Emotion Regulation in Three Cultures: A Multi-contextual and Multi-level Study of Preschool-age Children in the United States, China and Japan

by

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DEDICATION

To my family, especially my mother who has been unconditionally supporting me

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ABSTRACT

Emotion regulation (ER) has been studied intensively, yet there are major gaps in research on the critical role of contexts and cultural meanings of these contexts in the development of ER. Moreover, ER involves dynamic regulation at behavioral and neurobiological levels, systems that become sensitive to cultural contexts/priorities for adaptation. However, we know little about how children's ER systems are sensitive to cultural contexts/priorities, and at which levels of regulatory processing. In my dissertation, using multi-level and multi-contextual assessments of preschoolers in the United States, China and Japan, I will first examine cross-cultural similarities and differences in behavioral aspects of emotion expression and regulation among preschoolers living in three cultures. Second, I will determine whether children's neurobiological systems of ER are differentially sensitive to contexts. Finally, I will examine how cultural contexts/priorities may shape children's ER at both behavioral and physiological levels (emotional expressions and cortisol reactivity). I conclude by discussing implications for understanding ER as a complex system in cross-cultural perspectives.

Chapter I

Introduction

The development of emotion regulation has been studied intensively for nearly 35 years. In 1984, Carolyn Saarni suggested that compared to younger children, older school-age children (especially girls) were more likely to spontaneously monitor their expressive behaviors by maintaining positive behavior (such as smiling) when receiving a disappointing "baby toy" gift (Saarni, 1984). Hence, children's ability to control their expressive reactions to an emotion provoking situation (e.g., when disappointed by a gift), was recognized as one form of individual difference in emotion regulation (ER). Shortly after that, the formal concept of emotion regulation was introduced to the developmental literature (Campos et al., 1989; Dodge, 1989; Kopp, 1989). The establishment of the concept of emotion regulation marked a new transition in the emotion literature as prior research mainly focused on understanding knowledge about discreet emotions (Ekman & Friesen, 1978) and physiological arousal (Fox, 1989), but not the functional aspect of *regulating emotion* as a dynamic process (Thompson, 1994). Especially in the fields of developmental psychology and developmental psychopathology, emotion regulation has since been proposed as a core construct for understanding children's adjustment outcomes (Calkins et al., 2004; Cicchetti et al., 1995; Cole et al., 2004; Eisenberg & Spinrad, 2004). Similarly, in the social and personality psychology literature, Gross and colleagues proposed the process model of emotion regulation, focusing on the temporal dynamic of using different ER *strategies* (e.g., suppression and masking) to modulate emotional outcomes (Gross, 1998). Since the mid-90s, there has been an exponential increase in the study of emotion regulation across different subfields of

psychology (Gross, 2015). Through a simple search on PsycINFO in April 2020, I found that there were 558 studies that have the words "emotion regulation" and "children" (and 4686 studies with only the word "emotion regulation") in their titles.

After more than three decades of growing interest in the study of emotion regulation (ER), what have we learned and what remains to be learned about understanding emotion regulation across development? In this dissertation, I will first summarize the progress that we have made, then highlight and address three major gaps in the study of ER in young children. Specifically, in this introductory chapter, I will explain the rationale of studying ER across development and its related outcomes. Then I will go over the definitional and conceptual challenges, and why it is important to understand cultural contexts/priorities when studying ER in young children. In the next few chapters, I will describe three studies that are designed incrementally to address how culture and contexts may play an indispensable role the study of ER in young children: 1) at the behavioral level, I first begin to examine cross-cultural similarities and differences on emotion expression and regulation among preschoolers living in three cultures; 2) at the physiological level, I then focus on how contexts/priorities may shape the neurobiological system (i.e., HPA axis) for ER; and 3) finally, I aim to study ER as a *complex system* and to understand how cultural contexts/priorities may shape children's ER at both physiological and behavioral levels using a multi-level and multi-contextual approach. My dissertation aims to provide a new direction towards understanding ER in young children, and explain why it is important to address these limitations and how it can be done.

