperative communication.

A key corollary of this approach is the construct of an *adaptive prior* (Badcock et al., 2019a,b). Adaptive priors are evolutionarily endowed, heritable beliefs[1] that guide characteristic patterns of cognition and behavior in conspecifics. In other words, adaptive priors have been shaped by selection to steer action-perception cycles toward adaptive, unsurprising outcomes (Ramstead et al., 2018; Badcock et al., 2019a,b). Such priors depend upon genetic, epigenetic, and/or cultural inheritance, and often incorporate learned, *empirical priors* gleaned from experience to allow for sensitive adaptation to the local environment (Badcock et al., 2019b). Stated otherwise, adaptive priors effectively constrain the space of prior beliefs learned during ontogeny to enable adaptive action in local cultural niches (Badcock et al., 2019b).

Our proposal is as follows. We suggest that natural selection has endowed humans with an *adaptive prior for alignment*; i.e., an adaptive prior preference for action policies that generate sensory evidence that reliably indicates that their own mental states are aligned with, or similar to, those of conspecifics. This adaptive prior fosters intentional, patterned action sequences that gather *evidence* (i.e., sensory observations) for this belief; that is, that gather evidence for the hypothesis that 'we are the same kind of creature, inhabiting the same kind of niche.' The adaptive prior here functions to bias action and inference by leading agents to actively sample their sensorium in a way that, on average and over time, disambiguates conspecifics' (hidden) mental states. This sampling process is therefore *guided by*, and *generates evidence for*, the belief that our mental states are aligned. In short, we cast cooperative communication as an evidence gathering process; indeed, one that extends across temporally nested scales of analysis. The existence of this process follows from, and only from, an adaptive prior specifying the alignment of individuals' mental states[2]. Cooperative communication can thus be cast as a self-fulfilling prophecy, driven by the belief that we are alike. This belief is

[1]Crucial to our account, in the active inference formulation 'beliefs' refer to (subpersonal) Bayesian beliefs – in the sense of Bayesian belief updating or belief propagation (as opposed to propositional beliefs).

[2]On a deflationary view, this is the only solution that can exist, in terms of minimizing the surprise or free energy of coupled free energy minimizing agents. See below and Friston et al. (2015a) for a fuller discussion in the context of pattern formation.

then characteristically reinforced by the evidence generated by belief-guided communication.

Shweder and Sullivan (1993, p. 506) wrote that "cultural psychology endeavors to understand how such divergences [in the processes that underwrite consciousness] relate to acts of interpretation and to the socially constructed meaning or representation of stimulus events." The present article contributes to the project of cultural psychology and neuroscience (e.g., Han, 2015; and articles in the present collection) by explaining how a cultural milieu can shape and direct the dynamics of individual minds; and, in turn, how individual minds can shape their cultural milieu. We do this by providing an account of sociocultural cognition based on a shared adaptive prior for alignment, drawing on the active inference formulation. In turn, we argue that *how* one's cultural experience manifests in any given time and place – the particular tools one that uses in coming to grips with their world (i.e., words, gestures, and concepts) – is dependent on the history and current contingencies of one's culture and the minds, practices, and places that make it up.

The structure of the remainder of the paper is as follows. In order for readers to appreciate the broader context that underscores our proposal, we devote our second section to a review of some of the key phenomena that underwrite cooperative communication, as emphasized by other theorists to date. In the third section, we introduce relevant aspects of active inference, illustrated by examples drawn from studies of cooperative communication. In the fourth section, we leverage the background provided in the second and third sections to argue that human species-typical adaptive priors prescribe the alignment of one's mental states with those of conspecifics. This latter argument is presented in three subsections. The first subsection focuses on real-time dynamics (i.e., interaction) from the perspectives of an individual and dyad, respectively; the second focuses on ontogeny; and the third focuses on the timescale of cultural evolution. Our paper concludes with a few comments about the limitations of the current proposal of an adaptive prior for alignment. This is complemented with suggested directions for future research.

THEORETICAL BACKGROUND

The Evolutionary Origins of Cooperative Communication

Evolutionarily selected 'mutual expectations of cooperativeness' are thought to motivate the usage of cooperative communication (Tomasello, 2014). From the perspective of evolutionary biology, these expectations can be explained by considering the selective contexts that favored them. One promising candidate is so-called obligate collaborative foraging (Tomasello et al., 2012), where adaptive success in securing food and other resources is marked by a necessary dependence on cooperation with others (also, Baumard et al., 2013). For instance, in mutualistic 'stag hunt' games, a single individual is necessary to obtain a low risk, but low reward, food item (a hare), but two individuals are necessary to obtain a high risk, but high reward, food item (a stag). Here, collaboration appears as the riskier, but more rewarding, option[3]. It is riskier because, to cooperate effectively, the would-be partners must somehow align their mental states – their goals, intentions, and attention (Skyrms, 2001). Cooperative communication is thereby favored as a means to intentionally bring about the alignment of mental states. For instance, in high risk stag hunt scenarios preschool children communicated more, and more often, relative to low risk situations (Duguid et al., 2014). Such joint foraging scenarios may point toward an important and recurrent aspect of the early selective pressures that favored the motivations and skills underlying cooperative communication (Tomasello, 2008; e.g., McLoone and Smead, 2014).

Research examining the communicative behavior of extant non-human primates is crucial for understanding the evolutionarily nascent form of modern humans' communicative motivations and skills (Call and Tomasello, 2007; Mitani, 2009). Such work suggests that, generally speaking, the motivation and skills of non-human primates for intentional communication may have been gradually 'cooperativized' across human evolution (Tomasello, 2014); that is, exapted for both cooperative and competitive purposes with conspecifics. This trajectory may have begun with the usage of gestural communication geared toward simply eliciting specific responses from certain individuals (Call and Tomasello, 2007). For instance, something like ritualized great ape 'attention grabbers' – where an individual has learned that (for a certain conspecific) an action like slapping the ground loudly will likely bring about a desired state of the world (e.g., the initiation of play; Tomasello, 2008) – may have been the evolutionary precursor to certain manifestations of cooperative communication, like declarative pointing (Tomasello, 2019). Indeed, the motivational component is key (Rekers et al., 2011): human-raised non-human great apes will occasionally point for humans (though never for conspecifics). However, they only do this 'selfishly,' that is, only when they expect the gesture to cause the individual to (say) get an out-of-reach object for the ape (Bullinger et al., 2011). In contrast, with cooperative communication, the underlying motive is argued to be 'fundamentally' cooperative (Tomasello, 2019); that is, from the onset of cooperative communication in ontogeny, human infants only appear satisfied following a communicative bid when their communicative partner has aligned their mental states with their own, with respect to the infant's intended referent (reviewed in Carpenter and Liebal, 2011; for comparative considerations, see Carpenter and Call, 2013).

The Developmental Origins of Cooperative Communication

Human infants begin to use cooperative communication to align and coordinate mental states at 9–12 months of age (Carpenter et al., 1998). This window of emergence in ontogeny

[3]In the active inference formulation, below, collaboration is 'rewarding' in the sense of maximizing a shared or *prosocial utility* (Yoshida et al., 2008; Devaine et al., 2014).

is strongly maturationally constrained (Matthews et al., 2012), as evidenced by the emergence of communicative pointing at this age in every cultural setting studied (Callaghan et al., 2011; Liszkowski et al., 2012; Lieven and Stoll, 2013). One way this manifests initially is in declarative pointing gestures directed toward referents in the immediate environment. Experimental work suggests that the goal of infants' communication in such cases is to mutually align emotions, attitudes, and/or thoughts about a referent with another individual (Tomasello et al., 2007; e.g., Liszkowski et al., 2007, 2009). Consistent with this, infants become disgruntled when others ignore their communicative bids for alignment. For instance, Liszkowski et al. (2004) found that infants became unsatisfied with uncooperative adults who ignored infants' communicative bids, who did not provide an emotional response symmetrical to the infant's, and who did not shift the focus of their attention back and forth between the infant and their referent. This suggests that one aspect of the desired state of the world that motivates infants' earliest communication simply *is* alignment with other agents' mental states (Tomasello et al., 2007).

This example illustrates a signal feature of cooperative communication; namely, joint attention to a referent (Tomasello, 2008). There is substantial inconsistency in definitions of joint attention within and across psychological subdisciplines (Siposova and Carpenter, 2019). We follow the lead of Tomasello and colleagues (e.g., Tomasello, 1995) by defining *joint attention* as triadic situations in which two or more individuals possess reliable evidence that all participants are attending to the same referent, *and* that all participants know they are attending to the same referent (i.e., 'attending together'). This formulation of joint attention – in terms of reliable evidence for the mutually inferred alignment of attention (cf. mental states) – fits well with our proposal, which mandates the gathering of reliable evidence for the alignment of mental states.

The importance of joint attention for enabling cooperative communication comes from the fact that joint attention enables, and is enabled by, individuals' capacity to reliably 'ground' their communication in shared referents (Clark, 1996). Grounding creates something called common ground (Clark and Brennan, 1991). *Common ground* is the set of mental states (knowledge, beliefs, emotions, etc.) that is inferred to be reliably shared with others (Clark, 1996; Gadamer, 2004; Tomasello, 2014). The capacity to regulate communication with others by leveraging joint attention and common ground is present from the onset of cooperative communication (Tomasello et al., 2007). For instance, young infants use their shared experience with a particular person to interpret and produce utterances and pointing gestures directed toward that individual (Tomasello and Haberl, 2003; Ganea and Saylor, 2007; Saylor and Ganea, 2007; Liebal et al., 2009, 2010).

Moreover, part of regulating communication with respect to common ground is understanding, for instance, that one must try to 'fit' their communication to the inferred needs of another (Clark and Wilkes-Gibbs, 1986). As a simple example of this kind of 'perspectivizing' (Verhagen, 2007) or 'recipient design' (Schegloff, 2006) process, consider that how one chooses to talk about an artifact varies as a function of the inferred amount of cultural common ground shared with one's interlocutor. In the presence of much cultural common ground, a communicator might opt for brevity; and conversely, in the presence of less cultural common ground, one might use more precise (explicit, descriptive) language. For instance, when conversing with someone from non-Western cultural groups, one might employ the more cumbersome, longer descriptive utterance "the jolly old man in a red suit who gives presents to children" instead of the shorter proper name "Santa Claus". The upshot is that, in general, more common ground means less communication is needed to align mental states to a sufficient degree, and less common ground means more communication is required (Tomasello, 2008). In other words, the amount of information necessary to align mental states to a degree adequate to enable cooperative behavior within a given context is inversely proportional to the amount of common ground.

This turns on an important point: the optimization of relevance in cooperative communication (Sperber and Wilson, 1986). *Relevance* refers to the complexity-accuracy trade-off involved in the production and interpretation of communication; e.g., the trade-off between simplicity or compressibility, and meaningfulness or expressivity. A useful way to think about how this trade-off is finessed is in terms of communicative constructions (Goldberg, 2003). *Communicative constructions* are patterned pairings of form and meaning (e.g., word parts and order, intonation) whose synchronic use and form are the result of diachronic patterns of use and associated intergenerational transmission (e.g., processes of grammaticalization and reanalysis; Heine and Kuteva, 2002; Bybee, 2010). Cooperative communicators use communicative constructions to communicate (and thereby align their mental states).

Optimizing relevance, for a speaker, therefore means using the most minimal form that is expected to enable a listener to recover (something sufficiently similar to) the intended meaning (Kanwal et al., 2017); and for a listener, it means inferring the most parsimonious meaning that sufficiently explains the speaker's intentions (Kao et al., 2014; see Goodman and Frank, 2016). This means, as above, that individuals sharing more common ground require less form to adequately align mental states, while those sharing less common ground require relatively more form (Winters et al., 2018). Relatedly, simpler propositions generally require less form to convey, and more complex propositions require more form (Kemmer, 2003). Producing and interpreting relevant communicative constructions thus has implications across the communicative signal, which spans from (e.g.) lexical selection and word order choice to the sequencing of particular phonemes and intonation patterns (Aylett and Turk, 2004).

Importantly, how might an individual recognize another's intention to generate an act of communication intended 'for' oneself in the first place (e.g., Behne et al., 2005)? From another perspective, how might one make mutually apparent one's proximate motivation to align mental states, that one is communicating 'for' another individual? To this

end, researchers have proposed that *ostensive cues* (Sperber and Wilson, 1986), like eye contact, spatiotemporal contingency, and the communicative (e.g., vocal) signal itself, play an important role in making mutually apparent an agent's intentions to communicate information intended to align mental states (reviewed in Csibra, 2010; indeed, Tomasello, 2014, synonymously calls cooperative communication 'ostensive-inferential' communication). Ostensive cues work by 'grabbing' the attention of others to redirect it triadically (i.e., toward the intended referent) so as to comment on it (Szufnarowska et al., 2014). Thus, via their modulatory effects on the allocation of (joint) attention, ostensive cues play a critical (if indirect) role in increasing individuals' common ground and enhancing the reliability of one's inferences about this common ground (e.g., Moll et al., 2007). This has important downstream effects on subsequent behavior. For example, communicative eye contact causes preschoolers to quickly infer another's desire to collaboratively play a stag hunt game (Wyman et al., 2013; Siposova et al., 2018). Moreover, via their effects on attention, ostensive cues play an important role in guiding inductive inference and top-down categorization processes throughout ontogeny (Butler and Tomasello, 2016; Kovács et al., 2017).

Taking Stock

In sum, five key components characterizing cooperative communication were noted in this section. Discussion of these components structures much of the fourth section. First, great apes do not characteristically employ communication geared toward aligning mental states with conspecifics. Moreover, something like the motivations and skills underlying the communication of great apes likely served as a precursor to the evolution of cooperative communication in humans. Second, human communication is fueled by a motivation to align and coordinate mental states with conspecifics. This is a kind of mutual expectation of cooperativeness that is manifest most basically in processes of joint attention, which serves as a kind of 'evolutionarily endowed' common ground that gets the process of communication 'off the ground' in human ontogeny. Third, individuals using cooperative communication optimize the relevance of their communication, that is, the produced and inferred expressiveness of the communicative signal with respect to the production and processing costs of that signal. This depends on the common ground shared by interlocutors, such that, all else being equal, more common ground means less communication and less common ground demands more communication. Fourth, ostensive cues signal one's intention to communicate to another individual (and help one to disambiguate another's intention to communicate to oneself). These are cues like eye contact, contingency, and the speech signal itself.

Fifth and finally, it is useful to highlight that cooperative communication typically manifests, particularly in early ontogeny, as a circular or bidirectional flow of information (note, e.g., the double-arrowed base of the canonical 'joint attentional triangle'; Carpenter and Liebal, 2011). Thus, although we introduced cooperative communication by focusing largely on individual imperatives, it is a fundamentally collaborative process (Clark and Wilkes-Gibbs, 1986). The usage of cooperative communication is a relevance-optimized exchange of perspectives that manifests as a circular process of 'least collaborative effort' (Clark and Brennan, 1991). This characteristic circularity endows individuals with a single shared narrative constituted by their individual perspectives and roles in the collaborative exchange. **Table 1** summarizes these points along with several others introduced in the fourth section.

Implicit in the preceding discussion is the idea that it would be *surprising* – that is, highly atypical – to find an adult human without a communicative system that they could employ to align their mental states with those of others. In this sense, the usage of cooperative communication is a predictable, or expected, aspect that characterizes part of the human phenotype. A question one might ask is, How does this expectation over species-typical states (i.e., this aspect of the phenotype) persist, robustly, across time and (action in) a fluctuating niche?

TABLE 1 | Summary of key features circumscribing cooperative communication.

Scale of analysis	Characteristic dynamics and processes of cooperative communication
Real-time (mechanism)	• Ostension
	• Joint attention
	• Relevance optimization
	• Coupled, bidirectional flow of information
	• Proximate motivation to align and coordinate mental states (e.g., declarative, interrogative, and informative motives)
Development (ontogeny)	• Clearest behavioral onset at ∼9–12 months of age (i.e., cooperative pointing)
	• Gradual alignment with a conventionalized communicative system
Cultural evolution (phylogeny)	• Historical development of a communicative system (e.g., grammaticalization, syntactic reanalysis, and semantic bleaching)
	• Diversification of communicative systems across time, space, and speaker communities
Biological evolution (adaptation)	• 'Cooperativization' of non-human great ape communicative motives and skills (e.g., non-human ape attention getters as precursor to human declarative pointing)
	• Ultimate motivation to align and coordinate mental states (i.e., mutual expectations of cooperativeness)

Certain features, e.g., alignment with a communicative system, are discussed in the fourth section. This paper associates these phenomena with the corresponding scale of dynamics underwritten by the free-energy formulation and, more substantively, the hierarchically mechanistic mind (see Figure 4 in Badcock et al., 2019a).

ACTIVE INFERENCE

Active inference is a theory of belief-guided adaptive action (Friston et al., 2017a). It is a mathematical framework that models the processes by which organisms and their niche come to 'fit' or become 'attuned' to each other (for an introduction to the mathematical apparatus of active inference, see Bogacz, 2017; Buckley et al., 2017). In other words, active inference describes the manner in which organisms and their environments come to possess statistical properties that are predictable from each other (Bruineberg et al., 2018b; Constant et al., 2018). On this view, organisms come to embody statistical models of their ecological niche via perception and learning, and both cultural and natural selection (i.e., empirical and adaptive priors, respectively). Reciprocally, organisms modify their niche to fit their prior beliefs via adaptive action and niche construction. As detailed in **Figure 1**, the models in this formulation are 'generative models' that recapitulate the causal independencies between the factors that generate their sensory input (i.e., how the niche causes their sensory data; e.g., Hinton, 2007; LeCun et al., 2015). In active inference, organisms are, roughly speaking, normative models of what *ought* to be the case, given 'the kind of creature that I am' (Friston, 2011).

The main theoretical suggestion of this paper is that human individuals appear, characteristically (i.e., species-typically), to be endowed with an *adaptive prior that one's mental states are aligned with those of conspecifics*. Now, for human agents, the mental states of other agents are unobservable or 'hidden' states that need to be inferred on the basis of perceptual cues (e.g., gaze direction, posture, facial expression). In other words, mental state alignment is an inference problem: to align with others, an agent must infer the latent or hidden causes (i.e., mental states) that generate observable consequences (i.e., actions). Thus, for agents whose niche includes the mental states of other agents, the set of actions that resolve uncertainty about the niche must comprise actions that reliably disambiguate others' mental states[4]. We suggest that this is precisely the situation brought about by the presence of an adaptive prior for alignment. This adaptive prior fosters specific, patterned forms of (communicative) action and inference that are aimed at disambiguating the mental states of other agents. The characteristic result of this process is the alignment of mental states between conspecifics. The alignment process enables and maintains reliable hypotheses about shared narratives that contextualize our experience (Friston and Frith, 2015a).

Active Inference, Adaptive Priors, and Alignment

In active inference, actions are generated by hierarchically organized *policies* (beliefs about action). The policy pursued by an organism at a particular time is the one that minimizes an information-theoretic *variational free energy* term (Friston et al., 2015b; for a review of variational inference, see Blei et al., 2017). Roughly speaking, free energy quantifies the discrepancy between what an agent expects or prefers to sense and what it actually senses. This conception of free energy is closely related to prediction error (i.e., the mismatch between predicted and observed sensations; Clark, 2013). A complementary view of free energy is that it scores the (negative log) evidence for the internal model generating predictions, in the sense that sensory data that conform to predictions provide evidence for the veracity of the agent's generative model. In short, minimizing free energy is the same as soliciting sensory evidence for one's model of the world (sometimes known as 'self-evidencing'; Hohwy, 2016). On this view, we are our own existence proofs.

The free energy expected under a policy tracks the probability of that particular policy being pursued (i.e., of that specific policy being selected to guide action). Relatively less expected free energy indicates a relatively more probable policy (Friston et al., 2015b; Pezzulo et al., 2018; relatedly, Cisek, 2007). Expected free energy can be decomposed into two terms: *epistemic value* (the information gain of an observation), and *pragmatic value* (the expected log evidence of some outcome, given a generative model of how outcomes depend on action). The relative influence of each term quantifies the degree to which a particular policy generates actions that explore the niche (i.e., exploration), or actions that leverage reliable expectations about the niche to secure preferred outcomes[5] (i.e., exploitation) (Friston et al., 2015b). This is depicted in **Figure 1**[6].

Salient policies are those that have a high epistemic value or affordance (Parr and Friston, 2017). These energize actions that enable an agent to learn the statistical regularities of its environment (see caption, **Figure 1**). This, in turn, enables pragmatic imperatives to foster actions that capitalize on learned regularities (Friston et al., 2015b). For example, repeated exposure to the sensory phenomena characteristic of their culture's communicative constructions leads infants to become familiar with the statistical properties of those constructions (Romberg and Saffran, 2010). In turn, increasingly precise expectations about hidden causes may lead infants to prefer gathering information from speakers of their native language relative to speakers of a foreign language (e.g., Begus et al., 2016; Marno et al., 2016). This is predicted by the hypothesis that agents exploit their familiarity with the sensory phenomena characteristic of their culture's communicative constructions

[4]This is described anthropomorphically, as though individuals are explicitly engaged in an inference like 'I want to attune the statistics of our brains.' Clearly, this is not the case. Rather, this language is used for expository purposes. Indeed, this descriptive tendency is essentially the same as that used by, e.g., Tomasello (2019), where talk of humans' ultimate motivation to align and coordinate mental states often surfaces in place of proximate instantiations thereof. We thank L. Li (personal communication, December, 2018) for noting this ambiguity.

[5]These outcomes are *a priori* preferred because they are the least surprising ones; i.e., outcomes that 'a creature like me' would expect to encounter.

[6]A mathematically equivalent but complementary division of expected free energy is into *ambiguity* and *risk*. Ambiguity is the expected uncertainty about outcomes given some state in the future, while risk is the divergence between anticipated and preferred outcomes. Interestingly, risk is also the expected *complexity cost* found in statistics. This means that minimizing expected free energy – by selecting the right kind of policies – implicitly minimizes the complexity cost of inference. This is exactly the imperative established in the previous section; namely to find 'common ground' that minimizes communication cost. This particular perspective can be traced back to the foundational principles of universal computation, where variational free energy is often discussed in terms of minimum description or message lengths. See MacKay (1995), Wallace and Dowe (1999), and Schmidhuber (2010) for more discussion.

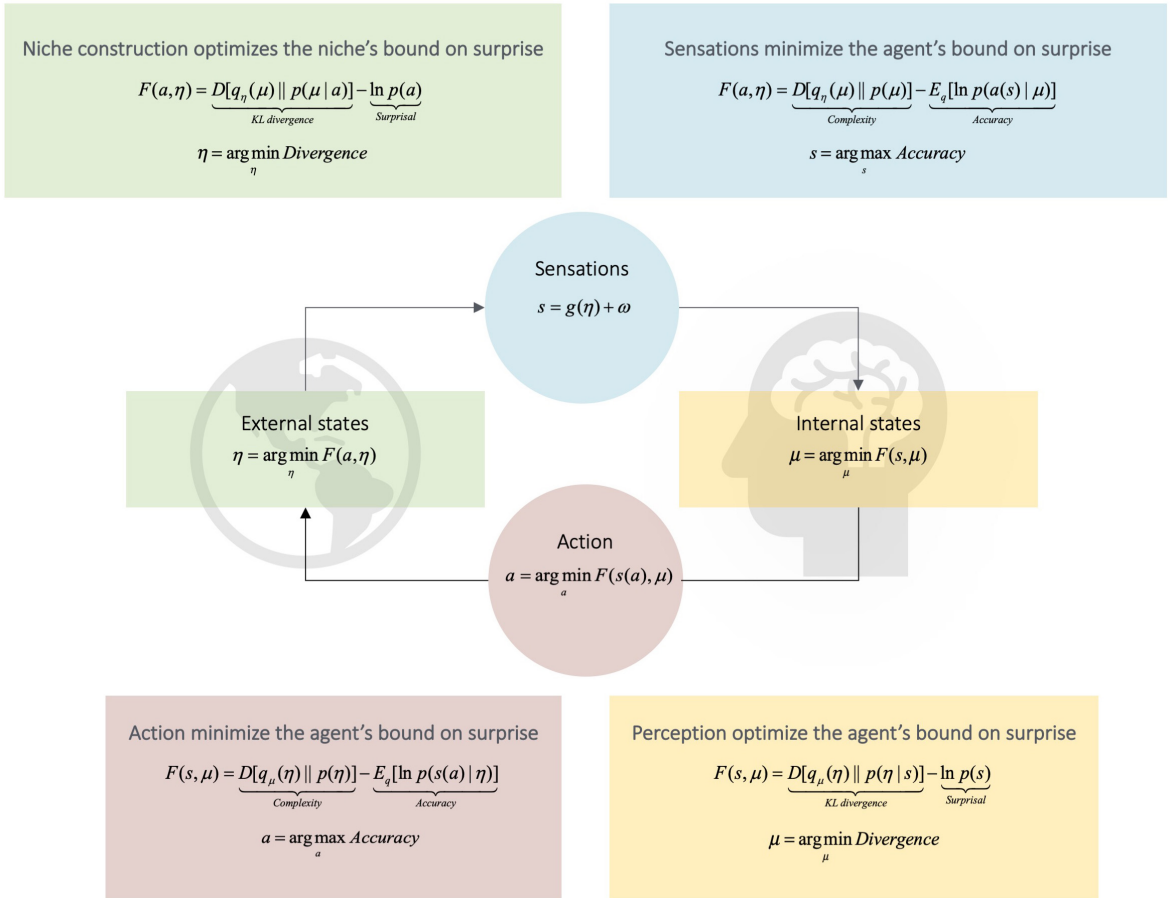

FIGURE 1 | Active inference. This Figure schematizes active inference. It depicts the coupling of an agent's internal states (the dynamics of which entail predictions or beliefs about the niche, μ) to its external states (the dynamics of the agent's niche, η). **Middle Panel:** The influence of the niche on the agent is given by the dynamics of the agent's sensations, *s*. Reciprocally, the influence of the agent upon its niche is given by the agent's action, *a*, upon the niche. This means that the niche is not directly observable from the perspective of an agent's internal states; and the agent's internal states are not directly observable from the perspective of the niche. From an agent's perspective, the niche is thus described as a set of *hidden variables*. Hidden variables must be inferred (i.e., predicted) from sensory observations. Thus, to minimize the probability of sampling surprising sensory states, the task for the agent is to attune the dynamics of internal states to those of the niche; or attune the dynamics of the niche to those of internal states. Attunement renders the agent an approximate (predictive) model of the hidden causes of its sensations. We can quantify the degree of attunement between organism and niche with a quantity called variational free energy (Bruineberg et al., 2018a; Constant et al., 2018). Free energy *F* bounds (i.e., is greater or equal to) the *surprisal –lnp(s)* associated with a sensation (Friston, 2010). Importantly, free energy is a function of two quantities to which the organism has access, namely, its sensations and predictions (for discussion, see Bruineberg et al., 2018a). **Lower Panel:** The bottom right details how perception optimizes free energy by implicitly minimizing a Kullback–Leibler (KL) divergence term *D*. The KL divergence tracks the statistical similarity of two distributions (Cover and Thomas, 1991); e.g., the similarity of prior beliefs about the state of the niche with posterior beliefs (Friston, 2012). Because the KL divergence provides an upper bound on surprisal, minimizing it renders the agent a model of the niche and thus implicitly bounds the surprise of sensory states. **Upper Panel:** These expressions define the relationship of the niche to the agent. Note the kind of 'mirror image' relationship between the equations in the (upper panel) with the equations in the lower. This relationship is a consequence of the mathematics of free energy minimization (see Bruineberg et al., 2018b; Constant et al., 2018). It means that the niche 'sees' and 'learns' about the agent (i.e., via the agent's action) in the same way an agent sees and learns about their niche (i.e., via the niche's 'action'). This insight is extended in **Figure 2**. Adapted with permission from Veissière et al. (forthcoming).

to guide attention toward sensory stimuli that is expected to be useful for disambiguating the mental states of others (**Figures 1**, **2**).

In active inference, the folk-psychological term 'attention' refers to two distinct, but closely related, phenomena; namely, epistemic value and *precision weighting* (Parr and Friston, 2017). Epistemic value, salience, or affordance is the component of policy selection just discussed; it is that component of the value of policies that tracks how much a policy reduces uncertainty about the state of the world (e.g., Friston et al., 2012). It provides a description of the folk-psychological phenomenon of actively orienting toward or 'turning one's attention' to a certain modality or part of the sensory field (e.g., in visual saccades that sample a particular location in visual space). In short, salience or epistemic affordance is an attribute of how we sample the world – in the sense that actively sampling sensory information will reduce uncertainty, in relation to our current beliefs. In contrast, precision is an attribute of the sensory data *per se*.

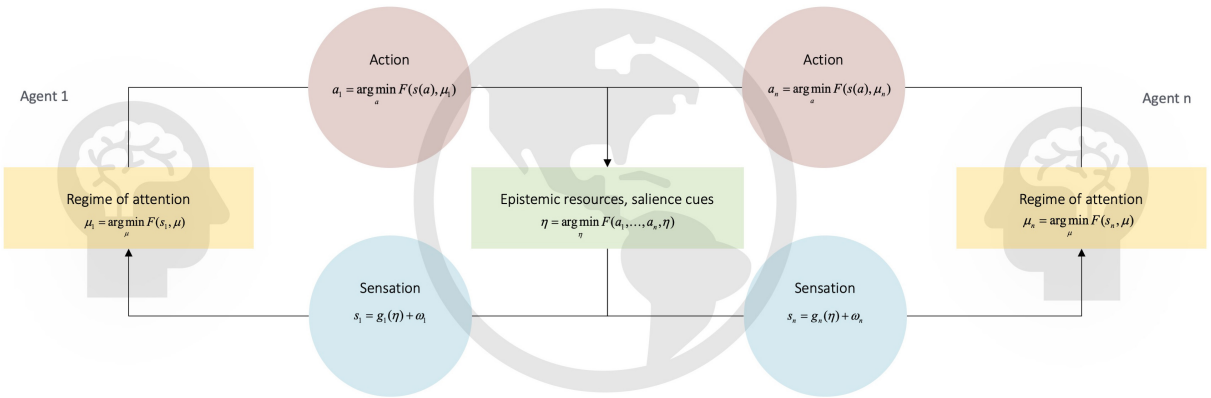

FIGURE 2 | Thinking through other minds. This Figure depicts a set of heuristic equations that describe the kind of free energy minimization hypothesized to underwrite the acquisition and production of learned cultural behaviors via the coupled dynamics sketched in the main text (full equations in **Figure 1**). In the context of human communication, coupled dynamics are energized by an adaptive prior for alignment. The adaptive prior for alignment specifies the characteristically enhanced precision of the hypothesis that 'we' exist. This prior motivates similar agents to actively couple their respective actions a_n and sensations s_n. Via the processes discussed in the main text, this statistical coupling of sensation and action enables each individual to reliably align with (i.e., infer) the hidden states μ_n of conspecific *n*. This circular process brings about a process of cultural niche construction that creates, maintains, and modifies a set of predictable epistemic (i.e., deontic) resources, η. These specify a set of high value (i.e., predictable) observation-policy mappings, which are used to disambiguate the mental states of conspecifics (Veissière et al., forthcoming). One important class of deontic resource is the set of observation-policy mappings that underwrite a system of communicative constructions (i.e., form-meaning pairings). This means that the use of communicative constructions plays a critical role in enabling agents with an adaptive prior for alignment to effectively disambiguate external states. This is because an agent's external states are constituted, in part, by the internal, mental states of another agent (and vice versa). This follows from the fact that external states cause sensation; for an agent equipped with an adaptive prior for alignment, inferring the motion of external states entails inferring other agents' hidden states. The production and observation of communicative constructions is useful because it effectively and flexibly guides 'regimes' of attention that enable species unique forms of cultural learning (see Ramstead et al., 2016; Veissière et al., forthcoming). Diachronically, communicative constructions are finessed by a community of agents via the inheritance and (intended or unintended) modification of constructions during either learning or usage. Adapted with permission from Veissière et al. (forthcoming).

Imprecise sensory data should have less effect on (Bayesian) belief updating, relative to precise information. It is therefore important to afford the right precision to each sensory sample, via precision weighting.

Precision-weighing is the related (but distinct) attentional process that determines the relative influence of bottom-up error signals and top-down expectations in the brain; e.g., a high precision on sensory signals corresponds to low confidence in top-down beliefs (Clark, 2013; Powers et al., 2016). That is, in the sense of precision-weighting, 'attention' refers to the optimization of the precision (inverse variance) of prior beliefs about the causes of sensory data, relative to the precision of those data; in other words, attentional selection is in the game of selecting the right sort of sensory information for belief updating. This precision weighting in the brain is thought to be mediated by the modulation of neuronal gain (Kanai et al., 2015). Precise (attended, ascending) error signals then serve to modulate action and direct what is learned (Feldman and Friston, 2010; Adams et al., 2013). The complement of this attentional selection is the attenuation of precision; known in psychophysics as *sensory attenuation*; i.e., attending away from or ignoring certain sensations; particularly those we cause ourselves.

Crucially, selective attention and attenuation of precision can be part of the covert (mental) actions that are entailed by a policy. In other words, when selecting the policy that minimizes expected free energy we are also committing to both overt action on the (embodied) world – through moving, blushing, speaking etc. – *and* a covert attentional set. We will now illustrate these aspects (orienting to salient stimuli and attentional selection) of active inference with two examples.

As a first example, in the case of human communication, orienting to salient sensory streams should enhance the ability to learn the causes (i.e., mental states) generating sensory evidence by making beliefs about mental states generating that stream more probable. With this in mind, note that one common motivation for infants' and young children's communication is quintessentially uncertainty resolving and 'interrogative' (Begus and Southgate, 2012; Harris et al., 2017). For instance, infants' pointing can function as a request for information about the name or function of objects (Begus and Southgate, 2012; Kovács et al., 2014). It is thus interesting that, in line with the present account, orienting to (the sensory effects of) one's communicative bids enhances learning of (e.g.) communicative constructions and object functions (Begus et al., 2014; Lucca and Wilbourn, 2018a,b; see Friston and Frith, 2015a). In short, infants evince sophisticated policies for resolving uncertainty and creating opportunities for epistemic foraging. In turn, attending to and learning the causes of the communicative stream then enables policies to exploit prior beliefs about how such sensations were caused; that is, inferring whether or not we are aligned, based on the evidence generated through our interactions (e.g., in using learned constructions to ask, explicitly, 'Do you understand?'). This brings us to our second example.

For agents who expect their predictions to be fulfilled, individuals who do not provide evidence for this expectation – despite one's attempts to actively attune mental states – should come to be treated as imprecise sources of sensory information, relative to others that fulfill their expected 'role' in the evidence gathering process; i.e., others that are afforded epistemic trust (Fonagy and Allison, 2014). In other words, in a given communicative interaction, salient policies are those that are expected to be useful with respect to the alignment of mental states; e.g., in certain instances of conversational repair (Schegloff et al., 1977). Across interactions with specific others, repeatedly experiencing surprising responses (i.e., insufficient evidence for, or evidence against, alignment) means that selective attention toward those specific others comes to be afforded low precision (i.e., ignored). Subsequently, action should lead the appearance, on average across time, of avoiding such unreliable parts of the niche (Constant et al., 2018) – much as we tend to avoid the dark when searching for something (Demirdjian et al., 2005).

We suggest that this provides an explanation of the findings by Liszkowski et al. (2004), discussed above, which reported that 12-month-old were dissatisfied with an uncooperative adult who failed to provide both look-backs between the infant and their intended referent and the same emotional response as the infant in response to the infant's communicative bids. On our view, infants were attempting a kind of fast 'error correction' by generating actions expected to minimize exposure to unexpected cues (i.e., allostatic control; see Pezzulo et al., 2015). This occurred via a rapid increase in the salience of policies that generate pointing behavior when sampling sensory data that was inconsistent with infants' prior beliefs about alignment. Moreover, only the group of infants who attempted to communicate with an uncooperative adult pointed significantly less across trials; through the lens of active inference, they had revised their expectations about the sensory effects of action, leading them to select other policies.

This second example suggests that, within and across trials of the experiment, infants appeared to climb an evidence gradient for their expectations. That is, repeated orienting to cues indicative of the (dis)alignment of prior beliefs – despite allostatic control geared toward avoiding such surprising encounters – caused infants to infer and learn that their interaction partner was unhelpful with regards to gathering evidence for their (species-typical) prior beliefs. For the infant, orienting to the sensory consequences of repeated failed attempts to elicit evidence from the adult indicative of alignment (e.g., look-backs and symmetrical emotions) had an impact on the expected free energy of policies. In particular, policies geared toward inferring the prior beliefs of the uncooperative adult came to be characterized by a relatively high expected free energy. Consequently, such policies became relatively unlikely to gain control over action; i.e., less communication with that adult.

In sum, by suggesting that humans are characterized by an adaptive prior for alignment, we effectively argue that policies expected to disambiguate others' mental states are characterized by a low expected free energy. This is by virtue of their high epistemic affordance (i.e., in a niche partly constituted by others' mental states). Consequently, these policies tend to dominate action – people tend to gesticulate and talk with others. Repeatedly leveraging this belief to guide context-sensitive patterns of action, in turn, enables agents to learn the structure and dynamics of their niche. Because the human niche includes others' mental states, beliefs about how to act to effectively infer and align with others will have high adaptive value (Constant et al., forthcoming). This means that learning likely entails refining one's set of 'communicative policies' to approximate the set of policies expected (i.e., typically used) in one's cultural milieu. In short, leveraging communicative constructions means converging on the mutually inferred, or deontic, value of policies geared toward disambiguating mental states among agents equipped with an adaptive prior for alignment.

Deontic Value: Shared Expectations About the Value of Policies

Above we assumed that the prior beliefs of conspecifics had converged on the set of constructions leveraged in their cultural niche. This assumption is important, as our argument considers the acquisition and (cultural) evolution of communicative constructions (below). Within active inference, the concept of *shared* or *deontic value* – and associated *deontic cues* – (Constant et al., 2018, 2019) may be useful for understanding the emergence of cooperative communication in ontogeny and cultural evolution.

The deontic value of a policy rests on a direct ('automatized') likelihood mapping between learned cues and associated action policies. The mapping from deontic cue to policy is 'direct' in the sense that observation of a deontic cue comes to 'automatically' elicit an associated (i.e., learned) policy[7]. Deontic cues are observations that trigger such automatic, or habitual, policy selection (Constant et al., 2019). Encultured agents learn deontic observation-policy mappings in development, through their engagement with the deontic cues that populate their local cultural niche (e.g., Chukoskie et al., 2013). By 'offloading' cognition into the environment in this way (see Clark, 2006, 2008), the direct mapping enables individuals to bypass costly updates to, and metabolic upkeep of, their beliefs about what to do (given what is inferred of the niche). This allows agents to rely directly on deontic cues to select the most appropriate policy (Constant et al., 2018). There is clearly a close relationship between deontic cues, semiotics, and signs (Sewell, 1992; Goodwin, 2000) that underwrite communication. Perhaps the most celebrated system of encultured deontic cues is language itself.

For instance, consider an individual who has learned the English construction 'let alone' (Fillmore et al., 1988); that is, a communicative construction marked by a comparative 'let alone' phrase centered between clause X and clause (fragment)

[7]Technically, expected free energy is combined with deontic value to score the likelihood of a particular policy. In the absence of deontic value, the expected free energy will select the most apt epistemic and *goal directed* policy, given beliefs about the current state of the world. Conversely, if certain cues render the deontic value of a policy sufficiently high, it will dominate policy selection – and emerge as a *habit*.

Y; e.g., 'I could barely run 1 mile let alone 4 miles.' Learning the 'let alone' construction, as one example of a more general phenomenon (see subsection "Dynamics at the Timescale of Ontogeny"), entails learning the deontic value of cues (for policies that parse spoken or written language). In short, if I hear you utter the phrase 'X' and possess prior, reliably shared knowledge of the construction 'X let alone Y,' then I can reliably expect you to follow up with 'let alone Y.' This example assumes a probabilistic (generative) model of how communicative sensations are caused (e.g., a scheme to reliably parse syntax; Levy, 2008; reviewed in Kuperberg and Jaeger, 2016). In particular, this turns on the acquisition of the deontic value of linguistic policies entailed by the hypothesis that one is witnessing a 'let alone' construction.

But how do such reliable mappings come to exist in the first place? That is, how do communicative constructions 'build up' over (neurodevelopmental or evolutionary) time? Consider a simple example: continually walking along the same path across a park each day wears down the grass along that path (Constant et al., 2018). As the grass wears down and a clear path forms, one learns to expect the associated sensory cues when revisiting the path. Because of this, the path becomes increasingly salient for both oneself and for others 'like me,' who can (like me) leverage such 'meaningful' traces left by my actions at later time points. Consequently, the cognitive processing associated with answering the question 'Where ought I to walk next' is afforded directly by physical features of the niche. This saves on the costs associated with planning as active inference (Attias, 2003; Botvinick and Toussaint, 2012; Baker and Tenenbaum, 2014; Mirza et al., 2016) – the inference is literally 'offloaded' into the environment (see equations in **Figures 1**, **2**). The niche provides a clue as to what to do, reliably, as a deontic cue.

Crucially, when this process of 'carving out' deontic *cues* in the niche is performed by an increasing number of agents, the deontic value of policies and associated cues becomes increasingly robust to perturbations. In other words, the expectations of the social niche – here, the set of form-meaning pairings constituting a communicative system – become increasingly precise with increases in the number of interactions between agents constituting that system (Constant et al., 2019). Increasingly precise, niche-based expectations mean that agents become more likely to sensitize their behavior to that cue; e.g., the dynamics of a cue become sufficiently precise so as to enable learning of that cue and its associated action policy in ontogeny (below). In multi-agent systems equipped with an adaptive prior to align mental states, learning of deontic value (i.e., inferring the most common policies undertaken by other denizens of the niche) is learning the 'shared' value of a policy – the value of a policy for people 'like me' in our community (**Figure 2**).

What might it mean to offload cognition into the environment in the fashion above, for agents equipped with an adaptive prior to attune mental states? Individuals effectively outsource solutions to the problem of 'How ought I to talk' to the niche itself. The traces left by repeatedly aligning mental states via communication may enable the niche to subsequently afford increasingly precise, shared expectations about how other agents 'like me' (should) act so as to align mental states most effectively (e.g., during evolutionarily relevant stag hunt scenarios; Grau-Moya et al., 2013). In principle, this takes pressure off inferring 'what sort of person am I in this context' (Moutoussis et al., 2014). Technically, it finesses the computational cost of belief updating from (deontically installed) priors to posterior beliefs about behaviors that are apt for the current setting. Consequently, the cue (or sequence of cues) may come to be preferred by both individuals during subsequent interactions in similar contexts (Schelling, 1960; Lewis, 1969; e.g., Clark and Wilkes-Gibbs, 1986). Formally speaking, at later instances of interaction, the expected free energy of historically selected policies – leveraged to align mental states – falls; such policies then tend to be selected to generate predictable action sequences geared toward the alignment of mental states (Friston and Frith, 2015b).

HUMAN COMMUNICATION AS ACTIVE INFERENCE

This section provides a discussion of our proposal. The species-typical motivation to align mental states with conspecifics is cast as an adaptive prior preference for alignment. This, we suggest, provides the basis for a normative framework for predicting, explaining, and modeling the behavioral, psychological, and neural underpinnings of cooperative communication. Our discussion in this section telescopes from considerations at the microscale (i.e., mechanism), to the mesoscale (i.e., ontogeny), and, finally, to the macroscale (i.e., cultural evolution).

Dynamics at the Timescale of Mechanism: The Individual in Context

A central part of the content of the prior for alignment is that the actions of agents (e.g., oneself) update the mental states (prior beliefs) of other agents. Because mental states cause action (and, hence, observations), gathering reliable evidence for this prior means that agents orient to the individual(s) toward whom their action is directed – the sensory consequences of one's action are realized by the actions of others. That is, if one expects to infer others' mental states, the only evidence available is found in the observed consequences of others' actions (**Figure 3**). Indeed, policies that direct action toward others – so as to disambiguate their mental states (e.g., attentional orienting and, later, cooperative pointing) – possess an evolutionarily unique (Seyfarth and Cheney, 2003), maturationally constrained salience from early in life (Reddy, 2003; Matthews et al., 2012). Gathering evidence for these expectations manifests in *coupled action-perception cycles* (Friston and Frith, 2015a); i.e., intentionally co-constructed loops of action-perception that induce a reliable statistical coupling between two coupled agents (reviewed in, e.g., Hasson et al., 2012; Feldman, 2015; Hasson and Frith, 2016). For expository purposes, we may say that, within the coupled action-perception cycle of human agents, evidence for the self amounts to evidence for the other; and evidence for the other is evidence for the self.

FIGURE 3 | One canonical 'loop' of the coupled action-perception cycle. This example is 'canonical' in the sense that the manifestation of the coupled action-perception cycle in a given instance may vary as a function of context and the experience of its constituent members (e.g., an infant's communicative needs with an adult are different than a pair of adults'). With this in mind, for two agents A and B expecting to reliably infer each other's mental states, the beliefs of A ('my idea') generate A's observable actions ('my behavior'). The actions of A, in turn, cause the (attended) sensory states of B. Attention directed toward agent A by agent B in turn enables the observations generated by A to entrain the hidden states of B ('your version of my idea'). This is just some hypothesis entertained by B about the causes of B's observations (i.e., about the mental states generating A's actions). To increase or maintain the reliability of B's hypothesis, B must then act on the niche ('your behavior') to test B's hypothesis about hidden causes, as it were (that is, to check for mutual understanding, for instance; e.g., Clark and Wilkes-Gibbs, 1986). B thereby causes A's attended observations and, hence, A's mental states ('my version of your idea'). This looping dynamics continues until both agents infer alignment (Friston and Frith, 2015a). Central here is that A is attending to the sensory states generated by B (and *vice versa*) because the only way to gather evidence for the adaptive prior that mental states are aligned is to attend to the sensory effects of one's actions; and evidence for hypotheses about the sensory effects of one's actions can *only* be given (in the present context) by the actions of the other agent. Working backwards, because the actions of another agent are generated by their mental states; and their mental states are entrained by (attended) sensory observations; and their sensory observations are generated by one's own actions; we thus arrive at the claim, given at the start of this section, that "A central part of the content of the prior belief prescribing the alignment of mental states among conspecifics is that the actions of agents (e.g., oneself) modulate the mental states (prior beliefs) of other agents." Adapted with permission from Friston and Frith (2015a).

Above, we discussed how mutual expectations of cooperativeness play a crucial role in getting cooperative communication off the ground in ontogeny. This just means that the (epigenetically and neurodevelopmentally) constrained, precise beliefs about the similarity of others and oneself enable nascent individuals to engage in cooperative communication. In particular, such couplings are only possible because both agents possess reliable expectations that the other agent is sufficiently 'like me' (cf. Meltzoff, 2007): we share the same prior beliefs to attune hidden dynamics. This provides an initial 'naive' confidence in beliefs about how one's action will influence another's prior beliefs (that, in turn, influence sensory outcomes via their actions). Borrowing from the language of social constructivist views of development (e.g., Rhodes and Wellman, 2017), our prior is a kind of naive certainty in one's intuitive theory about agential efficacy, with respect to the mental states of others (see also Kelso, 2016). This is to say that prior beliefs about the niche, e.g., others' mental states, bottom out just in their expected free energy. Belief-guided action (e.g., collaboration) may thus be constrained by salient policies entailed by a prior belief that, psychologically speaking, some hypothesis is in common ground. Put simply, to the extent that this hypothesis is sufficiently reliable, it will guide action and inference (see **Figure 3** and, e.g., Yoshida et al., 2008; Gallagher and Allen, 2018).

Pursuing this line of reasoning further provides a single, formally specified framework to subsume distinct proximate motivations for communication. That is, proximate motivations for communication (e.g., declarative, expressive, informative, interrogative motives; Begus and Southgate, 2012; Tomasello, 2019) surface as particular psychological manifestations of the same, species-typical tendency to align prior beliefs. Consider two proximate motivations for communication noted above; namely, a 'declarative' one motivated by the desired alignment of attentional states; and an 'interrogative' one motivated by a desire to learn about the niche. In the former case, individuals exploit their reliably shared beliefs to render the niche sufficiently similar to themselves (e.g., 'By ostensively pointing for that other agent, I expect to effectively align our mental states with respect to my intended referent'); and in the latter, individuals explore the precise, reliable parts of the niche (here, other agents) to improve their internal model of the niche (e.g., 'What is this thing called?'; reviewed in Harris and Corriveau, 2011; Harris et al., 2017). The underlying commonality in both cases is that individuals are effectively generating action-perception cycles that couple them to others, with the result being the alignment of mental states with respect to the niche.

Moving now to relevance optimization, we remind the reader that this process involves finessing the trade-off between the accuracy (e.g., meaningfulness, expressivity) and complexity (e.g., minimum description length, hierarchical depth of the policy) of their communicative constructions. Under active inference (see Pezzulo et al., 2013), if the prior beliefs of two individuals are inferred to be highly divergent on the basis of the evidence each provides to the other, and if both expect to minimize this divergence to a sufficient degree, then costlier (e.g., hierarchically deeper or more complex) policies should become relatively more salient as agents become increasingly dissimilar, as these policies will be necessary to resolve uncertainty or disambiguate the mental state of inscrutable others. This is in contrast to two individuals who 'speak the same language'. Here, less information needs to flow within the coupled action-perception cycle to attune mental states to a similar degree. In support of this view, one study (Kanwal et al., 2017) found that adults optimize the relevance of their communicative constructions during collaborative tasks as a function of their common ground, by using shorter words for common objects and longer words for uncommon objects (see also Winters et al., 2018). Related work suggests that children's adjective use (Bannard et al., 2017), turn-taking dynamics (Butko and Movellan, 2010), and question asking (Nelson et al., 2014) may be usefully cast as if they were optimizing the information content of produced communicative constructions with respect to processing and energy concerns (cf. Pea, 1979).

For a receiver, attention to the communicative stream enables updates to one's beliefs by providing 'contextual effects' (Sperber and Wilson, 1987); that is, orienting to a speaker influences the precision of hypotheses (about, e.g., the

interpretation of an utterance) through appropriate selection of ascending sensory information (indexed neurophysiologically by alpha suppression; Höhl et al., 2014; and increased theta; Begus et al., 2016; Köster et al., 2019). Specifically, individuals appear to explain away incoming sensory data by zeroing in on informative (useful) but parsimonious (i.e., efficient) explanations of hidden causes (Goodman and Frank, 2016; see also Gershman et al., 2015). For instance, Frank and Goodman (2014) report that adult and child listeners disambiguate ambiguous word meanings by optimizing their inferences of the relevance of a speaker's intended meaning[8]. In particular, these inferences can be captured as if individuals were maximizing model evidence for the prior belief that speakers are informative (see also Kao et al., 2014). This is captured by our extended formulation of cooperative communication, where inferences about mental states can be cast in terms of maximizing Bayesian model evidence (i.e., minimizing variational free energy) for the causes of one's sensation (e.g., another's mental states; Friston and Frith, 2015a).

Given an adaptive prior for alignment, one should tend to favor policies expected to reliably generate evidence of engagement in a coupled action-perception cycle. That is, such *ostensive policies* – policies expected to generate ostensive cues – are adaptive because they tend to generate sensory evidence for the hypothesis that one is engaged in a coupled action-perception cycle. Ostensive policies indicate to one's communicative partner that attending to one's action (i.e., to the individual generating ostensive cues) will likely be informative for them. Consequently, for a recipient, evidence provided by such cues increases the salience of certain policies; e.g., attentional orienting geared toward disambiguating the speaker's prior beliefs (Szufnarowska et al., 2014). As attention optimizes the precision of sensory cues, ostension in the coupled action-perception cycle plays a crucial (if indirect) role in reliably entraining and shaping prior beliefs (Axelsson et al., 2012; Butler and Tomasello, 2016; Kovács et al., 2017). Since prior beliefs generate action, ostensive cues are thus critical for guiding other individuals' actions and hence one's (attended) sensory states (e.g., Siposova et al., 2018).

By the same logic, in response to ostensive cues a recipient should (ostensively) signal their own inferred entrance into a communicative coupling (e.g., uptake signals; Austin, 1962); as well as, for example, their subjective degree of (and certainty in) the attunement of mental states (e.g., backchannel signals; Clark and Brennan, 1991). Indeed, other individuals – inferred to possess the same adaptive prior for alignment – preferentially leverage cooperative communication in turn; that is, respond to one's communicative bids (Kishimoto et al., 2007; Wu and Gros-Louis, 2015). This makes sense in light of the adaptive prior specified here: responding to another's communicative bids is something in the interest of both agents[9].

In summary, this subsection provided an active inference account of the microscale features of cooperative communication, from an individual's perspective, noted in the second section. We have thus outlined some important means by which individuals intentionally align their prior beliefs with respect to the dynamics of the niche (Constant et al., 2018), including others' mental states (Friston and Frith, 2015a). Indeed, a foundational facet of our account is that the alignment of the mental states of conspecifics manifests in the emergence of a novel scale of social and cultural dynamics constituted by synchronized component individuals (Ramstead et al., 2018). We turn to this now.

Dynamics at the Timescale of Mechanism: The Dyad

The precision of one's prior beliefs relative to another agent's, with whom one is coupled, has important implications for the degree and direction of attunement within and across couplings. In particular, the relative precision of the prior beliefs of each agent constrains the characteristic pattern of information flow between them – both at the level of turn taking in dialogical exchanges, and at the level of learning useful generative models of others[10] (and implicitly, of the self) (Friston and Frith, 2015a,b; Gencaga et al., 2015; e.g., Schippers et al., 2010). In terms of learning, this means that individuals endowed with relatively imprecise prior beliefs tend more, on average across time, to modify their own structure to fit that of their communicative partner(s), relative to individuals with relatively precise priors. This is a special case of generalized synchronization that is underwritten by the enslaving principle from cybernetics (Tschacher and Haken, 2007). To attune prior beliefs in such 'asymmetric' couplings, individuals with imprecise expectations in effect increase the precision of their sensory states (i.e., 'up the gain' afforded to sensory input; Moran et al., 2013; Auksztulewicz et al., 2017). This allows them to better change their own prior beliefs as a function of the evidence generated by their own (and others') action. This captures, for instance, the characteristic flow of information between agents following exposure to cues of prestige, with prestigious individuals being 'trend-setters' and others following suit (Henrich and Gil-White, 2001; Veissière et al., forthcoming).

[8]Interestingly, in machine learning, *automatic relevance determination* is a term used to denote model selection based upon variational free energy; namely, the removal of redundant model parameters to maximize efficiency or Bayesian model evidence. In turn, this is closely related to principles of minimum redundancy and maximum efficiency in perception (Barlow, 1974; Linsker, 1990; Wipf and Rao, 2007).

[9]It is useful to note that ostensive policies are salient insofar as they are (but one) intentional means for rapidly increasing the precision of (certain kinds) of hypotheses for another agent; e.g., that it is likely worthwhile to attend to the individual generating the ostensive cues. The account on offer therefore accommodates evidence suggesting that non-ostensive (unintentional) but nonetheless attention-grabbing actions, like shivering, may have similar effects on others' attentional orienting as ostensive cues (de Bordes et al., 2013; Szufnarowska et al., 2014).

[10]In numerical analyses of coupled communication, *turn taking* is usually implemented by a reciprocal augmentation and attenuation of sensory precision – so that one member of the dyad is listening while the other is speaking. Please see Friston and Frith (2015a) more details. A more enduring asymmetry relates to how one can learn from others, as illustrated using simulations of birdsong in Friston and Frith (2015b).

Additionally, such an asymmetry in information flow may capture the dynamics of the coupled action-perception cycles characteristic of interactions between human infants and children, and adults. Experimental and computational evidence suggests that older individuals possess relatively precise prior expectations, relative to those of younger, less experienced individuals (Wolpe et al., 2016; Karmali et al., 2018). Thus, younger individuals may ascribe greater precision to sensory information (Moran et al., 2014). The hypothesis here is, then, that repeated couplings between infants and children with adults (and more experienced peers) may cause the prior beliefs of inexperienced individuals to converge more toward the hidden causes generating sensory consequences (i.e., the mental states of more experienced others), rather than the other way around (Friston and Frith, 2015b; e.g., Fotopoulou and Tsakiris, 2017). That is, coupled action-perception cycles in such dyads tend to be characterized by an *asymmetric entrainment of prior beliefs* (for a closely related view, see Brownell, 2011).

What does this mean for the dynamics of (neural) belief updating during interaction? Technically, attunement to the niche instantiates the generalized synchronization of the statistics of prior beliefs and the niche (e.g., others' mental states); such that the structure and dynamics of individual brains come to recapitulate the structure and dynamics of the niche in which they are embedded[11] (Friston, 2012). This is depicted in **Figure 4**. Synchronization is a phenomenon that occurs in coupled chaotic dynamical systems (Pecora et al., 1997). Technically, it means that there is a (diffeomorphic) function relating the dynamics of the state of one system to those of the system with which it is coupled (Pecora et al., 1995). For instance, modeling results suggest that endowing two coupled hierarchical dynamical systems with an expectation to infer the hidden causes generating another's actions enables a bidirectional flow of information that synchronizes the statistics of their prior beliefs (Friston and Frith, 2015a; Constant et al., 2018). Alignment within and across coupled action-perception cycles means that the similarity (technically, the mutual information) of individuals' expectations increases (Friston and Frith, 2015b; Hasson and Frith, 2016). In this scheme, attention functions as a kind of coupling parameter, and its allocation is constrained by adaptive priors. Attention effectively increases the amount of information transferred from the system with precise priors to the system with imprecise priors (i.e., the system increasing the gain of its sensory states).

Indeed, studies in 'two-person' or hyperscanning neuroscience (Schilbach et al., 2013) have found evidence of the synchronizing effects of the usage of cooperative communication during, e.g., unidirectional person-to-person monologs (Stephens et al., 2010; Liu et al., 2017; Pérez et al., 2017), person-to-group monologs (Schmälzle et al., 2015), bidirectional person-to-person dialogues (Jiang et al., 2012), and even between classmates and their teacher during daily school activities (Dikker et al., 2017). Crucially, the degree of interbrain synchrony of neural dynamics appears to strongly predict psychological phenomena; for instance, the subjective meaningfulness of communication (Stolk et al., 2014), the accuracy of recall of the content of communication (Zadbood et al., 2017), and the perceived 'power' of political speech (Schmälzle et al., 2015; reviewed in Hasson et al., 2012; Feldman, 2015; Hasson and Frith, 2016; Schoot et al., 2016; Stolk et al., 2016). Indeed, the quality and amount of action-perception couplings over the course of early development better predicts later language ability (Hirsh-Pasek et al., 2015) and language-related brain function (Romeo et al., 2018) than more traditional measures, such as the number of words heard (Lindsay et al., 2019). Similarly, synchronous interbrain (limbic) dynamics in early infancy (i.e., prior to the onset of cooperative pointing) appears to be concomitant with several kinds of positive social experience, such as closeness and social bonding[12] (Atzil et al., 2014, 2017; reviewed in Feldman, 2015, 2017).

Dynamics at the Timescale of Ontogeny

The dynamics sketched above suggests a kind of Vygotskian scaffolding (Vygotsky, 1978; Moll and Tomasello, 2007) or 'co-construction' (Tomasello, 2019) of the dynamics of internal states; whereby – via recurrent engagement in loops of coupled action-perception with relatively 'entrenched' aspects of the niche – individuals learn (internalize) the salience of culturally anticipated policies used to infer hidden states. That is, by acting in a shared environment that contains older, relatively inflexible individuals that perform stereotyped behavior (characteristic of 'how we do things here'), younger individuals are able to learn the deontic value of policies (Ramstead et al., 2016; Veissière et al., forthcoming). For our purposes, this means that individuals' prior beliefs become more similar across couplings through (bidirectional) processes of (asymmetric) enculturation[13] (Renzi et al., 2017). That is, recurrent episodes of acutely increased alignment – of the kind typical of coupled action-perception cycles – are necessary for the creation and maintenance of species-typical states. In short, to gather evidence for an adaptive prior that mental states are aligned, one must act to bring about sensory states that are indicative of this belief (Chiel and Beer, 1997; Byrge et al., 2014).

[11]Technically, hidden states are characterized by their sufficient statistics. This denotes the minimum quantities needed to fully describe a probability distribution (Cover and Thomas, 1991). For the Gaussian distributions used in active inference, these are the mean and variance (see Buckley et al., 2017). Generalized synchronization implies that the mutual information of (the dynamics of) the states occupied by two (e.g.) chaotic dynamical systems is high (Pecora et al., 1995).

[12]To be clear, our claim is *not* that *only* the usage of communicative constructions can give rise to interbrain synchrony (see, e.g., evidence of non-verbal interbrain synchrony and associations with feelings of interpersonal closeness, Kinreich et al., 2017). Communicative constructions are merely a (highly useful) means to gather reliable evidence for the adaptive prior specified in the main text.

[13]For expository purposes we leave undiscussed the ontogenesis of critically important and later-appearing interactions with peers (e.g., Brownell and Carriger, 1990; Ashley and Tomasello, 1998; Brownell et al., 2006; see Brownell, 2016). Future explorations leveraging this approach should look to integrate data relating to peer-peer interactions in ontogenesis (reviewed in Brownell, 2011). Indeed, such phenomena are of great interest to the present account given the (possibly) more complex dynamics exhibited by the attunement of two systems embodying relatively imprecise expectations about how best to minimize uncertainty (e.g., Eckerman et al., 1989).

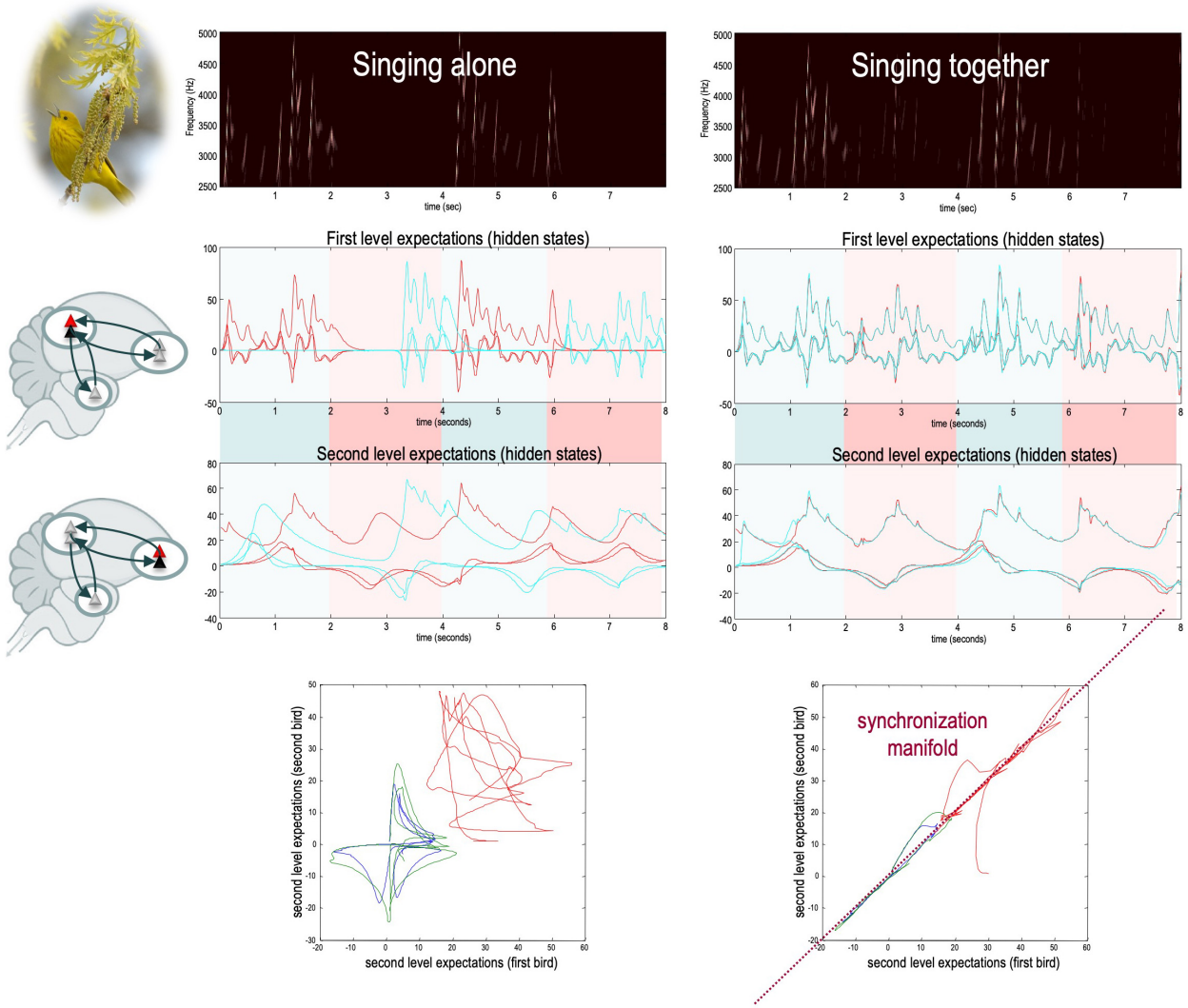

FIGURE 4 | A simulation of free-energy minimization of the sort implied by the coupled action-perception cycle. Two birds – endowed with prior expectations about the hidden states generating a shared (birdsong) narrative – sing for 2 s and then listen for a response. The posterior expectations for the first bird are shown in red; and the equivalent expectations for the second bird are shown in blue (both as a function of time). The left panel shows chaotic and uncoupled dynamics when the birds cannot hear each other ('singing alone'), while the right panel shows the synchrony in hidden states that emerges when the birds exchange sensory signals ('singing together'). The different colors correspond to the three hidden states for each bird. When singing alone, the birds cannot hear each other (because they are too far apart). Consequently, the dynamics diverge due to the sensitivity to initial conditions implicit in their (chaotic) generative models. The sonogram heard by the first bird is given in the **upper panel**. Because this bird can only hear itself, the sonogram reflects the predictions about action based upon its (first- and second-level) posterior expectations. Compare this to the case when the two birds can hear each other ('singing together'). Here, the posterior expectations encoded by internal states show (identical) synchrony at both the sensory and extrasensory levels, as shown in the **middle panels** (e.g., Pérez et al., 2017). Note that the sonogram is now continuous over the successive 2 s epochs, because the first bird can hear itself and the second bird. The ensuing synchronization manifold (i.e., the part of the joint state space that contains the generalized synchronization) is shown in the **lower panels**. These plot the second-level expectations in the second bird against the equivalent expectations in the first. The synchronization manifold for identical synchronization corresponds to the (broken) diagonal line. For details, see Friston and Frith (2015a). Obtained and adapted with permission from Constant et al. (2018).

Within and across interactions, such a dynamics increases the adaptive value of, e.g., collaborative foraging strategies by increasing inferred reliability in the hidden states generating observations (others' intentions; Han et al., 2015; Nakamura and Ohtsuki, 2016). This is because gathering evidence for the prior beliefs of other agents entails predicting how their beliefs relate to the niche; i.e., how others' beliefs relate to one's own mental states as well as non-social affordances. Consequently, gathering reliable evidence for others' mental states entails redirecting attention triadically (jointly). In this way, individuals become more reliable models of their interlocutor(s), and hence may leverage their own expectations about others' actions to guide expectations over sensory outcomes, like couplings with environmental

affordances[14] (e.g., Pezzulo, 2011; Gallotti and Frith, 2013; Bach et al., 2014).

A useful way to increase the degree of alignment of prior beliefs among individuals is to send more information to one's communicative partner. Holding the inferred common ground constant, one of the main ways to convey more information is to allow for hierarchically deeper policies (e.g., sequences of sequences) to generate action; that is, roughly, to provide more form (i.e., use longer communicative constructions). In effect, more information about mental states is thereby made observable. This perspective sheds interesting light on the species-typical trajectory from triadic attention (Striano and Stahl, 2005) to more reliably enacted forms of joint attention underwritten by reciprocal information flow – and the usage of pointing and gesture (Tomasello et al., 2007; Carpenter and Liebal, 2011) – to more complex constructions leveraged to transact with the hidden mental states of others (Aureli and Presaghi, 2010; see Colonnesi et al., 2010). The human agent appears to build up, nuance, and consolidate its (mutually expected) repertoire of action policies that, based on experience, have proven useful for adequately attuning with the mental states of conspecifics. That is, through this kind of continuous growth and hierarchical differentiation in communicative action policies (Goldin-Meadow, 2007; Tomasello, 2008), human individuals appear as though they were learning to tune themselves to the niche, and the niche to themselves.

Speaking generally, by repeatedly engaging in coupled action-perception cycles, individuals distil and abstract deeper observation-policy mappings (i.e., constructions) from the bottom up; that is, on an item-by-item basis (reviewed in Tomasello, 2000). In certain cases, individuals may then leverage learned hypotheses (about how best to disambiguate mental states) to reliably constrain the hypothesis space for learning and inference about constructions[15] (McClelland et al., 2010; see also Tenenbaum et al., 2011). That is, induction at higher layers of the model can serve to bootstrap learning at lower layers. Such 'domain-general' learning processes are illustrated by the model of Perfors et al. (2011). These authors provide a proof of principle account showing that several hours of child-directed input is sufficient for the posterior expectations of a hierarchical approximate Bayesian (i.e., active inference) learner – leveraging domain-general learning mechanisms – to converge toward a single, high level hypothesis about the causes of sensory input (here, a set of context-free grammars). That is, this set of context-free grammars had the greatest probability at the end of training. Consequently, this empirical prior functioned as abstract knowledge – it constrained expectations about likely hypotheses (in particular, auxiliary fronting) at lower layers[16] (see also Kemp et al., 2007).

Indeed, modeling schemes employing active inference provide evidence of their utility for modeling attunement to a communicative system (e.g., Kiebel et al., 2008, 2009; Friston et al., 2017b). For instance, Yildiz et al. (2013) used the active inference formalism to model word learning under optimal and noisy conditions and under variations in speaker accent. By attending to incoming input (i.e., increasing the precision of sensory signals), their model tuned its top–down beliefs to the structure of training data, which comprised sequences (of sequences) of spoken phonemes. The authors report that this model outperformed other computational learning schemes across a range of conditions and could be used to explain the judgments of adult second language learners. Future modeling work should investigate how an adaptive prior for alignment covers more ecologically valid instances of attunement to communicative constructions, such as the effects that 'starting small' and a prolonged period of developmental immaturity have on attuning to a communicative system (Elman, 1993; Bjorklund, 1997).

As noted, alignment with communicative partners means learning a set of 'automatic,' experientially robust (deontic) observation-policy mappings; e.g., the expectation (for English speakers) that a determiner typically precedes a noun (Meylan et al., 2017). Indeed, this view fits nicely with usage-based approaches to language acquisition (Tomasello, 2003; Lieven, 2016). Proponents of this view suggest that "constructions of all types are automatized motor routines and subroutines" that "come out of language use in context and... cognitive skills and strategies used in non-linguistic tasks" (Bybee, 2003, both p. 158).

Indeed, much of the structure and dynamics of the neural regions that underwrite the learning and usage of cooperative communication have been exapted (in particular, 'cooperativized') from their earlier evolutionary functions (Anderson, 2010; Bjorklund and Ellis, 2014). This has been emphasized, for instance, by embodied neurosemantics models of the neural underpinnings of the acquisition and comprehension of meaning in form-meaning pairings (reviewed in Pulvermüller, 2013, 2015). In such approaches, the meanings of both concrete and abstract constructions (e.g., 'kick' and 'love,' respectively) are grounded in low level sensorimotor dynamics and action-perception circuits contextualized by top–down input (Moseley et al., 2012; also, Harnad, 1990).

[14]From this perspective, it may be interesting for modeling work to investigate the notion of joint attention as an emergent property of coupling two hierarchical generative models attempting to infer the hidden states of each other (e.g., Friston and Frith, 2015a) while embedded in a broader ecological niche (e.g., Williams and Yaeger, 2017). In such a context, does joint attention effectively function to minimize a sensory Lagrangian over (jointly anticipated) sensory states (Sengupta et al., 2016)? What role does cooperative communication play in maintaining such a gauge invariance over the action of shared sensory states?

[15]Relatedly, because higher, contextualizing layers of a hierarchical model sample a larger space of inputs in estimating a smaller number of (more abstract) hypotheses (Tenenbaum et al., 2011), agents may, in certain instances, learn contextualizing 'overhypotheses' faster than learning at lower layers of the model (Gershman, 2017).

[16]We urge the reader to take the model of Perfors et al. (2011) with some caution. This is because part of the specification of their model was a set of (sets of) grammars; that is, their model came 'pre-equipped' with knowledge of various (formal, arbitrary) grammatical 'principles.' Thus, their model had simply to converge on the most probable set of grammars (hypothesis) given in its 'innate' repertoire. However, there is (i) no clear evidence for such innately specified (i.e., formal and arbitrary) linguistic principles in humans (Dąbrowska, 2015); (ii) no clear formulation of what may be included in such an innate repertoire (Tomasello, 2004); and (iii) numerous logical problems with the evolution of such innate structure (Christiansen and Chater, 2008; cf. e.g., Berwick et al., 2013).

To elaborate, human brains effectively combine two kinds – or two hierarchical levels – of general-purpose learning architecture to capitalize on the epistemic opportunities afforded by the action-perception cycle: (i) self-supervised (approximate Bayesian) learning, via the dynamic, hierarchical interplay between descending, neuronally encoded predictions and ascending prediction errors over time (Badcock et al., 2019b); and (ii) supervised (social) learning in a cultural niche via repeated, immersive practice in a set of culturally patterned routines (Roepstorff et al., 2010; Ramstead et al., 2016). In effect, attuning to a system of communicative constructions requires learning how to process and use form-meaning pairings in real-time communication. Thus, we are in agreement with Christiansen and Chater (2016a), who note that "learning [a cooperative communication system] involves creating a predictive model of the language, using online error-driven learning" (p. 121).

Deploying these learning processes in species typical communicative couplings means that, on average over time, individuals' communicative action policies become sufficiently similar; that is, not identical, but usable (Tomasello, 2003; Kidd et al., 2018). This is depicted in **Figure 5**. For instance, Bannard et al. (2009) found that the perplexity (an information theoretic measure that quantifies the fit of a distribution to a set of observations) of the (probabilistic) context-free grammar used to capture one child's (Brian's) utterances at age 2;0 (year;month) was able to account for approximately 15% of the utterances of another child (Annie, also 2;0). Similarly, the grammar imputed to Annie at 2;0 was able to explain approximately 36% of the utterances for Brian (2;0). Interestingly, at 3;0 model fit in either direction was increased. Thus, the grammar imputed to Brian at 3;0 accounted for roughly 59% of Annie's utterances (3;0), while the grammar imputed to Annie at 3;0 accounted for about 63% of Brian's utterances (3;0). Though the authors did not compute the significance of this change, this trend is precisely what one would expect under our model; namely, a trend toward statistically similar prior beliefs over hidden causes as individuals converge toward their cultural attractor (**Figure 5**).

In sum, by repeatedly 'filtering' one's action through others' mental states, one obtains a useful set of policies for flexibly and economically disambiguating prior beliefs. These correspond to policies with a high deontic value (Constant et al., 2019). In this way, one's set of constructions appears to converge on the set of constructions that constitute the communicative system(s) that predominantly generate one's sensory samples (i.e., those used by one's speaker community). This is to say that the prior beliefs of individuals converge toward an exploitable degree of similarity. One thus instantiates a sufficiently reliable model of the processes that generate sensory observations. This ontogenetic tendency repeats itself, cyclically, across generations. This has critical implications for the historical development of least effort communicative systems, to which we now turn.

Dynamics at the Timescale of Cultural Evolution

According to the model of cooperative communication proposed here, communicative systems (i.e., the dynamics of sets of form-meaning pairings) should appear, on average across time, to minimize their variational free energy (Ramstead et al., 2018). But what, exactly, does this mean; and how might this claim be investigated empirically? As noted above, a pointing gesture does not, in general, allow an agent to infer hidden causes as efficiently or reliably as the usage of a more complex construction. Therefore, in attempting to minimize their free energy, communicative systems should evolve toward a balance between usability and learnability (simplicity) on the one hand, and on the other, increasingly arbitrary, hierarchically deeper (complex) action sequences. This means that communicative systems should appear to optimize an accuracy-complexity, or expressivity-compressibility, trade-off (Tamariz and Kirby, 2016). Consider, for instance, the "drift to the arbitrary" (proposed by Tomasello, 2008, p. 219). Here, the suggestion is that 'grainy' bodily gestures like pointing give way to increasingly expressive, 'finer grained' gestures like pantomime. In turn, relatively expressive gestures give way to even more expressive, 'finely grained' vocal gestures like abstract and arbitrary communicative constructions (for similar views, see Wilcox, 2004; Fay et al., 2013; Perniss and Vigliocco, 2014). Interestingly, this roughly recapitulates the general ontogenetic trajectory of cooperative communication described above. It is as though – at multiple, nested scales of analysis – the human agent were becoming increasingly adept at flexibly deploying an increasingly sophisticated set of actions to resolve its sensory ambiguity.

These ideas are supported by the finding that the dynamics of relevance optimization across recurrent interactions, and generations of speakers, manifests in constructions that increase in expressivity with respect to production and processing costs (Tamariz and Kirby, 2016; e.g., Fay et al., 2010; Kirby et al., 2015). This means that human communicative systems, after a sufficiently long period of evolution, tend to cluster in a kind of 'least effort' subregion of a design space (i.e., parameter space) of communicative systems[17] (i Cancho and Solé, 2003; Seoane and Solé, 2018; see Evans and Levinson, 2009; Dediu et al., 2013). Expressed otherwise, relative to earlier generations of users of a particular communicative system, individuals in subsequent generations may be advantaged with respect to the range of communicative constructions that can be used to disambiguate mental states (Angus and Newton, 2015; perhaps, e.g., by coming to distinguish among previously undistinguished actions; Senghas, 2003). That is, communicative constructions themselves evolve to 'fit,' or gather evidence for, the adaptive priors favored by evolution and the specific demands of the local ecological niche (Kirby et al., 2007; Christiansen and Chater, 2008; Perfors and Navarro, 2014). This means that, over historical time, processes of cumulative cultural evolution (e.g., Richerson and Boyd, 2005; Henrich, 2015) tend to increase the deontic value of constructions by increasing the expressivity while minimizing the complexity of using and learning such constructions (for similar viewpoints, see Cornish et al., 2009; Dingemanse et al., 2015; Kirby et al.,

[17]To be clear, we are by no means claiming that this set of parameters exists in the brains of speakers. We are talking here about a scheme for modeling the dynamics of the cultural evolution of human communicative systems.

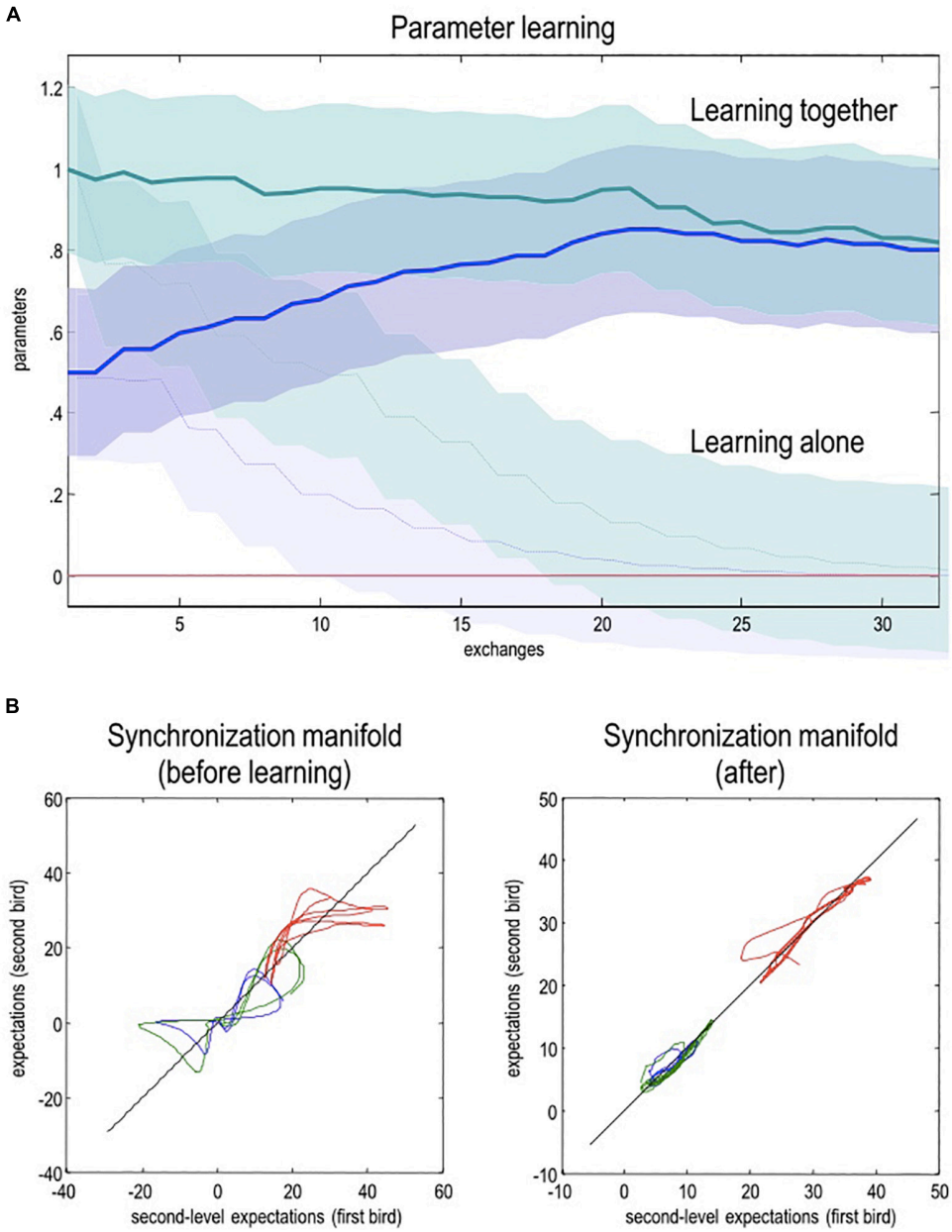

FIGURE 5 | A duet for one. This Figure depicts learning and communication via repeated engagement in coupled action-perception cycles in the context of an adaptive prior to align with conspecifics' hidden states. **(A)** Shows changes in the posterior expectations of an order parameter of the first bird (blue) and second bird (green) determining the chaotic structure of the songs depicted in **Figure 4** (by number of reciprocal sensory exchanges). The shaded areas correspond to 90% (prior Bayesian) confidence intervals. The broken lines (and intervals) report the results of the same simulation, but when the birds could not hear each other. **(B)** Shows the synchronization of posterior expectations encoded by extrasensory areas for the first (i) and subsequent (ii) exchanges, respectively. This synchronization is shown by plotting a mixture of expectations and their temporal derivatives from the second bird against the equivalent expectations of the first bird. This mixture is optimized by assuming a linear mapping between the birds' hidden states. In this example, the second (green) bird had more precise beliefs about its order parameter and, therefore, effectively, 'taught' the first bird. Parameter estimation (learning) converges toward the same value resulting in (generalized) synchrony between the two birds. For details, see Friston and Frith (2015b). Adapted with permission from Friston and Frith (2015b).

2015; Christiansen and Chater, 2016a; Tamariz and Kirby, 2016; Fay et al., 2018).

Cooperative communication emerges as a multiscale, self-organizing process that unfolds simultaneously across interaction, ontogeny, and cultural evolution (also, de Boer, 2011). Consequently, the adaptive prior under consideration enables, drives, and sustains each scale of dynamics. Circularly, each scale of dynamics generates actions that appear to gather evidence for the adaptive prior. Across developmental time, the contextualizing dynamics of cultural evolution appear

as a higher-order attractor – itself evolving in time, but sufficiently stable from the perspective of the developing individual – toward which individuals converge via recurrent engagement in coupled action-perception cycles that unfold in real-time. Taken together, interlocked dynamics at these three scales entrench the existence (i.e., probability) of the adaptive prior. In this way, cooperative communication becomes a self-fulfilling prophecy. That is, by gathering evidence for their adaptive priors, the low-level dynamics of interactants appear to create and maintain, at least for some period, the observable coherence of a contextualizing scale of (cultural) organization; namely, a communicative system (also see Szathmáry, 2015).

In active inference, the partitioning in the timescales that characterize a communicative system is formalized as between-scale differences in the precision of prior beliefs as one ascends scales (Constant et al., 2018; Ramstead et al., 2018). This is the result of, e.g., increasing the number of components (Smith et al., 2017) and the connectivity between components constituting a communicative system (Reali et al., 2018). This means that linear modifications to inputs to the system are associated with non-linear changes in its dynamics (Beckner et al., 2009; Shuai and Gong, 2014). Non-linearity is an inherent property of self-organizing systems (Prigogine and Stengers, 1984) and manifests in phenomena like critical slowing (i.e., phase transition; Gandhi et al., 1998; i Cancho and Solé, 2003), parameter reduction (Riley et al., 2011), and chaotic dynamics (Sanders et al., 2018). A change in the characteristic timescale of the dynamics of a cooperative communicative system is exemplified by Smith et al. (2017). These authors report experimental and simulation results suggesting that multi-person communicative systems exhibit slower regularization (decrease in conditional entropy) of a plurality marker across generations relative to communicative systems constituted by a single individual (for discussion of disparities of the pace of change across communicative systems, see Gray et al., 2013).

As noted above, the evolution of a communicative system may be cast as motion through a design space of communicative systems. Such spaces are effectively equivalent to the linguistic morphospace (Gray et al., 2013), or the space of states taken on by human communicative systems (e.g., linguistic networks; Seoane and Solé, 2018). Motion in design space may be relatively simple. For instance, Bybee (2010) has suggested that processes of grammaticalization – where flexible lexical forms gradually transition to fixed grammatical forms – may be modeled in terms of unidirectional (i.e., irreversible) motion through a continuous parameter space (also see Haspelmath, 1999). This might be modeled as a strange (Lorentz) attractor (Bybee, 2010), similar to that observed in models of communicative alignment (Friston and Frith, 2015a). In some cases, this motion may be more complex. For instance, the selection pressures acting on a system's constructions and, hence, the evolutionary trajectory of that set of constructions, varies as a function of the size of the population of speakers (Lupyan and Dale, 2010; Fay and Ellison, 2013; Reali et al., 2018; see Dingemanse et al., 2015).

In sum, the cultural niche construction implicit in free energy minimization in an ensemble of communicating conspecifics can be seen as a form of active inference on a (cultural) evolutionary level. In other words, selection pressures are just free energy gradients that allow us to cast *selection* (for useful communicative constructions) as a process of Bayesian *model selection* to maximize fitness; i.e., model evidence or the probability of communicative exchange, under a shared generative (phenotypic) model. This perspective nicely combines structure learning, evolution, and niche construction within the same formalism. For further discussion, please see Sella and Hirsh (2005), Frank (2012), Campbell (2016), and Constant et al. (2018).

FUTURE DIRECTIONS AND CONCLUSION

In this article, we have outlined an extension to existing theories of cooperative communication. Our extension is based on active inference and provides a novel, integrative take on the biobehavioral underpinnings of cooperative communication that complements existing psychological accounts (Tomasello, 2003, 2008, 2014, 2019). A more complete account of the dynamics entailed by the adaptive prior for alignment requires an integrative approach to research. To be sufficient, such research must aim to encapsulate the various timescales from which this prior emerges, particularly in a way that renders each scale of analysis complementary and mutually constraining with respect to the others (Tinbergen, 1963; Ramstead et al., 2018; Badcock et al., 2019b). The initial, though surely not exclusive, timescales of interest for cooperative communication were outlined in this paper. These range from the evolutionary history of early humans, to the intergenerational transmission of cultural patterns, down to individual development, and to two people conversing in real-time. This multiscale framework, arising from and underwriting the dynamics of the adaptive prior for alignment, should help to facilitate an understanding of inter- and intracultural similarities and differences in the structure and function of culture, mind, and brain. We conclude with a few comments about the limitations of the current proposal for the adaptive prior for alignment.

One limitation is the relative dearth of 'direct' evidence generated by empirical and computational studies of cooperative communication guided by the notion of an adaptive prior for alignment. We admit this is an important weakness, although one which can only be remedied through future research. Nevertheless, we have reviewed a substantial amount of indirect evidence generated by a range of empirical and simulation studies that speak to the integrative potential of the adaptive prior for alignment in making sense of cooperative communication.

For instance, our approach can be used to model the neuronal message-passing underwriting cooperative communication, as implied by active inference (e.g., Bastos et al., 2012; Parr and Friston, 2018). To illustrate this, regions in higher layers of cortex, such as anterior cingulate cortex (ACC; van den Heuvel and Sporns, 2013), integrate limbic afferents

encoding salience with control policies issued by motor cortex (Friston et al., 2014; Pezzulo et al., 2018). In turn, descending connections from paralimbic cortex convey signals that are unpacked as hierarchically nested sequences of cooperatively motivated action and inference, such as declarative pointing (Brunetti et al., 2014; see Holroyd and Yeung, 2012; Lavin et al., 2013; Haroush and Williams, 2015; Apps et al., 2016; Chambon et al., 2017). Interestingly, these neural considerations align with the psychological suggestions of Hare and Tomasello (2005), who suggest that early human selection pressures favored novel limbic dynamics that encode an increased tolerance and trust for conspecifics in the context of food (see the self-domestication hypothesis; Hare, 2017).

One specific, promising modeling approach pertains the usage of hierarchies of stable heteroclinic channels (SHCs; e.g., Rabinovich et al., 2014). SHCs are neuronally plausible models of hierarchically deep sequences (i.e., state trajectories of state trajectories) that may be scaled up to account for the acquisition and processing of more realistic cooperative communication data than have thus far been examined (Kiebel et al., 2009; see Rabinovich et al., 2015). In particular, it may be possible to use such a scheme to model the processing and use of communicative constructions, as these are hierarchically deep sequences of sequences (i.e., constructions are a statistically reliable ordering or 'chunk' of, e.g., word classes that entail chunks of morphemes that entail chunks of phonemes; relatedly, see 'chunk and pass' processing; Christiansen and Chater, 2016b). Indeed, the (re)use of hierarchical processing for language use may represent one instance of cooperativized, domain-general cognition exapted for usage in a cooperative social milieu. This is evidenced, for instance, by the presence of hierarchical processing of an artificial communication system in infants before 9 months of age (Kovács and Endress, 2014). Such a (developing) processing capacity may then be biased by the adaptive prior for alignment, after 9–12 months of age, toward disambiguating hierarchically organized communicative constructions (see Elman, 1993).

Another limitation of our proposal is that our consideration of the ontogenetic trajectory of cooperative communication focused exclusively on its typical trajectory. This was due to concerns about space. We readily acknowledge that there are all kinds of species atypical (i.e., unexpected) trajectories for the phenotypic expression of the adaptive prior for alignment. Arguably, studying how the dynamics of the adaptive prior for alignment may be perturbed in ontogenesis is crucial (e.g., discerning neurocomputational atypicalities or atypicalities in local niche dynamics; Thomas et al., 2019). Gaining a fuller grasp on the adaptive prior for alignment requires the integration of data and theory not just '*vertically*' (i.e., across scales), but also '*horizontally*' between the niche and its denizens. That is, the adaptive prior for alignment manifests distinctively not only across an array of timescales, but also at any given time across an array of cultural settings and, within cultures, neurotypical and neurodiverse populations.

For instance, in the fourth section, we discussed how, in neurotypical individuals, adequately explaining away sensory causes depends on a delicate, finely tuned balance of the top–down precision of hypotheses and the bottom–up precision of sensory fluctuations. But consider the case of autism, where neurocomputational atypicalities are thought to render the individual oversensitive to incoming error signals (Lawson et al., 2014; Mirza et al., 2019; see also Thomas et al., 2016). Such individuals would still expect to align mental states (Jaswal and Akhtar, 2019), and so would attend to others' communicative behaviors, but would be unable to attenuate the precision of sensory signals (Hadjikhani et al., 2017; Mirza et al., 2019).

Consequently, during initial interactive couplings, such individuals might initially look like they are typically developing (i.e., attending to others' eye gaze; Young et al., 2009). However, repeated attention to sources of sensory uncertainty (e.g., others' saccades), combined with an inability to adequately leverage predictions to explain away this uncertainty (owing to too much sensory precision), means that such individuals may develop idiosyncratic or atypical phenotypic expressions of the adaptive prior for alignment (e.g., avoiding eye gaze; Tanaka and Sung, 2016). In other words, early atypicalities in the internal dynamics generating evidence gathering cycles of action-perception may have downstream effects on joint attentional skills (Charman et al., 1997; Nyström et al., 2019), attunement to and use of communicative action policies (Loveland and Landry, 1986; Warlaumont et al., 2014), mental state inference (Tager-Flusberg, 2007), and other means for alignment (Heasman and Gillespie, 2019). In short, aberrant inference in a prosocial, developmental setting may easily lead to a pernicious kind of dyslexia – not for the written word – but for any communicative exchange (i.e., joint inference).

In summary, the adaptive prior for alignment 'sets the tone,' as it were, for species-typical patterns of evidence gathering, about oneself and the (social) world, that unfold over different timescales. The adaptive prior for alignment is, in effect, a kind of 'best guess' about the state occupied by the system at any point in time. Thus, for a human, processes of action, inference, learning, and (cultural) niche construction appear as if they were, on average across time, in the service of gathering evidence for the hypothesis that 'I' am like 'you,' that 'you' are like 'me,' and that 'we' exist.

AUTHOR CONTRIBUTIONS

JV and MR conceptualized the work for the manuscript. JV identified the manuscript's main target, i.e., cooperative communication. JV, PB, and MR worked out the argument and planned the manuscript. JV wrote the first draft of the manuscript. PB and AC helped with conceptualization work. AC drafted parts of the third section. PB helped edit the manuscript. KF and MR ensured that the technical aspects of the manuscript were presented accurately.

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REVIEW
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The Convergence Between Cultural Psychology and Developmental Science: Acculturation as an Exemplar

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The present article proposes an integration between cultural psychology and developmental science. Such an integration would draw on the cultural-psychology principle of culture–psyche interactions, as well as on the developmental-science principle of person↔context relations. Our proposed integration centers on acculturation, which is inherently both cultural and developmental. Specifically, we propose that acculturation is governed by specific transactions between the individual and the cultural context, and that different types of international migrants (e.g., legal immigrants, undocumented immigrants, refugees, asylum seekers, crisis migrants) encounter quite different culture–psyche interactions and person↔context relations. We outline the ways in which various acculturation-related phenomena, such as acculturation operating at macro-level versus micro-level time scales, can be viewed through cultural and developmental lenses. The article concludes with future directions in research on acculturation as an intersection of cultural and developmental processes.

Keywords: cultural psychology, developmental science, acculturation, international migration, mutual constitution, person↔context relations

INTRODUCTION

Cultural psychology has been well established as a scientific discipline for several decades. Although the term *'cultural psychology'* was first introduced by DeVos and Hippler in 1969, its theoretical and historical roots go as far back as the 1920s, when the Vygotsky-Luria Circle, an interdisciplinary group of psychologists, physicians, and educators, was established. Their collaboration centered around the idea of an integrative psychological theory based on the premise that mind, body, and culture were inseparable and that their development was fundamentally shaped by the individual's socio-cultural context. Although the goal of creating a unified theory never came to fruition, the legacy of the Vygotsky-Luria Circle inspired and influenced many schools of thought, including the development of the field of cultural psychology in the 1970s. Nonetheless, there remains a need to integrate developmental science principles into cultural psychology.

As such, the present article is intended to briefly review cultural psychology as a field and to integrate cultural psychology with developmental science. As we state in more detail below, cultural psychology is inherently a developmental discipline, and developmental science is inherently cultural. We use acculturation – which is defined as both a cultural and a developmental process (Berry, 2017) – as an exemplar to illustrate how cultural psychology and developmental science might be integrated. We seek to elucidate precisely *what is cultural* and *what is developmental* about acculturation and similar phenomena. We do not believe that the cultural and developmental components can (or should) be separated, but we do believe that each set of components should be enumerated. Doing so may help to pose important questions and directions for the fields of cultural and developmental science, and for the constructs that represent their intersection. We will focus primarily on international migration, given that acculturation applies largely to migrants and their immediate descendants. This article is organized into four primary sections: key postulates of cultural psychology, key postulates of developmental science, acculturation as an exemplar of the intersection of cultural psychology and developmental science, and future directions for acculturation research.

KEY POSTULATES OF CULTURAL PSYCHOLOGY

Cultural psychology focuses primarily on understanding the ways in which cultural processes and human psychological functioning interplay and shape each other (Shweder, 1991). An important point of distinction of cultural psychology from other branches of psychology, and from cross-cultural psychology in particular, lies in its relativist approach (Heine and Ruby, 2010). Cultural psychologists do not pursue cultural comparisons with the main objective of finding universals. On the contrary, they are interested in uncovering how cultural practices or shared traditions interact to shape psychological functioning in distinctive ways. Their investigations are informed by an underlying assumption that the same cultural processes might serve different purposes in different contexts (Rogoff, 2003).

Cultural psychology posits that human experience is the product of the reciprocal interaction between culture and psyche. This premise, however, has become increasingly complex to study within diverse sociocultural contexts, where psychological functioning and human development are simultaneously influenced by multiple cultural realities. This principle is aptly illustrated by how our understanding and conceptualization of culture have evolved in response to the ethno-cultural and linguistic diversification of contemporary societies.

Culture was once commonly defined as a system of understandings shared by a group of people and described as an operating system that is "invisible and unnoticed, yet playing an extremely important role in development and operation" (Matsumoto, 2001, p. 3). However, this depiction of culture has been increasingly criticized by cultural psychologists, because it provides a rather uniform and static view of cultural processes, especially in an increasingly global and diverse era when people from different cultures come into contact on a daily basis. Morris et al. (2015) argue that the main problem with the "operating system" metaphor is the underlying assumption that multiple cultural systems cannot co-exist within an individual without difficulty. As most computers are unable to run two operating systems simultaneously, if culture was indeed like an operating system, it would be very challenging, if not impossible, for individuals to navigate and exist within multiple cultural frameworks. However, a large body of research undertaken with immigrants and ethnic minorities shows that this is not the case at all (Hong et al., 2000; Nguyen and Benet-Martínez, 2013).

Instead, Morris et al. (2015) propose that "cultural knowledge is more like a set of apps that users select or even download unwittingly in the course of exploring the web" (p. 639). Specifically, just as users open apps for specific purposes (e.g., word processing, email, statistical analyses), individuals activate cultural knowledge – purposefully or otherwise – based on the specific surroundings and contexts in which they find themselves or with which they seek to engage. Cultural knowledge or schemas as a set of "apps" can thus frame, transform, and regulate all aspects of psychological functioning when they are activated and are relevant to the situation at hand. Which apps will affect how we think, feel, and behave depends on the types of schemata and knowledge we have acquired within and across cultures through the process of acculturation.

This inherent interconnectedness is analogous to the person↔context relations postulate from developmental science (Lerner and Overton, 2008). Culture and context provide opportunities for different experiences to emerge and shape psychological processes in unique ways. Culture molds the way we see the world and think, the ways in which we relate to others, and even our biology. For example, Park and Huang (2010) review research indicating that the brain regions activated when people are asked to think about their mother differed between North American and East Asian cultural contexts – suggesting that cultural differences in the importance and role of family become imprinted in the brain. At the same time, cultural traditions, values, and practices evolve along with the changing needs of communities. Some of these changes might evolve slowly and organically over time (e.g., practices around celebrating weddings), whereas others might require more direct action (e.g., achieving marriage equality for same-sex couples). There are many examples of people successfully challenging cultural norms and initiating social change through advocacy.

In developmental science, this mutuality has also been understood within the framework of co-constructionism. Co-construction postulates that while psychological processes exist at the individual level, they have a socio-cultural origin and are constructed through interaction with the broader environmental context (Valsiner, 1996). Actions, thoughts, feelings cannot be interpreted in a vacuum; they only become meaningful through context and culture. Further, culture is not just an independent variable that affects psychological functioning or development in a unidirectional way – and neither are people passive recipients of cultural influences. Individuals play an active role in their development by constructing and reconstructing

cultural processes through interactions, interpretations, and internalization. Cultural theories have long been influential to the study of human development, starting with the psycho-cultural model introduced by Whiting (1977) and its extensions into ecological-cultural approaches (Super and Harkness, 1986; Weisner, 2002), or concepts of developmental niche (Super and Harkness, 1986), zone theory (Valsiner, 1987), and micro-niche (Worthman, 2010). One common element in all of these approaches is the underlying principle that development is a result of co-construction between person and culture (Cole, 1996). A majority of the work in cultural-developmental science has been focused on understanding patterns of child development in cultural contexts. Cultural theory is seldom applied to development beyond childhood and adolescence (for an exception, see work on adult learning; Billett, 1998) and has not yet been integrated with life-course developmental theories.

A second tenet of cultural psychology emphasizes that psychological processes are culturally patterned. This relativist approach views experiences and behavior as embedded within culture, and posits that the function of psychological processes is relative to the context in which those processes occur. The relativist approach does not necessarily imply that cultural psychologists reject universals. In fact, some would argue that the cultural grounding of human experience is what is universal in psychological functioning (Markus and Kitayama, 2010). One of the most well-known examples of this grounding is the ways in which cultural practices enable the development and maintenance of independent versus interdependent self-construals (Markus and Kitayama, 1991). An independent self is rooted in personal attributes and characteristics, the unique configuration of which provides the person with a sense of individuality. Consequently, thoughts, feelings and actions are mainly determined by the person's needs, goals, and desires. An interdependent self, on the other hand, is embedded within and defined by a network of social relationships. The self is not seen as a unique entity, and identity is derived from meaningful social connections. In this configuration of the self, thoughts, feelings and actions are mainly determined by the needs, goals, and desires of meaningful others.

Markus and Kitayama (1991, 2003) have argued that this distinction cannot simply be reduced to differences in what people value, but that such differences translate into distinctive psychological processes. They reflect different modes of being and constructing reality through engagement with cultural practices. Cross et al. (2011) reviewed 20 years of empirical research on self-construals. Although the available evidence is limited in some areas, studies converge to link independent and interdependent self-construals to specific aspects of cognition (e.g., low versus high context sensitivity), motivation (e.g., promotion versus prevention focus), emotion (e.g., wellbeing derived from self-esteem versus wellbeing derived from harmonious relationships), and behavior (e.g., direct versus indirect communication style).

A number of cultural processes are assumed to underlie variability in self-construals. Among the most prominent of these dimensions is individualism-collectivism (Triandis, 1995). Individualism encompasses cultural practices, values and traditions that promote self-reliance, self-focus, and prioritizing one's own needs over those of family members and other close social ties. In contrast, collectivism encompasses cultural practices such as deference to family members, conceptualizing oneself as inherently connected to others, and cooperation. It is important to note that individualism and collectivism are not opposites (Oyserman et al., 2002; Taras et al., 2014). Likewise, independent and interdependent self-construals are not mutually exclusive (Markus and Kitayama, 2003). For example, people can be highly competitive at work but highly interdependent and cooperative in their family lives; or they can cooperate with others in pursuing personal goals. People living in the same context can engage in a multitude of cultural practices and daily experiences, which creates further variability and diversity within populations (Markus and Kitayama, 2010).

Although there is increasing research outside of the Western world, a major criticism of cultural psychology is its tendency to study participants with particular characteristics. Most of what we know about the interplay between culture and psychological functioning is based on studies conducted with samples in Western, educated, industrialized, rich, and democratic contexts (Arnett, 2008; Henrich et al., 2010). In addition to the range of under-represented cultural contexts, multicultural individuals (immigrants, ethno-cultural and racial minorities) are particularly under-explored. We argue that this is a missed opportunity for cultural psychology to study not only how psychological processes are shaped by multiple cultural influences simultaneously, but also the ways in which novel and hybrid cultural processes evolve from the experience of living at the intersection of cultures and contexts.

In an increasingly global world, intercultural contact has a great potential to become a central concept for cultural psychology. Within one's own cultural (or sub-cultural) context, one's behavior patterns may seem normative. For example, many Americans value self-enhancement and an orientation toward personal success (Bowman et al., 2009), and many Koreans and Chinese value familial honor and subjugating oneself to the needs of one's family (Yeh and Bedford, 2004). These values, and the motivation and behaviors associated with them, may not be noticeable when one is within one's cultural group where most people share these beliefs. Intercultural contact – communication between individuals and groups from different cultural backgrounds or contexts – brings out the cultural relativity of one's values and behaviors. For example, Vollhardt (2010) found that, compared to Germans who had not hosted international exchange students, German individuals who had recently hosted an international exchange student were more likely to use culturally sensitive (rather than xenophobic) framing to explain the behaviors of people from other cultural contexts. Similarly, research supporting intergroup contact theory (Pettigrew et al., 2011), in which some intercultural contact research is grounded, holds that contact with people from other groups – in this case cultural groups other than one's own – increases tolerance and decreases prejudice. A reasonable explanation for these findings is that intercultural contact increases awareness of cultural relativity (i.e., that the assumptions underlying one's own cultural system are not the

only correct assumptions, and that other cultural systems and assumptions may also be valid).

The ways in which cultural contexts frame human functioning, and the ways in which collective human action can transform cultural contexts, represent the primary areas of inquiry within cultural psychology (Adamopoulos and Lonner, 2001). However, what we learn about the embeddedness of human experience within cultural contexts is generally taken from cross-sectional surveys, descriptive and observational studies, or lab-based experiments. We know that neither culture nor human experience are static. Individuals grow and change over time, and cultural contexts evolve (Varnum and Grossmann, 2017). Matsumoto (2002) reviews the ways in which Japanese society, for example, has become increasingly individualistic since the 1970s and 1980s. Jones (2014) chronicles the political upheaval in post-Soviet Georgia following the collapse of the Soviet Union in 1991. Venezuela, once one of the wealthiest countries in Latin America, now suffers from such economic desperation that educated professionals are emigrating en masse to the United States, Spain, Italy, and neighboring Latin American countries (Tarver, 2018). Researchers studying people residing in these countries in the 1990s would be examining a different cultural context than they would had they conducted similar research in the same contexts 20 years later.

These examples highlight the need for understanding people's *changing* lives within *changing* structural, social and cultural contexts. Toward this end, there is a need for cultural psychology to increasingly draw on life course and developmental perspectives. Integrating principles from cultural and developmental science is not a new idea. Developmental perspectives have always been ingrained within cultural psychology and, in fact, the most important contributions to theory and research in cultural psychology have come from developmental scientists, such as Barbara Rogoff, Michael Cole, Joan Miller, Patricia Greenfield, and Jaan Valsiner.

KEY POSTULATES OF DEVELOPMENTAL SCIENCE

Developmental science is a vast field that extends across many levels of analysis ranging from the role genes play in maturation to how the broader ecology (e.g., community and neighborhood) impacts development. Many human experiences and constructs change over the life course – from brain structure and function (DeHaan and Gunnar, 2009) to peer relationships (Rubin et al., 2009) and ethnic identification (Rivas-Drake et al., 2014). However, there are a number of developmental postulates on which we can draw to derive a developmental framework for acculturation and similar cultural/developmental constructs. These postulates include developmental systems, person↔context relations, equifinality, multifinality, and irreversibility, among others (see Lerner and Overton, 2008; Overton, 2015; Cicchetti, 2016, for reviews).

All of these properties, however, stem from a relational developmental systems (RDS; Overton, 2015) perspective that depicts human development as a property of systematic change in the multiple and integrated levels of organization that comprise development and its ecology, rather than an exclusive property of the individual or of the environment. Within this metatheoretical perspective, development can best be understood as a complex *developmental system* and emerges through *bi-directional* relationships across multiple levels of organization (e.g., biological, psychological, and social ecological levels) that are structurally and functionally integrated (Lerner, 2012).

Like other systems (e.g., biological systems, social systems), developmental systems are hypothesized to operate based on a set of lawful properties. Among these is that the various components of the system – such as person and context – mutually influence one another. Indeed, RDS rejects Cartesian polarities or false dichotomies (e.g., nature vs. nurture), including the dichotomy of *person* versus *context*. Instead, it conceptualizes the unit of development as the embodied *person-in-context* and the unit of analysis as the bidirectional relation between person and context (person ↔ context) (Gestsdóttir and Lerner, 2008). As an example, the family context shapes children's outcomes, such that children from supportive and nurturing families generally evidence more favorable outcomes (e.g., higher self-esteem, lower depressive symptoms and risk taking behavior) compared to children from conflictual or distant families (e.g., Davis-Kean, 2005). At the same time, because the person is a co-equal contributor, a developmental systems perspective holds that the person is an active agent, rather than a passive recipient of environmental influences. As argued by Erikson (1950), Lerner et al. (2001), and Côté and Levine (2002), among others, there are important individual differences in terms of the extent to which people initiate transactions with their social and cultural environments. Individuals can draw on their own internal resources, such as agency and self-determination, to act upon their environments.

In summary, within an RDS perspective–which implies person↔context interplay – people influence, and are influenced by, their contexts. As applied to acculturation and international migration, migrants can seek out opportunities within their specific context to engage with their new cultural environment and to integrate elements of this new cultural system with their cultural heritage (e.g., Tadmor et al., 2009; Repke and Benet-Martínez, 2018; Meca et al., 2019). Migrants who adopt such an agentic and self-directed approach will likely evidence more favorable psychosocial outcomes compared to those who do not engage with the destination society or who do not retain their cultural heritage (Nguyen and Benet-Martínez, 2013; Berry, 2017). As we will note later in this article, many of the conclusions from developmental and cultural psychology are convergent and compatible.

The remaining properties of developmental systems stem from these foundational characteristics. To begin with, development is *irreversible* because the specific circumstances that contributed to a specific developmental pathway are unlikely to be undone. As a result of the vast complexity across multiple levels of organization (e.g., biological, psychological, and social ecological levels) that are structurally and functionally integrated, *equifinality* and *multifinality* represent complementary properties of conceptualizing development. Equifinality occurs

when two people arrive at the same developmental milestone despite different starting points – such as one adolescent consistently achieving excellent grades in school and another adolescent becoming a high achiever despite early academic difficulties. Multifinality occurs when two people have the same starting point but evidence different change trajectories. For example, two adolescents may be exceptional students in middle school, but one of them remains a high achiever whereas the other decreases in academic achievement.

From a developmental science perspective, change and the capacity for change (i.e., plasticity) is an inherent aspect of the developing system (Lerner and Overton, 2008) – given that the system is nested within a specific and *changing* historical context. As a result, developmental processes are also *malleable*. That is, developmental scientists emphasize that interventions can be used to redirect individuals and groups onto a different trajectory (e.g., Gifford-Smith et al., 2005). Such interventions may involve changing people's social contexts, providing individuals with new skills and competencies, or both. For example, there is a great deal of literature indicating that family strengthening programs can help to improve adolescents' social and relational functioning and to reduce depressive symptoms, disruptive behavior problems, and obesity (e.g., Kaslow et al., 2012; Marsh et al., 2013). Similarly, programs that teach skills to children and increase contextual support (e.g., positive parent and teacher behaviors) can help to promote positive outcomes many years later, such as high school completion and gainful employment (Hawkins et al., 2005).

THE INTERSECTION OF CULTURAL PSYCHOLOGY AND DEVELOPMENTAL SCIENCE: ACCULTURATION AS AN EXEMPLAR

Although cultural psychology is based in part on developmental principles, a key feature that is missing from much cultural psychology research today is an explicit integration of *developmental theory and methodology* that enable process- and change-oriented research on cultural and psychological phenomena. Most cultural research has been either cross-sectional or experimental, and as Cohen (2010) notes, cultural processes are often inferred from the country/ies studied – such as the assumption that East Asian cultural contexts are primarily collectivist (prioritizing the group over the individual) whereas North American cultural contexts are primarily individualist (prioritizing the individual over the group).

Some developmental psychologists have called for incorporating culture into the study of human development (e.g., Miller, 2005; Causadias, 2013; Nielsen and Haun, 2015). In this article, we build on these arguments and will also pursue the reciprocal argument – that *developmental* approaches and methods need to be more explicitly incorporated into the study of *culture*. At the same time, we emphasize the important role that the integration of the study of *culture* can have on the advancement of our understanding of *developmental* phenomena. Although a wide range of constructs might be examined with the developmental study of culture and the cultural study of development, here we will focus on *acculturation*. As applied to international migration, acculturation refers to cultural adaptation occurring following immigration (e.g., language learning, acquisition of attitudes and values reflective of the destination society, and expansion of one's sense of self to include the destination society as well as the society of origin). A Turkish person relocating to The Netherlands, for example, might learn the Dutch language and become bilingual, might adopt some individualistic Dutch values, and might come to view herself as Turkish-Dutch. Acculturation is inherently both cultural and developmental – it represents cultural change over time that occurs when two or more cultural groups (or their members) come into contact (Berry, 2017).

As a process of adaptation over time, acculturation is inherently developmental and represents an intersection between cultural psychology and developmental science (Sam and Berry, 2010). Indeed, just likely any other developmental process, acculturation emerges through bidirectional interactions between individuals and their *changing* ecology (e.g., family, peers, school.). For example, an extensive body of research has emphasized that caregivers (and other family members) undertake active efforts to socialize youth toward the values and behaviors of their own ethnic heritage (Umaña-Taylor et al., 2006, 2014; Schwartz et al., 2007). Moreover, parent–child differences in acculturation can compromise family processes and can create culturally related stress and mental health outcomes (Portes and Rumbaut, 2014; Schwartz et al., 2016).

Additionally, because acculturation is inherently a developmental process, a cross-sectional snapshot taken at any point during the process would paint an incomplete picture at best, and might mischaracterize the process at worst (Schwartz and Unger, 2017). Methodologically speaking, Maxwell and Cole (2007) review ways in which cross-sectional findings can bias the conclusions that would be reached using longitudinal designs. Theoretically speaking, cross-sectional research on acculturation may be misleading because different individuals may be at different points in the acculturation process – and as a result, we do not know whether the patterns observed represent individual differences in *timing* (e.g., one individual is further along in the acculturation process, but the other individual will catch up later) or in *approach* (e.g., the two individuals being compared have adopted qualitatively different styles of acculturation, and these style differences would continue to be observed over time).

One clear observation we can make is that the "worldviews" of developmental and cultural psychology – at least as these fields bear on the study of migration and acculturation – are quite different. Across multiple levels of organization (e.g., biological, psychological, and social ecological levels) that are structurally and functionally integrated, developmental science is concerned primarily with change processes, change patterns, and ways to intervene to redirect change processes so as to produce more adaptive or favorable outcomes. Cultural psychology focuses on the ways in which cultural processes shape cognition, motivation, emotion, and behavior, and the conditions that lead to different patterns of functioning across contexts.

Despite these differences between fields, there may be important points of convergence that can be leveraged to devise an integrative perspective on migration and acculturation. As noted at the beginning of this article, with regard to migration, acculturation represents an important point of confluence between cultural and developmental science. Acculturation is inherently a cultural construct because it refers to an interplay between culture and person – i.e., the dynamics that result when migrants and members of destination cultural groups come into contact with one another (Brown and Zagefka, 2011). It is also intrinsically a developmental phenomenon because it refers to changes in individuals' and groups' cultural behaviors, values, and identifications over time (Sam and Berry, 2010) – and these changes impact a variety of developmental processes and outcomes.

Acculturation Theory and Research

Although multiple perspectives on acculturation have been proposed, Berry's (2017) approach has been the most prominent within psychology and related fields. Berry conceptualized heritage-culture retention and destination-culture acquisition as the dimensions underlying acculturation. He proposed four acculturation orientations: separated (retains the heritage culture and rejects the destination culture), assimilated (discards the heritage culture and acquires the destination culture), integrated/bicultural (retains the heritage culture and acquires the destination culture), and marginalized (discards the heritage culture and rejects the destination culture). Berry's model has largely been validated in cross-sectional studies (e.g., Chia and Costigan, 2006; Schwartz and Zamboanga, 2008; Des Rosiers et al., 2013) – the separated and assimilated categories have emerged, along with multiple variants of biculturalism. In those studies where the marginalized category has emerged, it has represented an extremely small segment of the sample.

In keeping with acculturation as a cultural and developmental process, some studies have also tested Berry's model *longitudinally*. These studies were less likely to identify all four of the hypothesized categories. In a sample of Mexican American juvenile offenders in Arizona, Knight et al. (2009) extracted latent growth trajectory classes representing bilingualism (linguistic biculturalism), primarily English speakers, and monolingual English speakers (where the second and third categories represent variants of linguistic assimilation). Matsunaga et al. (2010), using measures of language use (English and Spanish) and ethnic identification among a sample of Mexican Americans, identified four latent profiles over time – three of which represented forms of biculturalism and one of which appeared to resemble assimilation.

Extensions of Berry's Model

A number of extensions of Berry's acculturation model have been proposed. These models help to flesh out the specific cultural and developmental processes and contents that intersect under the auspices of acculturation – as well as on the inherent complexity involved in these intersections. For example, whereas Berry was largely silent on the specific areas in which acculturation occurs, Schwartz et al. (2010) delineated three specific content domains in which acculturation processes could be assumed to operate. These domains were practices, values, and identifications. Schwartz et al. (2010) reviewed evidence indicating that behavioral acculturation (e.g., language acquisition and retention), individualist and collectivist values, and ethnic and national identity may or may not overlap. Portes and Rumbaut (2014), for instance, provide several examples of Asian immigrant adolescents who have lost (or never acquired) proficiency in their families' native languages but who nonetheless endorse strong heritage-cultural identities and endorse Asian values (e.g., filial piety, deference to parents, saving face). In an empirical examination, Lee et al. (2020) found that, among a sample of recently immigrated Hispanic adolescents in Miami and Los Angeles, practices tended to change first, followed by identifications and then values.

Of course, given the idiosyncratic nature of culture–psyche and person↔context relations, destination-society individuals will likely adopt their own specific and idiosyncratic reactions to migrants and migrant cultures. Haugen and Kunst (2017), for example, examined acculturation to migrant cultures among a sample of Norwegians. These authors extracted integrated, separated, and undifferentiated clusters, where integrated individuals were eager to engage with migrants, separated individuals tended to avoid and reject migrant cultures, and undifferentiated individuals scored midway between the other two clusters. Not surprisingly, separated individuals were most likely to perceive that Norwegian national identity was threatened by the presence of migrants. In general, non-migrant individuals who identify most strongly with their country of residence, and who adopt an essentialist view of the nation (i.e., only individuals with certain demographic profiles can be true members of the nation), tend to hold the most strongly negative attitudes toward migrants (Pehrson et al., 2009).

A third extension of Berry's model involves demarcating between public and private acculturation (Arends-Tóth and van de Vijver, 2007). Such demarcation is important because the culture–psyche and person↔context relations that govern interactions with others in public settings are likely quite different from those that govern interactions within private settings. Migrants may adopt destination-cultural practices at work or school but engage primarily in heritage-cultural behaviors at home, especially with their children (Gonzalez et al., 2016). There are established literatures on cultural frame switching and cultural mixing, focusing on the ways in which children from migrant families are exposed to their heritage and destination cultural systems at home (e.g., Martin and Shao, 2016). There are, however, developmental distinctions in the ways in which these cultural frame switching and mixing processes operate (Portes and Rumbaut, 2014): for people who migrated as *older adolescents or adults*, there is often a sharp demarcation between the cultural expressions used in private versus in public. However, for people who migrated *as children*, or who were born in the destination country, the demarcation between how one behaves in public versus private spheres may be far less apparent. Indeed, it is possible that individuals raised in both cultural contexts (e.g., heritage at home and destination in public) may switch effortlessly, and

frequently, between these cultural systems within a variety of social contexts.

Developmental Understandings of Acculturation

Developmental extensions of Berry's (2017) work make clear that acculturation is far more nuanced and complex than the original Berry model would suggest. Specifically, acculturation is likely to be regulated by person↔context interplay and by wider social-ecological influences (Meca et al., 2019), as developmental scientists (e.g., Lerner and Overton, 2008) would suggest. From an integrated developmental/cultural psychology perspective, the ways in which individual people and groups acculturate are multicausal – based on interactions between migrants and destination-society individuals *as well as* on social-ecological contexts such as family, neighborhood, political climate, and historical receptivity of the destination society toward migrants (see Fuller and García Coll, 2010, for a review). Acculturation also *affects* other developmental processes, including personal identity (Meca et al., 2017a,b) and family functioning (Schwartz et al., 2015). Further, the social-ecological conditions that guide acculturation can (and often do) change over chronological and generational time – such that the receiving context in a given country or region is likely different following a change in government, as economic conditions shift, and as political movements gain or erode rights and recognition for various segments of the population (Meca et al., 2019). Contexts of reception also likely change as the children and grandchildren of previous waves of migrants become part of the destination cultural group (van Oudenhoven and Ward, 2013).

Within a given cultural context and time, there is a great deal of diversity in the ways in which migrants acculturate. Within the same socio-cultural context, some migrants may engage more with the destination cultural system, and others may engage less. A similar statement can be made regarding retention of migrants' cultural heritage. One trend that has been reported across a range of studies and contexts is that *young* migrants – children, adolescents, and young adults – are especially likely to be bicultural (e.g., Berry et al., 2006; Chia and Costigan, 2006; Schwartz and Zamboanga, 2008; Nguyen and Benet-Martínez, 2013). Young migrants likely engage strongly with both their heritage and destination cultural systems, because they likely have been educated in the destination society *and* likely have older family members (e.g., parents, aunts/uncles, grandparents) who are oriented primarily toward the family's cultural heritage. Further, acculturation levels and profiles change over both "macro" (months and years) and "micro" (days and weeks) spans of time. Although research on acculturation at the micro level is only beginning, it appears that micro and macro level acculturation processes may be characterized by different patterns and correlates. Indeed, a key principle of developmental science is that the same process can operate differently across different time scales (e.g., days and weeks versus months and years; Lichtwarck-Aschoff et al., 2008; Lerner et al., 2009).

Schwartz et al. (2015, 2019) conducted studies both at the macro level (6-month time intervals) and micro level (daily intervals). At the macro level, Schwartz et al. (2015) found that, among a sample of recently arrived Hispanic adolescents in Miami and Los Angeles, acculturative change tended to be characterized by increases in Hispanic and US practices, values, and/or identifications. Youth who increased on all six acculturative components across time reported the most favorable psychological functioning (self-esteem, optimism, low depressive symptoms) and relationships with parents. Findings at the micro level (Schwartz et al., under review) with Hispanic college students in Miami indicated that daily changes were characterized as fluctuations (i.e., movement both up and down across days) in all six acculturative components, and that these fluctuations – especially fluctuations in US national identity and in collectivist values – were most deleterious for well-being, internalizing symptoms, and externalizing problems at the end of the 12-day study period.

It can therefore be surmised that, across longer periods of time (i.e., months or years), increases (or decreases) in indices of acculturation can be expected, and especially among migrant youth, increases in acculturation indices may be associated with positive well-being. Such change patterns may be most likely to take the form of biculturalism for migrant children, adolescents, and young adults – age groups who are apt to be exposed considerably to both private (heritage) and public (destination) cultural systems. Across short periods of time, however – such as days or weeks – change in acculturative processes are more likely to lead to negative psychosocial outcomes. One conclusion that can be drawn is that gradual change in acculturative processes may be most adaptive, and that sharp or sudden changes or fluctuations may be destabilizing and upsetting. It is possible that the person↔context relations that drive longer-term changes in acculturation are more stable, whereas the person↔context relations that drive daily changes are less so.

Types of Migrants

Contemporary theories of acculturation stipulate that acculturative processes – and therefore culture–psyche interactions and person↔context relations – operate quite differently across various types of migrants. Steiner (2009); Berry (2017), and Salas-Wright and Schwartz (2019) have enumerated several migrant types – namely legal immigrants, undocumented immigrants, refugees, and crisis migrants. Briefly, legal immigrants move by choice and with valid documentation for long-term stay in the destination country; undocumented immigrants cross national borders illegally or overstay their visa; refugees are displaced by wars, natural disasters, despotic governments, famines, droughts, and other catastrophic events and are involuntary settled in other countries by international aid agencies; asylum seekers move voluntarily but under duress, and request emergency permission to enter or remain in a new country; and crisis migrants do not fit neatly within any of the other categories. Some may seek asylum, whereas others immigrate illegally and still others may classify as refugees. The Syrian migration to Europe and the Venezuelan migration to the United States and to other South American countries represent examples of crisis migration. As Salas-Wright and Schwartz (2019) note, crisis migration is characterized by a number of

readily recognizable features: (a) the move is unplanned or hastily planned; (b) the flow of migrants is large, and many migrants arrive in the destination countries within a relatively short time span; (c) the migrant flow originates from a single country or region, but migrants settle in a variety of destinations (usually the nations that are willing to accept them); and (d) migrants arrive with considerable traumatic exposure and mental health burdens. It stands to reason that these various migrant types would experience quite different culture–psyche interactions and person↔context relations. We discuss some of these differences in the next section, where we propose ways to incorporate fundamental cultural-psychology and developmental-science principles into acculturation theory and research.

INCORPORATING KEY DEVELOPMENTAL AND CULTURAL PRINCIPLES INTO ACCULTURATION RESEARCH

Given the inherently developmental operationalization of acculturation, longitudinal studies are necessary to identify the specific patterns of, and challenges to, acculturation and adaptation within and across the migrant types enumerated in the previous section. It is also essential to conduct such studies with sufficient statistical power and nuanced measures to facilitate differentiation between legal and undocumented migrants, differentiation between refugees and asylum seekers, and identifying and separating crisis migrants from other migrant types. Thus far, the confluence between cultural and developmental science perspectives on acculturation has been limited largely to cross-sectional and experimental studies, which do not permit examination of how acculturative processes change over time in response to interactions between migrants and destination-society individuals, and in response to the social-ecological factors that are related to (and may be a function of) these interactions.

It is essential for such longitudinal work on acculturation to incorporate developmental principles such as equifinality, multifinality, and person↔context relations (Meca et al., 2019). The cultural principle of mutual constitution appears to be consistent with these developmental science themes. For example, two Turkish migrants in The Netherlands may start with the same levels of Turkish and Dutch practices, values, and identifications, but these two individuals may deviate considerably in their over-time trajectories of these acculturation components. These individual differences may be rooted in the two people's families, in the communities where they settle, or in the environments where they find employment.

It is also essential for developmentally oriented work in acculturation to incorporate cultural principles. Examining how cultural realities, such as the prevailing value systems and sets of acceptable behaviors and interaction styles, influence person↔context relations among migrants is an important research direction. It is important to examine how the cultural-developmental interplay may manifest differently for different categories of migrants – and especially (a) between legal and undocumented immigrants and (b) between "unwanted" or "threatening" migrants (e.g., crisis migrants, undocumented immigrants, and refugees) and other types of migrants. It is possible, for example, that undocumented immigrants may be scorned if they attempt to publicly identify with the nation where they reside (Staerklé et al., 2010). Legally admitted immigrants, on the other hand, may be *encouraged* to identify publicly with their nation of residence (Kessler et al., 2010). Unwanted or threatening migrants may be deliberately excluded or rejected from the destination society, as well as blamed for that society's social ills and problems (Chavez, 2013). As a result, the opportunities available to undocumented immigrants and to some refugee and crisis migrant groups may be limited by constraints imposed by the destination society.

Need for Pre-migration Timepoints

There may also be important *pre-migration* differences across migrant individuals, and these pre-migration differences may elicit specific culture–psyche interactions and person↔context relations. For example, Turkish migrants in The Netherlands may have lived in different parts of Turkey, may have interacted differently with Turkish social institutions, or may have left behind more versus fewer social ties in Turkey. Indeed, incorporation of pre-migration timepoints into longitudinal studies of acculturation is an important future direction (Tartakovsky, 2009; Salas-Wright and Schwartz, 2019). A *de facto* assumption in much migration research is that all migrants from a given group are equivalent upon arrival, or that experiences occurring prior to migration are not important. However, Tartakovsky's work, conducted with Russian and Ukrainian Jewish adolescents and young adults planning to move to Israel, indicates that pre-migration ethnic identity predicts post-migration perceived discrimination. That is, youth who were more attached to Russia or Ukraine prior to moving to Israel were most likely to perceive themselves as being discriminated against once they were living in Israel. So pre-migration experiences may contribute to equifinality and multifinality in acculturation (and other migration-related experiences) following migration. Pre-migration experiences may also be part of the person↔context relations that direct developmental processes.

Assessment of pre-migration experiences may be of greatest importance vis-à-vis refugees and crisis migrants. By definition, refugees and crisis migrants have experienced traumatic conditions that led them to leave their homelands suddenly (or to be forcibly displaced). As an example, Scaramutti et al. (2019) surveyed a sample of adult Puerto Rican Hurricane Maria survivors – half of whom had relocated to Florida following the storm and half of whom had remained on the island. These authors found that more than 65% of individuals who had migrated to Florida met clinical criteria for post-traumatic stress disorder. Although Puerto Ricans are US citizens, their experiences migrating to the US mainland are similar to those of other Hispanic migrants (Acosta-Belén and Santiago, 2018). Studies tracking the acculturation of these hurricane migrants would have to consider these people's traumatic exposure – experiencing a strong Category 4 hurricane with sustained

winds of 155 miles per hour (248 km per hour), losing their homes and many of their possessions, and making a hurried and unplanned move to the US mainland. It is likely that similar statements could be made about Syrians and Venezuelans fleeing crumbling societies, Central Americans fleeing gang violence, and individuals fleeing civil wars in various African nations. Although it is logistically difficult to assess people before they migrate, doing so would help us understand the person↔context relations, equifinality, and multifinality that these migrants experience following arrival in their destination societies.

Longitudinal Changes in Public Versus Private Acculturation

Yet another direction for future developmental research on migration involves the ways in which migrants express their heritage and destination cultural "selves" in private versus public settings. That is, are trajectories of acculturative processes different in terms of how migrants interact with family members and close friends versus how they operate in public settings such as work and school? Arends-Tóth and van de Vijver's (2007) demarcation of public versus private acculturation focused on language use and other cultural practices, but do migrants also identify with their heritage and destination societies differently when they are at home than when they are at work or school? Do expressions of individualist and collectivist values differ across public versus private settings? Do the developmental trajectories of these public versus private types of acculturation predict psychosocial and health outcomes differently? How are such differences attributable to culture–psyche interactions and person↔context relations?

It is also important to examine the extent to which daily fluctuations in acculturative processes – which have been shown to negatively predict mental health (Schwartz et al., 2019) – may be a consequence of discomfort with having to change one's cultural self between public and private settings. Given Rudmin's (2003) postulate that greater distance between heritage and destination cultural systems is more likely to lead to difficulties with acculturation and biculturalism, can a similar statement be advanced regarding the cultural distance between one's private and public cultural contexts? How does such cultural distance predict difficulties with acculturation, and does this predictive effect differ across migrant types?

CONCLUSION

In this article, we have outlined both cultural and developmental approaches to the study of international migrants, and have focused on acculturation as a point of confluence between cultural and developmental perspectives. The cultural context for migrants' developmental trajectories of acculturation (and other cultural processes) is framed by the interplay between migrants and destination-society individuals – and this interplay and the contexts that it creates are more versus less supportive for some migrant groups than for others. There are also important individual differences *within* migrant groups in terms of cultural adjustment – differences that may be due, at least in part, to experiences occurring prior to migration, as well as different interactions with family members, peers, coworkers, neighbors, et cetera.

It is also essential to capitalize on the information synthesized here to design interventions to promote successful acculturation among migrants *as well as* to increase destination-society individuals' receptivity to migrants. To be most effective, such interventions should involve both cultural and developmental principles. For example, facilitating contact between migrants and destination-society individuals may help to bring migrants and destination society members closer together and change the person↔context relations for both groups. At the same time, it is also essential to consider where individual migrants stand in terms of their pre-migration experiences, their interactions with social contexts within the destination society, and their specific acculturation profiles. Indeed, approaches have been developed that allow for specific intervention components to be delivered to individuals and subgroups who most need them (Collins et al., 2014). It is our hope that the present article will help to advance the study of international migration and to facilitate the design of interventions to help migrants to thrive within their destination societies and communities.

AUTHOR CONTRIBUTIONS

SS drafted the initial manuscript. ÁS, AM, VB-M, and CW reframed the cultural and developmental sections of the manuscript. CM, CC, JU, and NP made other substantive edits and comments.

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Growth Mindset as a Personal Preference Predicts Teachers' Favorable Evaluation of Positive Education as an Imported Practice When Institutional and Normative Support for It Are Both Strong or Both Weak

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Past research on pathways to cultural influence on judgment has compared the explanatory power of personal preferences, perceived descriptive norms and institutionalization. Positive education is an education movement inspired by Western positive psychology. The present study examined how these factors jointly predict Hong Kong teachers' evaluation of imported positive education programs in their schools. In a field study, we measured teachers' personal endorsement of growth mindset (a positive psychology construct developed in the US) and their evaluation of adopting positive education programs in their schools. We also measured teachers' perception of the extent of institutional and normative support for positive education in their schools. The results show that teachers' personal preferences for growth mindset predict more favorable evaluation of positive education programs when institutional and normative support for positive education programs are *both* weak, *or* when they are *both* strong. We interpret these effects from the perspectives of the strong situation hypothesis and the intersubjective theory of culture.

Keywords: growth mindset, personal preference, institution, perceived descriptive norm, cultural influence, cultural change

INTRODUCTION

"As scholars have noted of positive psychology …, the emphasis on growth and personal fulfillment in these influential theoretical perspectives not only reflects, but also serves to legitimize neoliberalism and associated selfways" (Adams et al., 2019, p. 204). According to Adams et al. (2019), positive psychology portrays the self as an ongoing development project and is rooted in the idea that personal growth promotes individual flourishing. By championing individual growth and affective regulation as the key to optimal well-being, positive psychology and its growing importance have served to reproduce and reinforce the influence and authority of neoliberal

systems. From this perspective, the spread of positive psychology and its expressions in positive education programs around the world represents a form of hegemonic cultural influence. Studying how teachers in non-Western contexts (e.g., Hong Kong) respond to the inflow of positive education programs in their school may provide insights on when local people accept or reject cultural influence from the West.

Cultural psychology has made important contributions to the understanding of why cultural insiders display culturally typical behaviors (see Cohen and Kitayama, 2019). Research has systematically examined how institutions, perceived descriptive norms and personal preferences constrain human psychology, creating systematic cultural differences in behaviors. However, how the same pathways of cultural influence affect the way people evaluate imported practices has received relatively little empirical attention. To fill this gap, the present study examined how Hong Kong teachers evaluated positive education programs, education programs imported to Hong Kong from North America and Australia.

In the following sections, we will first review the three pathways to cultural influence that have been systematically researched. Next, we will present the context of the present investigation. Finally, drawing on the strong situation hypothesis (Cooper and Withey, 2009) and the theory of intersubjective culture (Wan et al., 2007a,b), we develop two hypotheses regarding the circumstances under which personal preferences would have appreciable impact on the evaluation of imported practices.

PATHWAYS OF CULTURAL INFLUENCES

Cultural psychologists, in their attempts to explain why people display culturally typical judgments, have identified three pathways of cultural influence on judgment. First, culture can influence judgment through personal preferences (i.e., internalized values and beliefs). When individuals embrace and identify with the underlying beliefs or values a certain practice embodies, they will judge the practice favorably (Schwartz and Bilsky, 1990). As an example, consider an American teacher's evaluative responses to a positive education program in their school. Positive education is a movement that aims to promote students' learning outcomes as well as psychological wellbeing by applying positive psychology theories in education practices (Seligman and Adler, 2018). A positive psychology construct that has been used extensively in the design of positive education programs is the growth mindset – the belief that students can improve their abilities by mobilizing effective effort (Dweck, 2013). A teacher who possesses a growth mindset is expected to evaluate positive education positively.

However, recent research has questioned the efficacy of personal preferences in explaining why people display culturally typical behaviors. For example, in individualist societies, people who display some individualist behaviors (e.g., cognitive dissonance, socially disengaged emotions) do not have a greater tendency to display other individualist behaviors (e.g., field independence, analytical thinking; Na et al., 2010). This result raises the issue of whether people's behaviors are coherently organized around widely shared preferences for individualism in individualist societies. In addition, measures of individual differences in self-construal and individualism-collectivism do not always mediate cross-differences in behaviors that are relevant to these cultural constructs (see Chiu et al., 2010). Some researchers have argued that personal preferences impact private attitudes more than they do public behaviors (Fischer, 2006), although stronger effects of perceived norms vs. personal preferences have been observed on private cognitions as well (e.g., attribution; Zou et al., 2009). Another view is that personal preferences weigh more heavily than perceived norms in individualist societies than in collectivist ones (Cialdini et al., 1999), although extensive evidence for stronger effect of perceived norms vs. personal preferences on judgment has been reported in both individualist and collectivist cultures (Zou et al., 2009). One explanation for these results is that personal preferences are unimportant predictors of the likelihood that individuals will display culturally typical behaviors. An alternative explanation is that personal preferences influence behaviors, although their effects are often circumvented by normative factors (see Savani et al., 2015). Thus, instead of evaluating the size of the main effect of personal preference, it is prudent to consider under what normative circumstances personal preference will have appreciable effect on judgment.

Culture can influence judgment through institutionalized practices. When a certain practice is a part of the institution in an organization, the organization has set up physical support, as well as formal mechanisms for coordinating and assessing the effectiveness of the practice (Kwan and Chiu, 2015). The fish is the last to discover water. When a certain practice has become part of an organization's institution, people in the organization tend to align their judgment with the organization, evaluating the institutionalized practice favorably, even when they are not aware of the institutional influence of culture (Na et al., 2010). In the positive education example above, teachers will evaluate the positive education programs in their schools favorably if the school has already provided strong institutional support for it – material support is provided to the teachers practicing positive education; champion teachers have been appointed to coordinate the practice of positive education in the school; and mechanisms have been set up to assess and improve the effectiveness of the positive education programs.

Finally, culture can influence judgment through perceived descriptive norms (Morris et al., 2015). Perceived descriptive norms refer to the values and beliefs that are expected to be popular among members in the organization (Chiu et al., 2010). When individuals perceive that most of their peers embrace the beliefs or values behind a certain practice, even when the individuals themselves did not identify with these beliefs or values, they may still align their judgment with the perceived norms (Yamagishi et al., 2008; Zou et al., 2009). Again, consider the positive education example. Some teachers may not subscribe to the belief in malleable abilities. However, when they expect most teachers in the school to embrace the growth mindset, they may also judge positive education favorably out of conformity to the perceived descriptive norms.

CULTURAL INFLUENCES OVERLAP AND REINFORCE ONE ANOTHER

Although these three pathways (personal preferences, institutionalization, perceived norms) are sometimes portrayed as competing explanations of culturally typical behaviors (Yamagishi et al., 2008; Zou et al., 2009), these sources of cultural influences are not mutually exclusive. Instead, they have partial overlaps, and they reinforce one another (Leung and Morris, 2014). For example, an organization that has (vs. has not) provided institutional support to a certain practice tend to have more members who embrace the values and beliefs behind the practice and perceive these values and beliefs to be widely shared among other members in the organization. Likewise, an organization with more members embracing the values and beliefs behind a certain practice also tends to have perceived norms that are congruent with these values and beliefs. We tested this contention in the current study.

THE CONTEXT OF POSITIVE EDUCATION IN HONG KONG

As mentioned at the outset, how the three pathways of cultural influence affect how an imported practice is evaluated has received relatively little empirical attention. To fill this gap, we studied how teachers in Hong Kong evaluated imported positive education programs in their schools.

The positive education movement received primary inspirations from positive psychology. According to Seligman and Adler (2018), "The goal of PE (Positive Education) is to produce both well-being as well as to forward the traditional outcomes of schooling" (p. 54). To attain this goal, educators have designed positive education programs to produce visible wellbeing for both teachers and students by incorporating various evidence-based positive psychology theories in teaching. In a recent comprehensive review of evidence-based positive education programs around the globe, Seligman and Adler (2018) list the following positive psychological theories or constructs that have been incorporated in positive education programs and their respective evidence strength: self-perceptions (growth mindset, self-efficacy; medium evidence strength); achievement theories (achievement goal, intrinsic motivation, value-expectancy theory; medium to high evidence strength); perseverance (grit, engagement; low evidence strength); self-control (medium evidence strength); metacognition (high evidence strength); social competencies (leadership and social skills; evidence strength varied across specific skills); resilience and coping (medium evidence strength); and creativity (low evidence strength).

We use teachers' responses to positive education programs *in Hong Kong* as a case study to examine when personal preferences predict favorable evaluation of imported positive education practices for two reasons. First, positive education developed from the intellectual tradition of positive psychology in North America. Tahler (2019) has reviewed the intellectual history of positive psychology. According to her review, five major influencers of psychology include William James, Abraham Maslow, Martin Seligman, Mihaly Czikszentmihalyi and Christopher Peterson. Some influential constructs or theories in positive psychology include Albert Bandura's self-efficacy, Donald Clifton's strength-based psychology, Edward Deci and Richard Ryan's self-determination theory, Ed Diener's subjective well-being, Carol Dweck's growth mindset and Barbara Fredrickson's theory of positive emotions (Tahler, 2019). All theories or constructs have had significant impact on the design of positive education programs, including those used in the schools in Hong Kong.

Second, positive education is new to Hong Kong. In their review of positive education programs around the world, Seligman and Adler (2018) found that some countries or cities in Asia have introduced positive education programs in their schools. These countries or cities include Bhutan, Shenzhen, Beijing, and India. Hong Kong was not mentioned in the review. Although education in Hong Kong is largely modeled on the English system, the Confucian heritage, which emphasizes educational achievement and prescribes authoritarian teacher-student relationships, still has a strong influence on the school culture and educational practices in the city (Ho et al., 2001). The 2018 PISA study carried out by OECD (2019) revealed that Hong Kong high school students performed much better than their international peers in reading (reading score = 524 for Hong Kong; OECD mean = 487), mathematics (mathematics score = 551 for Hong Kong; OECD mean = 489) and science (science score = 517 for Hong Kong; OECD mean = 489). Despite their superior academic performance, much fewer Hong Kong students were satisfied with their lives (52% for Hong Kong, OECD average = 67%). In addition, much more Hong Kong students reported "always feeling sad" (13% for Hong Kong, OECD average = 6%), and fewer Hong Kong students possessed a growth mindset (43% for Hong Kong, OECD average = 63%). In short, positive education and its primary concepts (e.g., psychological wellbeing and growth mindset) was still a foreign idea in Hong Kong around 2018 when we conducted the present study[1].

The mental health crisis in schools has provided the motivation to introduce positive education in Hong Kong. Results from a survey of 3000 Hong Kong students carried out in 2016 revealed that 64% of students felt worried or frustrated and more than 50% felt useless (Fung, 2017). Partly as a response to this mental health crisis, some schools in Hong Kong started to practice positive education. Among them, four primary schools and three secondary schools joined the JC-PEAR program in 2017. JC-PEAR is a positive education program led by the Chinese University of Hong Kong and funded by the Hong Kong Jockey Club. Prior to joining this program, these schools had adopted some improvised practices of positive education. After joining the program, teachers in these schools received training in theories of positive psychology and coaching on the design

[1]The PISA data also showed that the percent of students with a growth mindset was higher in other Chinese societies (Mainland China, Singapore, Taiwan) than in Hong Kong. Therefore, the relatively low prevalence of growth mindset may be unique to Hong Kong's performance-oriented culture, and does not generalize to Chinese students in general (see Zhang et al., 2019).

of positive education practices. In early 2018 and 2019, teachers from these schools voluntarily participated in the current study.

To reiterate, the goal of the present study is to examine under what circumstances individuals' personal preferences predict their evaluation of imported ideas or practices. We used positive education programs in Hong Kong as an example of imported practices, and teachers' growth mindset as an example of personal preference. Answering our research question in the education context seems appropriate because teachers play an important role in the transmission as well as evolution of cultural values (Schwartz and Bilsky, 1990). They pass values and beliefs from mainstream heritage cultures to the new generations. In addition, teachers integrate ideas and knowledge from different cultures to create new knowledge, disseminate this new knowledge to their students, and create new cultures through education. In the context of the present study, teachers learn ideas about positive psychology from North American-Australian cultures and innovate local practices to create new education cultures in Hong Kong. Growth mindset, the idea that people's abilities and personality can develop through deliberate practices of effective learning strategies, is a major positive psychology concept in positive education. In contrast, fixed mindset is the belief that people's abilities and personalities are non-malleable (Dweck, 2013). We can ask under what circumstances teachers' internalized mindset would have a more pronounced impact on their evaluation of imported positive education programs[2].

Aside from conferring an opportunity to test our hypotheses regarding when internalized preferences are more predictive of judgment, the current context also enables us to explore when internalization of an idea (growth mindset) in a *foreign* movement (positive education) can predict local acceptance of the movement.

WHEN DO PERSONAL PREFERENCES MATTER?

We submit that personal preferences influence evaluation of an imported practice, although their effects are often circumvented by normative factors. Under what normative circumstances would personal preference have appreciable effect on the evaluation of an imported practice?

The strong situation hypothesis (Cooper and Withey, 2009) states that the impact of personal preferences (internalized values and beliefs) on judgment is accentuated when situational strength is low, and attenuated when it is high. Situational strength is defined as the amount of environmental pressure on the individual to engage in a particular behavior. Situational strength for a certain behavior is high when there is strong institutional support or normative expectation for the behavior. According to this hypothesis, personal preferences on judgment would have significant influence on the evaluation of a practice when the practice has weak institutional support *and* when the values or beliefs behind the practice are not widely shared in the organization. In the present research context, teachers' mindsets would have strong influence on their evaluation of positive education programs when positive education is not yet perceived to be an institutionalized practice and when growth mindset is not yet perceived to be a descriptive norm in the school. This hypothesis is consistent with the contention that personal preferences have greater effect on behaviors in loose societies (societies in which social norms are flexible and informal) than in tight societies (societies in which social norms are clearly defined and reliably enforced; Gelfand, 2018).

Another hypothesis is based on the intersubjective theory of culture (Chiu et al., 2010). According to this theory, individuals identify with the organization more strongly when their personal preferences are consistent with the perceived descriptive norms in the organization (Wan et al., 2007a,b). If a particular practice is an established one in the organization, these individuals would evaluate the practice more favorably because of the link between the practice and the organization they identify with.

In the present research context, teachers having a growth mindset will identify more strongly with their school if they expect growth mindset to be a widely shared belief among the teachers in the school. If in this school, positive education is an established practice, these teachers would evaluate the positive psychology programs in their school favorably because these programs are parts of the school's institution. Accordingly, teachers' mindset would have relatively strong influence on teachers' evaluation of their school's positive education programs when the following two conditions are met: (1) teachers' mindset is congruent with the mindset perceived to be widely shared among other teachers, and (2) positive psychology is perceived to be an established practice in the school.

The above discussion leads to the following hypotheses:

> H1: The effect of personal preferences on the judgment of a practice is more salient in weak (vs. strong) situations, where a weak situation is defined as one in which the practice is not an institutionalized one in the organization and the perceived descriptive norms in the organization are unclear.
> H2: The effect of personal preferences on the judgment of a practice is more salient when teachers' preferences are congruent with the perceived descriptive norm *and* when the practice has already been institutionalized in the organization.

In short, we hypothesize that internalization of an idea by the teachers is important both when positive education (an imported movement) is perceived to be an established practice in the organization and when it is not. When it is, alignment of personal preferences with perceived descriptive norms enhances conformity with the perceived institutional norms and predicts evaluation of positive education programs (H2). When it is not, the conformity pressure is weak and personal preferences should predict evaluation of the positive education programs (H1).

[2]We do not claim that positive education is effective or culturally appropriate in Hong Kong. Readers who are interested in the efficacy of growth mindset and positive education may refer to recent reviews, empirical research and critical reflections on these topics Seligman and Adler, 2018; OECD, 2019; Rissanen et al., 2019; Yeager et al., 2019).

MATERIALS AND METHODS

Context

The JC-PEAR positive education program started in August 2017. At the beginning of the program, the school principals informed the teachers that their schools had joined a 3-year positive education program co-organized by the Chinese University of Hong Kong (CUHK) and the Hong Kong Jockey Club. Teachers also learned from the school leadership that the schools aimed to develop a whole-school approach to positive education that would engage all teachers, students and their parents. In the first year of the program, all teachers participated in professional development workshops offered by the CUHK expert team. The workshops introduced teachers to basic concepts in positive psychology (e.g., growth mindset, grit, character strengths). All teachers were encouraged to apply these concepts in their teaching.

Initially, five to six teachers from each school volunteered to be champion teachers. Throughout the program, they received coaching from the CUHK expert team and gradually became proficient in innovating curricula, pedagogies and assessment to promote students' learning motivation and psychological wellbeing. The champion teachers also proactively disseminated their learning and experiences to other teachers in the school.

Sample and Recruitment Procedures

As mentioned, the participants were teachers from seven schools: 4 primary and 3 secondary schools. These schools covered a wide range of academic prestige, from least prestigious schools to most prestigious ones. The teachers completed the first survey in June-July 2018 and the second survey in June-July 2019. A total of 253 teachers participated in the first survey in 2018. In 2019, 293 teachers from the same schools participated in the study. Most of them had participated in the 2018 surveys, although we did not know exactly how many teachers participated in both surveys. This is because to protect teachers' anonymity, we did not record the participants' personal identity in both waves of data collection. For the same reason, we were unable to match the data from the two waves. Therefore, we treated the year of data collection as a between-participants factor. We acknowledge that treating the year of data collection as a between-participants factor is a limitation in our research design, because it would lead to under-evaluation of the effect of the year of collection.

Table 1 shows the distributions of the teachers across school types (primary or secondary schools), gender, age categories and educational attainment in the two waves of data collection. Also included in the table are descriptive statistics of teachers' years of teaching and years of teaching in their current schools. As shown in **Table 1**, there were no discernible differences between the two waves of data collection in these teacher characteristics.

To recruit the participants, we sent an invitation to participate to the school administrators. The invitation included a QR code that was linked to the survey. The school administrators forwarded the code to the teachers through e-mail or other e-platforms. Teachers were free to choose to participate in the survey or not. We did not know the number of teachers that the school administrators had invited to participate in the study. There were 60–70 teachers in each school. Assuming that the invitation was sent to all teachers, the response rates were at least over 50% in each survey.

Measures

Aside from the demographic information collected at the end of the survey, the teachers also completed measures of growth and fixed mindsets, perceived endorsement of growth and fixed mindsets among their peers (perceived descriptive norms), perceived institutionalization of positive education, and evaluation of the positive education programs in their school.

Growth and Fixed Mindsets

Mindset is a domain-specific construct; individuals who endorse a growth mindset in one domain may endorse a fixed mindset in another domain, and vice versa (Dweck et al., 1995). Thus, we measured growth and fixed mindsets in both the intelligence domain and the personality domain, the two domains that have been most widely researched in the past.

Each mindset was measured with 2 items adopted from Dweck et al. (1995). The items used for measuring growth mindset in the intelligence domain were: "You can substantially change how intelligent you are"; and "No matter who you are, you can significantly change your intelligence level" (Cronbach's $\alpha = 0.78$ in the 2018 survey and 0.77 in the 2019 survey). The items used for measuring growth mindset in the personality domain were: "People can always substantially change the kind of person they are"; and "No matter what kind of person someone is, they can always change very much" (Cronbach's $\alpha = 0.85$ in the 2018 survey

TABLE 1 | Summary of teacher characteristics in wave 1 and 2.

Teacher characteristics	**Wave 1 *N*(%)**	**Wave 2 *N*(%)**	**χ^2 (*p*-value)**
Sample size	253	293	
Gender			0.49 (0.483)
Male	88 (35.8)	88 (32.8)	
Female	158 (64.2)	180 (67.2)	
Type of schools			0.88 (0.347)
Primary schools	144 (56.9)	155 (52.9)	
Secondary schools	109 (43.1)	138 (47.1)	
Age (years)			2.11 (0.549)
≤30	52 (23.1)	47 (18.0)	
31–40	79 (35.1)	102 (39.1)	
41–50	68 (30.2)	80 (30.7)	
>50	26 (11.6)	32 (12.3)	
Education			4.25 (0.120)
Undergraduate degree	132 (53.4)	156 (58.4)	
Postgraduate degree	106 (42.9)	108 (40.4)	
Others	9 (3.6)	3 (1.1)	
Teacher characteristics	**Wave 1 *Mean* (*SD*)**	**Wave 2 *Mean* (*SD*)**	***t* (*p*-value)**
Years of teaching	14.06 (8.65)	13.85 (8.12)	0.28 (0.777)
Years of teaching in current school	11.62 (9.50)	10.86 (7.54)	0.99 (0.325)

and 0.83 in the 2019 survey). We used the following two items to measure fixed mindset in the intelligence domain: "You have a certain amount of intelligence, and you really can't do much to change it"; and "Your intelligence is something about you that you can't change very much" (Cronbach's α = 0.85 in the 2018 survey and 0.82 in the 2019 survey). Fixed mindset in the personality domain was measured with these two items: "The kind of person someone is something very basic about them and it can't be changed very much"; and "People can do things differently, but the important parts of who they are can't really be changed" (Cronbach's α = 0.74 in the 2018 survey and 0.78 in the 2019 survey). Participants indicated their extent of agreement or disagreement with each item on a 7-point scale, from 1 (strongly disagree) to 7 (strongly agree).

Items measuring mindsets in the intelligence domain are personally phrased ("*You* can substantially change how intelligent *you* are."), whereas those measuring mindsets in the personality domain were not ("*People* can do things differently, but the important parts of who they are can't really be changed). This is because researchers have been interested in how intelligence mindsets affect individuals' responses to their own achievement outcomes and how personality mindsets affect individuals' responses to other people's behaviors (see Dweck et al., 1995).

The specific instructions for these items were: "Using the scale below, please indicate the extent to which you agree or disagree with each of the following statements. There are no right or wrong answers. Please answer each of the following questions honestly."

Growth and Fixed Mindset Intersubjective Culture

We used the same mindset items and scale to measure the perceived descriptive norms of growth and fixed mindsets in the two domains. Following the procedures in past studies (Wan et al., 2007a,b; Zou et al., 2009), after the teachers had responded to the items that measured their personal beliefs about intelligence and personality, we asked teachers to estimate how most teachers in their school would respond to each of the 8 items. The instructions of this measure were: "For each of the statements below, which of the answers would *most teachers in your school choose*? If you think most of them would choose "Agree," then choose that option for that statement. We strongly encourage you to answer all questions. There are no right or wrong answers."

Reliability (Cronbach's α) was 0.88 for growth mindset–intelligence in the 2018 survey and 0.83 in the 2019 survey; 0.83 for growth mindset–personality in the 2018 survey and 0.81 in the 2019 survey; 0.79 for fixed mindset–intelligence in the 2018 survey and 0.80 in the 2019 survey; and 0.85 for fixed mindset–personality in the 2018 survey and 0.78 in the 2019 survey.

Although the same items were used in the personal preference measure and the descriptive norm measure, past studies that used the same method had provided evidence for the discriminative validity of the two measures. For example, the descriptive norm measure predicts judgment and behaviors above and beyond the personal preference measure. Furthermore, the interaction of the two measures predict group identification above and beyond the main effects of both measures (Wan et al., 2007a,b; Zou et al., 2009).

Perceived Institutionalization of Positive Education

We were not able to find an established measure of perceived institutionalization of positive education. Therefore, we developed one to assess the extent to which the teachers perceived positive education to be an institution in their school. This measure consisted of four items, which captured the extent to which the school had set up physical support, as well as formal mechanisms for coordinating and assessing the effectiveness of positive education activities. These items were "Teachers who are involved in positive education have reduced workload in other job aspects"; "Our school has provided material resources for us to implement activities in the positive education program"; "There is someone in our school responsible for coordinating the use of different positive education strategies"; and "Our school has mechanisms to help colleagues understand their effectiveness in doing positive education[3]." Participants indicated their agreement with each item on a 7-point scale, from 1 (strongly disagree) to 7 (strongly agree). Reliability of the measure (Cronbach's α) was 0.85 in the 2018 survey and 0.87 in the 2019 survey.

Evaluation of Positive Education

Our dependent variable was teachers' evaluation of positive education program (PEP). We used a measure Elfrink et al. (2017) developed to assess evaluation of PEP. This measure consists of five items: (1) "PEP is a valuable addition to our school"; (2) "PEP made me look more consciously at the well-being and engagement of the students"; (3) "PEP changed the school climate to a more positive climate"; (4) "PEP improved my relationship with the students"; and (5) "PEP made me become a better teacher". Participants indicated their agreement with each item on a 5-point scale, from 1 (strongly disagree) to 5 (strongly agree). Reliability of the measure (Cronbach's α) was 0.90 in the 2018 survey and 0.94 in the 2019 survey.

RESULTS

Cluster Analysis of the Mindset Measures

To identify groups of teachers holding different mindset profiles, we performed hierarchical cluster analysis using Ward's method on the four mindset measures: growth and fixed mindsets in the intelligence and the personality domains. As shown in **Figure 1A**, two major clusters of teachers were identified. To interpret this result, we performed t-tests on the four mindset measures, with membership in the two clusters as the independent variable. From these analyses, we can identify the mindset measures that differentiated participants in the two clusters. The two clusters differed along all four mindset measures: $t(543) = -18.28$ for

[3]The first two items were not included in the first wave of data collection in several schools. In the 2019 survey, all four items were included in the survey conducted in all seven schools. Effects of the year of data collection when it was included as a moderation in our prediction models were not significant.

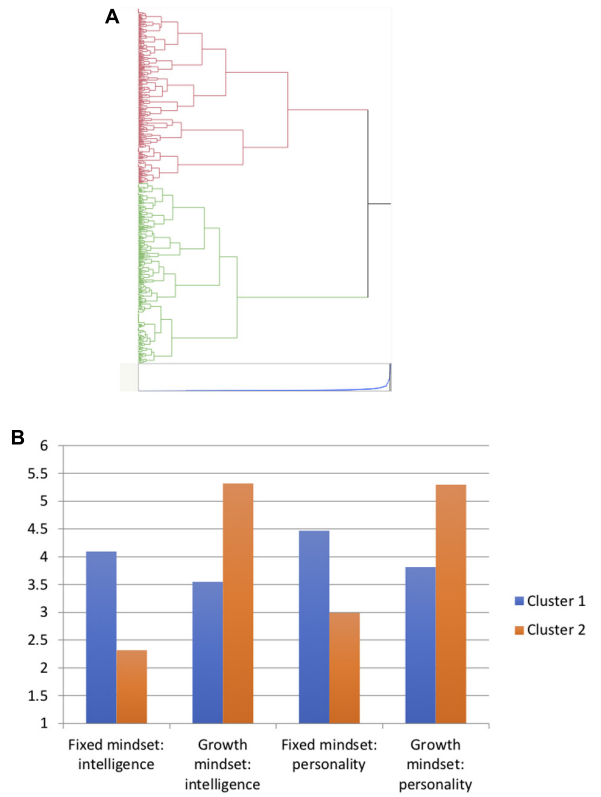

FIGURE 1 | Cluster analysis performed on teachers' mindset measures: **(A)** A dendrogram representing the cluster analysis results, and **(B)** means of the two clusters on the four mindset measures.

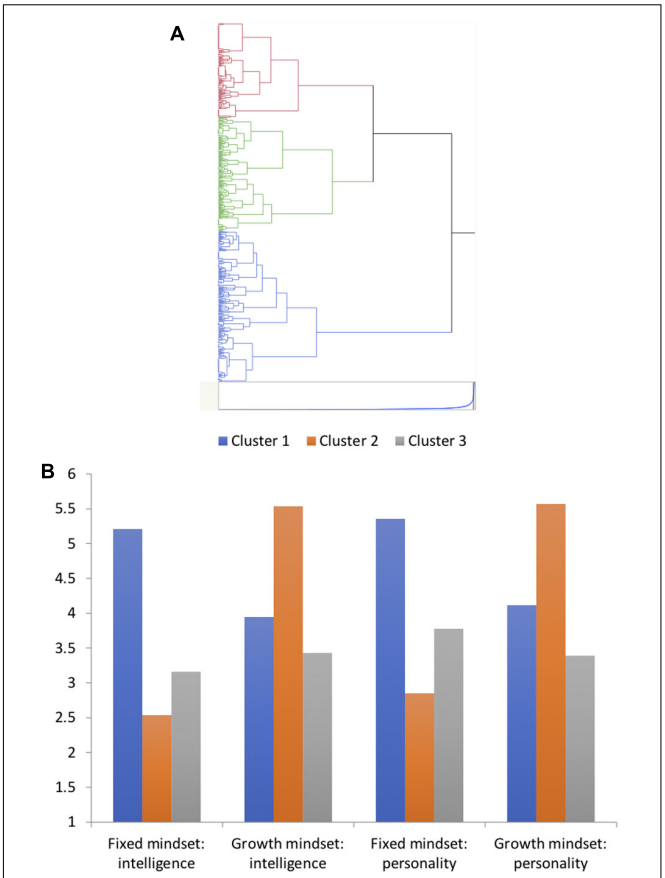

FIGURE 2 | Cluster analysis performed on the four measures of perceived mindset norms: **(A)** A dendrogram representing the cluster analysis results, and **(B)** means of the four clusters on the measures of perceived mindset norms.

intelligence fixed mindset, −13.81 for personality fixed mindset, 18.11 for intelligence growth mindset, and 15.02 for personality growth mindset, all *p*s < 0.0001. **Figure 1B** shows the means of the two teacher clusters on the four mindset measures. Cluster 1 (N = 261, 47.9%), represented by the blue bars and labeled *fixed mindset teachers*, had significantly higher means on the two fixed mindset measures and lower means on the two growth mindset measures, compared to Cluster 2 (N = 284; 52.5%, represented by the orange bars and labeled *growth mindset teachers*[4].

We also performed hierarchical cluster analysis using Ward's method on the four measures of mindset perceived norms. As shown in **Figure 2A**, three profiles of mindset perceived norms were identified. We performed one-way analysis of variance on each of the four measures of mindset perceived norms, with membership in the three clusters as the independent variable. Tukey's Honestly Significant Test was used as the method of mean comparisons. These analyses enable us to identify the mindset perceived norm measures that differentiated the three clusters. Significant differences were found among the clusters on all four mindset perceived norm measures: $F(2, 537)$ = 476.18 for intelligence fixed mindset, 258.64 for personality fixed mindset, 177.85 for intelligence growth mindset, and 190.36 for personality growth mindset, all *p*s < 0.0001. **Figure 2B** shows the means of the three profiles on the four measures of mindset perceived norms. Cluster 1 (N = 179, 33.1%), represented by the blue bars and labeled *fixed mindset norm*, had significantly higher means on the two measures of fixed mindset perceived norms and lower means on the two measures of growth mindset perceived norms, compared to the other two clusters. Cluster 2 (N = 158, 29.3%), represented by the orange bars and labeled *growth mindset norm*, had significantly higher means on the two measures of growth mindset perceived norms and lower means on the two measures of fixed mindset perceived norms, compared to the other two clusters. Cluster 3 (N = 203, 37.6%), represented by the gray bars and labeled *no mindset norm*, had relatively low mean scores on all four measures of mindset perceived norms.

Overlap of Personal Preferences, Perceived Subjective Norms, and Institutionalization

We performed logistic regressions to test our assumption that the three pathways to cultural influence are positively associated.

[4]Because of the lack of comparable teacher data (cf. Laine et al., 2016), we cannot comment on the prevalence of the growth mindset among teachers in Hong Kong, relative to that in other cultures.

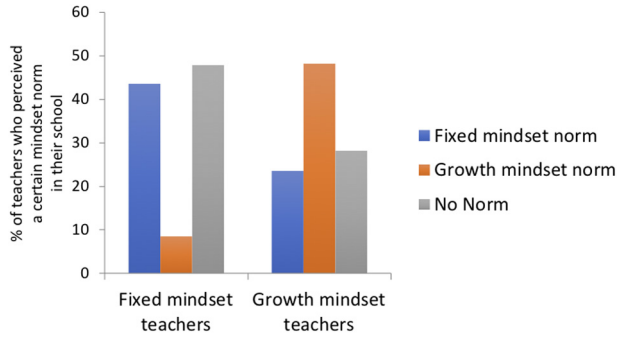

FIGURE 3 | Percentage of teachers who perceived the presence of a growth mindset norm, fixed mindset norm, or no norm in their school among growth mindset teachers and fixed mindset teachers.

For example, did teachers who endorsed a growth mindset also perceived growth mindset to be a descriptive norm in the school? The results are consistent with our assumption. First, logistic regression was performed on the likelihood of belonging to the growth mindset norm cluster (vs. the other two mindset norm clusters) with personal mindset cluster membership as the categorical independent variable. **Figure 3** shows that growth mindset teachers were more likely to expect their school to have a growth mindset norm (vs. the other two mindset norms). In contrast, fixed mindset teachers were less likely to expect their school to have a growth mindset norm (vs. the other two mindset norms), $\chi^2(N = 539, df = 2) = 102.99, p < 0.0001$.

Next, we performed logistic regression on the likelihood of teachers having a growth (vs. fixed) mindset, with perceived institutionalization of positive education as the continuous independent variable. The effect of perceived institutionalization of positive education was significant, $\chi^2(N = 539, df = 1) = 55.51$, $p < 0.0001$. To understand the nature of this effect, we estimated the percentage of growth (vs. fixed) mindset teachers when we centered perceived institutionalization of positive education at one standard deviation above (below) the mean. Among teachers who did not perceive positive education to be an institutionalized practice in their school (one standard deviation below the mean), 56.1% were fixed mindset teachers and 43.9% were growth mindset teachers. Among teachers who perceived positive education to be an institutionalized practice in their school (one standard deviation above the mean), 39.8% were fixed mindset teachers and 60.2% were growth mindset teachers.

Finally, we repeated this logistic regression analysis with the likelihood of belonging to the growth mindset norm cluster (vs. the other two norm clusters) as the dependent variable, and perceived institutionalization of positive education as the continuous independent variable. The main effect of perceived institutionalization of positive education was significant, $\chi^2(N = 539, df = 2) = 10.81, p = 0.005$. Follow-up analysis revealed that among teachers who did not perceive positive education to be an institutionalized practice in their school (one standard deviation below the mean), 22.6% expected other teachers to have a growth mindset, 36.2% expected other teachers to have a fixed mindset, and 41.2% did not expect other teachers to have either a fixed or growth mindset. In contrast, among teachers who perceived positive education to be an institutionalized practice in their school (one standard deviation above the mean), 35.9% expected other teachers to have a growth mindset, 30.1% expected other teachers to have a fixed mindset, and 30.1% did not expect other teachers to have either a fixed or growth mindset.

When Do Personal Preferences Matter?

To test our hypothesis regarding under what normative conditions personal preferences would predict evaluation of positive education programs, we performed a general linear model analysis on evaluation of positive education programs. The predictors in the model were year of data collection (2018 or 2019), school type (primary or secondary school), teachers' mindset (fixed or growth), perceived mindset norm (fixed, growth, or no norm) in the school, institutionalization of positive education in the school (mean-centered continuous predictor) and their interactions. We also controlled for the effects of teachers' gender, age, years of teaching experience, and years of teaching in the current school. The School Type × Year of Data Collection interaction was the only school type effect that approached the 0.05 level of statistical significance ($F = 3.39$, $p = 0.07$; Fs for all other school type effects < 2.07, ps > 0.15). Likewise, with the exception of the School Type × Year of Data Collection interaction, all year of data collection effects were non-significant (Fs < 1.70, ps > 0.18). Therefore, to simplify the model, we removed school type and year of data collection in the subsequent analyses.

The effect of gender was significant, $F(1, 406) = 4.44$, $p = 0.04$. Female teachers evaluated positive education ($M = 3.86$, $SD = 0.80$) slightly more positively than did male teachers ($M = 3.70$; $SD = 0.78$). The effects of age, years of teaching experience, and years of teaching in the current school were not significant (Fs < 1.17; ps > 0.28). In the final model, teachers' mindset (fixed or growth), perceived mindset norm (fixed, growth, or no norm) in the school, institutionalization of positive education in the school (mean-centered continuous predictor) and their interactions were included as predictors and gender was included as a control variable.

The final model is summarized in **Table 2**. The effect of gender remained significant, $F(1, 491) = 5.92$, $p = 0.015$. As expected, the main effect of teachers' mindset (self mindset) was significant, $F(1, 491) = 24.98$, $p < 0.0001$. Growth mindset teachers ($M = 4.93$, $SD = 1.23$) evaluated positive education programs more favorably than fixed mindset teachers did ($M = 4.53$, $SD = 1.22$). We interpret this main effect of personal preference in the context of the significant higher-order interaction reported below.

The main effect of Institutionalization of Positive Education (Institutionalization) was also significant, $F(1, 491) = 155.44$, $p < 0.0001$. Evaluation of positive education program was more positive when teachers perceived stronger institutionalization of positive education in their school, $r = 0.77$, $p < 0.0001$.

Aside from these two main effects, the Institutionalization × Perceived Mindset Norm interaction was also significant, $F(2, 491) = 3.34$, $p = 0.04$. To understand the nature of the interaction, we centered institutionalization

TABLE 2 | Summary of the general linear model analysis performed on evaluation of positive education.

Source	DF	SS	F-ratio	*p*-value
Self mindset (self)	1	9.57	24.98	< 0.0001
Perceived mindset norm (perceived norm)	2	0.69	0.91	0.41
Institutionalization of positive education (institutionalization)	1	59.52	155.44	< 0.0001
Self × perceived norm	2	1.05	1.37	0.25
Self × institutionalization	1	0.05	0.14	0.71
Perceived norm × institutionalization	2	2.56	3.34	0.04
Self × perceived norm × institutionalization	2	3.63	4.73	0.009
Gender	1	2.27	5.92	0.015

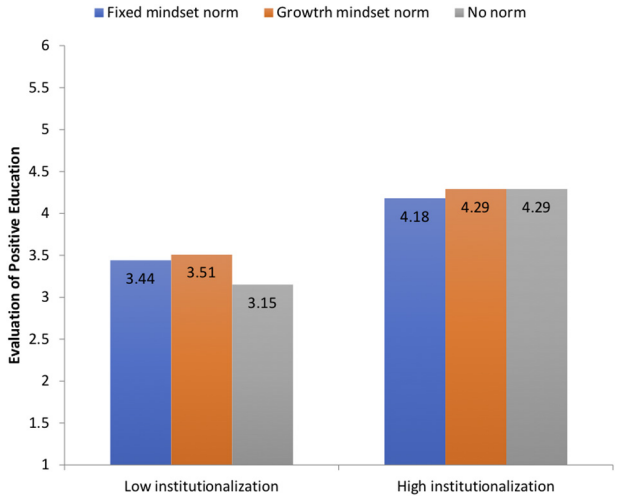

FIGURE 4 | Evaluation of positive education as a function of level of institutionalization of positive education in the school and perceived descriptive norms.

of positive education at one standard deviation both above and below its mean, and estimated the predicted level of evaluation of positive education programs when institutionalization of positive education would be high (one standard deviation above the mean) and low (one standard deviation below the mean) respectively. As shown in **Figure 4**, when institutionalization of positive education in the school was perceived to be relatively strong (one standard deviation above the mean), positive education programs were evaluated favorably regardless of the perceived mindset norm attributed to the school; estimated evaluation = 4.18 (*SE* = 0.15), 4.29 (*SE* = 0.13), and 4.29 (*SE* = 0.14) for fixed mindset norm, growth mindset norm, and no mindset norm, respectively. However, when institutionalization of positive education in the school was perceived to be relatively weak (one standard deviation below the mean), evaluation of positive education programs was least favorable when teachers did not perceive a prevalent mindset culture in the school; estimated evaluation = 3.15 (*SE* = 0.12), 3.51 (*SE* = 0.16), and 3.44 (*SE* = 0.14) for no mindset norm, growth mindset norm, and fixed mindset norm, respectively. This finding indicates that teachers did not support positive education programs when they did not perceive positive education to be an institutionalized practice and when the descriptive norm was unclear in the school. In short, teachers evaluated positive education most unfavorably in weak situations (no institutional and normative support). This finding underscores the importance of situational support for teachers' favorable evaluation of positive education programs.

The 3-way interaction is most relevant to our primary research question: Under what conditions would teachers' mindsets have an effect on the way they evaluated the positive education program? **Table 3** illustrates the nature of this three-way interaction. First, the results supported Hypothesis 1, which states that teachers' mindsets predicted evaluation of positive education programs in weak situations. Specifically, teachers' own mindsets predicted their evaluation of positive education program only when positive education was not perceived to be an established practice *and* when teachers did not expect other teachers to have a preference for either a growth mindset or a fixed mindset. When positive education was not perceived to be an institutionalized practice (one standard deviation below the mean) and when the teachers did not find any perceived mindset norm in the school, teachers with a growth mindset evaluated positive education programs (estimated value = 3.61, 95% CI: [3.39, 3.83]) more favorably than did those with a fixed mindset (estimated value = 2.95, 95% CI: [2.81, 3.09]).

The results also supported Hypothesis 2, which states that teachers' mindsets predicted their evaluation of positive education programs when they perceived the institutional and normative contexts aligned with their mindsets. Specifically, when positive education was perceived to be an established practice in the school, teachers with a growth mindset (vs. those with a fixed mindset) evaluated positive education programs more positively when they expected other teachers to have the same mindset. When positive education was perceived to be an institutionalized practice (one standard deviation above the mean), and when the teachers were aware that growth mindset was the perceived descriptive norm in the school, teachers with a growth mindset evaluated positive education more positively (estimated value = 4.52, 95% CI: [4.40, 4.73]) than those with a fixed mindset did (estimated value = 3.96, 95% CI: [3.79, 4.14]).

DISCUSSION

Most studies in cultural psychology have tried to explain culturally typical behaviors displayed by cultural insiders. Few studies have examined how people judge an imported practice. To fill this gap, the present study examined how Hong Kong teachers evaluated an imported education movement.

Past research on pathways to cultural influences on judgment has compared the explanatory power of personal preferences (internalized beliefs or values), perceived descriptive norms, and institutionalization (see Chiu et al., 2010, 2013). Some past findings show that personal preferences do not always predict culturally typical behaviors by cultural insiders (e.g.,

TABLE 3 | Estimated evaluation of positive education as a function of institutionalization, self mindset and perceived mindset norm.

	Growth mindset norm	Fixed mindset norm	No norm
Low institutionalization (1 *SD* Below the mean)			
Growth mindset (self)	3.54 (3.37, 3.71)	3.63 (3.42, 3.84)	3.61 (3.39, 3.83)
Fixed mindset (self)	3.36 (3.00, 3.72)	3.35 (3.20, 3.51)	2.95 (2.81, 3.09)
Effect of teacher mindset[#]	0.18	0.28	0.66
High institutionalization (1 *SD* Above the mean)			
Growth mindset (self)	4.52 (4.30, 4.73)	4.31 (4.18, 4.44)	4.38 (4.19, 4.57)
Fixed mindset (self)	3.96 (3.79, 4.14)	4.09 (3.71, 4.47)	4.19 (4.01, 4.37)
Effect of teacher mindset	0.56	0.22	0.19

95% confidence interval was indicated in parentheses. [#]Effect of teacher mindset = Growth mindset – Fixed mindset.

Yamagishi et al., 2008; Zou et al., 2009). We show that in our research context, personal preferences predicted teachers' evaluation of a foreign education movement although the effects of personal preferences were circumvented by normative factors. To elaborate, growth mindset is a positive psychology construct that has been widely used in designing positive education programs (Seligman and Adler, 2018). Accordingly, teachers who subscribed to this belief should evaluate positive education programs more favorably than those who did not. However, this effect was significant only under two circumstances. First, this effect was significant when normative influence was weak – when positive education was not part of the school institution *and* when there were not clear descriptive mindset norms in the school. This result is consistent with the strong situation hypothesis (Cooper and Withey, 2009), which states that effects of personal preferences on behaviors are stronger in weak (vs. strong) situations, in which norms are flexible and informal. Second, this effect was significant when growth mindset was the descriptive norm in the school *and* positive education was part of the school institution. Teachers with growth mindset identified with their school more when they perceived that most teachers in the school also had a growth mindset (Wan et al., 2007a,b). These teachers evaluated positive education programs favorably when they were part of the established institution of the school they identified with. In summary, at least in our research context, in response to an imported practice, personal endorsement of a pertinent belief predicts favorable evaluation of the practice when institution and descriptive norm supporting the practice are *both* weak, *or* when they are *both* strong.

Second, past research on why cultural insiders display culturally typical responses sometimes depicts personal preferences, perceived descriptive norms and institutionalization as competing pathways of cultural influence (e.g., Yamagishi et al., 2008; Zou et al., 2009). In our research context, these three pathways are positively correlated. Teachers who perceived positive education to be an institutionalized practice in their school also tended to endorse a growth mindset (a foundational concept in positive education) and expect other teachers to do so. In addition, teachers who endorsed a growth mindset also expected a growth mindset to be popular among other teachers.

Our findings may not generalize to evaluation of established cultural practices by cultural insiders. Nonetheless, the present study may inspire future research on the normative circumstances under which personal preferences would have significant impact on the likelihood of cultural insiders displaying culturally typical behaviors, instead of pitting the explanatory power of these three pathways against one another.

The present study has limitations. First, to protect the participants' privacy, we did not collect identifiable information in the surveys. Thus, we could not link participants' data from the two surveys. The analyses that compared the teachers' demographics in the two surveys confirmed that we had comparable samples in the two surveys (see **Table 1**). Nonetheless, given this limitation, we had to treat year of data collection as a between-participants variable in the analysis. This procedure significantly reduced the statistical power of detecting the effects of year of data collection. In addition, we cannot track the participants' changes in the three predictors (personal mindset, perceived mindset norms, and institutional support) over time and cannot assess the effects of such changes on the evaluation of the positive education programs. We thus missed the opportunity to perform alternative tests of our hypotheses using longitudinal data.

Furthermore, given the correlational nature of our analysis, there are alterative explanations of our results. First, we attribute growth mindset teachers' relatively favorable evaluation of positive education program in the high institutionalization-strong perceived norm context to their stronger identification with the school. However, it is possible that the strong situation induces compliance and favorable evaluation of the positive education programs among some teachers and psychological reactance and less favorable program evaluation among other teachers. Through the self-perception process or cognitive consistency maintenance, those who evaluate the programs favorably attribute to the self the belief in malleable traits (a belief congruent with positive education). In contrast, those who evaluate the programs unfavorably infer that they believe in fixed traits (a belief incongruent with positive education). Thus, personal preferences do not predict, but instead result from evaluation of the positive education programs.

Second, the strong situation hypothesis assumes that in weak situations, people follow their personal preferences when

rendering judgment. However, it is also possible that in weak situations, people infer their personal preferences from their judgment. When there are no clear norms in the school, among teachers who do not receive institutional support for positive education, some would dislike the positive education programs and hence oppose the growth mindset associated with them. In contrast those who like the positive education programs would have insufficient justification for their attitude. To reduce their cognitive dissonance, they would attribute their liking of the programs to their belief in the growth mindset. Our data cannot rule out these and other alternative explanations. Future research is needed to examine them.

We conclude with some practical implications of our results for cultural change. Some organizations or societies may try to create cultural change by importing foreign practices. When a foreign practice is first introduced to a local context, institutional support for the practice is weak and the perceived descriptive norms do not favor the practice or its underlying belief. Under this circumstance, it is important to convert the practice champions into strong believers of the idea behind the practice. These practice champions will perceive the practice favorably and promote it to others. When the practice has been institutionalized and the descriptive norm clearly favors the underlying idea, it is important to solidify the practice in the organization or society by fostering personal identification with the practice among members of the organization or society. These recommendations are applicable when a foreign education practice is introduced to a local school (e.g., when positive education programs are introduced to a local school in Hong Kong).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the research reported in the manuscript.

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Culture and Attention: Future Directions to Expand Research Beyond the Geographical Regions of WEIRD Cultures

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Henrich et al. (2010) highlighted the necessity of broadening the range of regions for cross-cultural investigation in their seminal paper "The weirdest people in the world." They criticize the current psychological framework for relying dominantly on American undergraduate students for their participant database, and state that there is a risk associated with investigating human nature by focusing solely on a unique population. This line of research has, over the past 30 years, successfully demonstrated the diversity of human cognition. However, it is true that there are still only a limited number of studies that have extended their geographical regions of research outside of G7 (Canada, France, Germany, Italy, Japan, United Kingdom, and United States) and G20 countries (Argentina, Australia, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, EU countries, and the above G7 countries). In order to fully examine the issue of culture and cognition, we maintain that the field of psychology must extend its research globally. In this paper, we will briefly discuss the history of cross-cultural research in the 1960s which can be seen as the beginning of addressing the above concerns, and review some contemporary empirical studies which took over their 1960s predecessors' mission. Here we address three strengths of extending the geographical scope to advance cultural psychology. In the second half of the paper, we will introduce our preliminary study conducted in Mongolia as a sample case study to demonstrate a way of administering cultural psychological research outside of the existing research field. We will then discuss implications of this line of research, and provide tips on how to open a new research site.

Keywords: culture, Mongolia, drawing, holistic vs. analytic attention, WEIRD

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INTRODUCTION

A group of researchers in the late 1980s and early 1990s began advocating for the development of a new research field in social sciences in order to understand the human mind in cultural contexts (Bruner, 1990; Shweder, 1991; Miller, 1999). This interdisciplinary field of research, which includes linguistics, psychology, anthropology, and neuroscience, is now known as "cultural psychology." Researchers in this field challenged the universality of human psychological processes

and advocated the importance of understanding human psychology in cultural contexts. Recently, they have developed a variety of theoretical frameworks, devised research methodology and tasks for experimentation, and demonstrated substantial cultural variations in even basic psychological processes—notably human cognition (e.g., Masuda et al., 2019, for review). However, research programs have not fully expanded to new geographical regions. In this paper, we address the need to conduct research outside of G7 (Canada, France, Germany, Italy, Japan, United Kingdom, and United States) and G20 countries (Argentina, Australia, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, EU countries, and the above G7 countries), and discuss an important direction to further advance research on culture and human cognition. As one example that demonstrates this new way of conducting research, we will also share results from a case study held in Mongolia.

Patterns of Cognition and Social Orientation

One of the goals of cultural psychologists is to present empirical evidence that the majority of so-called "universal psychological phenomena" reported in North American professional journals are actually the products of mutual constitutions between culture and the mind. For over 30 years, cultural psychologists have examined cultural variations in basic psychological processes between people in East Asian and North American societies in order to address this goal.

A theoretical framework developed by Nisbett et al. (2001), Nisbett (2003), Nisbett and Masuda (2003), Nisbett and Miyamoto (2005), and Masuda et al. (2019), for example, contrasted two patterns of cognition: *analytic* and *holistic*. *Analytic cognition*, dominant in Western cultures such as Western Europe and North America, is characterized by discourses that emphasize an object-oriented focus in visual attention (selectively focusing more on objects than on context). In contrast, *holistic cognition*, dominant in East Asian cultures such as China, Korea, and Japan, is characterized by discourses that emphasize a context-oriented focus of attention (attending to objects in relation to their context).

Based on this theoretical framework, a substantial number of empirical studies have demonstrated that East Asians are more likely than North Americans to be sensitive to contextual information in many aspects of social cognition (see Masuda, 2017, for review). For example, Masuda and Nisbett (2001) demonstrated that, when asked to describe animated vignettes of underwater scenes, Japanese tended to holistically capture the entire scene, whereas Americans tended to analytically detach the main object in the scene, and selectively describe the features of that object. Implementing the theory of holistic vs. analytic cognition, researchers have documented cultural variations in causal attribution, inference, categorization, spatial and temporal perception, emotion perception, and even artistic expression and design of Internet web pages (Masuda, 2017, for review).

Varnum et al. (2010) further discussed that people's social orientation—*interdependence vs. independence*—could play an important role for people to develop culturally specific cognitions—*holistic vs. analytic,* respectively. One explanation for the connection between *independence* and *analytic cognition* is that those who live in societies where independent social orientation is dominant find that the world consists of events, people, and objects which are, in general, independent from each other. Such a view facilitates people to selectively pay attention to what they think is the most important event, object, or person in the scene, while intentionally ignoring the context. In contrast, an explanation for the connection between *interdependence* and *holistic cognition* is that those who live in a society where interdependent social orientation is dominant need to become sensitive to other people's feelings in order to maintain the society. This requires having communal and cooperative relationships. Such a sensitivity to relationships facilitates people to pay attention not only to the target issue but also to its surrounding context. When such social practices are generalized, people tend to use holistic attention, capturing all of the scenes and relationships in a single event.

The Criticism Against General Psychology: WEIRD People in the World

Recently, a problem was addressed by Henrich et al.'s (2010) seminal paper "The Weirdest People in the World," in which the authors criticized psychological data reported in major North American journals for relying too much on North American undergraduate students to have their findings naively accepted as universal. Henrich et al. called this population "WEIRD," which stands for "Western, Educated, Industrialized, Rich, and Democratic." More specifically, WEIRD people in many cases represent American undergraduate students who have taken psychology courses, and whose contributions make up a major part of the psychological database. Although the database is valuable for advancing psychological science, Henrich et al., 2010 argue that it is not representative of the human population, and therefore cannot be generalized. In fact, the ratio of the WEIRD population to the entire human population is very small, suggesting that WEIRD people are rather unusual outliers.

Why are researchers reluctant to access people outside of the WEIRD category? Possible reasons attributing to the biased data collections include the following: (1) the North American student subject pools at universities allow researchers to easily conduct studies as they are familiar with participating in experiments as their human subjects and there is little cost to using them; (2) the majority of psychologists have trained in North American academic institutions; the Western tradition of scientific investigation is quite analytic (i.e., ignores contexts by assuming they play less important roles in shaping one's mind); and (3) researchers are not fully aware of the fact that they are culturally biased, and assume that the North American mind is standard, universal, and invariant across all cultures.

History of Cross-Cultural Investigation in Human Cognition and Perception

Outside psychology, doubts of universality in the mind and the idea that there are substantial variations in psychological processes have been discussed in a broader context in the

Humanities and Social Sciences. The history of cross-cultural studies regarding human nature is rather long. For example, the seeds of cultural psychology can be traced back to Wilhelm Wundt's (1916) "völkerpsychologie" (folk psychology), where he addressed descriptive investigations of cultural phenomena. A variety of fields have also contributed to the study of cultural variations in human nature, including anthropology (e.g., Kluckhohn, 1949; Geertz, 1973) and linguistics (e.g., Whorf, 1956). Furthermore, other domains of psychology including developmental psychology (e.g., Vygotsky, 1978; Luria, 1979), and social psychology (e.g., Sherif, 1936) have also contributed to the study of cultural variations. In the field of cognitive sciences, "New Look Psychology," advocated by Bruner and Goodman (1947) and Bruner (1957), researchers maintained that even our perception—so called basic psychological processes—is highly influenced by cultural contexts.

While theoretical discussions have been addressed in a variety of fields, empirical studies on cross-cultural variations in basic psychological processes have focused on small-scale societies since the 1960s (for an extensive review see Cole and Scribner, 1974; McCauley and Henrich, 2006). One of the earliest empirical studies where researchers extended their data collection outside the geography of North American laboratories is a series of anthropological studies involving the Müller-Lyer illusion (Rivers, 1901, 1905; Segall et al., 1966). This optical illusion refers to people's perception of the length of lines where same length lines with inward arrows are judged to be longer than the lines with outward arrows. Segall et al. (1966) demonstrated that the effect of the Müller-Lyer illusion, which had been reported in Western data, was observed in Melanesian and Indian tribal members, but not in a hunter-gatherer group in the Kalahari Desert.

These early studies have maintained that ecological factors—people's actual life experiences in a particular geographical and ecological environment—are keys to understanding people's perception and cognition. For example, the "carpenter hypothesis," maintains that one's experience of viewing things three dimensionally affects the magnitude of the illusion, especially if the environment contains rectangular architectures. In such an environment, lines with inward arrows often appear as front edges of rectangular shaped buildings, which are closer to the viewer, whereas lines with outward arrows often appear as rear edges, which are farther away from the viewer. Because of this experience, people tend to overestimate the length of inward arrows compared to outward arrows. In other words, the magnitude of the optical illusion is reduced for those who have not experienced such an environment, suggesting that the optical illusion is not innate but shaped by one's environmental experience (Hudson, 1960, 1962a,b, 1967; Mundy-Castle, 1966; Deregowski, 1968a,b).

In other early research on perception, researchers contrasted perceptual styles in field-dependent vs. field-independent perception (e.g., Witkin et al., 1954; Witkin, 1967; Witkin and Berry, 1975; Witkin and Goodenough, 1977). Using perceptual tasks (e.g., embedded figure task), these researchers investigated individual differences in context sensitivity. For example, field-independent individuals were better at detecting target shapes which were superimposed on multi-layered shapes than field-dependent individuals. These perceptual tasks were later used to identify cultural variations in attention, finding that people in cities, independent cultures, and hunting communities tended to show context independent patterns of perception (Dowson, 1967; Berry, 1971, 1976).

In sum, cross-cultural investigations into human cognition were conducted from the 1960s through to the 1970s, but fell out of favor partially because mainstream North American psychologists began searching for evidence of universality rather than specificity (e.g., Fodor and Pylyshyn, 1981; Fodor, 1983; Pylyshyn, 1999). The contemporary cultural psychology research began in the late 1990s by focusing on empirical investigations and applying some of the classic methods from earlier cross-cultural studies to different populations (e.g., Ji et al., 2000). There is an inherent affinity between contemporary cultural psychology and cross-cultural studies from the 1960s. In line with the WEIRD critics, we maintain that researchers should acknowledge the classic cross-cultural studies in small-scale societies and should reconsider the importance of conducting research outside of G7 and G20 countries.

Beyond the East vs. West Dichotomy

The idea of holistic cognition/interdependent social orientation vs. analytic cognition/independent social orientation has been applied to many cross-cultural studies of East Asians and North Americans. Why has the East vs. West dichotomy been so often utilized by contemporary cultural psychologists? After Markus and Kitayama's seminal review paper (1991) was published, the issue of culture caught mainstream psychologists' attention, which resulted in advancing contemporary cultural psychology for two main reasons: First, going beyond cross-cultural studies of the 1960's, contemporary psychologists successfully demonstrated that cultural variations in cognition linger even when they target post-industrial societies in East Asia. For example, Japan is one of the G7 countries, of which demographic factors such as the level of education, level of modernization, GDP level, as well as methodological factors such as accessibility to undergraduate participants and school curriculums in colleges are quite comparable to that of North American and European counterparts, yet researchers persuasively demonstrated substantial diversity in cognition between these countries (e.g., Kitayama et al., 1997). Second, from a social sciences perspective, the rapid economic growth in the East Asian economy would also influence mainstream psychologists' perception about culture. The East/West dichotomy dominated the business discourse of the 1980's due to economic competition between America and Japan, and it still persists. Retrospectively, it has been one of the factors which indirectly increased the number of audiences who were interested in successful findings in cultural psychology.

However, like Henrich et al. (2010)'s argument regarding the limits of relying on data from WEIRD societies, the East/West dichotomy also limits our scope and forces us to question our ability to claim universality in cognitive processes. There are at

least three beneficial points for researchers to further broaden this field of research to go beyond the East/West dichotomy.

First, while a plethora of evidence has depicted differences between the cultures of the two continents of East Asia and North America, researchers need to be prudent not to overgeneralize this dichotomy onto cultures in other continents: there is not much known about Europe, South America, the Middle East, Africa, and Central Asia. It is only recently that researchers have acknowledged the gaps in the data of the global population. For example, Kitayama et al. (2009) demonstrated that British and German participant's level of holistic attention fell between Americans and Japanese, showing a moderate level of context sensitivity. Meanwhile, all the Western groups showed stronger dispositional biases in person perception compared to Japanese, and in the implicit measurement of interdependence, Japanese scores were higher than the Western populations. Similarly, San Martin et al. (2018) studied Arab populations, and identified that Saudis and Lebanese were as interdependent in their self-perception, holistic in their attention, and context-oriented in their behavioral inference patterns as Japanese, yet they were more assertive in their emotional experiences than Japanese. Uskul et al. (2008) also tested three small communities in the Black Sea region of Turkey. Participants were ethnically similar and spoke the same language but differed in their primary economic activities and subsistence systems. They found that herders, who often work alone, tend to hold a more independent social orientation and analytic thinking style, whereas farmers and fishers, whose cooperative working styles are both valued and required, tend to hold a more interdependent social orientation and holistic thinking style. However, research has scarcely been conducted in other regions such as Central Asia, South America, and Africa, even though there are substantial amounts of ethnography and data provided by anthropologists, sociologists, and regional researchers.

Second, the East-West dichotomy often results in unclear explanations regarding the key variables that directly influence one's pattern of cognition. For example, Southern Chinese tend to hold holistic patterns of attention, and it is often argued that their rice-farming tradition, which requires intensive collaboration such as creating irrigation systems, is the antecedent of their interdependent social orientation (Talhelm et al., 2014). However, there is still a need for researchers to articulate the causality between culture and cognition, and much research is needed to test the replicability of the findings. Can interdependent social norms be independent from the culture's dominant economic system? What if the dominant economic system of the target culture is nomadic pastoral (a potential ecological facilitator of analytic cognition), yet they are socially interdependent (a potential factor in making people holistic)? In order to answer these questions, researchers must investigate explanatory variables and scrutinize the magnitude of the effect of each variable.

Third, while cultural psychologists have advocated for many theoretical frameworks predicting cultural variations in human cognition, it is important to further search for variables and dimensions by which researchers can capture a variety of cultural phenomena all over the world. For example, San Martin et al. (2018) identified that interdependence and assertiveness are key variables in explaining Arabs' mentalities. Where does the assertiveness come from? Are there other cultures which show similar mentalities? What are the effects of religious beliefs (e.g., shamanism, monotheism, polytheism, animism, etc.), political systems (e.g., communistic, socialistic, democratic, etc.), population density (e.g., dense, intermediate, scarce, etc.), or relational mobility—a socioecological variable (Yuki and Schug, 2012) that represents how much freedom and opportunity a society affords individuals to choose and dispose of interpersonal relationships based on personal preference (e.g., high-voluntary vs. low-fixed)? Currently, cultural psychologists can provide few answers to these questions.

In summary, this section has discussed a brief history of the theoretical development of cultural research, classic empirical studies, and the recent advances of research on culture and cognition outside of the WEIRD population and the East-West dichotomy. We also discussed three major reasons for researchers to extend their region of research outside of G7 and G20 countries. In the next section, we will introduce a case study as an example of initiating a cross-cultural study in a new culture.

MONGOLIAN SCHOOL-AGED CHILDREN AND TEENAGERS' LANDSCAPE DRAWING STYLES: A CASE STUDY

In this study, we selected Mongolia as our target culture and created networks with Shine Mongol Elementary and Secondary schools, part of the New Mongol Academy, Ulaanbaatar, Mongolia, where we implemented a study using a simple picture drawing task (Masuda et al., 2008). The main objective of this study was to examine Mongolian children and teenager's patterns of perception. In addition, we aimed to compare the data with an existing cross-cultural dataset (Nand et al., 2014) to examine the similarities and differences in drawing styles across three countries: Mongolia, Canada, and Japan. By doing so, we attempted to demonstrate a way of extending research to a non-WEIRD culture (e.g., Henrich et al., 2010) and strove to go beyond the East-West dichotomy (e.g. Markus and Kitayama, 1991; Nisbett, 2003).

Mongolian Culture

Ancient historical documents reported that people of many ethnic backgrounds have lived in the geographical area of Mongolia[1]. The earliest report of Mongolians appeared in Chinese documents published in the 11th century, but their activities can be traced back to the 9th century. In the 13th century, Genghis Khan (Chinggis Khaan) founded the Mongol Empire, and his influence spread across Eurasia. From the 17th century, the area was ruled by the Qing dynasty in China, influencing the country until the end of the 19th century.

[1]The studies involving human participants were reviewed and approved by the Research Ethics Office, University of Alberta. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with national legislation and institutional requirements.

In the early 20th century, the Mongolian People's Republic was established under the authority of the Soviet Union. The Mongolian people further transformed in the late 1980s and early 1990s, and in 1992, the government issued a new constitution implementing a multi-party system and endorsing a market economy.

Because of their herding and nomadic traditions, family oriented lifestyle, religious beliefs (e.g., Buddhism, Shamanism, and Animism), and the ecology of the area, researchers can speculate a variety of socio-economic-geographical variables which may influence Mongolians' minds. While acknowledging intra-cultural variations, we assumed there would be a dominant pattern of psychological processes in this culture. Although there are many anthropological and sociological studies (e.g., Fijn, 2011; Sakamoto et al., 2015), psychological studies with empirical methodology have rarely been conducted thus far.

Historically, Mongolian culture has developed independently from WEIRD populations and from East-West contrasts, while they have experienced political influences from Russia and China. Therefore, it is important for cultural psychologists to examine Mongolians and their civilization in order to discover potentially unique characteristics in their mindset. We present two competing hypotheses: (1) since Mongolians value family ties, they hold more interdependent and less independent social orientation (Markus and Kitayama, 1991; Varnum et al., 2010), therefore their patterns of attention are more similar to East Asians than North Americans, or (2) because of their tradition of pastoral and nomadic lifestyle, one that has been said to be relatively independent from any other subsistence system, Mongolians are less holistic and more analytic (Nisbett et al., 2001; Uskul et al., 2008; Masuda et al., 2019), suggesting that their patterns of attention are more similar to North Americans than East Asians. In addition to the need to test the above competing hypotheses, we sought to discover unique characteristics of the Mongolian mind.

The current study chose to implement a landscape drawing task used in previous studies (Masuda et al., 2008; Nand et al., 2014; Senzaki et al., 2014). Those results indicated that East Asians have developed an artistic tradition of expression which emphasizes context, whereas Westerners, especially North Americans, have developed another artistic tradition of expression which emphasizes main objects rather than context. Furthermore, contemporary members of each culture (as opposed to classic painters), such as school-aged children, teenagers, and young adults demonstrate culturally dominant patterns of artistic expressions when asked to draw a landscape image. Masuda et al. maintain that the observed patterns of drawing reflect the dominant pattern of attention: East Asians view things holistically and in a context-oriented manner associated with their sense of interdependent social orientation, whereas North Americans view things analytically and in an object-oriented manner associated with their sense of independent social orientation (Nisbett et al., 2001; Nisbett, 2003; Nisbett and Masuda, 2003; Masuda, 2017; Masuda et al., 2019).

We focused selectively on school-aged children because we assumed that cultural variation in cognition is attributable to one's internalization and socialization of a culturally shared meaning system (Miller, 1999). By using a drawing task which assess school-aged children's cognition (e.g., Nand et al., 2014), we examined whether Mongolian school-aged children and teenagers would show a pattern of drawing styles similar to, or different from analytic/object-oriented/independent North Americans (e.g., European Canadians and European Americans) or holistic/context-oriented/interdependent East Asians (e.g., Japanese). We also examined whether Mongolian children and teenagers would draw any particular objects (e.g., houses, clothing, animals, scenic images) which may represent unique characteristics of Mongolian culture.

Materials and Methods

Participants

A total of 334 school-aged children and teenagers from Grade 1 through Grade 12 at Shine Mongol School in Ulaanbaatar, Mongolia, participated in the current study. The participants consisted of 23 first graders (13 females, eight males, two undeclared), 25 second graders (12 females, 13 males), 29 third graders (14 females, 14 males, one undeclared), 28 fourth graders (18 females, 12 males), 30 fifth graders (15 females, 15 males), 27 sixth graders (13 females, 14 males), 27 seventh graders (11 females, 16 males), 22 eighth graders (11 females, 11 males), 25 ninth graders (14 females, 11 males), 30 tenth graders (13 females, 17 males), 39 eleventh graders (22 females, 17 males), and 29 twelfth graders (21 females, 8 males). An additional 14 students were tested but were not included in our analyses due to the omission of necessary items. The majority of students were born in Mongolia, but 20 students were born abroad (eight in Japan, three in the United States, two in Australia, two in the United Kingdom, one in Korea, one in China, one in Singapore, one in Canada, and one in Germany). All students understood the instructions in Mongolian, and data from these students made up only 5.9% of the total data; therefore, we included their data into our final analyses.

Materials and Procedure

The materials and procedure were identical to those used in the previous studies (Nand et al., 2014; Senzaki et al., 2014). Students who participated in the study were provided with a pencil and a 392 mm × 271 mm sheet of paper on which to draw a landscape picture. The study was conducted in a classroom setting, where a male teacher, who is the second author, accompanied by the first author, gave instructions in Mongolian. It was emphasized that there was no right or wrong way to draw the picture, and that the children were free to complete their own artwork as they wished. The classroom teachers were sometimes present to observe the session and help with collecting students' artwork, but they did not administer the session. After instruction and their consent to participate, the students were asked to draw a landscape image including a human, house, tree, and a horizon. They were also told that they could incorporate any other additional objects into their pictures. To standardize students' understanding of the concept of horizon, the teacher explained what a horizon is, using the following instruction: "When you go outside, you see that the sky comes down and meets the ground, and makes one line. That

FIGURE 1 | A sample of a Mongolian participant's landscape drawing.

line is called a horizon." The total time of the session including instruction and data collection was 30 min.

Results

Types of Drawings with Horizon Lines

Based on Senzaki et al.'s (2014) coding scheme, we measured the top and bottom parts of the horizon drawn by each student. We then computed the average of the two values as the artwork's location of horizon, and the ratio of the horizon height against the entire frame height. A research assistant and the third author independently measured the location of the horizon. Intercoder agreement in measuring these values were $r = 0.995$. For the random 30% of the data, the intraclass correlation coefficient (ICC) between the two coders was ICC = 0.976, [95% CI = 964; 984], indicating an excellent reliability. Disagreement was resolved through discussion.

While the majority of students drew a conventional landscape image, a small number of students produced other patterns of drawings (see **Figure 1**). For example, in some illustrations, a single horizon was drawn but objects were floating above the horizon (coded as "pictures with floating objects"). In these cases, the height of that single line was measured as the location of the horizon. If children drew an air-gap line (a second line in the sky in addition to the line representing the ground), only the ground line was measured (coded as "pictures with air-gap"). If children used the bottom edge of the paper as a horizon line and placed objects on it, a value of 0 (i.e., a height of 0 cm) was given for the location of the horizon (bottom edge line). Lastly, if children drew only floating objects, we categorized the image as having no horizon line (no horizon) and this data was excluded from the analysis. As seen in **Table 1**, these patterns are consistent with Canadian and Japanese data (Nand et al., 2014; Senzaki et al., 2014). The universality of this pattern has been addressed in previous papers (Eisner, 1967; Lewis, 1990; Cox and Chapman, 1995; Toku, 2001).

Location of Horizon

First, we carried out the ANOVA's below by including the gender of the participants as one of individual variables. However, there were no main effects or interaction of gender and other independent variables. Therefore, we collapsed this variable in the analyses reported below.

By taking the participants' grade as an independent variable, a one-way ANOVA was applied to the ratio of the location of the horizon against the entire frame. As shown in **Figure 2**, there was a significant main effect of grade, $F(1, 327) = 11.97$, $p < 0.001$, $\eta_p^2 = 0.290$. The results of multiple t tests indicated that as children grow older, the location of the horizon in their drawings becomes higher. For example: Grade two's location of horizon ($M = 0.40$, $SD = 0.22$) was significantly higher than that of Grade one's ($M = 0.27$, $SD = 0.22$), $t(322) = 2.82$, $p < 0.01$; Grade three's location of horizon ($M = 0.54$, $SD = 0.29$) was significantly higher than that of Grade two's, $t(322) = 3.07$, $p < 0.01$. However, Grade four's location of horizon ($M = 0.61$, $SD = 0.14$) did not significantly differ from that of Grade three's, $t(322)$ (1.54, ns; and the location of horizon of Grade five ($M = 0.610.61$, $SD = 0.150.15$), Grade six ($M = 0.620.62$, $SD = 0.160.16$), Grade seven ($M = 0.62$, $SD = 0.09$), Grade eight ($M = 0.59$, $SD = 0.08$), Grade nine ($M = 0.65$, $SD = 0.09$), Grade ten ($M = 0.63$, $SD = 0.18$), Grade eleven ($M = 0.64$, $SD = 0.15$), and Grade twelve ($M = 0.63$, $SD = 0.16$) did not significantly differ from each other, $t(322) < 1$, ns.

The general patterns of the location of the horizon from Grade one through twelve seem to be identical to that of Canadian and Japanese school-aged children and teenagers reported in Nand et al. (2014) and Senzaki et al. (2014). However, it is important to scrutinize cultural variations in the artworks by comparing the patterns across cultures in detail. We merged the current data with those of previous studies (Nand et al., 2014). A 3 (Culture: Mongolians, Canadians, and Japanese) × 12 (Grade: Grade one through Grade twelve) was applied to the ratio of the location of the horizon against the entire frame in order to examine cultural variations in the artworks. The results indicated

TABLE 1 | Grade distributions of understanding the concept of horizon.

			Grade distributions											
	n	%	1	2	3	4	5	6	7	8	9	10	11	12
Conventional horizon	309	87.5	12	17	23	28	30	27	27	22	25	30	39	29
Floating objects	12	3.4	4	5	2	0	0	0	0	0	0	1	0	0
Air gap	15	4.2	7	5	3	0	0	0	0	0	0	0	0	0
Bottom edge line	3	0.8	2	1	1	0	0	0	0	0	0	0	0	0
No horizon	14	4.0	0	2	0	1	0	1	0	0	1	3	6	0

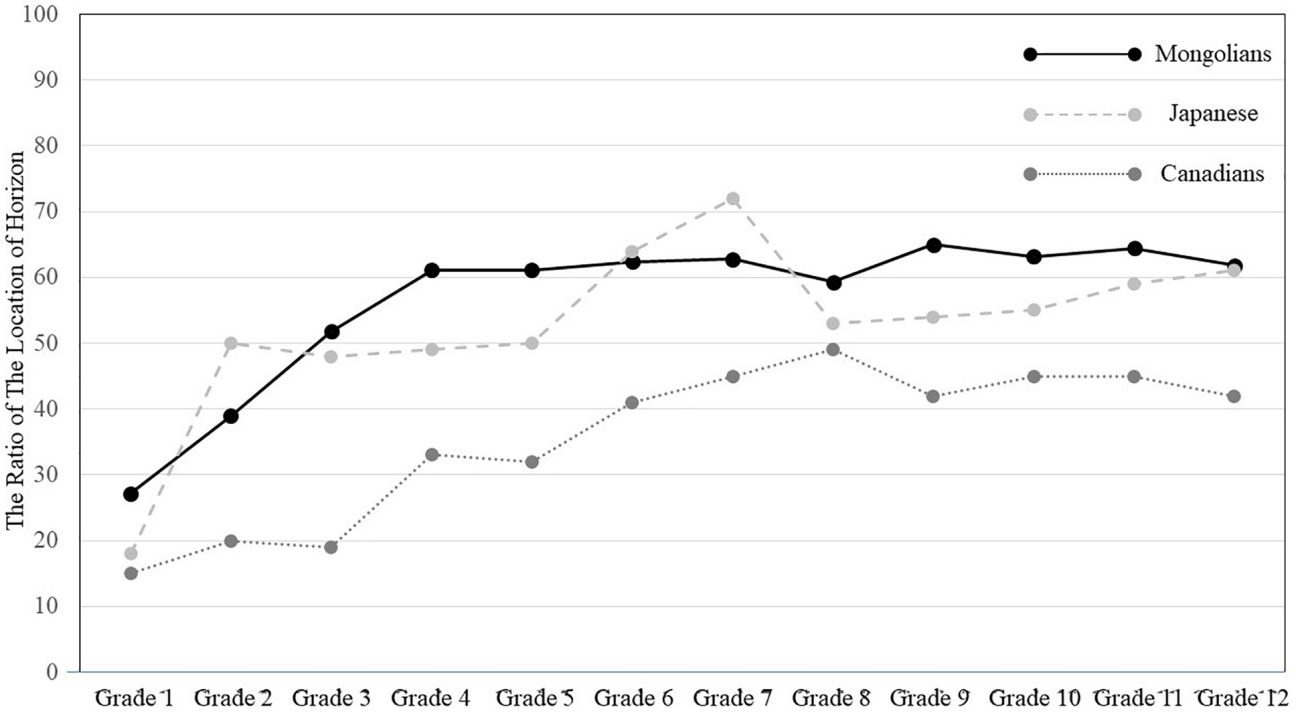

FIGURE 2 | The ratio of horizon height to the entire frame height.

that there was a main effect of culture, $F(2, 1192) = 117.73$, $p < 0.001$, $\eta_p^2 = 0.169$. In general, the location of horizon in Mongolian data ($M = 0.58$, $SD = 0.19$) is higher than that of Japanese ($M = 0.53$, $SD = 0.27$), $t(1192) = 2.84$, $p < 0.01$, and Canadian's data ($M = 0.35$, $SD = 0.21$), $t(1192) = 15.12$, $p < 0.001$. There was also a main effect of grade, $F(11, 1193) = 29.85$, $p < 0.001$, $\eta_p^2 = 0.221$. Overall, the location of the horizon in drawings became higher with the participant's increased grade level: Grade two's location of horizon ($M = 0.38$, $SD = 0.300.30$) was significantly higher than that of Grade one ($M = 0.18$, $SD = 0.20$), $t(1192) = 5.89$, $p < 0.001$; Grade three's location of horizon ($M = 0.37$, $SD = 0.29$) did not differ from that of Grade two, $t < 1$, ns; Grade four's location of horizon ($M = 0.46$, $SD = 0.23$) was significantly different from that of Grade three, $t(327) = 3.15$, $p < 0.001$; Grade five's location of horizon ($M = 0.46$, $SD = 0.23$) did not differ from that of Grade four, $t < 1$, ns; Grade six's location of horizon ($M = 0.55$, $SD = 0.24$) was higher than that of Grade five, $t(1192) = 3.23$, $p < 0.001$; and the location of horizon of Grade seven ($M = 0.58$, $SD = 0.17$), Grade eight ($M = 0.53$, $SD = 0.16$), Grade nine ($M = 0.55$, $SD = 0.19$), Grade ten ($M = 0.55$, $SD = 0.20$), Grade eleven ($M = 0.59$, $SD = 0.16$), and Grade twelve ($M = 0.56$, $SD = 0.19$) did not significantly differ from each other, $ts(1192) < 1.50$, ns.

More importantly, there were interactions between culture and grade levels, $F(22, 1192) = 2.93$, $p < 0.001$, $\eta_p^2 = 0.053$ (see **Figure 2**). The location of horizons drawn by all grades of Mongolians was higher than that of Canadians: Grade one: $t(1192) = 2.44$, $p < 0.01$; Grade two: $t(1192) = 4.00$, $p < 0.001$; Grade three $t(1192) = 2.44$, $p < 0.01$; Grade four: $t(1192) = 2.44$, $p < 0.01$; Grade five: $t(1192) = 2.44$, $p < 0.01$; Grade six: $t(1192) = 2.44$, $p < 0.01$; Grade seven: $t(1192) = 2.44$, $p < 0.01$; Grade eight: $t(1192) = 2.44$, $p < 0.01$; Grade nine: $t(1192) = 2.44$, $p < 0.01$; Grade ten: $t(1192) = 2.44$, $p < 0.01$; Grade eleven: $t(1192) = 2.44$, $p < 0.01$; and Grade twelve: $t(1192) = 2.44$, $p < 0.01$. As for the comparison between Japanese and Mongolian data, there were a few significant differences in the location of the horizon. First, the location of horizons drawn by Mongolian children and teenagers was higher than that of their Japanese counterparts only in Grade one: $t(1192) = 2.08$, $p < 0.05$; Grade five: $t(1192) = 2.54$, $p < 0.01$; Grade six: $t(1192) = 2.44$, $p < 0.01$; Grade nine: $t(1192) = 1.99$, $p < 0.05$; and Grade ten: $t(1192) = 2.44$, $p < 0.01$. The location of horizons drawn by Japanese was higher than that of their Mongolian counterparts in Grade two, $t(1192) = 2.33$, $p < 0.02$, and there were no statistical significances in the location of horizons in Grades three, four, seven, eight, eleven, and twelve, $ts(1192) < 1.60$, ns. In sum, the cross-cultural comparisons among Canadians, Japanese, and Mongolians allowed us to conclude that the pattern of Mongolian data was quite similar to that of Japanese data, but substantially different from Canadian data.

Types of Houses

In addition to the cross-cultural comparisons regarding the locations of horizons, we observed several unique drawing styles in the Mongolian data. One aim of the current paper was to emphasize the importance of overcoming the WEIRD issue in psychological research (e.g., Henrich et al., 2010) and extend

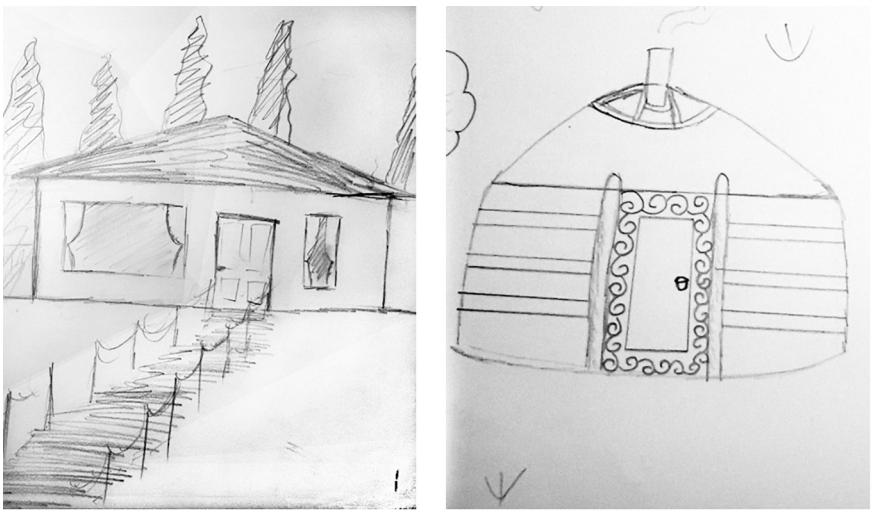

FIGURE 3 | Samples of traditional vs. modern houses drawn by Mongolian participants.

away from the East vs. West framework (e.g., Nisbett, 2003 Masuda, 2017). In order to do this, we first focused on the types of houses. Historically, Mongolian houses are a round shaped portable tent called *a ger*, made of wood and felt, a textile material that is produced by matting, condensing, and pressing fiber of sheep wool. We examined whether children and teenagers drew modern houses (e.g., Western style houses) or traditional *ger* houses (see **Figure 3**). Participants were asked to draw at least one house in their landscape as one of the required objects to complete their drawing. In the analysis phase, we assigned a value of one for each type of house depicted in the drawing. For example, if a participant drew two traditional houses and a modern house in his/her artwork, we assigned 1, 1, respectively. If they drew a traditional house but did not draw a modern house, we assigned 1, 0, respectively.

Next, we contrasted whether there were any trends in the types of houses, by carrying out a 2 (Types of Houses: traditional vs. modern) × 12 (Grade: one through twelve) ANOVA, treating types of houses as a repeated measure. The results indicated that there was a main effect of types of houses, $F(1, 322) = 74.21$, $p < 0.001$, $\eta_p^2 = 0.187$. Overall, Mongolian children and teenagers were more likely to draw traditional houses ($M = 0.73$, $SD = 0.44$) than modern houses ($M = 0.33$, $SD = 0.47$). There was an interaction between types of houses and grade as well, $F(1, 322) = 1{,}89$, $p = 0.04$, $\eta_p^2 = 0.061$. The results of multiple t tests indicated that participants drew traditional houses more than modern houses in Grade two, $t(322) = 5.87$, $p < 0.001$; Grade three, $t(322) = 4.59$, $p < 0.001$; Grade four, $t(322) = 3.57$, $p < 0.001$; Grade five, $t(322) = 3.34$, $p < 0.005$; Grade six, $t(322) = 2.73$, $p < 0.05$; Grade seven, $t(322) = 2.94$, $p < 0.01$; Grade ten, $t(322) = 2.25$, $p < 0.05$; Grade eleven, $t(322) = 3.65$, $p < 0.001$; and Grade twelve, $t(322) = 2.37$, $p < 0.05$, but the pattern did not reach statistical significance in Grade eight, $t(322) = 1.30$, ns, and Grade nine, $t < 1$, ns. Finally, the pattern was reversed in Grade one but again did not reach statistical significance, $t < 1$, ns (see **Figure 4**).

Types of Clothes

Second, we examined whether children and teenagers drew people with modern clothes (e.g., Western style clothes) or traditional clothes called *deel* (see **Figure 5**). Participants were asked to draw at least one person in the landscape image. Types of clothes were categorized into two types: modern vs. traditional. Similar to the analyses in the previous section, we assigned a value of one for each type of clothing observed. For example, if they drew a person who wore traditional clothes and two people who wore modern clothes, we assigned 1, 1, respectively. If they drew a person with traditional clothes but did not draw a person with modern clothes, we assigned 1, 0, respectively. Then we contrasted whether there were any trends in the types of clothes, by carrying out a 2 (Types of Clothes: traditional vs. modern) × 12 (Grade: one through twelve) ANOVA, treating types of houses as a repeated measure. The results indicated that there was a main effect of types of clothes, $F(1, 322) = 110.29$, $p < 0.001$, $\eta_p^2 = 0.255$. Overall, Mongolian children and teenagers were more likely to draw people with modern clothes ($M = 0.73$, $SD = 0.44$) than traditional clothes ($M = 0.30$, $SD = 0.46$). There was an interaction between types of clothes and grade as well, $F(1, 322) = 3{,}18$, $p < 0.001$, $\eta_p^2 = 0.098$. The results of multiple t tests indicated that participants drew modern clothes more than traditional clothes in Grade one, $t(22) = 15.20$, $p < 0.001$; Grade two, $t(24) = 5.31$, $p < 0.001$; Grade three, $t(28) = 5.27$, $p < 0.001$; Grade four, $t(27) = 2.50$, $p < 0.02$; Grade five, $t(29) = 2.90$, $p < 0.01$; Grade six, $t(26) = 3.32$, $p < 0.005$; Grade eight, $t(21) = 2.93$, $p < 0.01$; Grade nine, $t(24) = 2.31$, $p < 0.05$; and Grade ten, $t(29) = 3.75$, $p < 0.001$; however, this pattern did not reach statistical significance in Grade seven, $t(26) = 1.77$, $0.05 < p < 0.10$; Grade eleven, $t < 1$, ns; or Grade twelve, $t(29) = 1.68$, $p > 0.10$ (See **Figure 6**).

Types of Animals

Although it was not required, many Mongolian children and teenagers drew animals including sheep, horses, goats, dogs,

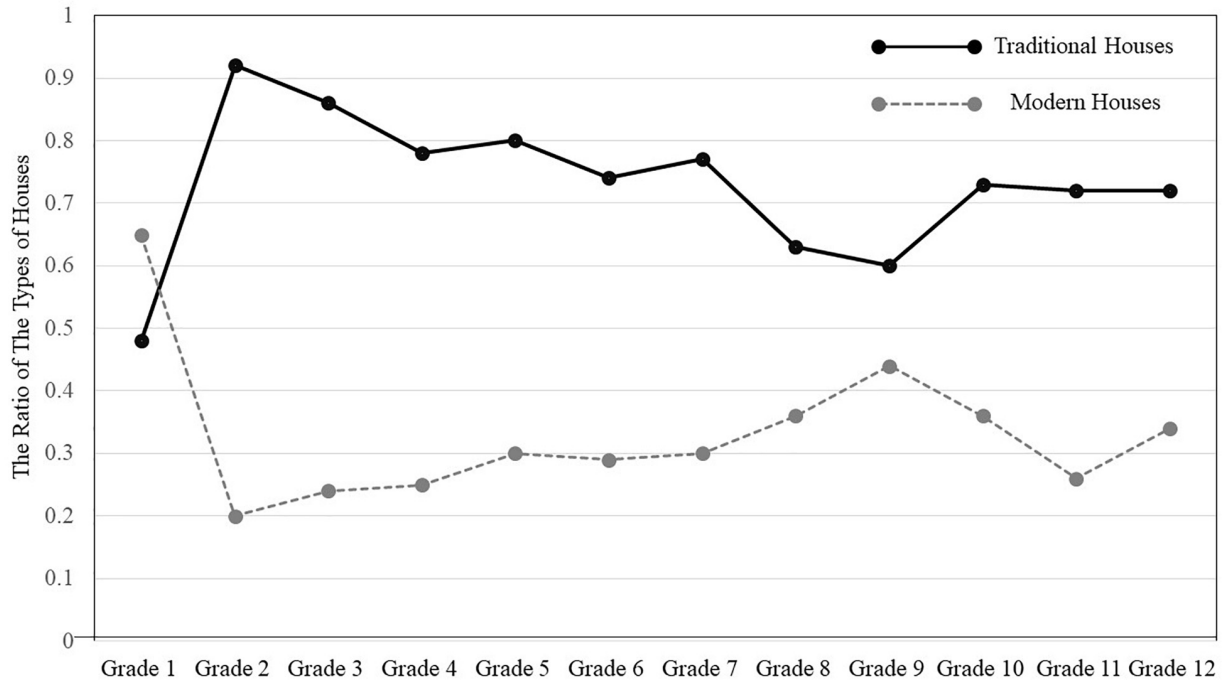

FIGURE 4 | The ratio of traditional vs. modern houses.

cows, camels, and reindeer as additional objects in their artwork (see **Figure 7**). We assume that the large number of animal images is due to the participants' familiarity with herding lifestyles. Historically, Mongolians have lived with five animals including horses, sheep, goats, camels, and cows. Additionally, dogs are seen as useful domesticated animals which serve as shepherds, and reindeer have been domesticated in Western and Northern Mongolia, but are not as popular in Central, South, and East Mongolia. We targeted these seven animals since they were most commonly drawn. A 7 (Types of Animals: Sheep, Horse, Goat, Dog, Cow, Camel, and Reindeer) × 12 (Grade one through twelve) ANOVA was carried out, using the number of Types of Animals as a repeated measure (see **Figure 8**). The results indicated that there was a main effect of types of animals, $F(1, 322) = 34.34$, $p < 0.001$, $\eta_p^2 = 0.096$. Overall, Mongolian children and teenagers draw more sheep ($M = 3.00$, $SD = 9.81$) than horses ($M = 0.21$, $SD = 0.61$), $t(322) = 5.25$, $p < 0.001$, camels ($M = 0.01$, $SD = 0.18$), $t(322) = 5.56$, $p < 0.001$, goats ($M = 0.05$, $SD = 0.33$), $t(322) = 5.51$, $p < 0.001$, cows ($M = 0.03$, $SD = 0.28$), $t(322) = 5.54$, $p < 0.001$, dogs ($M = 0.05$, $SD = 0.22$), $t(322) = 5.49$, $p < 0.001$, and reindeer ($M = 0.01$, $SD = 0.16$), $t(322) = 5.57$. $p < 0.001$. The second most popular animal in their drawings were horses. They drew more horses than camels, $t(322) = 5.58$, $p < 0.001$, goats, $t(322) = 4.63$, $p < 0.001$, cows, $t(322) = 4.98$, $p < 0.001$, dogs, $t(322) = 4.63$, $p < 0.001$, and reindeer, $t(322) = 5.79$, $p < 0.001$. Goats and dogs were more popular than reindeer, $t(322) = 2.07$, $p < 0.05$ and $t(322) = 2.77$, $p < 0.01$, respectively. Other comparisons among animals did not reach statistical significance.

FIGURE 5 | Samples of traditional vs. modern clothes drawn by Mongolian participants.

There was an effect of grade, $F(11, 322) = 2.16$, $p = 0.017$, $\eta_p^2 = 0.069$, but it should be qualified by the interaction between types of animals and grade as well, $F(11, 322) = 1.99$, $p = 0.029$, $\eta_p^2 = 0.064$. The results of multiple t-tests indicated that as children and teenagers' grades went up, they drew more sheep. Young school-aged children rarely drew sheep, and the values were significantly lower for Grade one ($M = 0.00$, $SD = 0.00$) participant's when compared to Grade seven ($M = 3.11$, $SD = 6.19$), $t(322) = 3.01$, $p < 0.001$, Grade two ($M = 0.20$, $SD = 0.81$), $t(322) = 2.88$, $p < 0.001$, Grade three ($M = 0.48$, $SD = 1.50$), $t(322) = 2.70$, $p < 0.001$, and Grade four ($M = 0.46$, $SD = 2.26$), $t(322) = 2.70$, $p < 001$, but there were no

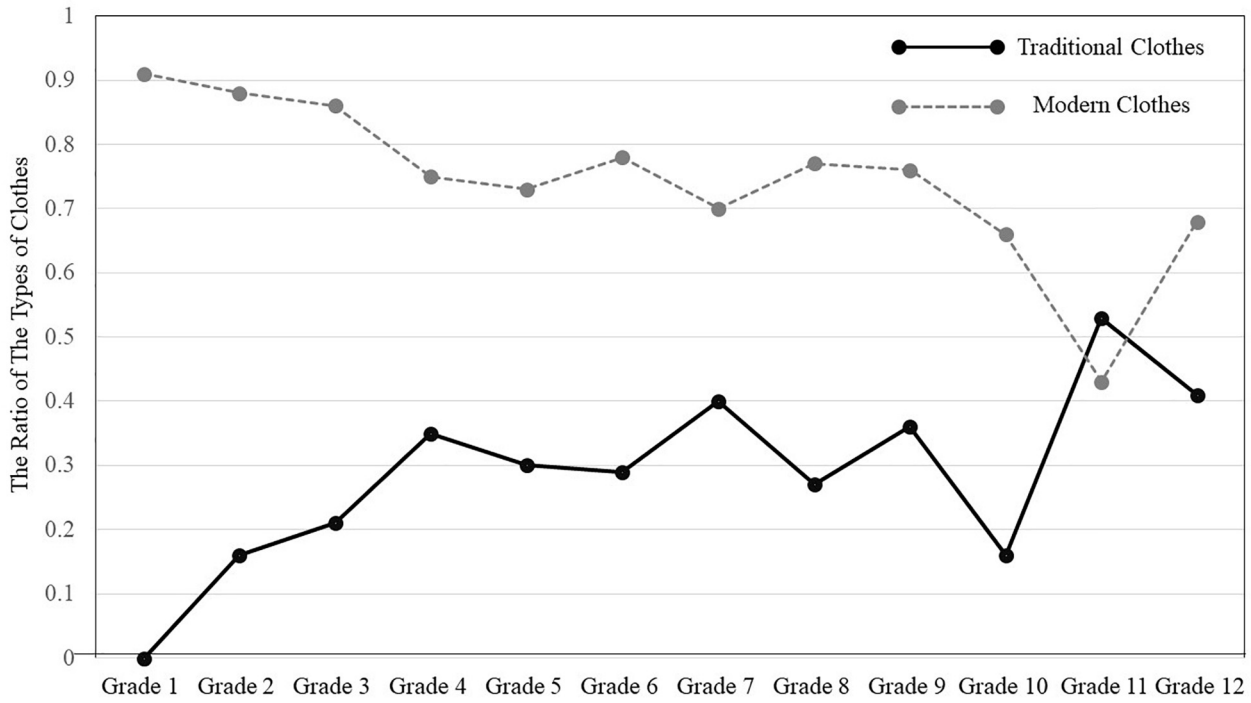

FIGURE 6 | The ratio of traditional vs. modern clothes.

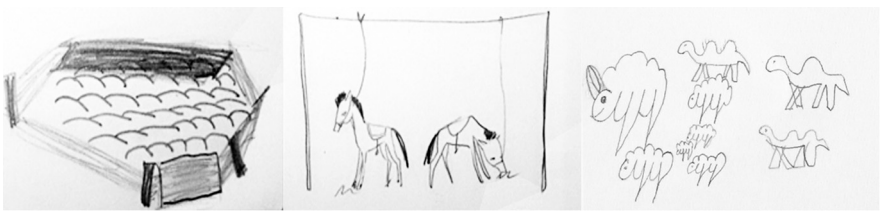

FIGURE 7 | Samples of animals drawn by Mongolian participants.

differences between Grade five (M = 1.67, SD = 7.50) and seven (M = 3.11, SD = 6.19), $t(322)$ = 1.49, ns, and between Grade six (M = 1.67, SD = 4.67) and seven, $t(322)$ = 1.45, ns. However, there were significant gaps in values between Grade seven and nine (M = 6.16, SD = 19.97), $t(322)$ = 3.02, $p < 0.001$ as well as Grade eight (M = 1.09, SD = 2.34) and nine, $t(322)$ = 4.77, $p < 0.001$. Grade nine, ten (M = 5.70, SD = 13.03), eleven (M = 6.08, SD = 9.04), and twelve (M = 7.07, SD = 17.57) showed the highest values regarding the number of sheep and the value of Grades, however, we did not observe any trends in other animals, $ts(322) < 1, p < 0.001$.

Correlational Analyses

We further analyzed associations between the location of the horizon and the number of modern/traditional houses, modern/traditional clothes, and animals drawn in the scene. The results (N = 334) indicated that there were significant positive correlations between the location of the horizon and the number of traditional houses (r = 0.13, p = 0.01), traditional clothes (r = 0.21, $p < 0.001$) and sheep (r = 12, p = 0.03), suggesting that traditional Mongolian cultural resources may sustain their holistic/context-oriented/interdependent cognition, rather than analytic/object-oriented/independent cognition.

The number of traditional houses positively correlated with the number of traditional clothes (r = 0.21, $p < 0.001$), horses (r = 0.27. $p < 0.001$), sheep (r = 0.21, $p < 0.001$), and goats (r = 0.15, $p < 0.006$). The number of traditional clothes also positively correlated with the number of horses (r = 0.17, p = 0.002) and goats (r = 0.12, p = 0.034). In contrast, the number of modern houses negatively correlated with the number of traditional houses ($r = -0.28$, $p < 0.001$), and horses (r = 11, p = 046), but positively correlated with the number of modern clothes (r = 0.26, $p < 0.001$). The number of modern clothes negatively correlated with the number of traditional clothes ($r = -0.30$, $p < 0.001$), but positively correlated with the number of modern houses (r = 0.26, $p < 0.001$). These findings suggest that there was clear consistency among the objects drawn by Mongolian school-age children: the more they drew traditional

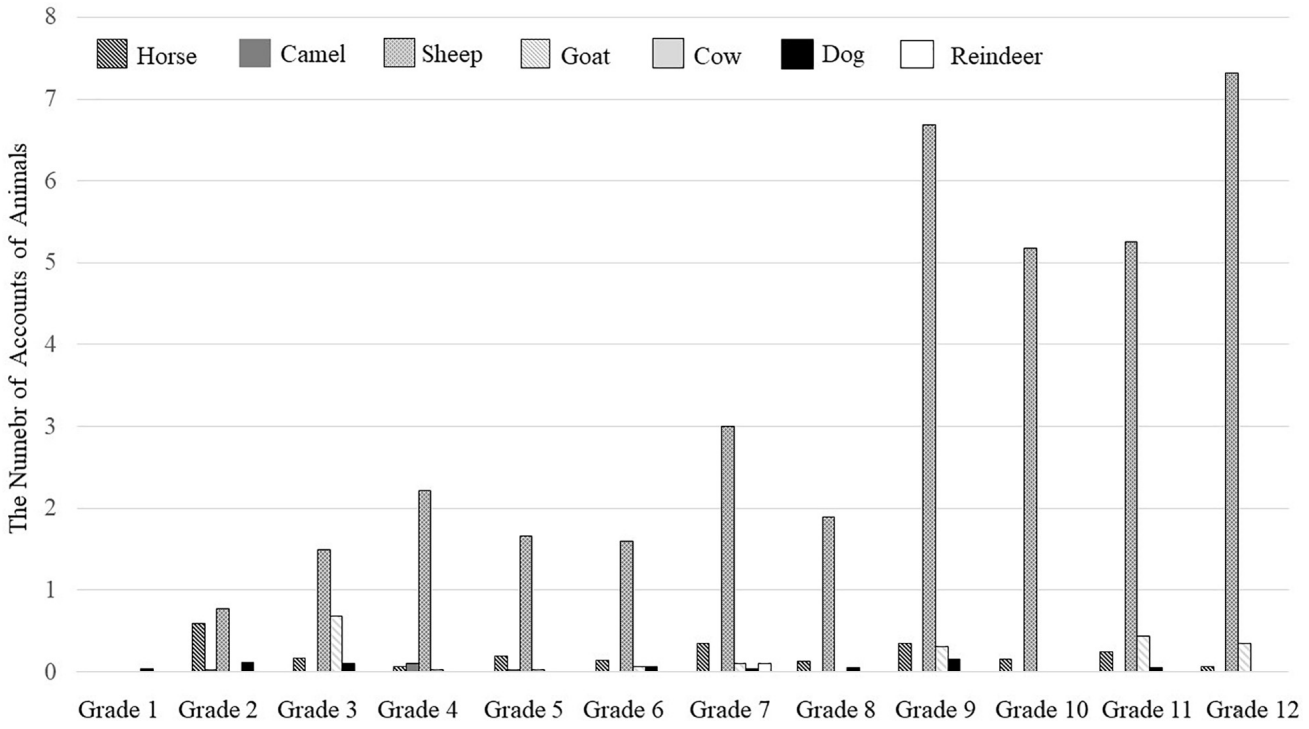

FIGURE 8 | The number of accounts of seven types of animals: Horses, camels, sheep, goats, cows, dogs, and reindeer.

TABLE 2 | Grade distributions of culture-specific mountain drawings.

			Grade distributions											
	n	**%**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mountain drawing	21	6.2	3	2	2	4	1	2	0	1	1	2	2	1
Total	334	100.0	23	25	29	28	30	27	27	22	25	30	39	29

objects, the less they drew modern objects, and vice-versa, suggesting that they still have rich and tangible sources for drawing traditional scenes in modern Mongolia, and that they conceptually distinguish traditional objects from modern objects.

For drawings of animals, the number of horses positively correlated with the number of sheep ($r = 0.20$, $p < 0.001$) and goats ($r = 0.22$, $p < 0.001$). The number of camels positively correlated with the number of goats ($r = 0.14$, $p < 0.011$). Finally, the number of sheep positively correlated with the number of goats ($r = 0.11$, $p < 0.042$). These findings suggest that Mongolian school-age children completed the assigned drawing with rich sources from herding culture, when they drew such countryside scenes.

Types of Mountains

Finally, there was one more unique characteristic in Mongolian children and teenagers' drawings worth mentioning (**Table 2**). A small number of participants across almost all grades drew a multi layered chain of mountains (**Figure 9**). This style of drawing is observable in conventional artworks and images in the city. However, no Canadian or Japanese participants drew mountain chains in such a way. This implies that Mongolian children and teenagers were exposed to a specific visual representation accessible in their society and internalized

FIGURE 9 | A sample image with a culturally specific mountain drawing.

the techniques of drawing images in accordance to the culturally shared tradition. Further investigation into the transmission of cultural representations of artwork is required.

Discussion

The current case study examined Mongolian children and teenagers' landscape artwork. The results of local comparisons of Mongolian data, and cross-cultural comparisons between Mongolians, Canadians, and Japanese provided us with a variety of new knowledge. First of all, similar to their Canadian and Japanese counterparts, young Mongolian children (e.g., Grade one) captured three-dimensional scenes by placing the horizon in a lower section of the frame. But the location of the horizon gradually moved up as their grade level increased. Finally, a culturally dominant way of landscape drawing styles stabilized around Grades four to five, and became constant in their teenage years. Overall, the results of the Mongolian data were more similar to that of Japanese than to Canadians, suggesting that, while being exposed to their pastoral social orientation (which has been discussed as the antecedent of analytic/object-oriented/independent cognition), Mongolian children and teenagers were more likely to be influenced by their holistic/context-oriented/interdependent cognition when they drew landscape images (e.g., Masuda, 2017; Masuda et al., 2019).

Beyond the discussions of universality and cultural specificity of landscape drawing, the current study also provided us with rich information on Mongolian children and teenagers' life experiences. For example, while the school is situated in the center of Ulaanbaatar, the capital city of Mongolia, where Western style houses and buildings are dominant, many children in fact have had the opportunity to visit the countryside and view traditional *ger* houses. We assume that such experiences provided an image of what a unique Mongolian landscape looks like. Therefore, when they were asked to complete the landscape drawing, Mongolian children and teenagers seem to accurately represent traditional *ger* houses. In contrast, though traditional Mongolian clothes are popular for attending special events such as ritual ceremonies and festivals, modern clothes are dominant both in cities and the countryside. We assume that when Mongolian children and teenagers were asked to draw a landscape drawing, they reflected on images of familiar clothing for their drawings. However, it is interesting that such a tendency weakened as they became teenagers, potentially implying that adolescents think the traditional *deel* clothes play an important role in identifying themselves as mature Mongolians. Future studies should further investigate the relationship between cultural traditions and identity.

In terms of the types of animals, the data showed that sheep and horses were two popular animals in the landscape drawings. The number of sheep drawn increased gradually as children attended higher grades. These results may reflect the fact that older children and teenagers were more aware of the importance of the pastoral economy in Mongolia as well as the fact that horses are an important symbol that represent this society, or it may just reflect the fact that older children are generally more skilled at drawing. The fact that the number of sheep are larger than any of the other animals may reflect that sheep are dominantly popular around the village: compared to horses and cows which search for grass far from the village, goats and sheep roam the grassland closer to the village, which allow them to be viewed more frequently. Furthermore, the ratio of goats to sheep in this area is traditionally 1:10. As a result, herds of sheep are frequently viewed by Mongolians, which can explain their patterns of drawings. The current results may accurately represent reality for Mongolians.

The findings based on correlational analyses further give credence to the connection between their holistic/context-oriented/interdependent drawing style and their motivation to draw traditional resources such as traditional *ger* and *deel*. The number of sheep also supports this connection. One may question why the pattern of cognition shared by this traditionally herding-oriented culture appears to contradict with that of other herding societies (e.g., Uskul et al., 2008). Fijn's (2011) observation in her book "Living with Herds: Human-Animal Co-existence in Mongolia" may provide some insights. In her book, she observed that Mongolians' pictorial depiction of their homeland captures the whole range of valley and mountain in their drawing as if they perceive the connectedness of all elements (p. 58), suggesting that it is natural for them to sustain holistic/context-oriented/interdependent tendencies. Future research should investigate possibilities of more nuanced differences in cognition among these traditional herding cultures.

Limitations

While we maintain that the cultural variations in drawing styles could be explained by the framework of holistic vs. analytic cognition, there remain other possibilities which affect Mongolian school age children's drawing patterns, such as their perceived social expectations regarding their performance, and their intentions on what they want to communicate to others. For instance, their sense of social desirability to express their cultural identity may direct them to draw more traditional objects rather than modern objects in the scenes. By adding other measures, future studies need to mitigate such possible biases.

It is also noteworthy that several years have passed between the collection of the current Mongolian data and previous studies targeting Canadians and Japanese. While we maintain that patterns of cognition do not change quickly, and the data would be replicable if we were able to collect Canadian and Japanese data again, it is prudent to address this limitation. Future research should elucidate this point.

Finally, the current study assumed that there is a sensitive period for school-age children to develop culturally specific patterns of responses, and the patterns we observed are similar to those of young adults in previous studies (Nand et al., 2014; Senzaki et al., 2014). Therefore, it was crucial for the current study to select school-age children as subjects and match their age range with the previous studies. We examined whether there are any trends regarding how they draw images, and whether the patterns are similar to holistic Japanese school-age children's data or analytic Canadian school-age children's data. While we argue that this preliminary investigation successfully controlled for age factors, and replicated the effectiveness of the methodology, it is also prudent to further examine whether the patterns are actually

sustained among young adults, middle-aged, and elder people in Mongolia. By using this useful drawing task, we also plan to examine potential within-culture variations between those who live in cities and those who live in the countryside, such as mountainous and desert areas.

GENERAL DISCUSSION

The current paper addressed the importance for cultural psychologists to target research fields outside of G7 and G20 countries, while going beyond the constraints of the WEIRD cultures and the East/West dichotomy. While reviewing classic cross-cultural studies in the 1960s, we discussed the similarities between them and contemporary cultural psychology. At the same time, we addressed the field's need to evolve by focusing more on the internalization and socialization processes of a given culture's meaning system (Bruner, 1990; Shweder, 1991; Miller, 1999) in order to elucidate the impact of culture on human cognition. The motivation to search for universal phenomena is inherent in scientific investigation, but we may too easily accept equivalency in cognition across cultures without a broad enough sample set outside of North America. Given recent discourse on the pros and cons of globalization, now is a good time to expand our research in order to scientifically define culture's role on cognition—and the actions we take that have global scope. We hope that our paper will motivate scholars to break through existing constraints in our field.

Here, we include a case study from Mongolia, and compare the data with previous cross-cultural findings from Japan and Canada (Nand et al., 2014; Senzaki et al., 2014). The case study had several implications. First, it demonstrated a possible way of extending established research to a new cultural site, Mongolia. Second, the addition of new cultural data suggested universal patterns of human development with regards to the concept of horizon. For example, there appears to be a general trend in which the pictorial representation of the location of the horizon gradually rises across 12 years of schooling. Third, by incorporating the current data into the existing dataset (Nand et al., 2014), we identified cultural similarities and differences between Mongolians, Japanese, and Canadians. These findings allow us to speculate the causes of cultural variation in drawing styles such as the level of interdependence, holistic thinking style, and specific aspects of herding traditions shared in Mongolia. Future studies must investigate the causes of cultural variations in order to understand the mutual relationship between culture and the human mind.

How to Conduct Research in a New Culture

In addition to presenting our case study, we would like to share our experiences in conducting cultural research. Here, we will discuss some potential challenges along with possible solutions, in hopes that they will inform new cultural researchers. Some of these points have been already discussed in anthropology and cultural studies, yet we maintain it is worth sharing them with contemporary cultural psychologists who are interested in broadening their scope of research.

Respect the Target Culture's Rules and Customs

Each culture has its own rules and customs for communicating and creating interpersonal relationships with people. Although researchers may be more comfortable following their own rules and customs, it is important for them to accommodate the guidelines of the target culture. This message is especially important for researchers studying basic psychological processes who have collected data from participants only in their cultural community, because, in most cases, they would be unaware of substantial cultural variations in human behaviors in general. We strongly urge these researchers to expose themselves to new cultural experiences and deeply learn about the target culture and its language. Such observational and anthropological knowledge will be the foundation of their research ideas.

Find a Way to Thank Local Collaborators

Finding collaborators in a new culture is indeed time-consuming and laborious. Once you create a relationship with them, it is necessary for researchers to find a way to thank them, both in the short-term and the long-term. Benefits for the collaborators could include direct monetary support or official recruitment of paid assistants. However, there are also many indirect benefits. For example, if you collect data at a high school, the local collaborators may request you to give a series of lectures, to establish exchange programs, or even collect data from your own culture. Unidirectional relationships can be destructive, so it is important to search for long-term mutual benefits after the data collection is complete, so that a positive relationship can be formed between cultures.

Spend Enough Time Discussing Research Ethics

While collecting data under the institution to which you belong, the ethics board requires you to follow the board's cultural ethics and rules. In some cultures, however, there might not be such a human ethics board, or if there is, the structure and procedure of conducting research might be quite different from yours. In this case, you are required to discuss with both human ethics boards and representatives of the target culture to find a comparable and optimal set of rules to follow. This may include how to get consent and agreement, maintaining participants' voluntary participation rules and their right to select alternative tasks, withdrawal from the session, confidentiality of participants' identities, a data withdrawal policy, and permission for researchers to publicly report their findings. The meticulous solution and optimization will be the foundation of your publication in international journals which meet the standard of international academia.

Using Easy-to-Administer Research Materials

Beginning with an easy task is a suitable way to collect data from a new target culture for many reasons. First, procedural ease helps the collaborators administer the session, and reduces potential mistakes. Second, the first experience is key for the collaborators to estimate the cost of the research and future collaborations. Third, carrying specific experimental devices and materials are costly for both researchers and collaborators, and

may require filling out documents and paying extra fees when going through customs. In general, paper-and-pencil materials are tangible and make it easy for participants to follow the instructions. A successful and positive first experience is essential for developing a long-term relationship between researchers and local collaborators.

Sharing the Findings With Local Collaborators

It is the researchers' responsibility to discuss and get approval from the local collaborators when their paper is accepted by a professional journal. Once the paper is published, it can impact the collaborators' personal lives, their institution, and even their culture—especially when the paper addresses a core component of their cultural values to which they are strongly associated. Providing collaborators with enough time to consider the costs and benefits of publishing the paper allows both researchers and collaborators to develop confidence and responsibility regarding their research program. If the population size of a given society is small, the impact of a single publication may strongly influence the target society. Continuous observation of researchers' output may be required, and researchers need to answer the local people's queries and concerns responsibly.

CONCLUSION

This paper was intended to provide readers with advice to help further advance the field of cultural psychology. We believe that acknowledging the long history of research on cultural variations in basic perceptual processes since the 1960s and reviving these lines of research will enrich the discourse of cultural psychology. Through the current study, we shared our experience of starting novel research with collaborators from a school in Ulaanbaatar, Mongolia, and reported the findings. Our future research plans include examining potential variabilities between people living in the countryside and the city, as well as the effect of geographical and vocational variation on Mongolian mentalities. We hope this paper will motivate cultural researchers to go abroad and establish new research sites for advancing cultural psychology.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary files, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Board, University of Alberta; Shine Mongol School. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

TM analyzed the data and wrote a main part of the manuscript. BB administered whole sessions and wrote a part of the manuscript. SS analyzed the data and wrote a part of the manuscript. All authors contributed to the article and approved the submitted version.

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CONCEPTUAL ANALYSIS
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Studying the Same-Gender Preference as a Defining Feature of Cultural Contexts

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Research on culture would be enriched by studying the connection between gender and peer relations. Cultures vary in the roles, privileges, opportunities, and right that are ascribed to girls and boys. They are known to also differ in the degree to which girls and boys interact with each other. Although the preference for same-gender peers has been observed across multiple cultural contexts, the degree of this segregation between girls and boys varies across contexts. We argue that variability in the divide between girls and boys is an important cultural feature of contexts that is likely to affect developmental processes and outcomes.

Keywords: gender, culture, peer relations, same-gender preference, human development

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INTRODUCTION

In this paper, we propose that a well-established finding from research on peer relations can be used to measure and understand diversity in gendered experiences across cultural contexts. The peer finding that interests us is the observation that, beginning in early childhood and continuing across the school-age years and into adolescence, girls and boys are more likely to associate with and like same-gender peers more than other-gender peers (Rubin et al., 2016). This divergence is meaningful in at least two ways. It provides insight into the degree to which gender functions as a social category that organizes interpersonal experiences. It also provides important descriptive information about the social structure of children's peer-based developmental contexts. We argue that it can be used to expand our understanding of how gendered experiences within the peer group vary across cultural contexts and how these differences may affect development.

The same-gender preference is typically conceived of and measured at the level of the person. It refers to the degree to which a person prefers to like, befriend or become acquaintances with same-gender peers compared to other-gender peers. In this respect, it is perceived to be a form of personal preference. We propose that this same-gender preference can also be conceived as a feature of social groups. Our point is that this key component of gender segregation will vary in meaningful ways across contexts, and that these contextual variations have important consequences for basic forms of development. Finally, although we recognize the limitations of this decision, we have chosen to predominately reference traditional, binary gender categories (e.g., boy/girl and man/woman) in this text. This decision was made to allow for simplicity in the comparisons made across time and cultural contexts.

We recognize that culture can be a contested construct that is difficult to define (Geertz, 1995). We define culture as the activities and the related cognitions, attitudes, and values that are characteristic of a particular context (Ratner, 1999). The points we wish to make can be applied to a broad set of contexts. These contexts may be small, such as a classroom-based peer group

or large, such as a nation state. They can also vary in their status as either formal institutional structures, such as a school context or informal voluntary groups, such as a fitness class at a neighborhood gym.

THE SAME-GENDER PREFERENCE

The same-gender preference has been widely replicated (Thorne, 1986; Maccoby and Jacklin, 1987; Maccoby, 1998). It has been observed across multiple studies using either observation-based measures of social interaction (Martin et al., 2013) or sociometric indicators of liking (Bukowski et al., 1993; Sippola et al., 1997; Burton-Smith et al., 2001; Poulin and Pedersen, 2007). Other studies of the same-gender preference have assessed differences in the degree to which children and adolescents expect to enjoy interacting with same- and other-gender peers (Strough and Covatto, 2002). Alternatively, some studies focus on the importance of respecting the boundary or the dividing line that keeps same- and other-gender peers apart from each other during preadolescence (Sroufe et al., 1993). Although research on the same-gender preference has been focused largely in the childhood and adolescent periods, there is evidence that it extends well into adulthood (Mehta and Strough, 2009).

The well-documented evidence that females and males of all ages tend to like and spend more time with their same-gender peers than with their other-gender peers is a traditional staple of the literature on both gender (e.g., Ruble et al., 2006) and peer relations (Rubin et al., 2016). It is one of the primary contact points between developmental research on gender and research on peer relations.

Based on the evidence of this gendered divergence in social experiences, Maccoby (1999) chose to describe the social contexts of girls and boys as "two cultures." She used this term somewhat broadly to capture a general set of differences between what goes on in the peer interactions and relationships of girls and boys as well as the limited degree of contact between them. The generality in her use of the word "culture" presents strengths and weaknesses. Its strength is its capacity to summarize into a single term or concept the differences taken from different forms of functioning and from different levels of social complexity including the levels of the individual, dyad, and group. This breadth is also a limitation. As Underwood (2004) has noted, basing culture on a broad set of indicators taken from different forms of functioning prevents simple tests of the validity of the "two cultures" concept.

The study of the same-gender preference and of gender issues more generally, has received little attention in both the literature on peer relations and culture as well as on gender and culture. Gender rarely enters into culturally informed studies of peer relations. A similar comment can be made, albeit to a smaller degree and from a different perspective, about the study of gender and culture. Cultural analyses of gender have typically centered on issues of power, access to resources, privileges, and social roles. They highlight and reinforce the evidence that the different social roles, experiences, and opportunities that are ascribed to women and men vary across cultural contexts. Social and cultural analyses of gender have a group focus in the sense that women and men are perceived to constitute different groups within contexts. In spite of this apparent group focus, analyses often deal with social phenomena at the level of the individual. These comparisons typically examine the rights and personal experiences that are ascribed to individuals as a function of the gender category in which they are situated. In this way, their focus is on what individual people do, or can do, as a function of their gender rather than focusing on gender as a group level construct or category.

This emphasis on the rights, roles, and privileges that are ascribed to individuals as a function of their gender, fails to capture differences in the degree to which individuals see the same-gender and the other-gender as distinct social groups—or the degree to which the same-gender group is taken to be the primary domain of social participation. It is known already that, in some contexts, strong prescriptions keep men and women apart, especially in the social sphere. This divergence between women and men, or between the same and the other, can be the result of well-established traditions reinforced by institutional practices. As an example, in some groups, men and women are not allowed to touch each other, except in narrowly defined personal circumstances (Feldheim, 2013); girls and boys cannot be students in the same primary and secondary school classrooms (Bahrami et al., 2016); and in some houses of worship, separate sections are designated for male and female members of the congregation (Sorin, 2001). In contrast, in other places, individuals are allowed to associate more freely with members of the other gender. They can work and socialize together without formal concerns about crossing a boundary that keeps the same and the other apart. Nevertheless, behavioral practices are assumed to coexist in these contexts as well, such that members of the other gender are truly seen to be the "other." Thus, even in contexts where gender integration is not proscribed by particular rules or norms, it can nevertheless occur. It should be noted that network analyses of social groups in different cultural contexts consistently reveal a same-gender bias in social selection processes (for reviews see Martin et al., 2013; Veenstra et al., 2013).

CONTEXT, GENDER, AND THE SALIENCE OF THE "OTHER"

The concept of the "other" has been a main stay of theory and research on gender conducted by developmental psychologists. Starting in early childhood, children can identify the gender group to which they belong and have a set of schemas about gender that guide them to approach or avoid behaviors that are "appropriate" or "inappropriate" for their gender (Martin and Halverson, 1981; Martin, 2000; Ruble et al., 2006). Children's understandings of gender are believed to create an in-group orientation that guides them toward gender-typed activities and toward same-gender peers and away from other-gender peers (Maccoby, 1998; Martin and Fabes, 2001). The concept of the "other" is especially prominent in developmental intergroup theory (Bigler et al., 1997). It claims that the salience of social group memberships is the result of context-based practices that

clearly delineate social category memberships, including gender. These concepts are typically used to explain, in part, their preference for same-gender peers.

A direct consequence of category salience is the infrequent levels of interaction between individuals from different groups. Other consequences that come from this infrequent interaction may be more insidious and have stronger developmental effects. One of these effects may be the limited level of exposure that children and adolescents have to the norms, expectations, and practices of the other-gender group. This restricted exposure to a broader set of standards and beliefs has the potential to create a narrow perspective on how to function with other-gender peers and on available opportunities for self-presentations and self-perceptions. These processes may create a very constrained and canalized sense of what it means to be a female or male or even what it means to be a "normal" person. Another consequence may be a reinforcement and reification of the legitimacy of well-defined gender categories. The creation of inflexible gender conceptions is likely to have especially negative costs for children and adolescents who do not see themselves as fitting into traditional gender categories.

The issue of contextual variance in category salience that is central to intergroup theory is also seen in one anthropologist's reflections on the origins of some cultural dimensions. Clifford Geertz (1995) pointed to this topic in his descriptions of the language training he received in preparation to work on field projects in Morocco and Indonesia. He explained that the person teaching him Arabic would admonish him harshly when he made gender-based grammar errors, whereas the person teaching him the Javanese language was more concerned with mistakes with status-related terms. Geertz demonstrates that while place/language gender was a critical form of social distinction in one place, status was a salient factor in another. Geertz's point reinforces the central claims of intergroup theory, specifically that the importance ascribed to a social category is contextually variant and that membership in these categories leads to conformity to the group's norms for some forms of social participation.

This convergence of ideas across scientific disciplines (e.g., developmental psychology and anthropology) and the widespread recognition that the salience of social concepts varies across social/cultural contexts point to potentially using the same-gender preference as a means to better understand variations between social contexts. Developmental psychologists have used the same-gender preference as a way of describing the features of the peer group and of assessing how the peer system changes with age. Studies of variations in the same-gender preference have typically focused on differences between individual children using measures of gender schemas (Powlishta et al., 1993), social behavior (Sippola et al., 1997), and activity preferences (Martin et al., 2013) all measured at the level of the person. Contextual analyses of variations in the same-gender preference have been far less frequent. Given that a basic point of intergroup theory is that the salience of gender categories will derive from environmental/contextual factors, understanding between-context differences would appear to be of critical importance. This general inattention to place differences is not entirely surprising in light of the overall paucity of research on cultural differences in many aspects of development.

CONTEXT DIFFERENCES IN THE SAME-GENDER PREFERENCE

An important exception to the lack of attention paid to contextual differences in the same-gender preference is the study of Whiting and Edwards (1988) of the social interactions between girls and boys in different contexts including communities in India, Kenya, Mexico, Peru, Liberia, Guatemala, the Philippines, Okinawa, and the United States. In this extensive study, titled *Children of Different Worlds*, Whiting and Edwards made careful observations of the amount of contact that girls and boys had with their same-gender and other-gender peers. From the outset, they used concepts from theory and research on cognitive development to form hypotheses about age differences in the preference for same-gender peers. Similar to other researchers (e.g., Maccoby, 1999), they expected that the rigid use of categories by young children would promote a strong in-group identification that would lead to a same-gender preference. They also proposed that a basic curiosity to know what it means to be a male or female within their own culture would lead children to pay more attention to the peers whom they perceived to be like the self rather than to those whom they perceived to be different. In this way, they ascribe a functional self-related purpose to having a primary affiliation with same-gender peers. It is important to note that an implicit feature of this reasoning is that gender role conformity is a consequence of gender segregation rather than an antecedent of it.

The study of Whiting and Edwards (1988) of *Different Worlds* revealed similarities and variability across the contexts they studied. A general preference for same-gender peers was observed in each of the contexts they observed. In every community, school-age children were more likely to associate with members of their own gender than members of the other gender. More importantly, the magnitude of this preference varied considerably across contexts. For example, when children's peer interactions were observed in a free-play context, children in all communities were more likely to be in gender segregated peer groups. In one Kenyan community, the percentage of children in same-gender peer groups was 55, collapsed across boys and girls. The corresponding percentages for children from two other communities in Kenya as well as in communities in Guatemala, the United States, and Peru were 63, 74, 61, 80, and 100%. The variance across these groups is, to us, vastly more impressive than the claim that groups in each community show a same-gender preference.

Strough and Cavatto (2002) have noted that in Gold and Gold's (1982) comparative study of school-age children in Sweden, Australia, England, and North America, the same-gender preference was weaker with the Swedish children than for the children from the other contexts. A more complicated set of findings observed by Cohen et al. (1980) points to the challenge of assessing the degree of desired contact with the other gender. In their study, preadolescent children from Sweden and the United States were asked to choose the peers whom they would

like to have as a partner in a school-related task (i.e., help with homework) or in a personal exchange (i.e., sharing a secret). Three important findings were observed. First, on the school task, 34% of the boys from the United States chose at least one other-gender peer, whereas only 5.3% of the girls did the same. No differences were observed between the Swedish girls (11%) and boys (12%). Second, similar findings were observed with the personal task. The boys from the Unites States chose an other-gender peer more frequently (18%) than did the girls from the United States (2%). Again, no differences were observed between the Swedish girls (19%) and boys (14%). Third, a direct comparison demonstrated that the American boys (34%) were more likely than the Swedish boys (12%) to choose a girl for the school task, but there were no differences on the personal task (18 and 14%, respectively). A different pattern was observed with the girls. On both tasks, boys were chosen more frequently by Swedish girls than by girls from the United States (11.4 and 5.3% for the instrumental task and 18.6 and 1.8% for the expressive task for the American and Swedish girls, respectively). These findings indicate that the tendency to choose other-gender peers as associates varies as a function of context, type of task, and gender.

The findings of contextual variations reported by Whiting and Edwards (1988) and by Cohen et al. (1980) are intriguing. They reveal substantial between-context variability in the orientation toward same- and other-gender peers. It is hard to overlook the variability revealed by their findings. At the same time, however, this is only a beginning as these data are descriptive rather than explanatory. They present evidence of variability but they fail to explain the source or the consequences of this variability across national contexts.

SAME-GENDER PREFERENCE AS EXPERIENCE

The same-gender preference is, of course, much more than just an interesting descriptive feature of children's and adolescent's peer groups. Instead, it is a powerful structural factor that defines the social-developmental environment across the lifespan, from childhood through adolescence and into adulthood. By affecting how and with whom a child can, or should, associate, these social and cultural barriers and/or biases have a direct effect on the day-to-day experiences and interactions that children and adolescents have in social spaces, particularly in the school context. Moreover, by providing direct evidence of the dimensions that organize the social context, these same-gender preferences may reinforce the constructs that account for intergroup conditions. Such exclusionary preferences may also reify and strengthen the belief in rigid and traditional gender categories.

Contextual variations in the strength of the same-gender preference are also likely to have important consequences on development. Peer experiences, for example, are known to promote well-being *via* several processes including opportunities for acceptance and validation, the promotion of social skills, and protective experiences that minimize the effects that may result from negative experiences within the family (Rubin et al., 2016). In this capacity, interactions and relationships with peers can function as social assets and developmental protective factors. When access to other-gender peers is foreclosed by a sharp divide between the same- and the other-gender peer groups, the range of these beneficial functions of peer relationships can be limited.

Two processes may be especially important to consider. The first is that segregation by gender limits access to social capital. It is known that well-being derives from being accepted by both same- and other-gender peers (Bukowski et al., 2017). Seclusion to one's own gender minimizes access to the benefits of being accepted by the other gender. The second process is concerned with protective factors. Some children are not liked by same-gender peers (Bukowski et al., 1999). Within the same-gender peer group, they may be friendless or have very few positive social connections or many negative social connections as a function of peer rejection and bullying. For these children, positive and supportive other-gender peer relationships may provide an important protective refuge. Thus, for such children, opportunities for interactions and relationships with other-gender peers may have the potential to reduce the negative effects of problems with same-gender peers. When these opportunities are not available because of a structural and/or socially normative separation between the two gendered peer groups, the possibility of finding a protective shelter with other-gender peers may be limited.

Between-context differences in the orientation toward the same- and other-gender peers are also likely to have consequences for gender identity development. Gender identity development is a complex and multifaceted construct (Perry et al., 2019). We speculate that two of its basic components may be affected by variations in gender segregation. One of these components is the degree to which a person identifies with being a member of their own gender category (i.e., being a female or male). It is likely that this aspect of gender identity will be stronger in contexts, where gender segregation is strong. It is also the case that the negative consequences of not identifying with one's gender category may be more drastic in highly gendered contexts. A second aspect of gender identity that may vary as a function of the same-gender preference may be the level of flexibility in the features that define what it means to be female or male. One can predict that greater flexibility will be observed when gender segregation is weak. That is, one can expect that gender roles will be more fluid or less fixed when there is a more balanced orientation toward same- and other-gender peers.

This balance may be especially important in the current historical context. The discursive landscape about characteristics linked to sex and gender and the intersection between them has never been as open and as active as it is in the present moment. Ideas about what it means to be a woman or a man and how the concepts of femininity and masculinity are defined and expressed have been issues throughout history. In the present moment, however, these issues have become especially poignant. More so than at any other time, discussions of the variability in the features that define the biological sex-based categories of women and men and that define the social gender-based categories of female and male appear on a nearly daily basis in multiple forms and media. This attention has been accompanied by a movement away from a binary conceptualization of gender categories toward more fluid and non-binary definitions and labels.

A full assessment of the claims we have made about the importance of assessing the gender segregation as a feature of cultural contexts may need to be studied from a multilevel approach. The consequences of being in a small context, such as a school environment, in which there is a high level of gender segregation may vary as a function of the prevailing level of segregation in the broader social environment, such as the community where the school is located. The effects of gender segregation may also need to consider the degree to which it promotes or limits cross-gender comparison. It has been reported that within-gender social comparisons decrease gender differences in self-representations, whereas between-gender comparison increases gender differences (Guimond et al., 2006). If, as we have proposed, high levels of gender segregation foster a view of the other gender as the "other," then one can expect individuals in these contexts to see themselves in more stereotypical manners. Alternatively, it may be that gender segregation will have the opposite effect. It may promote within-gender comparisons that, in turn, will decrease gender differences in self-representations. Along these same lines, gender segregation may be motivated by multiple factors, including religious traditions, historical factors, and culture-based conceptions of gender. The reasons underlying gender segregation may moderate the effects of functioning in a context with a division between males and females. Accordingly, a key feature of research on the effects of gender segregation should be an assessment of whether the strength and features of these effects vary as a function of the cultural factors that cause this divide. All of these issues need to be addressed in empirical studies.

CONCLUSION/BOTTOM LINE

Our main point is that there is value in studying gender, peer relations, and culture in an integrated manner. An initial starting point for a research program that brings these domains together should be variations in the same-gender preference. This construct provides a direct means of characterizing societies according to the affective and participatory divide between females and males. It is a feature of the day-to-day experiences of females and males across the lifespan. Already, there is evidence that the same-gender preference varies across cultures. This evidence that the cultural variation in a gender-related construct is manifested in a form of social experience is consistent with the claim of Geertz (1973) that "Behavior must be attended to…because it is through the flow of behavior – or, more precisely, social action – that (cultural) forms find articulation" (p. 17).

There are practical implications of this work as well. To consider these implications, let us first review what we know. First, we know that gender segregation occurs. Second, we know that gender segregation occurs across the lifespan, within various groups, structural settings, nation states, and cultures. We importantly realize, however, that there are also significant and potentially meaningful variations in the degree of gender segregation across contexts. Thus, if we aim to move toward a more gender integrated – rather than segregated – world, we must first recognize baseline similarities (i.e., gender segregation is likely to occur) as well as differences (i.e., gender segregation will vary across contexts). Accounting for these similarities and differences in our research programs will help us to also more accurately anticipate the degree, source, and outcomes associated with gender segregation within and between various contexts. It is only through such an adaptive understanding that we can begin to think about designing intervention and prevention efforts to support a more gender integrated and socially equitable world.

A key advantage of studying of gender segregation is that it can be studied with simple, easy-to-implement techniques. Many studies of the same-gender preference have used traditional sociometric methods to measure the degree to which children are drawn to same- and other-gender peers. These data can be used to assess the same-gender preference at the level of each individual child; these data can then be used to create group means. These same data can be used in network analyses to create indices of gender integration. Regardless of how one analyzes the data, the study of cultural variations in the same-gender preference provides a powerful and direct way of learning about gender, peer relations, and culture all within the same analysis.

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

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REVIEW
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The Epistemology of Evolutionary Psychology Offers a Rapprochement to Cultural Psychology

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Many detractors of evolutionary psychology (EP) presume that adaptive arguments are nothing more than whimsical and unfalsifiable just-so stories. The reality though is that the epistemology of EP is precisely the opposite of this antiquated canard in that it fixes the evidentiary threshold much higher than is typically achieved by most scientists. EP amasses evidence across cultures, time periods, disciplines, paradigms, methodologies, and units of analyses in validating a given scientific explanation. These nomological networks of cumulative evidence stimulate greater interdisciplinarity, lesser methodological myopia, and increased consilience (unity of knowledge). A component in building such nomological networks is to examine phenomena that are cross-culturally invariant (human universals) versus those that vary cross-culturally as adaptive responses (the domain of behavioral ecologists and gene-culture coevolution modelers). The epistemological efficacy of this unique approach is highlighted using two cases studies, the sex-specificity of toy preferences and men's preference for the hourglass figure.

Keywords: culture, epistemology, evolutionary psychology, sequential sampling, nomological networks of cumulative evidence, toy preferences, hourglass figure, consilience

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INTRODUCTION

Many critics of evolutionary psychology (EP) wrongly presume that the field is largely focused on identifying human universals while ignoring cross-cultural differences (Saad, 2011, p. 27, claim 4). This speaks to the fact that many social scientists remain bound to the false nature-nurture dichotomy while evolutionary behavioral scientists have long recognized that culture does not exist outside of our biological heritage. As explained by the famed biologist Wilson (1978, p. 167), "The genes hold culture on a leash. The leash is very long, but inevitably values will be constrained in accordance with their effects on the human gene pool." The cataloguing of human universals as well as the identification of innumerable cultural differences are within the purview of evolutionary theorizing. I demonstrate this crucial point by highlighting the manner by which cultural expressions (including human universals) are often necessary elements when building a nomological network of cumulative evidence in support of an evolutionary argument. A central feature of any such endeavor is knowing when one has amassed a sufficient level of cumulative evidence, a process captured by sequential sampling, and a topic to which I turn next.

SEQUENTIAL SAMPLING AS AN EPISTEMOLOGICAL TOOL

Suppose that you are facing a choice between two cars to purchase, two politicians to vote for, or two prospective mates to go out with. How do you know when you have sampled enough information about the competing alternatives to make a final choice? In other words, when should you stop acquiring additional information about the alternatives, and choose a winning option accordingly? The stopping decision is a central element of human decision making notwithstanding the fact that classical economists would posit that individuals ought to acquire all of the relevant information prior to making a choice (as this would ensure that utility maximization is achieved). This form of sequential sampling was famously developed by Wald (1947) in the context of hypothesis testing. Specifically, the idea was that the sample size for a given experiment was not fixed but rather was determined based on when the iteratively collected data reached an absorption barrier (also known as a stopping threshold). For another early application of sequential sampling, imagine that you are a firm trying to establish whether your manufacturing process surpasses some benchmark of quality control (e.g., some minimal number of defective products are produced in the production line). How many products do you need to sample prior to establishing that you now have a sufficient amount of evidence to clear the manufacturing process?

This class of sequential sampling was eventually applied to binary multi-attribute choices (Aschenbrenner et al., 1984; Saad, 1994; Saad and Russo, 1996; Saad et al., 2009). In **Figure 1**, a pictorial representation of the process is shown. A decision maker is facing a choice between Alternatives A and B and must decide how many pieces of attribute information she should acquire on both alternatives prior to stopping and choosing a winning alternative. The stopping thresholds dictate the cumulative differentiation that must be achieved (as set by the decision maker in question) to be sufficiently convinced to stop the search process and choose the winning alternative (the one for which the stopping threshold is reached first). In the depicted example, the first piece of attribute information is in favor of Alternative A but since the threshold is not reached, the process continues. The second piece of attribute information is in favor of Alternative B but cumulatively speaking, A is still ahead (after two pieces of acquired attributes). After attributes 3 and 4 are acquired, B is clearly in the lead. However, once the fifth, sixth, and seventh attributes are acquired, the stopping threshold of A is surpassed causing the decision maker to stop acquiring additional information and choosing A accordingly.

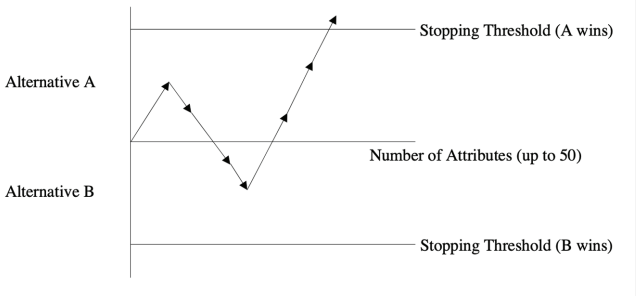

FIGURE 1 | The binary sequential choice model.

Let us suppose that this hypothetical choice between A and B had up to 50 attributes that could have been acquired. The shown example demonstrates that the stopping threshold for A was reached after only 14% of the available information (seven out of 50 attributes) was acquired.

This sequential model is applicable in a very broad range of contexts including in understanding a fundamental feature of the epistemology of science (Saad, 2017). How do we know when we have amassed a sufficient amount of evidence to suggest that a documented phenomenon can be incorporated into a field's core knowledge (while recognizing that scientific knowledge is always provisional)? A literature review allows us to qualitatively gauge the extent of support for a given effect while a meta-analysis permits us to do so quantitatively. But while such approaches are very valuable in establishing the veracity of the standard proximate effects in science (say the strength and directionality of the causal relationship between variables X and Y), they are incapable of evaluating the evidentiary state of a grand theory. Take for example Charles Darwin's *On the Origin of Species*. In order to build a persuasive case for his theory, Darwin amassed evidence from a very broad range of disciplines. These disparate sources of data all pointed to the same incontrovertible conclusion, namely that his theory was airtight. To place Darwin's theory of evolution within the parlance of the current sequential model, he amassed enough confirming cumulative evidence to surpass a stopping threshold of support for his grand theory. In **Figure 2**, the first two lines of evidence offer strong support for the phenomenon under investigation while the third line of evidence provides some smaller measure of refutation. Finally, once the fourth line of evidence is presented, the support threshold is surpassed suggesting that a sufficient amount of evidence has been amassed to reach an epistemological conclusion. The length of each arrow captures the amount of cumulative support or refutation for a given line of evidence.

NOMOLOGICAL NETWORKS OF CUMULATIVE EVIDENCE

This synthetic approach has been systematized via the use of nomological networks of cumulative evidence (Schmitt and Pilcher, 2004; Saad, 2017, 2020a, chapter 7; Saad, 2020b). The objective is to identify sources of data across disciplines (e.g., from cultural psychology, comparative psychology, developmental psychology, classics, behavioral genetics, medicine, and cognitive neuroscience), methodologies (surveys, archival data, lab and field experiments, and observational studies), measurements (e.g., paper-and-pencil, eye-tracking, hormonal markers, and fMRI data), cultures (e.g., establishing a human universal), and time periods (demonstrating the robustness of

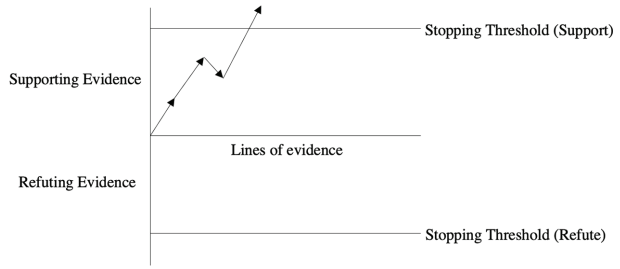

FIGURE 2 | Sequential sampling of evidence for and against a scientific explanation.

the phenomenon across eras) that converge onto an unassailable support for a given scientific explanation (see **Figure 3** for a pictorial representation).

In a manner similar to how prosecutors seek to systematically build an inculpatory mountain of evidence that surpasses the "reasonable doubt" threshold, the building of a nomological network of cumulative evidence is meant to offer such incontrovertible support in the scientific domain. I shall demonstrate how this process works via two specific examples, both of which are poignant in that they have straddled the nature-nurture (or genes vs. culture) debate, namely the biological roots of toy preferences and the evolutionary basis of men's preference for the female hourglass form (for a pictorial representation of these nomological networks, refer to Saad, 2017, **Figures 2**, **3**).

TOY PREFERENCES: SOCIALLY CONSTRUCTED OR BIOLOGICAL BASED?

Social constructivists typically argue that most sex differences arise due to differential socialization (cf. Eagly and Wood, 2012; Fausto-Sterling et al., 2012). When it comes to toy preferences, children are supposedly taught the appropriate sex-specific toys that they should prefer (e.g., truck vs. doll), and the sex-appropriate play styles that they should adopt (rough and tumble play for boys). These early lessons then apparently serve as the starting point of a never-ending cascade of gender role socialization that shapes the behavioral trajectory of the two sexes. How would one go about constructing a nomological network that casts doubts on the premise that sex-specific toy preferences are socially constructed?

A powerful way to demonstrate that a preference is not due to socialization is to highlight its presence in infants that have yet to reach the developmental stage to be socialized (think back of the cognitive stages delineated by Jean Piaget). For example, infants exhibit a preference toward attractive faces at an age when they could not have been socialized about the "social construction of beauty" (Langlois et al., 1990; Slater et al., 1998). Similarly, infants exhibit sex-specific toy preferences that rules out the socialization premise (Alexander et al., 2009; Jadva et al., 2010). Hence, one source of data in building the relevant nomological network stems from developmental psychology. Pediatric endocrinology offers another distinct line of evidence that also utilizes children samples. Girls diagnosed with congenital adrenal hyperplasia, a masculinizing endocrinological condition, hold more masculinized toy preferences than girls unafflicted with this condition (Berenbaum and Hines, 1992; Nordenström et al., 2002).

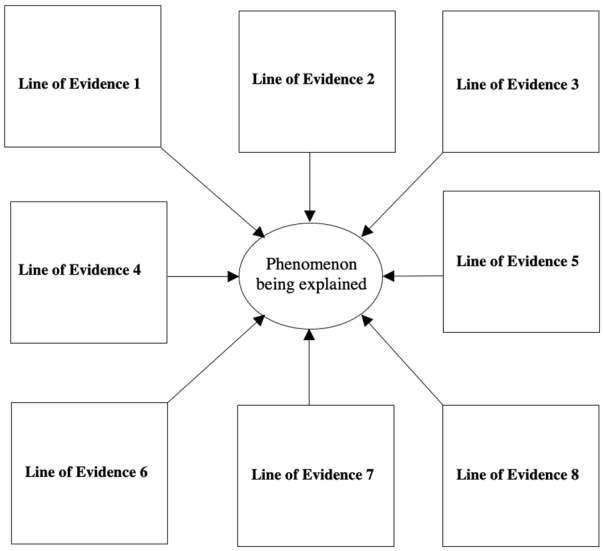

FIGURE 3 | Nomological network with eight distinct lines of cumulative evidence.

Hormonal effects on toy preferences were also examined using children stemming from non-clinical populations. The digit ratio (e.g., the 2D:4D digit ratio measures the relative lengths of the index and ring fingers) is a sexually dimorphic morphological marker that captures the extent to which individuals have been exposed to testosterone in utero. In pre-school boys, a negative correlation was documented between their digit ratios and their Pre-School Activities Inventory scores (PSAI; includes items that measure the extent to which children play with various types of toys) as collected from their parents (Hönekopp and Thierfelder, 2009). Smaller digit ratios correspond to greater masculinization while more positive PSAI scores signify more masculine play. In other words, boys who have more masculinized morphological features are more likely to engage in masculine play. Lamminmäki et al. (2012) assessed the testosterone levels of boys and girls starting at 7 days old until 6 months of age via monthly urinary samples. These were subsequently correlated to the infants' PSAI scores and to their observed play behaviors with masculine, feminine, and gender-neutral toys at 14 months of age. The pattern of play with trains and dolls yielded the expected sex difference. Furthermore, PSAI scores and testosterone were positively correlated in boys, and the extent of play with the doll was negatively correlated with testosterone in boys while the extent of play with the train was positively correlated with testosterone for girls.

Comparative psychology serves as another powerful distinct line of evidence against explanations rooted in social constructivism. Specifically, if a phenomenon exhibits homologous regularity across several species, it likely possesses a biological/evolutionary signature. By demonstrating that infants of several primate species (vervet and rhesus monkeys and chimpanzees) exhibit sex-specific toy preferences congruent with those of human infants (Alexander and Hines, 2002; Hassett et al., 2008; Kahlenberg and Wrangham, 2010), this casts further doubt that toy preferences are socially constructed. The evidence presented thus far stemming from developmental psychology, pediatric endocrinology (clinical and non-clinical samples), and comparative psychology is more than sufficient to surpass the support threshold that toy preferences are not solely socially constructed (refer back to **Figure 2**). However, a compelling nomological network of cumulative evidence should be exhaustive if it is to prove maximally persuasive against all prospective detractors. With that in mind, several additional distinct lines of evidence are presented next.

If one wishes to argue that a given phenomenon is rooted in evolutionary and/or biological realities, it is often necessary to demonstrate that it is a human universal (albeit I will later explain how cross-cultural differences are also within the purview of the evolutionary lens). Readers interested in human universals in general and psychological universals in particular should refer to Brown (1991) and Norenzayan and Heine (2005), respectively. In a recent meta-analysis, Todd et al. (2018, p. 25) conclude "…the finding of robust sex differences in boys' and girls' toy preferences across a range of ages, different time periods, countries, and settings indicates an innate influence on this behavior…" However they note (p. 22) that "Despite the relative consistency across regions showing some support for biological determinants of preferences, a limitation of this meta-analysis, and of this research area in general, is that most of the research has been conducted in Western countries and findings cannot be generalized elsewhere." In their meta-analysis, they included data from the Canada, the United States, Europe, Israel, and Hong Kong. However, as warned by Henrich et al. (2010), researchers must be mindful of not succumbing to a form of convenience sampling, namely, relying on samples that solely stem from Western, Educated, Industrialized, Rich, and Democratic (WEIRD bias) societies. With that in mind, Rossie (2005) conducted a comprehensive non-Western anthropological study of dolls and doll play stemming from a very broad group of peoples from the Saharan and North African regions who have maintained links to their ancestral heritage. Two key findings were that female dolls are much more prevalent than male dolls and playing with dolls is a domain largely reserved for girls. Of note, the universality of sex-specific toy preferences has been documented not only across cultures but also across epochs. An examination of funerary monuments from ancient Greece found that girls were shown with dolls, whereas boys were represented with wheels (Grossman, 2007, p. 321). It would appear that the sex-specificity of toy preferences is not only invariant across Western cultures but also applies in radically different cultural settings and time periods.

Of 50 countries whose masculinity-femininity scores have been tabulated, Sweden scores as the most feminine and the nation with the greatest gender equality (Hofstede, 1998, p. 9). As a matter of public policy, it has sought to systematically eradicate gender markers where possible (e.g., linguistic markers of gender), but more generally it has pursued a far-ranging social experiment meant to create a post-gender society. If there ever were a country in which sex-specific toy preferences might be lessened if not eradicated, it would be in Sweden, a truly ideal longitudinal experiment to gauge the veracity of the premise that toy preferences are socially constructed. Nelson (2005) took an inventory of actual toys that were present in the rooms of Swedish boys and girls aged 3 and 5 years of age. A total of 40,673 and 40,891 toys were inventoried in girls' and boys' rooms, respectively. The sex-specificity of toy preferences was no different than those repeatedly documented in other cultural settings. Apparently, no amount of social engineering can alter a cross-culturally invariant sexual dimorphism. Of note, the gender equality paradox, which refers to a broad range of phenomena beyond toy preferences, highlights the fact that countries with greater gender equality often exhibit the same if not *more* pronounced sex differences (cf. Costa et al., 2001 within the personality domain; Stoet and Geary, 2018 within the educational realm, and Zhang et al., 2019 for mating preferences).

Incidentally, to argue that the sex-specificity of toy preferences is innately determined does not negate the possibility that parents do indeed socialize their children to adopt such preferences. Patterns of socialization are not antithetical to evolutionary explanations rather they serve to reinforce biological imperatives. In a study of actual toy purchases, parents were intercepted upon leaving a toy store and queried about the purchases that they had just made and to whom the toys in question were targeted (Fisher-Thompson, 1993). These were coded as either sex-typed (i.e., sex appropriate) or sex-inappropriate. Only 1 and 3% of purchased toys were sex-inappropriate in studies 1 and 2, respectively. Evolutionary psychologists do not contest the fact that socialization occurs but to the extent that universally similar forms of parental influence take place, these are likely rooted in biological realities. More generally to state that "… culture is a partner in producing body systems commonly referred to as biology…" (Fausto-Sterling, 2005, p. 1516) overstates the role of culture in producing biological systems (including the human mind). Nurture exists in its varied forms because of nature albeit this in no way negates the fact that both are crucially important in defining our personhoods.

THE HOURGLASS FIGURE: SOCIALLY CONSTRUCTED BEAUTY MARKER OR EVOLVED PREFERENCE?

Social constructivists have long argued that beauty is socially constructed. To some extent this is true in that some beauty markers and/or beauty rituals are culturally specific such as neck elongation (Padaung and Kareni women in Myanmar),

lip plating (Surma women in Ethiopia), and foot binding (Chinese women). Contrary to most instances around the world where women are judged in beauty pageants, the Geerewol festival in West Africa involves Wodaabe men being the participants in an extravagant beauty pageant (a manifestation of a sex-role reversal). Each of the latter examples and many others point to the social construction of some beauty features and beauty rituals. However, it is also true that many beauty markers are universally operative. This is not surprising given that sexual selection, the evolutionary mechanism that selects for traits that bestows reproductive benefits, yields culturally invariant sex-specific mating preferences.

Let us consider men's near-universal preference for the hourglass figure in women, which morphologically corresponds to a waist-to-hip ratio ranging from 0.68 to 0.72. The postulated reason for this preference, namely that it serves as an accurate signal of health and fertility, has been validated across several studies (see Singh, 2002 for relevant references but see Lassek and Gaulin, 2018a,b, and Bovet, 2019, for works that challenge this link). Cross-cultural preferences for the hourglass figure were obtained using photographs of women's physiques prior to and subsequent to having had cosmetic surgeries, and via line drawings of women's shapes exhibiting various waist-to-hip ratios (Singh et al., 2010 and references within). While many of the preferences were collected via paper and pencil tasks, more sophisticated methods have been employed including eye-tracking and brain imaging (Platek and Singh, 2010; Dixson et al., 2011). Content analyses have been conducted of female escorts' online advertisements of their waist-to-hip ratios stemming from 48 countries across Europe, Asia, Oceania, Latin America, and North America (Saad, 2008), of Playboy centerfolds and Miss America winners across a number of decades (Singh, 1993), of 286 ancient Egyptian, African, Greco-Roman, and Indian sculptures and statuettes from several millennia ago (Singh, 2002), of 155 prehistoric Jomon figurines (Hudson and Ayoyama, 2006), and of Western artworks covering roughly 2,500 years (Bovet and Raymond, 2015). While some temporal variations do exist (consistent with the fact that the waist-to-hip preference is a near-universal), the general hourglass effect holds across these studies. The commercial premium that men place on the hourglass figure was captured by Griffith et al. (2016) in their analysis of online ads of female escorts. Specifically, online female escorts who advertise the hourglass figure charge higher fees. Finally, in a very compelling refutation of the premise that beauty standards are socially constructed (via visual media), congenitally blind men prefer the hourglass figure as elicited by touch (Karremans et al., 2010).

That the preference for the hourglass figure is a near-universal (rather than a human universal) recognizes the fact that cross-cultural differences do exist, and that these serve as adaptive responses to local ecological realities. For example, Marlowe and Wetsman (2001) demonstrated that in an ecosystem defined by lesser food surpluses, men's preferences shift to a higher waist-to-hip ratio. On a related note, the prevalence of pathogens within a particular local niche has also been shown to affect the differential import ascribed to specific mate preferences, including physical attractiveness (Gangestad et al., 2006). In other words, specific mate preferences vary as a function of cultural contingencies. I turn to a discussion of this general issue next.

CULTURAL DIFFERENCES AND INDIVIDUAL-LEVEL HETEROGENEITY AS ADAPTIVE RESPONSES

While the identification of human universals is a central feature of the evolutionary paradigm, cross-cultural differences as well as individual-level heterogeneity are also within its purview (Brown et al., 2011). Behavioral ecology, a sub-branch of the evolutionary behavioral sciences, is rooted in the fundamental understanding that humans exhibit wide behavioral plasticity as adaptive responses to local niches (Winterhalder and Smith, 2000; Nettle et al., 2013). In other words, the capacity to adapt is itself an adaptation akin to how the human immune system has evolved built-in flexibility permitting it to mount responses against novel and/or rapidly mutating pathogens (Cziko, 2000). This adaptive plasticity manifests itself in numerous ways including in the varied expressions of cultural forms. Take for example gastronomic traditions, which differ in endless ways across the globe. What determines the extent to which a culinary tradition will contain meat versus vegetable dishes? Why are some cuisines much spicier than others? Why do some cultures engage in geophagy (eating of dirt)? Why do certain food taboos arise? Most social scientists that tackle such issues do so as a means of documenting the rich and diverse forms of cultural expressions. Evolutionary scientists on the other hand ask the ultimate Darwinian *why*, namely, they seek to establish whether these culinary traditions might be adaptive responses to possible pathogenic exposure.

Billing and Sherman (1998) analyzed the frequency with which 43 different spices were used in meat-based cuisines of 36 countries across Africa, North America, Asia, Oceania, and Europe by examining 4,578 recipes from 93 cookbooks. Furthermore, they tabulated the yearly averages for temperature and precipitation (rain) for the countries in question. Since spices possess a wide range of antimicrobial properties, and given that food-borne pathogens are more prevalent in warmer and wetter climates, the researchers reasoned that spice use would correlate with these environmental conditions. This is precisely what they found. In a follow-up study using data from the same 36 countries, Sherman and Hash (2001) examined the use of 41 spices in 2,129 vegetable-only recipes from 107 traditional cookbooks. Their key objective was to establish that since food-borne pathogens are more prevalent in meat-based as compared to vegetable-only dishes, the latter should necessitate the lesser use of spices. This was strongly confirmed using both countries and spices as the unit of analysis. Similar antimicrobial principles have established the adaptive nature of anti-spoilage techniques in Japanese food (Ohtsubo, 2009), Fijian food taboos as a means of protecting against marine toxins (Henrich and Henrich, 2010), kosher prohibitions

regarding shellfish (Saad, 2011), and geophagy or the eating of earth (Young et al., 2011).

I have thus far provided examples of food-related cultural traditions that serve as instantiations of adaptive processes. At a more fundamental level, some food-related adaptations are encoded in the human genome in ways that vary across cultures (cf. the Human Genome Diversity Project housed at Stanford University). For example, the global distribution of lactase persistent genes (help in the digestion of lactose) is correlated with pastoral living. This is a manifestation of gene-culture coevolution (Laland et al., 2010; Henrich, 2016; Moya and Henrich, 2016), the process by which a cultural practice (pastoral living) shapes the selection of genes that are advantageous within a given environment. Other diet-related cross-cultural differences in genetic expressions include those that conserve sodium in near-equatorial populations (Weder, 2007), as well those that help in the digestion of starch (Perry et al., 2007) and in the metabolism of alcohol (Osier et al., 2002). Viewed from this perspective, aggregate consumption patterns of particular foods and drinks are in part due to cross-cultural genetic differences that originally evolved as adaptations to local niches.

While it is perhaps consistent with people's folk wisdom to link culinary traditions to pathogens, a growing number of studies have documented pathogenic effects in surprising contexts including in explaining country-level differences in scores on personality traits and cultural values. These include sociosexuality, openness to experience, and extraversion (Schaller and Murray, 2008), religiosity and the strength of family bonds (Fincher and Thornhill, 2012), conformity (Murray et al., 2011), and individualism-collectivism (Fincher et al., 2008). The general theoretical thesis is that aggregate-level personality scores and cultural traits (integral elements of a nation's character) in part arise as adaptive responses to local niches (Nettle and Penke, 2010). Cultural neuroscientists are increasingly gathering empirical support for this premise at the genetic level. Specifically, cross-cultural distributions of several aggregate-level personality scores and cultural traits are correlated to the differential frequencies of genetic polymorphisms associated with the traits in question (Chen et al., 1999; Chiao and Blizinsky, 2010; Way and Lieberman, 2010).

CONCLUSION

The epistemology of evolutionary psychology yields a rapprochement to cultural psychology in at least two distinct ways. First, when seeking to demonstrate the veracity of an evolutionary-based phenomenon, the corresponding nomological network of cumulative evidence will typically include at least one distinct line of evidence stemming from cultural psychology (establishing the universality of the phenomenon in question). Second, rather than the erroneous reflex of many social scientists to pit cultural and evolutionary explanations against one another, some cross-cultural differences are adaptive expressions across various units of analyses (e.g., genes, personality types, cultural traits, and cultural traditions such as local cuisines). The cataloguing of these adaptive responses could serve as one of the distinct lines of evidence in a nomological network (i.e., one of the boxes shown in **Figure 3**). Culture does not exist in a vacuum detached from our biological heritage. Rather, our common human nature and some of our cultural differences are instantiations of the long reach of evolution in shaping the rich tapestry of human expressions.

Nomological networks of cumulative evidence yield many important advantages irrespective of one's research interests. One need not be an evolutionary psychologist to appreciate the epistemological benefits of this synthetic approach. Twenty years ago, Wilson (1999) spoke of the importance of seeking consilience across the social sciences, natural sciences, and the humanities. Nomological networks of cumulative evidence systematize this laudable objective by encouraging scholars to think of all possible sources of evidence that might test the veracity of their scientific explanations (Saad, 2017, 2019). If you refer back to the two case studies described earlier, the lines of evidence originate from across the social sciences, the natural sciences, and the humanities. E. O. Wilson's call for consilience was heeded. Garcia et al. (2011) contrasted the number of disciplines represented by first authors of articles published in evolutionary-based psychology journals (e.g., *Evolution and Human Behavior*) to non-evolutionary-based ones (e.g., *Journal of Experimental Psychology: Learning, Memory, and Cognition*). Not surprisingly, they documented that the evolutionary perspective promotes greater interdisciplinarity. The building of nomological networks of cumulative evidence by definition accentuates the ethos of interdisciplinarity by forcing scholars to search assiduously for supporting as well as refuting evidence well outside their disciplinary silos. While most psychologists are constrained by methodological and field fixation (Sternberg and Grigorenko, 2001), nomological networks of cumulative evidence offer an opening toward methodological pluralism (free yourself of your experimental priming paradigm that you learned as a graduate student!). Finally, given the replication crisis in psychology that has been written about extensively, nomological networks amass cumulative evidence stemming from direct and conceptual replications (Schmidt, 2009) but more importantly they uncover what I coin as meta-replications (i.e., replications of a grand effect across a very broad range of disciplines, cultures, time periods, methodologies, etc.). Muthukrishna and Henrich (2019) argued that the replication crisis in psychology stems in part due to a lack of organizing theoretical frameworks. Nomological networks of cumulative evidence speak to this lacuna of theoretical consilience.

As an evolutionary behavioral scientist and a consumer psychologist, I have long been interested in the interplay between our shared biological heritage and our idiosyncratic cultural environments in shaping *Homo consumericus*. One of my prospective projects is to create a global consumer atlas that would identify universal consumer phenomena along with those shaped by cultural forces; a database akin to the Human Relations Area File (started at Yale University) or the Standard Cross-Cultural Sample albeit for consumer phenomena. Typically, consumer researchers have focused with much greater

alacrity on identifying cross-cultural differences rather than human universals. This might be due to the misguided sense that to catalog similarities across cultures is akin to finding null effects, whereas cross-cultural differences are "significant" effects. I suspect that this bias is likely pervasive across other subdisciplines of psychology. That said, it is my hope that in the near future, scholars in general and psychologists in particular will be exposed to the synthetic power of nomological networks of cumulative evidence. Through the application of this formidable epistemological tool, cultural psychologists and evolutionary psychologists will likely experience a much-needed rapprochement.

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AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Who Can Buffer Marginalization Risk? Affect Experience, Affect Valuation, and Social Marginalization in Japan and Brazil

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Previous research has associated social marginalization with the rejection of mainstream cultural values. Since cultural values reflect affect valuation, the present research investigates the relationships between social marginalization and ideal/actual affect in two different non-WEIRD cultures, Brazil and Japan. As a social marginalization index, we used the NEET-Hikikomori Risk Scale (NHR). We predicted that cultural differences would emerge in the valuation of affective states. Affect valuation theory suggests that in East Asia, individuals are encouraged to pursue and value low arousal positive emotions (LAP: e.g., calmness, serenity) over high arousal positive emotions (HAP: e.g., excitement, elation, etc.) as they can harm social relationships in these societies. In contrast, Latin American cultures value HAP over LAP, because social relationships are promoted through vibrant positive emotional expression in these cultures. Hence, we hypothesized that individuals' ideal affect, actual affect, and the discrepancy between ideal and actual affect would be associated with higher risk of social marginalization. Participants from Japan (N = 54) and Brazil (N = 54) reported their ideal affect and actual affect and completed the NEET-Hikikomori Risk Scale (NHR). Regression analyses showed that actual HAP and the discrepancy between ideal and actual HAP were negatively associated with NHR in Brazil, but no association was found in the Japanese data. The other variables, including ideal affect, were only minorly or not significantly associated with NHR. Though the study has limitations regarding its small sample size, we can explore future perspectives and discuss the relationships between emotion and cultural marginalization. Socioecological factors that promote actual HAP in Brazilians may encourage other mainstream cultural ideals, which buffers against cultural marginalization.

Keywords: social marginalization, affect valuation, culture, East Asia, Latin America

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INTRODUCTION

Since the 1990s, pressures stemming from globalization and long recessions have changed social and economic systems in most countries. In Japan, while business elites and senior government officials resisted pressures to change the labor market structure, a peripheral labor force, mostly composed of youth, has been pushed out of the system. Thus, Japanese youth compose the social stratum most prone to marginalization (see Toivonen et al., 2011 for a review).

Norasakkunkit and Uchida (2011, 2014) argue that marginalization can assume three forms – "freeter lifestyle orientation", which refers to those who do not seek a full-time job, engaging in part-time jobs only; "NEET", those "not in education, employment, or training"; and "*hikikomori*" (social withdrawal), a more extreme form of social marginalization, referring to those who do not take part in social interactions, even with family members, shutting themselves in their rooms for six months or longer.

Hikikomori is considered a more severe type of marginalization on the spectrum and was posited to be a culture-bound syndrome (Saito, 1998; Teo and Gaw, 2010), although similar cases have now been observed in countries outside of Japan. For instance, Kato et al. (2012) sent two *hikikomori* case vignettes to psychiatrists from Australia, Bangladesh, India, Iran, Japan, Korea, Taiwan, Thailand, and the United States. The psychiatrists were asked to rate the prevalence and etiology of the syndrome among other characteristics in their countries. Participants from all the studied countries perceived *hikikomori* as a present syndrome in their own countries, and most of them considered the *hikikomori* phenomenon to be associated with rapid socio-cultural changes derived from globalization. Other reports include cases in countries such as China (Wong et al., 2017), Spain (Ovejero et al., 2014), and Brazil (Gondim et al., 2017; Prioste and Siqueira, 2019). As such, the growing prevalence of such tendencies across the world requires additional investigation, especially in countries outside of Japan.

Cultural Marginalization

Considering cultural marginalization as a spectrum encompassing freeters, NEET and *hikikomori*, Uchida and Norasakkunkit (2015) developed a scale to measure one's tendency of becoming culturally marginalized, named the NEET-*Hikikomori* Spectrum Risk scale (NHR). Based on previous research, the authors identified psychological risk factors related to cultural marginalization and developed measurements for them. Their objective was to create an instrument that can measure the tendency to reject cultural values and become marginalized as a spectrum, so it allows researchers to analyze the mechanisms and processes of youth marginalization in society. In their studies, Uchida and Norasakkunkit (2015) compared individuals in three groups: those considered Hikikomori, those considered NEET, and workers. Those in the Hikikomori group scored the highest in NHR, followed by the NEET group and the workers group, all group differences being statistically significant. Despite these differences in score, no cut-off score for diagnosis was established in their article. This scale was used in several studies to further investigate the relationship between marginalization and rejection of cultural values. The scale consists of three subscales: "Freeter lifestyle preference", "Lack of self-competence", and "Unclear ambition for the future". Freeter lifestyle preference refers to an inability to attain the cultural standard for becoming a socially sanctioned "adult" in society. "Lack of self-competence" encapsulates one's confidence in social skills and academic and working skills. "Unclear ambition for the future" reflects whether individuals hold a clear vision of what they might want to do in the future. Norasakkunkit and Uchida (2011) showed that individuals scoring high on cultural marginalization tendency would score lower in interdependence on Singelis (1994)'s self-construal scale. Also, the same study showed that NHR was negatively associated with persistence after failure feedback, which is considered a mainstream Japanese behavior (see Heine et al., 2001), but not significantly positively associated with persistence after success feedback. This framework is similar to the theory of "cultural consonance", which refers to the connection of an individual's practices to shared cultural models, as proposed by Dressler (2007). An individual's cultural consonance is assessed through the degree to which that individual, in their own beliefs and behaviors, approximates the socially shared expectations of their group.

As exemplified above, numerous studies relating NEET and hikikomori phenomena to an unwillingness to conform to mainstream cultural values during emerging adulthood have been done in Japan. However, studies on the same issue are rather less common in other cultures. Furthermore, while some researchers have investigated the relationship between mainstream values and social marginalization (e.g., Toivonen et al., 2011; Norasakkunkit and Uchida, 2014; Ishii and Uchida, 2016), to date no researcher has investigated how affective values are associated with social marginalization.

The above-mentioned literature suggests that a mismatch between mainstream culture and individuals' own values might be associated with NEET and *hikikomori* psychological tendencies. Social marginalization occurs mostly in people during their late teenage years, twenties, or early thirties, a period of life conceptualized as emerging adulthood. This concept refers especially to young people in industrialized societies, who are between adolescence and adulthood, facing instability, exploring their own identity, self-focusing, feeling in-between, and contemplating possibilities (Arnett, 2007).

Cultural Marginalization in the Brazilian Cultural Context

In Brazil, emerging adulthood, as a period of exploration of identity, the pursuit of diverse experiences, and the postponing of adult responsibilities, is particularly present in high socioeconomic status (SES) youth, who are more influenced by globalized values. Low SES youth, having limited access to the internet and tertiary education and thus being less influenced by globalized values, tend to comparatively assume traditional adult roles such as having a full-time job, focusing on their

families, and having children and a stable partner (Dutra-Thomé and Koller, 2014).

Dressler et al. (2018) conducted a study in Brazil in which they measured individuals' cultural consonance as well as the degree to which they knew about their society's cultural model and compared these measures to their level of psychological distress. They found that both knowing about their society's cultural model and having high levels of cultural consonance were associated with lower levels of psychological distress. However, cultural consonance acted as the stronger buffer for psychological distress.

The concept of NEET is getting particular attention in Brazil, where people in poverty, with fewer years of formal education, limited access to the internet, and a lower likelihood of being in a stable relationship have a higher probability of becoming NEETs due to the difficulties of securing a position in the current labor market without a high educational level, and lack of financial support to engage in other activities. Currently, the government has been implementing policies to try to mitigate this issue (Almeida and Figueiredo, 2017).

Cases of hikikomori are rather uncommon in Brazil, but there are some case studies. Gondim et al. (2017) described the case of a 25-year-old man, without previous history of psychiatric treatment; after breaking up with his girlfriend and quitting his job, the man stayed in his parents' house for 29 years, having minimal contact with other people and rarely going outside. Prioste and Siqueira (2019) described the case of a 38-year-old man who had quit his job more than 10 years prior and refrained from social relationships for more than 5 years, spending his time playing computer games and browsing the internet. These cases showed some overlapping tendencies with cases in Japan.

Affect and Culture

According to Affect Valuation Theory (Tsai et al., 2006; Tsai, 2007), affect can be divided into two types: "ideal affect", which is what people idealize and would like to feel as shaped by mainstream cultural values, and "actual affect", internal affective states that people actually feel in response to a situation. In general, culture guides which ideal affective states are pursued and valued more than others as they serve various functions, such as self-affirmation or relationship building, which are prioritized differently by different cultures. In turn, the consequences of the actual affect that individuals feel are determined by how in line they are with their culture's ideal affect.

For example, the discrepancy between actual and ideal affect (i.e., the further away people are from culturally valued and desired affective states) is associated with greater intensity in depression (Tsai et al., 2006) and poorer psychological functioning (Tran et al., 2017).

In East Asian cultural contexts, individuals are encouraged to pursue and value low arousal positive emotions (LAP), such as being calm or serene. High arousal positive emotions (HAP), such as excitement and elation, are less desired since they can harm social relationships in these societies (Tsai et al., 2006). In Latin American cultural contexts, individuals follow an opposite pattern, valuing HAP over LAP, because social relationships are promoted through vibrant positive emotional expression in these societies (Ruby et al., 2012).

Exploratory Study With Data From Brazil and Japan

As a small but important first step to see the difference between Brazilian and Japanese cultural marginalization and emotion, we conducted a survey study. Both cultures are commonly depicted in cultural psychology as collectivist (Triandis, 1995) and interdependence-fostering (Markus and Kitayama, 1991, 2010), in which the establishment and maintenance of social relationships are essential to the maintenance of order and development of social relationships in society, as well as the constitution of individuals' selves. However, recently there has also been a growing body of research showing that East Asian and Latin American cultures have many differences when it comes to social and psychological features.

The function of emotions in each of these cultures as well as how they are valued varies (e.g., Ruby et al., 2012; De Almeida and Uchida, 2019). Therefore, we expected that each culture would display a specific relationship between social marginalization and affect.

This cultural difference is also reflected in cultural products such as song lyrics and news articles. A study comparing cultural products from Brazil and Japan showed that Brazilian products have more positive words, which can be related to HAP, than neutral and negative words, while Japanese products tend to have proportionally more neutral words, which can be related to LAP, than positive and negative words (De Almeida and Uchida, 2019). Hence, the current paper extends past literature by providing a new way of distinguishing two interdependent cultures, by comparing these cultures using ideal affect valuation.

We hypothesized that an individual's affect (both ideal and actual) would be associated with the risk of being socially marginalized. Due to the cultural differences in affect valuation between the two cultures, we predicted that high actual and ideal HAP in Brazil would be connected to low marginalization risk in Brazil, while LAP would buffer against marginalization risk in Japan.

MATERIALS AND METHODS

Participants

Due to the exploratory nature of this study, we opted for having university students as participants since previous studies suggested that there were more than 10% of university students at risk of marginalization, even including those in top elite universities in Japan (Norasakkunkit and Uchida, 2011) and in Singapore (Liew et al., 2021). University students in both Japan and Brazil are undergoing emerging adulthood, which is a time when people receive strong influence from globalization. In addition, since they are facing the pressure of getting a job after graduation, there is a risk of social marginalization. Thus university students can be studied as representatives of this particular life stage from each country. Also, despite this population being less prone to cultural marginalization, they are

TABLE 1 | Participants demographic information.

Culture	N	Gender	Mage	SDage	SES
Brazil	54	30 F, 24 M	21.9	2.72	44 high SES, 10 low SES
Japan	54	21 F, 23 M	21.4	3.03	–

not immune to it; there are many reported cases of university students falling into social marginalization in several countries (e.g., Uchida, 2010; Bowker et al., 2019).

Participants were 54 Brazilian (30 females, mean age = 21.9, SD = 2.72) and 54 Japanese (21 females, mean age = 21.4, SD = 3.03) university students from various departments in top tier universities in each country (see **Table 1**). Brazilian participants were born and raised in Brazil and spoke Brazilian Portuguese as their first language, and Japanese participants were born and raised in Japan and spoke Japanese as their first language. Participants from neither group had lived for more than a year in a foreign country. Past or present psychiatric conditions were not asked about or measured.

In the Japanese university, an announcement was posted on a bulletin board in one of the main buildings, as well as on an online version of the bulletin board. Participants came to the lab and answered the questionnaires on a laptop and received ¥500 Japanese yen (around 4 USD) for their participation.

Brazilian participants received invitations to participate through internal mailing lists. They answered the questionnaires outside the lab, and they did not receive compensation for their participation[1]. For this sample, information about the type of school the participants attended before university was also collected as a measure of SES. 44 participants attended only or mostly private schools (high SES), and 10 participants attended only public schools (low SES).

Materials

Firstly, participants answered the Affect Valuation Index (AVI; Tsai et al., 2006). This index consists of two parts, both concerning 30 emotional states (enthusiastic, astonished, nervous, dull, quiet, relaxed, excited, surprised, elated, sleepy, still, lonely, strong, passive, content, sluggish, inactive, sad, euphoric, fearful, happy, idle, calm, unhappy, aroused, hostile, satisfied, rested, peaceful, and serene). In the first part, in order to measure ideal affect, participants answered how often they would ideally like to experience each emotional state over the course of a typical week on a 5-point scale (1-Never, 5-All the time). In the second part, participants rated how often they actually experienced each emotional state over the course of a typical week, using the same 5-point scale. For this study, we focused on high arousal positive affect (HAP – enthusiastic, excited, and strong) and low arousal positive affect (LAP – calm, at rest, relaxed, and serene), as classified by Tsai et al. (2006) in previous research.

Secondly, participants answered the NEET-*hikikomori* risk scale (NHR), developed by Uchida and Norasakkunkit (2015). It consists of 27 items (refer to the original article for details on each item) that participants rate on a 7-point scale (1- Completely disagree, 7- Completely agree), which are averaged to create the final score. This scale was made to assess NEET and hikikomori tendencies as a spectrum. It focuses on attitudes and values which suggest deviance from the cultural mainstream, commonly held by both groups.

Both materials already had a Japanese translation used in previous research. A Brazilian Portuguese version was made using back-translation.

Finally, participants provided some demographic information.

RESULTS

Statistical analyses of the present study were performed using the statistical programming language R.

First of all, we examined the reliability of the NHR scale for Brazil, since it has only been validated for Japan and the United States. The Cronbach's alpha score of the NHR was high for the Brazilian data (0.81), as it was for the Japanese data (0.78). There was no significant difference in NHR [$t(106) = 1.95$, $p = 0.054$] between the Brazilian group ($M = 3.8$, $SD = 0.7$) and the Japanese group ($M = 3.6$, $SD = 0.5$) (see **Figure 1**). Compared to the original study in which the scale was developed (Uchida and Norasakkunkit, 2015), both groups studied here scored similarly to the non-marginalized group ($M = 3.5$) and lower than the group classified as NEET ($M = 4.4$).

Next, to investigate cultural variability in ideal affect a 2 (Affect Type: HAP vs. LAP) × 2 (Culture: Brazil vs. Japan) mixed-model ANOVA with Affect Type as the within-subjects factor was conducted. There were significant effects for Culture, $F(1,106) = 11.44$, MSE = 0.43, $p < 0.01$, $\eta_p^2 = 0.06$, Affect Type, $F(1,106) = 30.23$, MSE = 0.29, $p < 0.001$, $\eta_p^2 = 0.10$, and the interaction between Culture and Affect Type, $F(1,106) = 7.23$, MSE = 0.29, $p < 0.01$, $\eta_p^2 = 0.02$. Bonferroni p-value adjusted *post hoc* tests were performed to evaluate Affect Type differences in each culture. In the Brazilian sample, LAP and HAP were not significantly different ($M = 3.9$ and $M = 3.7$, $p = 0.1$), however, Japanese participants scored significantly higher in LAP than HAP ($M = 3.8$ and $M = 3.2$, $p < 0.001$).

The Japanese data replicated results from previous studies (Tsai et al., 2006), showing that Japanese, as has been commonly found for East Asians, would prefer LAP over HAP. However, the Brazilian data did not replicate previous findings considering Latin Americans (Ruby et al., 2012), since there was no significant difference in affective preference (see **Figure 2**).

Regarding actual affect, we conducted another 2 (Affect Type: HAP vs. LAP) × 2 (Culture: Brazil vs. Japan) mixed-model ANOVA with Affect Type as the within-subjects factor.

[1]It is a common practice in Brazilian universities to set up mailing lists within the university's departments (e.g., "Graduate School of Engineering's mailing list"), or students' year (e.g., "class of 2012"). These mailing lists work as an alternative to bulletin boards as well as a direct means to deliver information to a whole class or department. They can be used for announcements and sharing information about things such as summer courses, internships, research grant opportunities, and recruitment for studies. It is customary to have voluntary participants in research in Brazil.

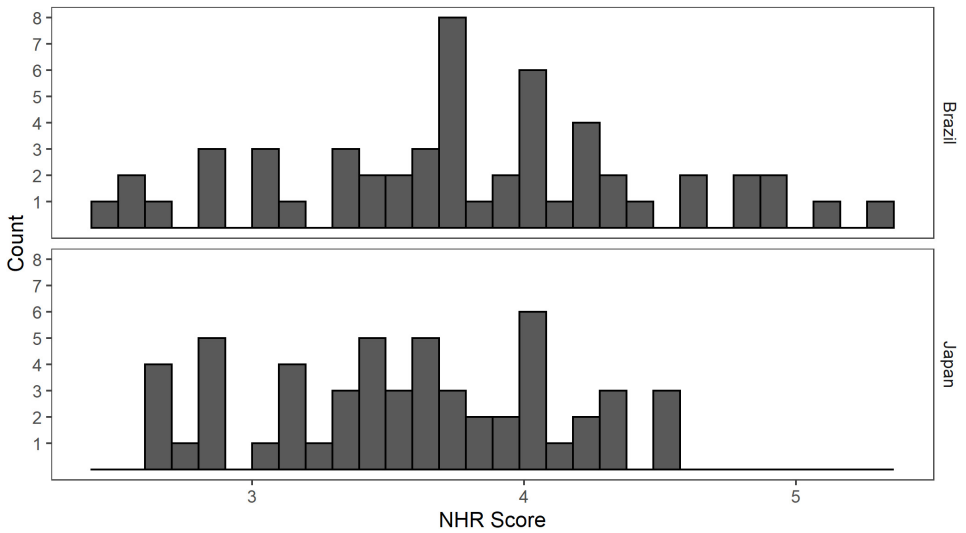

FIGURE 1 | Histogram of NHR scores from each sample.

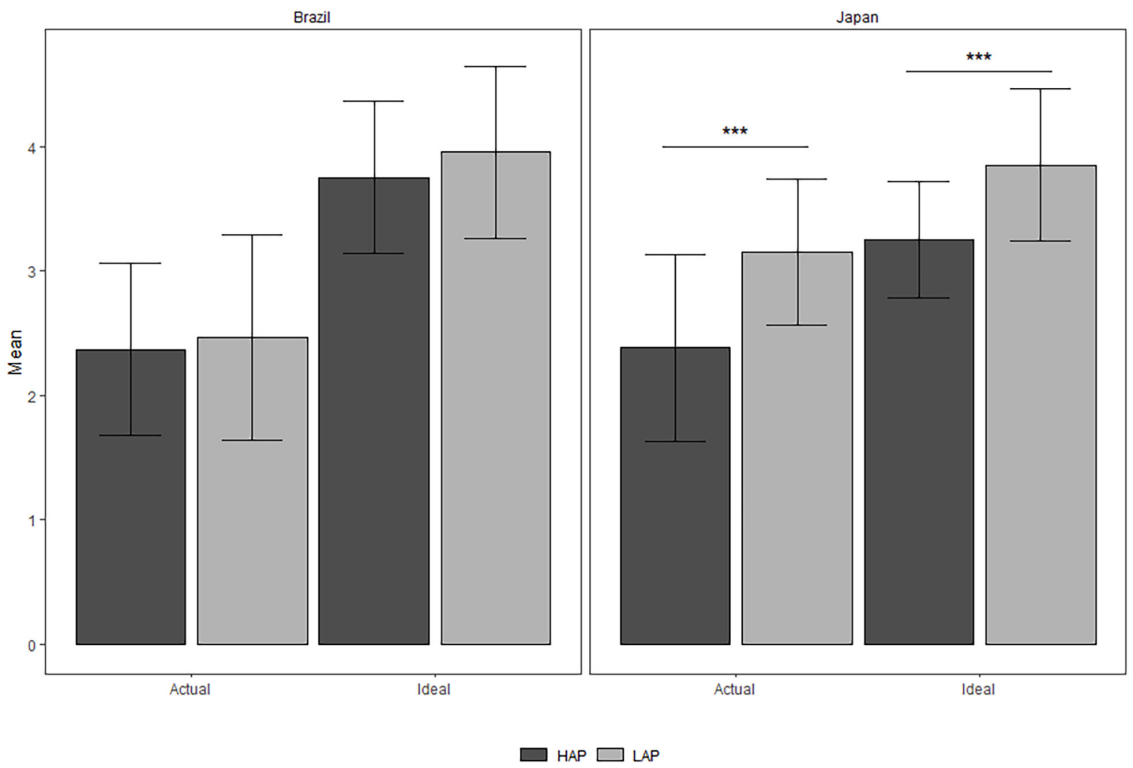

FIGURE 2 | Comparison of actual and ideal HAP and LAP between Brazil and Japan (error bars represent standard deviation of the mean). ***$p < 0.001$.

There were significant effects for Culture, $F(1,106) = 10.00$, MSE = 0.65, $p < 0.01$, $\eta_p^2 = 0.05$, Affect Type, $F(1,106) = 26.88$, MSE = 0.38, $p < 0.001$, $\eta_p^2 = 0.08$, and the interaction between Culture and Affect Type, $F(1,106) = 16.19$, MSE = 0.38, $p < 0.01$, $\eta_p^2 = 0.05$. Bonferroni p-value adjusted *post hoc* tests were performed to evaluate Affect Type differences in each culture. In the Brazilian sample, LAP and HAP were not significantly different ($M = 2.5$ and $M = 2.4$, $p = 0.37$), however, Japanese participants scored significantly higher in LAP than HAP ($M = 3.1$ and $M = 2.4$, $p < 0.001$).

Finally, three multiple regression analyses were conducted to examine the effect of affect valuation and experience on social marginalization for each culture.

Each multiple regression followed the same general formula – NHR was predicted by HAP or LAP and their interaction with culture (Brazil or Japan). This way we could evaluate how HAP and LAP in ideal affect, actual affect, or the discrepancy between ideal and actual affect influences NHR in each culture, as well as the effect of culture on the model.

Firstly, the possible effects of ideal affect (high arousal positive and low arousal positive affect) on marginalization risk in each culture were evaluated through a regression model (culture was dummy coded). Contrary to our hypothesis, the results of the regression indicate that ideal HAP and ideal LAP did not explain the variance [$F(5,102) = 1.5$, $R^2 = 0.02$, $p = 0.2$].

Secondly, the possible effects of actual affect (high arousal positive and low arousal positive affect) on marginalization risk in each culture were evaluated through a regression model (culture was dummy coded, see **Table 2** for details). The model explained 23% of the variance [$F(5,102) = 7.55$, $R^2 = 0.27$, $p < 0.001$,]. Culture did not have a significant effect, thus the two groups had similar scores on NHR. For the Brazilian sample, LAP ($\beta = -0.20$, $p = 0.05$) had a marginally significant influence and HAP ($\beta = -0.40$, $p < 0.01$) had a large influence. However, for the Japanese sample both LAP ($\beta = -0.19$, $p = 0.71$) and HAP ($\beta = 0.25$, $p = 0.11$) did not significantly influence NHR.

Thirdly, the possible effects of the discrepancy between ideal and actual affect (raw values of ideal minus actual affect) on marginalization risk in each culture were evaluated through a regression model (culture was dummy coded). Results show that the regression model significantly explained the variance [$R^2 = 0.12$, $p < 0.01$, $F(5,102) = 3.96$]. Similar to the actual affect model, culture did not have a significant effect. In the Brazilian sample, only the discrepancy in HAP ($\beta = 0.40$, $p = 0.03$) had a significant influence on NHR. In the Japanese sample, neither the discrepancy in HAP or LAP had a significant influence on NHR.

DISCUSSION

The study presented provides evidence that associates affect, as a mainstream cultural value, and the risk of social marginalization.

TABLE 2 | Regression results using NHR as the criterion, actual affect as the dependent variable and culture (Brazil and Japan) as dummy variables.

Predictor	*b*	*b* 95% CI (LL, UL)	sr^2	sr^2 95% CI (LL, UL)	Fit
(Intercept)	5.24**	(4.66, 5.82)			
Culture	−0.50	(−1.60, 0.59)	0.01	(−0.02, 0.03)	
HAP (Brazil)	−0.40**	(−0.64, −0.16)	0.08	(−0.01, 0.16)	
LAP (Brazil)	−0.20	(−0.40, 0.00)	0.03	(−0.03, 0.08)	
HAP (Japan)	0.25	(−0.06, 0.57)	0.02	(−0.03, 0.06)	
LAP (Japan)	−0.06	(−0.38, 0.26)	0.00	(−0.01, 0.01)	
					$R^2 = 0.270$**
					95% CI (0.10,0.37)

A significant b-weight indicates the semi-partial correlation is also significant. b represents unstandardized regression weights. sr^2 represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.
$^{**}p < 0.01$.

This can be seen as a first step in this line of research, which can be fruitful not only for future studies, but also for the development of policies, and for professionals involved in applied work who design interventions and diagnose patients.

NEET-Hikikomori Risk Scale (NHR) had high reliability in this study's Brazilian sample, showing that the latent variables are consistent and reliable in a culture outside of Japan. Future use of this scale in Brazilian culture in other facets of research may yield meaningful results. Future research can also expand the participant sampling pool to include those such as NEETs or people who are socially withdrawn to observe and analyze their psychological risk factors.

The present study adds to the literature with novel data from Brazil. We found that there is an association between the cultural valuation of affective states and social marginalization. The results of the regression models indicate that ideal HAP and ideal LAP did not explain marginalization risk in either culture. However, in the Brazilian sample (but not the Japanese sample), considering actual affect and the discrepancy between actual and ideal affect, low HAP predicted marginalization risk. LAP had a similar influence on marginalization risk, albeit only a marginally signiticant one. This implies that for Brazilians, actual positive affect has an important buffering effect toward marginalization risk. In particular, HAP is more likely to work as a buffer of marginalization risk in Brazil than in Japan. Actual affect and the discrepancy between ideal and actual affect had significant results, suggesting that it is the individual's actual emotional state, not their ideal emotional state, that influences their cultural engagement. Considering that lived experiences are the major influence on one's actual affect, one possible explanation for the present results is that environments and situations that promote actual HAP in Brazilians will also promote adherence to other mainstream cultural ideals, buffering against cultural marginalization. Future research may address this issue directly as well as exploring other consequences of one experiencing actual affect that goes against the ideal affect of mainstream culture.

Aside from our main hypothesis, this data suggests that for the mean score of ideal affect, Brazilian data (preferring LAP and HAP equally) ended up being similar to what was found in previous studies, in which, contrary to expectations, European-Americans (Tsai, 2007) and European-Canadians (Ruby et al., 2012) did not score significantly differently on ideal HAP and LAP. A recent study's result has shown Colombians, European-Americans, and Japanese scoring significantly higher on ideal LAP than HAP, and Japanese scoring significantly lower than the other groups in HAP (Salvador et al., 2020). While questionnaire-based studies with participants sometimes show this pattern, behavioral and cultural products-based studies have consistently shown affective cultural values (e.g., Tsai et al., 2006; Tsai, 2007; De Almeida and Uchida, 2019). Therefore, there is the possibility that in the present study, the participants' ideal affect was not a perfect reflection of what is expected in terms of affect in the Brazilian culture.

In addition, the previous studies mentioned here obtained data from Mexico (Ruby et al., 2012) and Colombia (Salvador et al., 2020), while we obtained data from Brazil. It is also

arguable that valuing both HAP and LAP is a characteristic of Brazilian culture that differs from other Latin American cultures, or at least Colombia and Mexico. For instance, Zubieta et al. (1998) identified variables such as indigenous population, characteristics of the pre-Columbian cultures, socio-economic development, gender differences, and climate that can influence how emotions work in Latin American cultures. This difference between Latin American cultures further highlights the need for more studies comparing cultures within the same region rather than generalizing effects across cultural regions. Also, it suggests that the current usage of affective valuation as a functional means to explore cultural differences may have unique contributions compared to other more commonly used cultural measures.

Based on the divergence of the results from the present study and previous research on affect in Latin America, it is possible that the patterns and functions of emotions, as well as how and why they differ in each country, are simply not well understood. This could be due to a lack of studies focusing on this topic, especially when compared to the number of studies done with Western, or even East Asian populations.

Despite previous research suggesting that LAP supports social adjustment, while HAP may hinder social relationships in East Asian cultures (Tsai et al., 2006)—and LAP being considered a mainstream value in these societies and thus related to marginalization risk (Ishii and Uchida, 2016)—we could not find evidence that supports this hypothesis in our results. There are numerous possible explanations for this result; for instance, emotion could not be related to cultural marginalization in Japan, or this relationship could not be measurable in Japanese university students. Future research should investigate this further.

In summary, actual HAP can act as a buffer to cultural marginalization risk in Brazil, however, HAP and LAP may not be related to cultural marginalization risk in Japan. The current results should be interpreted in context, since they have limitations. First of all, the findings presented here may not be generalizable beyond the studied population, which consists of students from top tier universities (i.e., people with small chances of becoming socially marginalized) in each country, living in urban and economically developed regions of their countries, who are mostly high SES. Therefore, future studies must expand the findings of this study by addressing populations that are more at risk of becoming socially marginalized, or are at least not as privileged as the participants of this study. Secondly, other complementary measurements could be used for a better assessment of the situation, such as behavioral and physiological indices, psychiatric history, longitudinal measures, and cultural artifacts.

As globalization becomes more prevalent, societies around the world have to change accordingly, oftentimes pushing people into social marginalization. Despite being a global phenomenon, the present research shows that this process can happen in distinct ways according to local cultural values. Thus, future studies, as well as policies and perhaps treatments, can benefit from paying attention to how the relationship between cultural values and social marginalization develops in each society.

In a world where social marginalization is an important and frequently discussed topic (e.g., OECD, 2019), studies and policies tackling the issue from different angles are of urgent necessity. This study is a small but novel step in the direction of better understanding how this phenomenon works and, possibly, how it can be tackled in the future.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The procedures used in this work were in accordance with the American Psychological Association Ethical Guidelines and the Japanese Psychological Association guidelines. All participants gave their informed consent and were debriefed and informed about the true purpose of the research immediately after the experiment.

AUTHOR CONTRIBUTIONS

Both authors contributed to the conception of the study and worked on the final version equally. ID did data collection, data analysis, and wrote the first draft. YU worked on the second version, contributed with interpretation of the data and theoretical review. Both authors contributed to the article and approved the submitted version.

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REVIEW
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Elements of Neuroanthropology

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Neuroanthropology is the integration of neuroscience into anthropology and aims to understand "brains in the wild." This interdisciplinary field examines patterns of human variation in field settings and provides empirical research that complements work done in clinical and laboratory settings. Neuroanthropology often uses ethnography in combination with theories and methods from cognitive science as a way to capture how culture, mind, and brain interact. This article describes nine elements that outline how to do neuroanthropology research: (1) integrating biology and culture through neuroscience and biocultural anthropology; (2) extending focus of anthropology on what people say and do to include what people process; (3) sizing culture appropriately, from broad patterns of culture to culture in small-scale settings; (4) understanding patterns of cultural variation, in particular how culture produces patterns of shared variation; (5) considering individuals in interaction with culture, with levels of analysis that can go from biology to social structures; (6) focusing on interactive elements that bring together biological and cultural processes; (7) conceptual triangulation, which draws on anthropology, psychology, and neuroscience in conjunction with field, clinic, and laboratory; (8) critical complementarity as a way to integrate the strengths of critical scholarship with interdisciplinary work; and (9) using methodological triangulation as a way to advance interdisciplinary research. These elements are illustrated through three case studies: research on US combat veterans and how they use Brazilian Jiu Jitsu as a way to manage the transition to becoming civilians, work on human-raptor interactions to understand how and why these interactions can prove beneficial for human handlers, and adapting cue reactivity research on addiction to a field-based approach to understand how people interact with cues in naturalistic settings.

Keywords: neuroanthropology, culture, neuroscience, veterans, raptors, cue reactivity, addiction

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INTRODUCTION

In researching how our nervous system functions in both common and varied ways across settings, neuroanthropology has drawn on the strengths of anthropology—a holistic approach that fosters interdisciplinarity, the theory of culture, and field-based research. Neuroanthropology has also embraced the attention to the process that comes with biology and cognitive science as well as increasing understanding of neuroplasticity of neuroscience. Together, these have fostered examining "brains in the wild" (Lende and Downey, 2012a,b).

Related fields, such as cultural neuroscience and critical neuroscience, have also drawn on shifting views of the brain, while social science research has increasingly focused on how the explosion in neuroscience matters for society (Chiao and Ambady, 2007; Rose and Abi-Rached, 2013; Fitzgerald and Callard, 2015; Choudhury and Slaby, 2016; Kitayama et al., 2019).

Neuroanthropology can contribute to these exciting interdisciplinary developments by offering ways to incorporate the empirical and conceptual developments made by anthropologists. By studying human variation in context, neuroanthropology helps to bridge the gap between the laboratory studies favored by neuroscience and field-based anthropology focused on sociocultural phenomena.

In this paper, we review three domains that prove important for neuroanthropological research: (1) how holism and biocultural approaches foster interdisciplinary research that draws on neuroscience and on field research (Hruschka et al., 2005; Quinn, 2018), (2) ways to incorporate culture at varying levels into a project, and (3) how different forms of triangulation offer ways to integrate different ideas and methods into research (Patton, 1999; Maxwell, 2004; Fusch et al., 2018). After covering these key elements, we provide lessons learned from three different research projects—work with veterans, human-raptor interactions, and how people react to cues for drugs—for neuroanthropology.

HOLISM

Combining Biology and Culture

Neuroanthropology starts with a reciprocal understanding of how humans work: We create culture, and culture creates us. For neuroanthropology, culture is interactive, a dynamic set of processes both outside and under the skin. This view means that enculturation—or how culture comes to be embodied in a specific person—works *via* biocultural transformations that happen over time and in particular settings (Hruschka et al., 2005; Worthman, 2009; Lende and Downey, 2012a).

Researchers who are less familiar with biological processes should recognize that the specifics of neural processing are not intuitively obvious—often times, they correspond neither to our mechanical understandings of how the world works, nor our representationalist view that there is a perceiving subject somewhere inside the brain (Lende and Downey, 2012a). For example, the popular press has covered Marilyn Monroe or Jennifer Aniston neurons, conveying the idea that specific neurons correspond to specific faces (or, more broadly, this part does that function; Abbott, 2010; Goldhill, 2016). However, research on facial recognition remains a work in progress and shows that both higher-level and lower-level kinds of processing matter for recognizing a face. For example, the fusiform face area in the dorsal visual cortex does higher-order face processing of basic visual perceptions, helping us to recognize familiar faces (Kanwisher and Yovel, 2006) even when the perceiving subject is blind from birth (Murty et al., 2020). At the same time, recent primate research also has made clear that the brain makes sense of faces by breaking faces down into separate componential processes, attending to relatively invariant sensory features that can then be used to create a composite (or constructed) face (Chang and Tsao, 2017). Thus, the specifics of how the biology actually gets a particular function done matter for doing good neuroanthropology and for linking biology to cultural science.

From the culture side, researchers less familiar with anthropology should recognize that their common-sense categories of how we perceive and act and experience the world represent western ethnopsychologies. Ethnopsychologies divvy up the world in particular ways, and that divvying up is not necessarily something natural or preexisting inside the world. Rather, it comes from culture. For example, westerners rely on a model of the five senses, each as its own separate domain from the other, which together comprise how people perceive the world. However, other cultures operate from different assumptions. For example, in Ghana, the Anlo-Ewe-speaking people view balance as a main sense and central to defining what it means to be a person (Guerts, 2003). Moreover, the Anlo-Ewe approach senses not as perception but as feeling, something that is intuited and felt within the body; in contrast, western psychology generally views perception happening at the interface of the mind and physical body. Thus, the Anlo-Ewe view of sensory perception/feeling is distinct from the mind-body dichotomy commonly used in the west.

To navigate between both a nonintuitive biology and a non-intuitive culture, neuroanthropology has drawn on neuroscience that can connect to learning, human development, and culture (Wexler, 2011; Lende and Downey, 2012a; Sherwood and Gómez-Robles, 2017). At the biological level, neural reuse provides one approach that helps to understand how the brain can repurpose existing elements as a way to solve novel tasks and support culture (Anderson, 2010). *Via* neuroplasticity acting from cellular to circuit levels, built-in functions can be adapted to new demands, and new functions can emerge from combining existing neural components with learning and environmental inputs. Culture excels at demanding exactly this sort of learning and by structuring inputs in ways that push both human (and sometimes nonhuman) brains to do novel things, such as using symbols (Matsuzawa, 2009; Whiten, 2017), reading (Dehaene-Lambertz et al., 2018), and tool use (Stout and Hecht, 2017).

Neuroconstructivism provides an approach that can connect neural function and reuse to development in specific contexts (Bates et al., 1996; Westermann et al., 2007). Neuroconstructivism focuses on the experience-dependent development of neural structures, where experience can play a fundamental role in shaping functionality and the emergence of both competent function and neuropathology (Campos et al., 2019). In turn, neural reuse and neuroconstructivism can work with embodied, enactive, and extended mind approaches. This research connects neural and cognitive processing to local contexts (Clark and Chalmers, 1998; Clark, 2008; Wilson and Golonka, 2013). As Wilson and Golonka (2013) argue, these approaches need to look at the task to be solved from the point of view of the agent, and then examine the resources available to solve that task. These resources are not just internal—brain, body, other people, symbols, and tools can all help.

Emotion can provide an example of this integrative approach. Work by Barrett and colleagues approaches emotions as constructed rather than reducible to universal patterns (Barrett, 2017; Gendron et al., 2018). In their approach, emotions still involve bodily states and brain processing but also rely on contextual cues and learned interpretations. Thus, they can vary cross-culturally rather than having discrete and distinguishable signatures in brain signals or bodily states. In this type of

approach, emotions can be similar cross-culturally not just because of an innate biology but because of commonalities in our bodies and faces, how our brains process both general states (from hunger and illness to anger and anxiety) and specific emotions (say, *schadenfreude*), and similarities in social situations and recurring cues that can guide specific interpretations (Crivelli et al., 2016; Barrett et al., 2019; Srinivasan and Martinez, 2021). It is the recurring combinations, from inside to outside, that can lead to commonalities across cultures.

SAY-DO-PROCESS

Alongside theoretical considerations of how to bring together neuroscience and anthropology, neuroanthropology builds its approach to research problems, using insights from the field. As Roepstorff and Frith (2012) argue, anthropology is well-equipped to handle competing discourses and models while also providing a focus on specific examples in concrete settings. With field research, anthropology has stressed the importance of paying attention to what people say and what people do. They are not the same thing; people might say one thing and do another. Moreover, what they say about what they do and why, does not necessarily match up with what they actually do.

Here, we add a third element—what people process. Process brings in emphasis of cognitive science on understanding mechanisms, functions, and mediating factors. Psychology has long recognized the distinction between what people say and what people process (Nisbett and Wilson, 1977). In contrast, field-based research in anthropology has often focused on higher-level sociocultural phenomena. Through a process, neuroanthropology draws on biology, cognition, and development to better understand human variation and outcomes in real-world settings. Process brings attention to how things happen, not just to what people say and do.

In research, Say corresponds best to language, symbols, metaphors, and meaning that shape how we think and speak (Hutchins, 1995; Tedlock and Mannheim, 1995; Zarger, 2010). For neuroanthropological research, getting at Say can happen through watching people speak together and doing informal interviews in field settings, as well as *via* interviews, questionnaires, and other forms of verbal response. Listening to how people interpret what happens and why, as well as developing their views on things in their own words, forms an important part of capturing Say in field research.

Do corresponds best to practices and how people interact in specific contexts. These often form the core of ethnographic research, particularly participant observation where researchers can interact informally with local people and observe firsthand how life plays out in real time. For neuroanthropology, what people do can connect senses and movement and action on the neuroscience side, and the skills and practices and doing on the anthropology side (Worthman, 2009; Downey, 2010). Neuroscience here provides a wealth of work on senses, movement, balance, and more that can effectively work with the emphasis that anthropology provides on how people behave, whether following one individual or looking at coordinated behavior in specific settings (Clark, 2008; Han, 2015; Chiao et al., 2016; Kitayama et al., 2019).

It is important, nonetheless, to view what people do as happening in public and between people. That means that culture and interactions are available for observation. Provided researchers frame questions right, questionnaires can also get at what people do by asking about specific experiences and behaviors, and getting informants to report on behaviors done within specific contexts (e.g., home, work, and other types of sociocultural contexts). Finding specific moments where things happen that crystallize insights is the mainstay of ethnographic research and equally important to field-based neuroanthropology.

What people do and what people say do not provide automatic access to how and what people process. Roepstorff and Frith (2012) argue that anthropological approaches need to pay attention to mechanism (or process) to effectively bridge laboratory and field. To understand process, ethnographic research combined with biocultural approaches can help. Understanding how development, plasticity, neural reuse, algorithmic processing and the like impact any particular problem will help to capture how people process (Anderson, 2010; Worthman, 2010; Wilson and Golonka, 2013). These processes often happen outside of conscious awareness and cultural modes of understanding but play a major role in shaping human variation. Observations on process have been proved effective in getting at process in field settings (Worthman, 2009; Xygalatas et al., 2013; McGraw and Krátký, 2017). Alongside observations, researchers can encourage informants to do thick description of what they experience, what happens as they do something, and what the context is like.

CULTURE

Sizing Culture Appropriately

After establishing a holistic approach, it is important to consider how "culture" is sized in a particular study, and how that fits any proposed interactions or effects that culture might have (see **Table 1**). Cultural neuroscience has generally taken a broad approach to culture, approaching "culture" as a regional or national phenomenon and linking it to changes in psychological or neural states and functions (Chiao and Ambady, 2007; Han, 2015). This research has yielded important insights. For example, societies that stress interdependence over independence show differing patterns of neural activation in self-other tasks; interdependent cultures tend to show greater activation in circuits that are generally considered "self" oriented in western contexts (e.g., greater activation in Germans than Chinese in the medial prefrontal cortex; Korn et al., 2014).

However, two potential problems can arise. First, such a broad generalization (east vs. west) can hide significant variation, whether within a particular group, community, or region (Lende and Downey, 2012a; Seligman et al., 2016). Second, by using a generic level of culture, broad differences are likely to be distal compared to more immediate influences on psychological and neural function. For example, context deeply shapes human behavior but is often not assessed in large-scale generalizations

TABLE 1 | Sizing culture appropriately.

Level of granularity	Symbolic/ interpretive	Societal/ political economy	Ecological/ environmental
Macro	Symbols	Political economic structures	Local ecology
Meso	Rituals	Social institutions	Food and making a living
Micro	Interpretations	Households	Interspecies interactions
Mental	Subjective meanings and models	Individual preferences and tastes	Local environmental knowledge and practices

*At a practical level, sizing culture needs to work in an iterative fashion from the broadest considerations down to the most micro to figure out what is an appropriate level of analysis for any particular project. Often the broadest orientations—symbolic, political economic, ecological—are not enough to understand variation within a particular society. Once researchers have chosen an appropriate overall approach, they will need to work down to the level of granularity that most impacts their specific research problem. The level of granularity in cultural analysis is presented on left, from large-scale considerations (the bird's eye view) down to how individuals relate to culture. On the top level, in italics, are prominent approaches to assessing culture in its broadest sense; these different orientations all represent decades-old research paradigms. The more fine-grained labels (e.g., social institutions, households, and tastes) are placemarkers to indicate the level of granularity, a label to exemplify a type of variation. Other possible research foci are possible (e.g., Mosse's, 2004 research on non-profit organizations, internal NGO organization, and cognitive contradictions in goals vs. practice). Researchers should consider which type of approach to culture best fits their research problem (**Table 2**), and from there, how many levels of analysis (e.g., degrees of granularity) are feasible to include in the research. Often times researchers might consider broad patterns of meaning making (language, nationality, and history) but focus in on smaller-scale aspects of culture (prominent interpretations that relate to sensory processing, and experience-near descriptions of sensory details). Interpretive, political economic, and ecological approaches are not the only ways to "size culture." Research on globalization and on the materiality of cultural life are other prominent ways to analyze the patterning of variation; however, these approaches generally engage with one or more of these macro views on human culture.*

(Moore, 2004; Medin et al., 2010; Roepstorff et al., 2010; Northoff, 2013). Thus, large-scale sizing of culture brings advantages, from ease of research and ability to work across labs in multiple countries, and disadvantages, such as overgeneralization across groups and the underpowering of the specific effects of culture.

Neuroanthropology has generally focused on more proximate approaches, sizing culture at a more local level. Research of Lende (2005) on drug use and dopamine function framed culture at the level of shared understandings of addiction in urban areas in Colombia. An even more local approach came from the work of Downey on capoeira and proprioception focused on specific training regimes and skill acquisition in the context of the *roda*—the setting where capoeira training takes place, with its concrete patterns of play, music, and bodily movements (Downey, 2005, 2012). Rather than viewing balance as innate, research of Downey showed how training, context, and interpretation shaped whether capoeira practitioners could overcome initial neural reactions such as the righting reflex while maintaining balance. In this case, understanding the specific outcome—balance—depended on a series of considerations that would not be available in current neuroimaging research but were highly relevant to how capoeira worked as a dynamic human skill.

Even these localized approaches to culture generally orient themselves within three broad approaches: symbolic and interpretive approaches, political economic approaches, and ecological and environmental approaches. Research can use more of an interpretive approach to culture, analyzing symbols, rituals, language, and meanings, as well as associated practices (Geertz, 1973; Tedlock and Mannheim, 1995; Holland et al., 2001). Or, one might look at how political economic structure shapes identity, sense of self, gender, class, consumption, and even disease (Mintz, 1986; Di Leonardo, 1991; Farmer, 2004). These social structures shape who we are, how we think and feel, our daily experiences, and the material resources we have to solve tasks and grow and develop. One could also take an ecological/environmental approach, with its emphasis on how ecology shapes ways of living, and thus ways of relating to nature and to others, as well as how one feels and thinks about the local environment (Biersack, 1999; Stepp et al., 2003; Zarger, 2010). **Table 2** provides a way to help figure out which of these three major approaches to culture—interpretive, political economic, or ecological—will be the most useful for a research project that aims to assess the specific effects culture has within these domains.

Considering Cultural Variation

Three common issues affect "sizing culture appropriately," or taking into account considerations of similarity and difference in cross-cultural variation. First is the WEIRD problem (Henrich et al., 2010) that most psychological research has been done with university students. These samples have been both homogeneous and skewed; these students represent not just Western, educated, industrialized, rich, and democratic but also young, privileged, and often self-indulgent and myopic (Lende and Downey, 2020). WEIRD results do not generalize well, and the antidote is not simply better replication of existing theories based on WEIRD samples (Muthukrishna and Henrich, 2019). Rather, research needs to recognize how context-dependent samples affect both results and the interpretation of results; research that makes broad assertions about culture and human variation must be examined in a comparative approach that takes into account the extraordinary range of variation already known to anthropology.

The second issue is that culture is a shared problem rather than an individual variation problem (LeVine, 1984). Many approaches in neuroscience and psychology focus on an individual as the unit of analysis, and use statistical approaches that emphasize how individuals vary from each other. Cultural science must move beyond treating culture as just another individual variable to measure (which often reduces culture to quantitative demographics, whether that is gender, world region, race, age, or similar type of measurement). This approach to "sizing culture appropriately" gives culture the theoretical space to be an actual working entity in the lives of the people participating in any particular study.

In anthropology, culture is generally approached as a shared phenomenon, for example, the shared meanings that a group uses to understand its place in the world. Take language. Psychologists might focus on variation in linguistic skill (say, evaluating individual reading ability) while anthropologists might focus on how the acquisition of literacy by a group creates broad changes

TABLE 2 | Cultural Approaches.

Cultural Approaches	Potential Features
1. Symbolic & interpretive	Symbols, language, ideology, religion, emotion and self
2. Political & economic	Inequality, political institutions, capitalist or egalitarian ideologies
3. Ecology & environment	Local ecologies, forms of food production, animal-human interactions, learning about nature

What kind of cultural approach is useful for your research? Option 1: Does your research connect to symbols, language, ideology, religion, or something similar? Option 2: Does your research connect to economy, inequality, political institutions, capitalist or egalitarian ideologies, or something similar? Option 3: Does your research connect to the local environment or ecology, learning about nature, interacting with animals, or something similar? Option 1 is Symbolic and Interpretive, option 2 is Political Economy, and option 3 is Ecology and Environment (see ***Table 1****). If you answered no to all three of these, consider a following option: Globalization or Material Culture. However, globalization and material culture approaches generally draw on one of the three main orientations—symbols, political economy, or ecology—for help in understanding specific aspects of how a changing world marked by migration, money, and media (globalization) or how the physical and interactive aspects of built environments, from clothing to smart phones to architecture to trees to reliquaries (material culture), relate to how people live, experience, and understand. Examples of Symbolic and Interpretive Research: Shweder's (1991) text is foundational to this line, looking at emotion, self, and morality across culture and centered on the person in relation to culture as a key analytic unit (see also Markus and Kitayama, 1991; Cole, 1998; Nisbett et al., 2001). Continued work in cross-cultural psychology (e.g., Bender and Beller, 2016; Sternberg, 2017) links cognitive phenomenon such as perception to culture, while a great deal of psychological anthropology continues examining culture in relation to Shweder's classic concerns with emotion, self and person-centered analysis (Quinn, 2018; Bock and Leavitt, 2019). Examples of Political Economic Research include: The psychology of neoliberalism (Adams et al., 2019), Decolonizing community psychology (McNamara and Naepi, 2018), Sense of closeness and helping behavior (Hackman et al., 2017), Nationalism (Sapolsky, 2019), Distributed cognition and economic reform (Lieber, 2015), and Folk-economic beliefs (Boyer and Petersen, 2018). Examples of Ecological and Environmental Research: Cultural neuroscience and psychology have looked at how patterns of food production, whether more collective (rice farming) or individualist (individual farmsteads), have led to changes over time in psychological and neurological patterning (Chiao and Blizinsky, 2009; Talhelm et al., 2014). Here, patterns of ecological productivity create both selective effects, favoring certain gene types over others, and enculturation effects, working through value systems, patterns of social coordination, and the demands of making a living. But this broad level is not the only way to connect culture to mind and brain. For example, research on how children learn about local ecologies emphasizes language, institutions like schools, family networks, exposure and experience, and other more immediate factors that shape how children think about nature (Hermann et al., 2010; Zarger, 2010; Quinlan et al., 2013; Ojalehto and Medin, 2015). Globalization and Material Culture: Globalization offer another major way to analyze cultural change (Andepson-Fye, 2003; Kirmayer, 2006; Hong and Cheon, 2017). Similarly, materiality—or looking at how the material aspects of our lives are central to cognition and culture—represents an important recent area of recent research (Hutchins, 1995; Clark, 2006; Sutton, 2008).*

in how people communicate with one another. Put in statistical terms, rather than studying normal distributions, anthropologists study J distributions, where most people share in a common culture (LeVine, 1984). An important research consideration related to the shared aspects of culture is that smaller samples become viable (Guest et al., 2006), since commonalities will occur in most members of even small samples.

The final consideration is to recognize the shared production of difference within members of a particular group or culture. In other words, shared culture can, nonetheless, produce a difference in ways that are not reducible to individual differences. Gender, class, and age represent recurring features of social organization, and, in turn, these social features shape what one does and knows. While these variables are often reduced to individual-level features in WEIRD research, they actually represent patterns of shared experience, behavior, knowledge, interpretation, and/or language.

TABLE 3 | Analytic levels: individuals and interactions.

Level	Individual	Interaction
Body	Biology	Embodiment
Mind	Psychology	Practices
Micro	Self	Context
Macro	Social Self	Social Structures

Alongside sizing culture, researchers should consider the levels of analysis that they take with regards to the individual and interactions with culture. Culture can shape biology, psychology, self, and social self, but at the same time, these levels can change the impact and function of culture, particularly at meso, micro, and mental levels (see ***Table 1*** *on Sizing Culture). At the same time, interactions mediate between individual and culture, and thus can be actively considered in neuroanthropology and other research on culture, mind, and brain. The interaction level focuses on how culture can specifically impact the individual, from shaping physical bodies and biological functions via culture (Gravlee, 2009; Redcay and Schilbach, 2019); how social practices shape what people learn, how their biology functions, and how they relate to others (Downey, 2010; Roepstorff et al., 2010; Hari et al., 2015), how specific contexts shape how the brain interprets local information as well as what sorts of practices a person might use and what sort of self and social self they might present (Moore, 2004; Quinn, 2006; Schilbach et al., 2013), and how larger social structures can have quite individual impacts (Lende, 2012) as well as shaping context, practices, and embodiment (Gravlee, 2009; Roepstorff et al., 2010).*

Individuals and Interactions

Given how patterns of shared experience form part of human variation, neuroanthropology uses an approach that considers individuals and interactions in relation to culture. For example, addiction has cultural and social roots—drug-use experiences are intimately related to symbols and meanings, while addiction runs along the fault lines of society, both at the level of households and of socioeconomic organization. Nevertheless, addiction can also be potentiated by certain types of interactions that happen in specific times and places (for example, hanging out at a "hard drinking" bar—Alasuutari, 1992) as well as whether drug use has sensitized the dopamine system (Lende, 2005). Thus, understanding addiction requires putting together how individuals interact with drugs as well as with local patterns of inequality, people, and places that favor drug use, and cultural meanings surrounding excessive use (Lende, 2012).

Similar to "sizing culture appropriately," the level of granularity can matter when considering an individual and interactions (**Table 3**). For the individual, one can go from a focus on biology to psychology and then self and social self. At the biological level, one might consider not just brain function (Roepstorff et al., 2010) but also physiological functions. For example, Worthman (2009) argues that "habits of the heart" (affective-cognitive processing) shape individual relations toward immediate sociocultural contexts, and thus what local niches individuals sought out and how they worked to exploit social and material resources.

For self, one can draw on the discussion of self of Quinn (2006) in anthropological light. She argues that "self" references neurological and psychological processes but should be understood as a larger unit, one that can also exist in relation to cultural symbols and have contextual features shaped by

interactions with others. Self, in this case, might be understood as a sense of identity and other types of "coherence" (in the words of Quinn) that brings together disparate aspects of experience into the sense of who an individual is as a person (see also Galloti and Frith, 2013).

Finally, self can also exist socially, for how we play certain social roles and present ourselves to others. This social self represents two different things: (1) the overlapping aspects of who we are, and how race, gender, class, and sexuality, as forms of similarity and differentiation that intersect within a particular person, shape a person (Crenshaw, 1989; Brah and Phoenix, 2004; Veenstra, 2011; McCormick-Huhn et al., 2019), and (2) how that intersection is not simply imposed but also agentive and performed, enacting who we are through our behaviors in specific settings (Butler, 1993; Barad, 2003). This acting in the social world comes from "a regularized and constrained repetition of norms" (Butler, 1993, p. 95), producing a certain social self, such as cisgender man, and precluding others.

Interactions, for neuroanthropology, generally focus on granularity that holds an individual constant rather than reaching down into how environment-organism interactions might shape things like epigenetic regulation, gut microbiomes, and similar aspects of how context can drive biology. At the broadest level, interactions between individuals and their local environments are structured by local socioecologies, which include how political economic factors shape neighborhoods (Chen et al., 2015, 2019; Nadan et al., 2015), scaling effects that happen in cities (Bettencourt et al., 2010; Turchin et al., 2018) and how social structures, in turn, shape how people learn class and other relevant aspects of social position (Mintz, 1986; Bourdieu, 1987).

One way to understand these interactions is to use the social science approach to practices (Bourdieu, 1977; Ortner, 1984), among others. A study of Downey has adapted practice *via* the notion of skill. Enculturation can work through skill, not just abstract knowledge and language, indicating the need to look at "changes in physiology, perception, comportment, and behavior patterns" (Downey, 2010, p. S22), where learning by doing and processes of embodied feedback shapes the creation of shared skills. A similar approach is in the "patterned practices" of Roepstorff et al. (2010) where social interactions can correlate with neural and psychophysical patterns. Here, looking at specific patterns of practice, whether in the field or experimental settings, moves researchers beyond more abstract notions of culture.

Interactive Elements

Ritual provides an example of how practices use interactive elements that bring neurobiology and culture together. At a broad level, cultures structure ritual (Boyer and Liénard, 2006; McGraw and Krátký, 2017; Hobson et al., 2018). Rituals work because human groups create both particular settings and practices that, in turn, can drive human biology *via* specific processes that interact with a person, from the social self to basic neurobiology. Indeed, cultures have figured out that aversive rituals can produce group cohesion through intense events, whereas routine rituals work through repetition (Whitehouse and Lanman, 2014).

Researchers such as Rappaport (1999) and Turner (2011) have highlighted how rituals are seen by individuals as compulsory yet work through the condensation of specific elements that can produce subjective and neurological changes in participants. Rituals work by combining sensory elements with associative elements (or ideological elements, in the terminology of Victor Turner), focused on specific material instruments and bodily practices within the ritual (Bull and Mitchell, 2015). These interactive elements produce specific types of neurological effects, for example, blurring self/other processing, extending the tendency of humans toward immediate social rewards to broader sociocultural elements, extending associative learning to capture aspects of meaning through the concentration of linked associations, and using intense experience to promote neural reuse *via* cross-talk (as psychedelics have long done; Xygalatas et al., 2013; Whitehouse and Lanman, 2014; Bull and Mitchell, 2015).

Interactive elements are not the same as affordances, the concept initially devised by Gibson (1986) to refer to aspects of the environment that can support and even help accomplish cognition. Recently, affordance approaches have been applied to culture (Ramstead et al., 2016; see also Lende and Downey, 2020, for a discussion). While interactive elements might be seen as comparable to affordances, these interactive elements are conceived first from the point of view of culture in relation to an individual, not from an internal position of mind or cognition.

The materiality and patterning of the interactive elements that operate between individuals and culture are central to how culture has figured out how to hack the brain. They are, in many ways, analogous to the material processes that mediate between DNA and cell function. These interactive elements are another set of mechanisms, just like epigenetics. They are interactive elements on top of our cognition, and thus not reducible to affordances that exist in relation to cognitive processing and biophysical constraints. Crucially for research, these interactive elements are there in what people say and do, not just in the biological and cognitive processes that comprise the lower levels of individual analysis.

TRIANGULATION

Conceptual Triangulation

A central concern for interdisciplinary research on mind, brain, and culture is how to productively bring together different ideas and methods. While there are many ways to do this, we have found that triangulation proves useful. In its initial use, triangulation meant using multiple methods to produce a more complete picture of the phenomenon under study while also counteracting, *via* those same multiple methods, the biases that come with relying on any one data source (Patton, 1999; Maxwell, 2004; Denzin, 2010; Fusch et al., 2018). Today, triangulation also applies to combining different theoretical viewpoints (Pitre and Kushner, 2015; Fusch et al., 2018). In our work, two types of triangulation help to frame research: laboratory-clinic-field and psychology-neuroscience-anthropology.

Laboratory-clinic-field references how laboratory, clinical, and field research can all add to understanding a problem

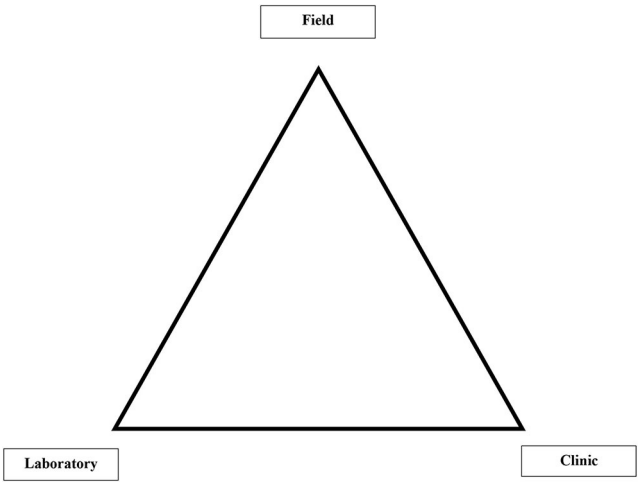

FIGURE 1 | Conceptual triangulation between field-laboratory-clinic. Conceptual triangulation happens *via* asking questions and considering the data and viewpoints from different arenas of scholarship. For example, how can field research test ideas that come from clinical and laboratory based settings? What results and ideas do they offer that are relevant to what I am finding? What is lab-based research missing that is apparent in the field? How does the clinical problem present itself in everyday circumstances? What other factors shape this problem in the everyday that are apparent in the field but might not be in the clinic? The onus is on the field research to, first, understand research from laboratory and clinical settings, and second, to look at how one can provide data that can at least inform a scholarly debate. One might also consider what bridging ideas exist between field-clinic and field-laboratory. Where is the common ground? What specific approaches can mutually inform each other? What are specific methods, research foci, and theoretical issues that overlap between field-clinic and field-laboratory? For further ideas on integrating field and laboratory research, see Willis and Miller (2011), Teddlie and Tashakkori (2012), Hay (2016), Gurven (2018), Hruschka et al. (2018), and Matusz et al. (2019). For field and clinical research, see Weisner and Hay (2015), Kirmayer and Ryder (2016), Kaiser and Kohrt (2019), Lewis-Fernández and Kirmayer (2019), and Watson et al. (2019).

(**Figure 1**). Neuroanthropology, with its field-based approaches, can provide a crucial empirical check on theories and results that come out of laboratory and clinical settings. This research is often presented as helping to understand how a specific problem plays out in the "real world" but generally does not take the additional step of testing its ideas in that real world. At the same time, field-based research should aim to develop data that can address relevant issues and ideas that come from the clinic and the laboratory. Certainly, researchers using neuroanthropology can address theoretical and practical problems that emerge primarily from field research. But these data do not have to exist on their own; developing conceptual triangulation increases the relevance of field-based data to researchers and practitioners in the lab and clinic settings; **Figure 1** provides further suggestions.

The second type of conceptual triangulation is psychology-neuroscience-anthropology. Neuroanthropology started with an emphasis on the intellectual yields that come from integrating neuroscience and anthropology. Cultural neuroscience performs a similar intellectual move, focusing on psychology and neuroscience (Kim and Sasaki, 2014; Chiao et al., 2016). Substantive integration of all three disciplines is the logical next step, although often difficult in practice. As a convenient shorthand, this type of triangulation can start from a simpler premise: research should address mind-biology-culture.

Mind is not uniquely the domain of psychology, as there are many disciplines that consider thought, affect, subjective experience, and more. Similarly, biology is not unique to neuroscience; biological anthropology, evolutionary biology, comparative biology, and physiology all explicitly consider biology, whereas social science and humanistic inquiry increasingly address notions of the body, embodiment, corporality, and materiality. Finally, culture long ago escaped anthropology, and is now considered in many disciplines, including in evolutionary biology. Thus, mind-biology-culture represents a pragmatic approach, ensuring that each domain is explicitly considered during the development of research.

Critical Complementarity

Simply stating that triangulation is useful is not sufficient to indicate how to actually triangulate approaches that can come from disparate fields with differing types of data, theoretical assumptions, and scholarly emphases. Triangulation is inevitably strengthened the more it can be tied into research that comes directly from psychology, neuroscience, and anthropology, and even better, placed within the inevitable disciplinary debates within that field, rather than assuming that the insights from another discipline are somehow less laden by constraints of methods, relevant data, disciplinary debates, and intellectual history.

Here we advocate using "critical complementarity" as a mechanism to figure out what is useful for robust research on the interaction of culture and people versus what might remain discipline- or site specific. Critical complementarity uses critical analysis first to understand background assumptions and methodological biases, and then stresses how different ideas can complement each other, providing their initial limitations are taken into account. Critical complementarity brings together the strengths of critical approaches with the interdisciplinary emphasis on finding which ideas and data can best illuminate a particular problem.

Here, it is easiest to discuss the research of Lende (2005) on incentive salience and addiction. The incentive salience approach to dopamine function represented a cutting-edge theory about what drives addiction (in a nutshell, incentive salience mediates "wanting" *via* dopamine signaling, and drugs drive excessive salience signaling, thus heavy users want too much and use to great excess). However, this research had two critical limitations: (1) it was laboratory-based research, using animal models, and thus not tested with humans in either clinical or field settings at the time, and (2) it advocated strongly for its particular view of dopamine function against other interested actors in neuroscience and thus did not fully consider how incentive salience might usefully combine with other types of dopamine-related research.

At the same time, there was complementarity between what Robinson and Berridge (1993) proposed as the subjective experience of incentive salience—wanting—and views of

Colombians of addiction as a problem of "wanting more and more" (quite different from the emphasis in the United States on pleasure). Yet some anthropologists would take this cultural view of "wanting" and assert that dopamine function is completely constructed *via* culture; a critical view from biocultural anthropology argued against reducing the subjective experience of desire to either culture or biology (Lende, 2005). Finally, the approach of both Robinson and Berridge and cultural anthropology to "wanting" left it rather undefined as a psychological process. Rather than drawing on a specific psychological theory, this research drew on experience-near and person-centered approaches in anthropology (Wikan, 1991; Levy and Hollan, 1998). Intensive questions helped informants to describe both specific experiences and how they felt and acted in specific contexts; this qualitative understanding of wanting then informed the development of a scale to test whether incentive salience was actually reported by people who had greater problems with drug use and abuse.

For guidance on the neuroscience side for how to do critical complementarity, one can combine critical neuroscience (Choudhury and Slaby, 2016) with cultural neuroscience (Chiao and Ambady, 2007; Kim and Sasaki, 2014; Kitayama et al., 2019). Developing critical complementarity also means drawing on social science research, for example, critical analyses done by anthropologists and others on neuroscience (Martin, 2010; Pitts-Taylor, 2010; Rees, 2016) as well as biocultural and integrative approaches (Hruschka et al., 2005; Seligman and Brown, 2010; Fitzgerald and Callard, 2015). The point is not to rely excessively on a particular perspective but to use critical complementarity to build bridges among different areas of research.

Methodological Triangulation

By using a combination of methods, researchers can address differing aspects of culture, examine how individuals interact with culture, and capture aspects of say-do-process as relevant to the research problem. Given the emphasis that neuroanthropology places on the field, ethnographic methods are often important. Ethnographic methods attend to the perspective of the participants in the field, capture context effectively (particularly through participation as well as methods that let informants show what contexts are like, such as Photovoice), and buttress the ability for researchers to understand how people engage in symbolic interpretation. Similarly, qualitative methods can permit rapid assessment of results from laboratory, clinical, and epidemiological studies—claims that results reflect such and such among a study population can be assessed, using rapid ethnography, focus groups, and expert interviews. Within mixed methods approaches, triangulation increasingly means addressing the applied and societal implications of research to increase its impact and relevance (Fusch et al., 2018).

At the processual level, different methods are useful. For example, between psychology and anthropology—or what people say—methods that rely on the language are preferred, from studies of metaphor and embodiment on the anthropology side to how language can work between sensory perception and sensory discrimination, for example, with olfaction. On the anthropology and neuroscience side—or what people do—mobile methods can be particularly effective, whether these are participant observations by the researcher (such as focal follows), intensive interviews that elicit what people do during the course of a particular day or event, and technological assessments that permit the capture of biological and psychological data as people move about and interact in and across settings.

Finally, on the neuroscience and psychology side—or what people process—one can use a variety of approaches. First, mobile psychophysiology increasingly permits real-time assessment of ongoing bodily reactions, potentially reflecting underlying processes. Second, biomarkers—for example, blood spots that can assess a range of biomarkers or saliva that can assess stress reactions—permit an assessment of accumulated processes, and thus insight into biological processes that might not be available using other field-based approaches. Other approaches in this vein include elicitation techniques and quasi-experimental techniques that can combine aspects of controls and comparative research with specific results.

But these types of experimental and quantitative methods are not the only ones useful to get at process. Qualitative methods serve equally as well, provided they take into account considerations already raised in this paper. For example, intensive interviews can address process—for example, incentive salience and how it relates to drug use—provided that the interviewer focus on specific processes and moves beyond just getting informants to describe what people say. In other words, people often give pat answers rather than getting into the nitty-gritty of how something actually plays out for them.

Participant observation methods can also address what actually happens at the processual level. Here, the researcher can take informants at face value (yes, capoeira actually changed how my balance worked, inside and outside the roda—it is not simply "culture" saying that) as well as using neuroscience to attend to changes that relate to underlying processes, for example, how the righting reflex when one falls backward gets relaxed in capoeira. In this case, methodological triangulation involves bringing together neuroscience of process, descriptions of change related to practice and context of the informants, and the match of the experience of the researcher to both the neuroscience and the explanation of the informants from their own points of view.

This long-term inductive approach centers the validity of the data in real-life settings, in watching and talking about how things play out in local lives, and, from there, creating a dialog with theoretical approaches. Rather than using the lab or clinic to fix a theoretical perspective, ethnographic work aims to discover patterns in the data and then find corresponding ideas for deepening analysis.

APPROACH TO CASE STUDIES

Together, the nine elements provide a holistic approach that sizes culture appropriately and uses effective triangulation of theories and methods. The case studies show how these elements come together in specific projects and illustrate three important takeaways for this type of research: (1) do field research because

that matters for understanding specific problems, (2) do not rely on just anthropological or neurobiological approaches to get at what happens—complex problems require critical complementarity, and (3) get types of data that help assess which combination of theories makes sense of any particular problem.

EXAMPLE #1: BRAZILIAN JIUJITSU AND VETERAN REASSIMILATION

In research between 2015-2018, co-author Collura worked with a group of 20 U.S. military combat veterans to understand their assimilation back to civilian life. In particular, he examined how their participation in Brazilian jiujitsu (BJJ) assisted reassimilation. This research recognized that veterans had to negotiate dual demands: (a) entering the armed forces and going to war were processes of enculturation with their own social structure and reward system that shaped desired outcomes and interactions within combative environments, and (b) returning to civilian life brought its own challenges, from navigating a cultural environment structured differently than the military and the loss of the rewards and interactions from the military. For veterans, transitioning to civilian life post-military service also did not have the same institutional support—whether military or civilian—to facilitate the enculturation that they encountered when they enlisted (Finley, 2011; Collura and Lende, 2012). On both sides, the US cultural assumption is that, as individual adults, they had to handle this process of change on their own. In contrast, societies elsewhere often provide specific institutions and cultural ideas that support adult men as they transition to new roles in their lives (Evans-Pritchard, 1937; Wood, 1999; Worthman, 2010). This research looked at what particular individual and institutional elements of BJJ made the difference in the reassimilation of veterans.

Research included participant observation doing BJJ with veterans and interviews on military life, transition to civilian life, and BJJ. Methodologically, this research took a close-in view of culture, sized at the level of the training academy, the mat where participants grappled, and the social interactions between the men. The research also emphasized an experience-near understanding of psychology rather than utilizing measures to assess psychological states such as trauma. The combat veterans expressed considerable hesitancy and even distrust about these assessments; thus, the scales initially planned were left to one side as a way to heighten validity through increased ability to interact freely with the veterans. Finally, the research drew on neuroscience to go beyond "ethnography as usual" by also paying attention to task demands, stress, neuroplasticity, and learning.

The research revealed an ethnographic model around the engagement of veterans in the military, their transition to being veterans, and why BJJ helped with that transition. This model highlighted the importance of physical + mental transformations to enculturation, often grounded in how basic training had impacted their lives and, from there, recognized how much the social side of military life had shaped how they became accepted and valued members of a group. Thus, the veterans used a mind/body model located within an individual (D'Andrade, 1987) but also stressed how the social mattered in negotiating challenges (Quinn, 2006).

By shaping how individuals interpret what happens to them, such cultural models can impact how the function of their nervous system (Quinn, 2006; Lende and Downey, 2012a). For combat veterans, "physical + mental and social" referenced combining the mental side of a task with the physical side in order to achieve a specific outcome in defined contexts. This model was drilled into them time and again; the combat veterans saw the power in their ability to deal with the real-time ebb and flow of powerful sensations while having to cognitively filter what needed to be done at any given time.

In subsequent analyses, we adapted this ethnographic model to understanding why BJJ proved effective. This approach—working with an informant model to inform subsequent theory development—was inspired by Downey (2005, 2012), where a "native model" of how balance changed while becoming a capoeira practitioner integrated physiological changes with how specific training practices mattered. For veterans, they found that BJJ training was very similar to the "physical + mental and social" model that they learned while going through boot camp, specialty schools, and combat deployment. Using neuroanthropology, we modified their ethnographic model of "physical-mental and social" to a physical-mental-social model (see **Figure 2**), which recognized how each element can flow into the next.

These different elements combined to provide an effective task structure for combat veterans. Overall, BJJ required veterans to negotiate intense conditioning that had specific goals. This type of practice worked best when the cognitive side of participation was in sync with the physical side and *vice versa*. For example, not hurting your partner while engaging in combative play was central to BJJ practice, demanding that embodied practices work in line with specific rules and objectives. As veterans built aptitude in a specific BJJ task, research showed simultaneous growth between mental ability, physical prowess, and social relationships.

Overall, BJJ combined different types of task structures into one encounter. First, BJJ requires the synchronization of bodies and thus parallels how coordinated behavior in laboratory settings involves inter-brain synchronization handled by fast, nonmentalizing neurological systems (Dumas et al., 2010). Second, BJJ involves cooperation, where opponents play within a set of rules and have to modify ongoing actions and responses. At the same time, BJJ is a competitive social encounter, looking to make an opponent submit. In task-based studies, social coordination and competition involve different neural systems (Decety et al., 2004; Nummenmaa et al., 2018) to negotiate these tasks. In summary, BJJ provides a complex task structure that brings together synchronization, cooperation, and competition in ways that require the activation and coordination of brain systems in real time.

Furthermore, it was clear during the research that BJJ also got "under the skin." During training, physical exhaustion was obvious, given the sweat dripping off their bodies. Given that BJJ was similar to physical training in the armed forces, it provided an acceptable way to engage in strenuous activity that helped

reduce stress and blunt the reactivity they often developed while deployed. This type of intense training has been linked to the promotion of neuroplasticity and thus likely has carryover effects on helping these veterans reassimilate versus those who do not exercise (El-Sayes et al., 2019). Moreover, almost all participants expressed a need for something to "cut the edge" from everyday civilian life. For some participants, the comfort and solace found in their BJJ training also provided a way to actively avoid illegal or prescription substances because they knew they had training the next day or because their need to get into better physical condition superseded their longing to use.

When navigating daily stressors and adversity, training in BJJ helped the military veterans frame assimilation stressors in a more productive context. In the BJJ academy, the hierarchy, the physical sacrifice, and the demanding nature of the training took the participants back to a familiar environment that helped them express and change their understandings of violence and trauma. For example, BJJ required intimate physical contact while requiring them to be in control, thus helping to rework their understanding of what combat and restraint meant. Moreover, the physicality of the BJJ experience and the acquisition of new skills often brought a new perspective on one's self, but that happened *via* negotiating relationships on the mat in ways that were both experienced and interpreted in ways quite different from what happened in the military settings. Returning to Wilson and Golonka (2013), BJJ provided an extended task structure that involved their bodies, partners, local meanings, and social structures, thus directly linking an internal view of the tasks the brain had to solve with the agentive and cultural ways that these veterans engaged with BJJ.

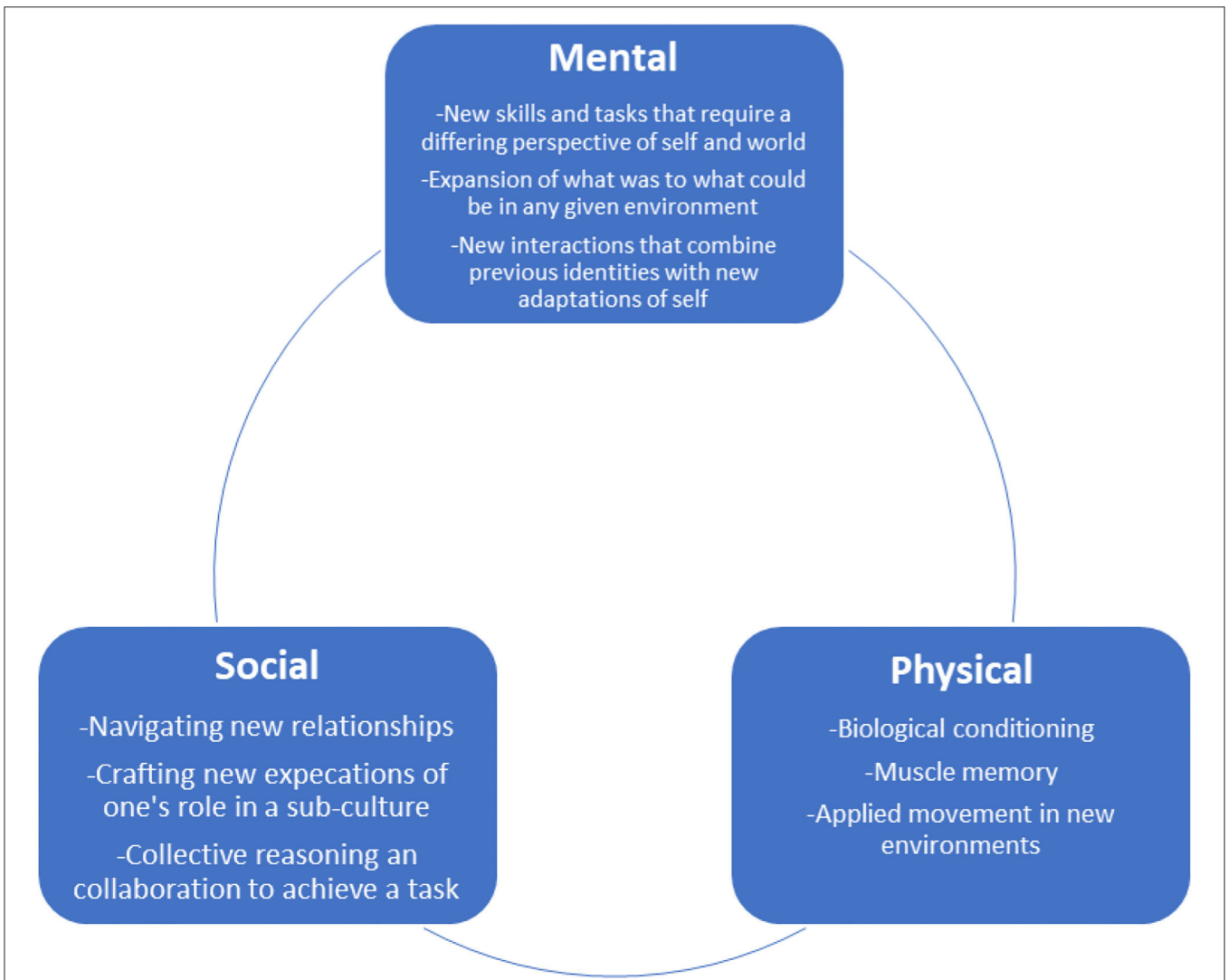

FIGURE 2 | The physical-mental-social model as it played out in Brazilian Jiu Jitsu (BJJ) with military combat veterans. BJJ helped with the transition to civilian life because it engaged all three elements, and relied on how the men talked, practiced, and experienced BJJ. It is important to note that any activity during training could start as social, physical, or mental and mesh into the other elements. For example, the new social circles of the academy can also bring mental models that require physical interaction; at the same time, new physical activity challenges previous mental models and push individuals to new social interactions.

Overall, this research revealed that successful assimilation is helped by drawing on current and prior experiences to reframe how veterans can and should act. These are conceptualized as cultural bridges, where similarities in cultural practices and meanings can help individuals adapt. In BJJ, familiar notions such as a uniform, structured goals, and a sense of collectivity and belonging signified by material culture proved useful to participants. BJJ used similar components of self, social self, and contextual interactions but within an environment that was both new and welcoming to the men and their families and friends. This applied impact resulted from bringing together neurological function, learning, and plasticity with a task structure in a dynamic and locally constituted context.

Veterans then were able to link these changes with successful management of other areas of their life. Cultural bridges—rather than individuals finding their own way—can help people take intense enculturation experiences and reapply them to areas that are not directly part of the initial enculturation. For the veterans, BJJ served as a bridge activity from military to civilian life, helping them to explore differing mentalities and identities while engaged in both physical and social interactions. The effectiveness of cultural bridges from one domain to another likely plays a role in similar intense activities, such as dance and its effect on diminishing depression (Pylvänäinen and Lappalainen, 2018), how playing an instrument can decrease autism severity (Broder-Fingert et al., 2017), and how being balanced helped capoeira practitioners in other domains of their life (Downey, 2005).

For future research, it would be useful to incorporate biomarkers into the research (Worthman and Costello, 2009). In particular, cortisol measures might show differences in diurnal patterns of activation on BJJ practice days versus non-practice days, providing a measure of biological stress processing. Building on work on storytelling and brain synchronization (Hasson et al., 2012), BJJ practitioners could jointly recount a story about a recent bout while being scanned, thus providing insight into the neural dynamics of BJJ as a coordinated activity.

EXAMPLE #2: RAPTORS, INTERACTIONS, AND CULTURE

Since 2016, co-author Hoyt has investigated human-raptor relationships, looking at how these relationships are formed and examining what processes make raptors such good candidates for use in animal-assisted therapies. In the past few decades, animal-assisted interventions (AAI) have developed alternative forms of therapy that use animals as "emotional mediators" and "catalysts" for facilitating improvements in health and well-being (Kulick, 2017). While dogs and horses constitute the majority of AAI treatments, employment of other species, such as dolphins, cats, and smaller farm animals, have become popular additions. Conversely, therapies involving raptors are far from the mainstream. Raptors are the antithesis of "cute" and "cuddly" pets that comprise the majority of human-animal bond research. Working with raptors requires considerable attention and patience, as one misstep could mean the difference between a successful training session and a spontaneous trip to the ER. Yet volunteers who work with raptors claim to experience similar therapeutic outcomes to those described in other animal-assisted approaches.

Our research looked specifically at a program in the southeastern United States that facilitated interactions between birds of prey who were not able to be released back to the wild and local volunteers. The research used a multispecies approach situated within ecological anthropology, recognizing that animals, plants, and the natural environment participate in the formation of culture (Haraway, 2003; Kohn, 2013; Rees et al., 2018). This multispecies approach combined with neuroanthropology to provide a framework to examine the assemblage of social, environmental, and neuroanatomical pathways that connect us with other species. Specific methods used in the research included focus group discussions, semi-structured interviews, and over 150 h of participant observation. Alongside assessing the program as a whole, research specifically engaged the participants who self-identified as suffering from trauma and stress. These participants indicated that working with raptors improved their ability to manage their daily lives. Field-based research of Hoyt focused on examining how and why raptor therapy made a difference.

Research on raptor cognition has long had to deal with culturally embedded ideas about animals, particularly higher versus lower animals (e.g., "bird brains"; Shimizu, 2009). For example, the presence of a six-layered neocortex in mammalian brains not seen in birds was long thought to afford the ability to perform complex computations and behaviors only in mammals. In fact, avian brains are capable of performing highly complex tasks, including remembering the past, reasoning about how to manipulate objects and thinking about perspectives of others (Clayton and Emery, 2015). Yet birds use a different neural architecture that relies on an alternatively designed nuclear pallium and an enlarged optic tectum (Shimizu, 2009). Avian brain studies have also helped to debunk myths like "bigger is better." Brain-body scaling techniques focused on neuronal densities, rather than relative brain size, have revealed how ravens possess 1.2 billion more pallial neurons than capuchin monkeys (Olkowicz et al., 2016). Based on this avian research, we approached raptors as capable of complex cognition that is both responsive and situationally dependent. Drawing on the systemic approach of Hutchins (1995) to cognitive tasks like flight and navigation, we viewed birds as shaping both the larger systemic context and the specifics of interactions between handlers and raptors.

Our research first explored the infrastructure of the nonprofit raptor program to better grasp the larger elements involved in bringing people and raptors closer together; these elements formed the dynamic backdrop through which raptor-human relationships developed. Data indicated the importance of "charismatic leadership" and "sense of community among volunteers" for the program. The director provided guidance, wisdom, and motivation for volunteers through continual program expansion, generation of new ideas, passion for birds, and willingness to offer advice whenever necessary. A strong sense of "volunteer community" played a significant role in retaining long-term volunteer handlers through the formation

of friendships and shared interests in raptors that did not exist outside of the park. Thus, the reasons for volunteering with the raptor program ran deeper than simply interacting with the birds; the experience provided a chance to spend quality time in nature with other "bird nerds."

Humans have cultivated relationships with raptors for at least 2,500 years (Epstein, 1943; Oggins, 2004; Soma, 2012), making these relations part of the novel multispecies cultures that emerged throughout the Anthropocene (Prummel, 1997; Ikram et al., 2015). However, relations with raptors are often different from those with mammals. As apex predators, raptors possess a number of adaptations uniquely suited for spotting and killing an unsuspecting quarry. When dealing with humans, raptors can be dangerous, often temperamental creatures who can evidence significant disinterest and even distrust toward humans. Thus, it was not intuitively obvious why interacting with raptors helped the participants.

Over the course of the research, participant observation helped guide the development of an approach for understanding how multispecies relationships facilitate novel forms of regulatory processing. In 1992, Bagozzi called for an approach to self-regulation that addressed the "processes that occur between intentions and goal-directed behaviors" (Bagozzi, 1992, p. 200). Argument of Bagozzi against reductive terms like "attitude" resonated with holism of anthropology, and his proposal that both intentions and behaviors matter for self-regulation provided a way to understand that raptors and people were actors within a regulatory network of any person.

Building from critical complementarity to field research, our research focused on identifying the interactive mechanisms that happen in small-scale contexts between individual raptors and humans. Self-regulation, as a generic concept, discounts aspects of context and individual experience that proved important for human and non-human interactions observed during fieldwork; in turn, these interactions shaped whether human participants had positive or negative outcomes. These interactions are akin to the "hidden regulators" that Hofer (1994) described. Hofer viewed "attachment" as an overarching concept to understand specific physiological processes that played out between rat pups and mothers. These hidden regulators are identified through breaking attachment into smaller pieces—specific interactions and physiological processes then constitute the differential effects the mother can have on the rat pup.

This project recognized the need to capture data that were relevant to psychological and AAI approaches while engaging in participant observation. By moving between ecological validity (data to relate back to laboratory and clinical approaches) and ethnographic validity (data that capture how they interact in specific contexts, and examining that interaction from the point of view of both the bird and the handler), the research aimed to build a better model of what happens between birds and handlers.

By using neurobiology and psychology to help interpret the data, we identified six processes that existed in raptor-human interactions that could be linked to regulation. These were selective attention, modified response, physiological feedback, reward, novelty/threat, and resiliency. For example, "modified response" referred to how a bird of prey trainer could intentionally change his or her approach to accommodate the needs of the raptor he or she is holding; consequently, this behavioral shift afforded raptors the opportunity to return "physiological feedback" to their handler as the raptor equivalent to "thumbs up" or "thumbs down."

However, bating behavior—when a raptor jumps off the glove—was often interpreted as a direct result of things, such as particular personality traits that make some birds less amenable to training, a lack of proficiency on the part of the handler, or an outright form of protest against living in captivity. The anthropomorphic associations at times limited multispecies interactions because nonhuman behaviors were viewed as either static and unchanging or responding only to human activity.

For example, "selective attention" mattered in the context of bird handling. If the person was training, he or she should be looking at the bird. This might seem obvious; however, raptors can sit still for long times, and some handlers interpreted the bird as calm and then started to look at other things in their local environment. By not paying attention, handlers might not notice that the bird could become fidgety. In such a case, "selective attention" could create waves that the handlers had to correct. In the context of a specific training bout, the bird jumping off the glove was not good. However, these unexpected reactions were generally good in the long term, because it added to the novelty of continuing to work together and finding a balance between the bird and the handler.

Overall, this project demonstrated the need for a two-step approach to understanding how interactions can impact regulation and therapeutic outcomes between birds and handlers. First, having an on-the-ground understanding of the institutions and specific contexts proved important. Second, getting at the processes that constitute interactions between raptors and handlers is crucial. **Figure 4** illustrates how a general model of raptor-human interaction then takes life with the specifics of ethnographic research and the neuroanthropology of interaction and regulation. Future research could bring in portable electrophysiology to measure arousal and engagement while participants interact with raptors.

EXAMPLE #3: FROM CUE REACTIVITY TO THE NEUROANTHROPOLOGY OF CUE-DRIVEN DRUG USE

The final example covers research on cues and substance use currently in development. Cues have long been used as a way to investigate how individuals learn, from the dogs of Pavlov salivating at the sound of the dinner bell to rats pushing a lever to access a drug reward (Yokel and Wise, 1975). With addiction research, cue reactivity has formed a theory of relapse, which proposes that people can be "particularly vulnerable to drug use when in the presence of stimuli related to previous episodes of use" (Carter and Tiffany, 1999, p. 327). Over time, models for cue reactivity have moved beyond the stimulus-response paradigm, in which addicts are unilaterally drawn toward use by cues, because of changes in understanding how complex addiction and

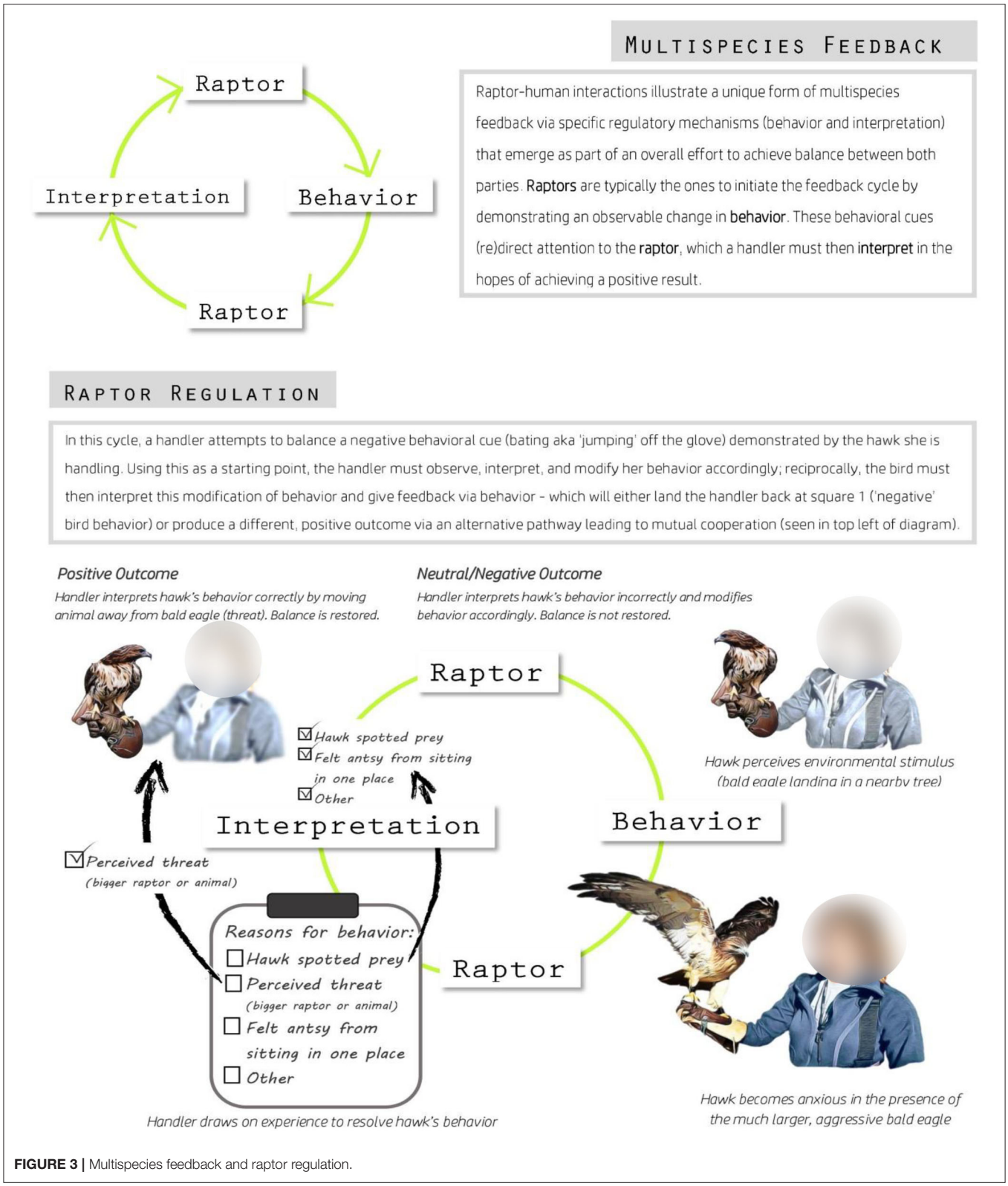

FIGURE 3 | Multispecies feedback and raptor regulation.

recovery are. But research on cue reactivity has also shown several limitations. First, research relating to cue reactivity and rates of relapse has produced mixed results; for example, physiological and subjective reactions to cues are not directly linked, and only physiological cues have been shown to be correlated with future rates of relapse (Witteman et al., 2015).

Another limitation is that cue reactivity has yet to yield significant clinical applications (Childress et al., 1993; Conklin and Tiffany, 2002; Mellentin et al., 2017). While there is some recent evidence of cue-based approaches having value-added clinical impact (Wiers et al., 2014, 2015; Kober et al., 2017), the most clinical practice still focuses on established therapies and on dealing with the consequences and family impacts that come with addiction. The lack of a match between lab results and clinical outcomes demonstrates the complex nature of the cue reactivity phenomenon.

Here, we draw on the integration of clinical and laboratory research of Drummond, which highlights three domains of reactivity: symbolic-expressive, physiological, and behavioral (Drummond et al., 1995; Drummond, 2000). The first domain is craving, or the reactive surge in wanting a cue such as seeing someone use. Symbolic-expressive cue reactivity represents the interpreted urge people feel when presented with an internal (stress, anxiety, etc.) or external (paraphernalia, advertisements, etc.) cue. The second domain is physiological cue reactivity, the bodily effects (increased heart rate, skin conductance, changes in temperature, etc.) that come from tolerance, opponent process reactions, and other physiological reactions that come with interaction with cues (Smith, 1990; Robinson and Berridge, 1993, 2008); physiological reactivity can happen both in anticipation of use and withdrawal.

Finally, behavioral cue reactivity comes *via* obtaining and using drugs; these actions in themselves can be cues that prompt relapse and augment use. On the seeking side of behavioral cue reactivity, the cue of the lever can drive lever pressing in laboratory animals; for humans, seeing alcohol might lead to an impulsive purchase and then relapse. On the consumption side, behavioral cue reactivity lends itself to excess, for example, the speed or overall amount of drinking. Pregaming on college campuses, where students get together to drink large amounts before going to a sporting event, is a social situation that can drive behavioral cue reactivity leading to extreme intoxication.

Overall, most of the research has looked at symbolic-expressive and physiological drug craving in a laboratory or otherwise controlled settings (Rohsenow et al., 1994; Carter and Tiffany, 1999; Conklin and Tiffany, 2002; Sinha, 2007; Carpenter et al., 2009; Verdejo-Garcia et al., 2012; Witteman et al., 2015). Recently, some behavioral research has aimed to bridge the gap between the lab and the field. For example, Witteman et al. (2015) utilized long-term journaling as a method of data collection, and Shiffman et al. (2008) used ecological momentary assessment (EMA) as a way to study cue reactivity in context (Shiffman et al., 2008). In these studies, participants employ mobile technology to do stimulus-response activities at intervals throughout a day (Warthen and Tiffany, 2009; Wray et al., 2015). However, these studies present cues specifically selected by investigators rather than naturally occurring environmental cues and generally assess the relationship between cues and seeking after the fact.

Despite these developments, cues remain undertheorized in terms of how they form part of the interactions between individuals and their local environments. Here, we view cues as forming part of the everyday, even mundane aspects of using and recovery. Cues can signal opportunities to use, to forget, and to do something different; as such, cues provide an adaptable framework to consider many different factors that can be important to facilitating and sustaining recovery. In this way, cues are amenable to ethnographic work, using a neuroanthropological lens. From the point of view of neuroanthropology, cue reactivity connects the brain, learning, and the environment.

Conceptual triangulation can first focus on the field-clinic-lab triangle. Given the experimental approach, cue-reactivity research, in general, cannot focus on actual moments of drug seeking and relapse; rather, cue reactivity has examined often artificial aspects of context (e.g., generic pictures of someone drinking or of liquor bottles). Thus, this research could benefit from triangulation that can provide field-based data on how cue reactivity might work in naturalistic settings. Conceptual triangulation can also pull together insights from anthropology, psychology, and neuroscience to drive forward a greater understanding of context-driven cue reactivity (illustrated in **Figure 4**). Neuroscience and psychology together help make clearer how people engage with their environment, how they attend to meaningful cues and the physiological components and outcomes of deep-rooted attentional bias.

Cue reactivity research sets the expectation that meaningful cues lead to craving, drug seeking, and, potentially, relapse. A neuroanthropological approach can consider biological and ethnographic variables and assess the relationship between physiological, interpretive, and behavioral craving and encounters with stimuli. In particular, an ethnographic approach can better capture the moments participants actually encounter cues and how they react in their everyday lives. For example, the incentive salience approach to associative learning and cues can also provide insights *via* neuroscience. According to this theory, cues—to be compelling—have to be imbued with incentive salience, or something that causes people to pay attention, move toward, and desire what is linked to that cue (Robinson and Berridge, 1993, 2008). However, what cues work better in real-world settings to capture the attention of people and to be the targets for greater attribution of incentive salience are questions that are hard to address, particularly, initially, in the lab.

Thus, anthropology, through its understanding of how contexts can funnel drug use and other activities like gambling (Schüll, 2012), provides a way to understand cues from the perspective of the context. This field-based work can also increase validity and potentially provide both theoretical understanding of how cues work in contexts as well as novel stimuli that can be more contextually and individually relevant. By understanding field-based dynamics better, we might be able to reinvigorate ideas and implementations of this research in clinical settings.

To make these insights come together will require methodological triangulation. First, by spending time in the local environments, ethnographers can capture instances of use and craving, when they occur, and the surrounding events (internal and external cues). From there, a combination of EMA research (real-time assessment of cues and craving), assessment of physiological reactivity (heart rate and electrodermal activity), and prolonged participant observation and/or interviews could

look specifically at how to relate contexts and experiences to the types of considerations of cues and cue reactivity outlined above. Finally, participants could use photovoice (photos taken by informants on a specific topic, for example, what triggers a craving) to capture what cues look like for them in real-life settings, providing both prompts for subsequent interviews as well as personalized cues that could be utilized in a laboratory setting. Overall, a neuroanthropological approach to cue reactivity employs interdisciplinary theoretical and methodological innovations to better approach how cue reactivity can be applied in clinical settings.

CONCLUSION

Ethnographic research in field settings often reveals gaps between laboratory research and the specifics of a particular problem in a naturalistic setting. The three examples above all used qualitative approaches to better bridge between how problems manifest and what is known from experimental research. This interdisciplinary negotiation between anthropological approaches to human variation and specific studies that tease apart the variables and processes that shape that variation is central to how neuroanthropology contributes to cultural science.

Each case study can also illustrate specific elements of the overall framework shown in **Table 4** for how to engage in neuroanthropological research. For example, the research by Collura with veterans located the problem of the veterans at the intersection of biology and culture. What the veterans faced was not simply an individual problem, for example, PTSD or a lack of coping. As combat soldiers, they had been encultured into the military; becoming veterans was also an encultured transition.

For Collura, considering cultural variation also made a difference. The research recognized the United States as unusual, as weird, in how it handles veteran transitions. Becoming a veteran is not a natural thing, but something mediated through culture, and thus related to the production of shared variation. A crucial insight came with recognizing that transitioning

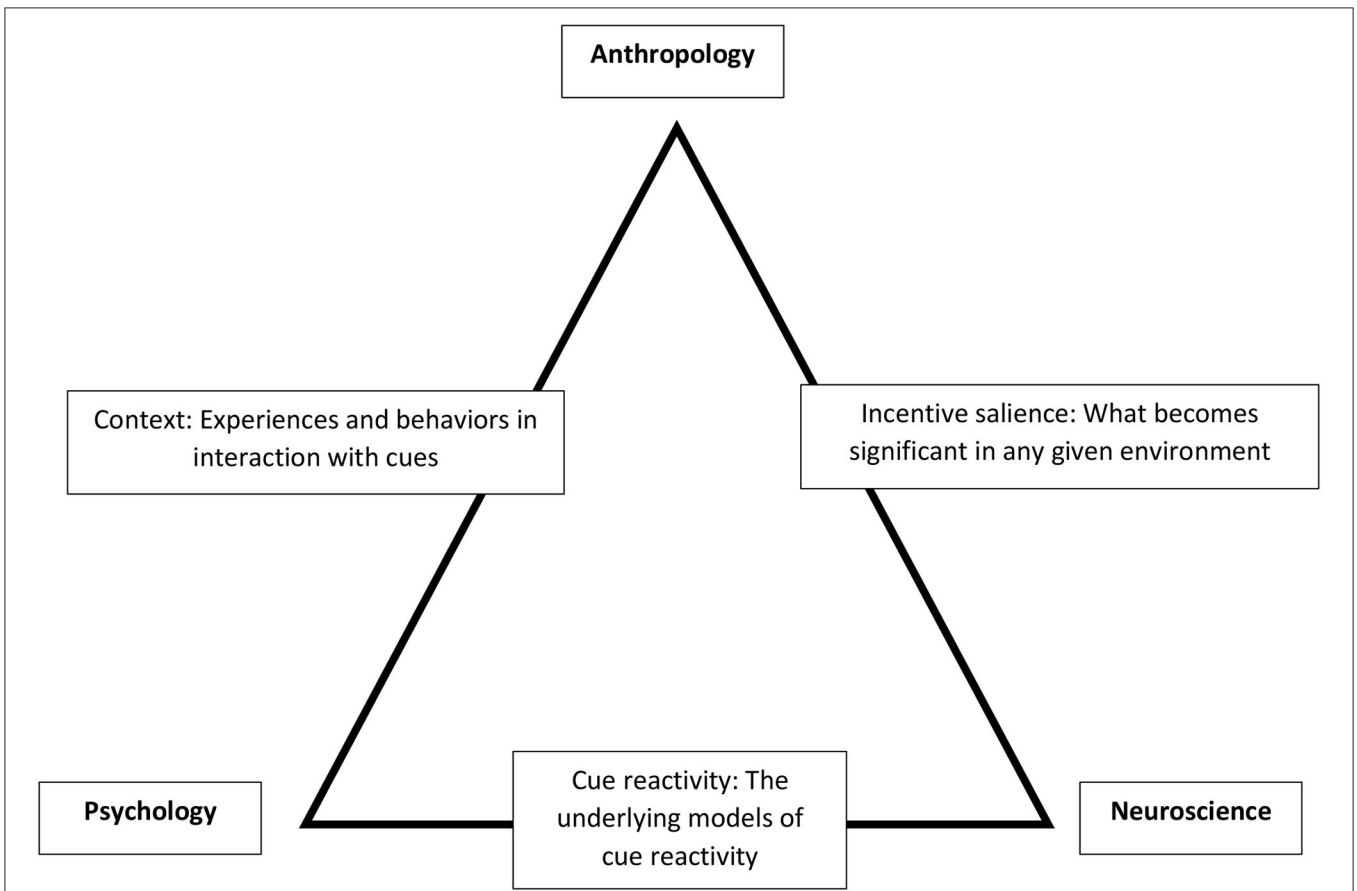

FIGURE 4 | Theoretical triangulation for cue reactivity research. This figure demonstrates how to use theoretical triangulation to help develop aneuroanthropological approach to cue reactivity. Psychology and anthropology both look at human experience and behavior. For example, psychology lends insights into how humans interact specifically with cues while anthropology brings an understanding of how contexts can structure both cues and behavior. Psychology and neuroscience inform models of cue reactivity, including the psychophysiological basis of reactions to cues and cognitive models on the interpretation of cues. Neuroscience and anthropology overlap in the theoretical understanding of incentive salience, specifically understanding the relations between the external environment and the internal human environment.

effectively was about finding new ways of generating shared variation. BJJ fostered exactly that. Finally, as **Figure 2** illustrates, Collura pushed the say-do of normal ethnographic research into the say-do-process. The "mental + physical and social" model of veterans became a way to examine the processes involved in how BJJ worked to foster the production of shared variation.

The study of Hoyt first represents sizing culture. The work with raptors situated itself within an ecological approach, which fit well the animal-human interactions taking place at both institutional and individual levels, and how raptors can have agentive characteristics. Drawing on critical complementarity, the research navigated between insights coming from Animal Assisted Interventions research, interspecies anthropology, and the psychology of regulation. The critical part helped overcome assumptions about "lower animals" (like birds) that existed in some of the literature, as well as how animals can be anthromorphized. The complementarity part also helped connect AAI with psychology and anthropology. From there, the research identified specific interactive elements between the handler and the raptor that shaped mutual regulation, as shown in **Figure 3**. Specific behaviors and interpretations on both sides shaped both positive and negative outcomes.

The developing work by Casper drew on conceptual triangulation (**Figure 4**). Cue reactivity is a well-established approach in laboratory research but has not had as much impact on clinical practice; field-based work can address some of the shortcomings of laboratory work while also using real-world experiences to increase clinical relevance. Accomplishing that means drawing on anthropology as a crucial way to understand how cues work in real-world contexts.

Rather than relying on an exclusively cultural approach, however, this research considers how individuals and interactions in specific contexts can help tease apart how cues work and what types of interactions can drive reactivity. This framework moves beyond seeing "cue reactivity" as a thing in itself—a psychobiological phenomenon reducible based on learning theory and the pharmacological power of drugs—to examining how learning happens in specific contexts, how cues might get concentrated in specific arenas, and how interpretations can form part of why people react more or less.

To get at how reactivity adheres to individuals and learning and contexts requires using multiple methods together. Here, methodological triangulation provides a nested approach to address ideas about cue reactivity, to gather data that can relate to clinical relevance, and have data from multiple sources to aim to tease apart some of the broad conceptual framings that need to be tested against what actually happens with cues and reactivity in the field.

As this review of the three projects shows, successful research within neuroanthropology does not have to use the overall framework to get the job done. The nine features represent a set of guidelines and considerations that help promote successful research; however, specific emphases can be developed that are most related to the research problem and to the specific stage of the research. Indeed, for people interested in culture, mind, and the brain, specific elements will likely be more useful than others. Sizing culture might facilitate how to bring cultural insights to bear on what are often seen as individual problems, say-do process might help anthropologists develop new ways to view their ethnographic research, and critical

TABLE 4 | The elements of neuroanthropology.

Element	Aspect #1	Aspect #2	Aspect #3
Biology and culture	Identifying specifics of biology and culture	Going beyond assumptions	Combining components
Say-do-process	What people say: Language, cognition, symbols	What people do: Movement, senses, actions and reactions	What people process: How outcomes/variation come to be
Sizing culture	Granularity of cultural lens: Macro, meso, micro, mental	Specific approach: symbolic, political economy, ecological	Identifying specific effects of culture
Cultural variation	Beyond WEIRD	Level of sharedness	Production of difference
Individuals and interactions	Individual: Biology, Psychology, Self, Social Self	Interaction: Embodiment, Practices, Context, Social Structures	Culture: How interactions hack brain processes
Interactive elements	Cultural practices that structure interactions	Materiality and patterning of interactive elements	How elements engage specific biological systems
Conceptual triangulation	Anthropology-Neuroscience-Psychology	Field-Lab-Clinic	Mind-Body-Culture
Critical complementarity	Draw on critical neuroscience, philosophy of science, cultural anthropology for critical analysis	Use complementary fields, such as cultural neuroscience and psychological anthropology	Complement strengths, Minimize analytical weaknesses
Methodological triangulation	Ethnographic methods, participants' perspectives, real-world empirical testing	Experimental, quantitative, biological, qualitative methods for assessing process	Include macro framing–culture, history, evolution–for interpretation of data

These nine elements outline how to approach doing neuroanthropology. Researchers can work through the entire set in developing and executing their research. That said, different projects are likely to emphasize different elements as most relevant to their research problem. Specific elements can also be utilized for other types of research. Each element is condensed into three aspects that represent how to operationalize it for research. For example, cultural variation first implies getting beyond the individual-based and convenience-sample aspects of a lot of research (e.g., available university students), and then looks at shared aspects of variation and whether there are systematic differences within any particular aspect of shared variation.

complementarity might be useful for interdisciplinary research more generally.

For cultural science more broadly, we believe that by using this type of approach we can start to figure out the building blocks out of which patterns of variation are built both within and across societies. Neuroanthropology aims to go from a local to a comparative level and, from there, a comparative to a generalizable level. Good comparative work builds on good local work; good generalizations build from comparisons that accurately assess both the pattern of variation and a range of potential causes for that pattern. For many human problems, these patterns of variation emerge in the interaction of individuals with specific features of local culture and larger political economies and ecologies. Neuroanthropology offers an approach to understanding these types of human problems.

AUTHOR CONTRIBUTIONS

DL wrote the main sections of the manuscript. BC, KH, and GC wrote their corresponding sections. All authors contributed to the article and approved the submitted version.

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