The critical role of emotion regulation across development

Emotion regulation has been conceptualized as a core component of self-regulation across development (Calkins et al., 2004; Cole et al., 2004; Eisenberg & Spinrad, 2004; Gross & John,

2003). Extensive research has shown that even among healthy individuals, ER is associated with myriad forms of adaptive human functioning, including success in academic and occupational performance, interpersonal relationships, physical and behavioral adjustment as well as overall quality of life (Eisenberg et al., 2001; Gross, 1998; Gross & John, 2003). On the other hand, emotion dysregulation is regarded as a core aspect of most forms of psychopathology (Aldao et al., 2010; Sheppes et al., 2015), including eating disorders (Harrison et al., 2010), borderline personality disorders (Gratz & Gunderson, 2006), and anxiety and mood disorders (Campbell-Sills & Barlow, 2007; Joormann & Stanton, 2016). Therefore, deficits in ER have been implicated in the etiology and maintenance of developmental psychopathology (Cicchetti et al., 1995; Cole et al., 2008; Zeman et al., 2006), such as aggression and antisocial problems (McLaughlin et al., 2011; Trentacosta & Shaw, 2009), anxiety (Carthy et al., 2010; McLaughlin et al., 2011; Suveg & Zeman, 2004), depression (Berking et al., 2014; Silk et al., 2003) and self-harm behaviors (Adrian, Zeman, Erdley, et al., 2011).

Children's ability to regulate negative emotions is thought to be a central self-regulatory skill for long-term behavioral, emotional and social adjustment outcomes (Calkins & Perry, 2016; Ip et al., 2019; Kim & Cicchetti, 2010; Olson & Sameroff, 2009). Emerging evidence for example, suggested that 6-month old infants' visual attention to frustrating stimuli (arm restraint and toy removal) predicted aggressive behavior at 2.5 years, whereas looking away from frustrating event (e.g., looking at another object or looking at mother) was associated with less aggressive behavior, but for girls only (Crockenberg et al., 2008). Moreover, infants' distress to limits (rated by mothers) at 6 months predicted aggressive behavior only when mothers encouraged their infants to look *at* the frustrating stimuli (Crockenberg et al., 2008). During toddlerhood, Hill and colleagues (2006) revealed that the ability to regulate frustration in tasks that elicit distress (e.g.,

tasks in which children are blocked from reaching a reward) at age 2 differentiated the severity of girls' externalizing problems across the preschool period (Hill et al., 2006). Similarly, Eisenberg and colleagues have found that preschoolers who are prone to anger and characterized by parents as having low attentional and inhibitory control (i.e. effortful control) had relatively high levels of concurrent externalizing problems (Eisenberg et al., 2001), and were at increased risk for externalizing problems by mid and late childhood (Eisenberg et al., 2009). These findings therefore suggest that children who are unable to regulate their negative emotions, either by inhibiting or disengaging their anger and frustration, may be at elevated risk for the development of externalizing problems.

Expressions of sadness and anger, on the other hand, have been linked to internalizing problems (Eisenberg et al., 2001; Eisenberg et al., 2009). Some evidence has also shown that lower effortful control, especially in the attentional control domain, is related to the development of internalizing problems, albeit with mixed findings (Dennis et al., 2007; Eisenberg et al., 2005, 2009; Murray & Kochanska, 2002; Oldehinkel et al., 2007; White et al., 2011). From an emotion regulation standpoint, attentional control may be indirectly related to internalizing problems, such that children's inability to switch or redirect themselves from an emotionally provoking situation may be associated with attentional bias towards threat stimuli (Lonigan & Vasey, 2009), and/or maladaptive use of ER strategies such as rumination (Verstraeten et al., 2009), which in turn have been associated with internalizing problems such as depression and anxiety (McLaughlin & Nolen-Hoeksema, 2011).

Over-and-under modulation of negative emotions in response to situational challenges may foster negative consequences, such as peer rejection and rule violations (Denham & Burton, 2003; Kim & Cicchetti, 2010; Trentacosta & Shaw, 2009). In a study of school-age children, children

who experienced neglect and maltreatment had lower levels of emotion regulation rated by camp counselors, and ER vulnerabilities were related to concurrent internalizing and externalizing symptoms and higher peer rejection one year later, which in turn were related to behavioral symptoms (Kim & Cicchetti, 2010).

But what is emotion regulation?

Despite the growing interest in the study of emotion regulation, the definition of emotion regulation is unclear and debates on this concept continue to occur (Campos et al., 2004; Cole et al., 2004a; Eisenberg & Spinrad, 2004; Gross, 2015; Thompson, 1994, 2011). How the construct of emotion regulation is being defined and measured is heavily influenced by perspectives from different subfields of psychology (e.g., developmental vs social vs neuroscience), study populations (e.g., child vs adult) and schools of thought (e.g., theoretical vs functional purposes).

From a dual-model perspective, the concept of emotion regulation involves two systems of processing: a bottom-up emotional reactivity process that is involved in the generation of emotion, and a top-down control process that is involved in the management or mismanagement of emotional responses (Ochsner & Gross, 2014). This dual model of emotion regulation has been supported by the identification of two neural circuits that are thought to be involved in emotion reactivity and regulation (Ochsner & Gross, 2014). The bottom-up limbic system including the amygdala, ventral striatum and insula, together with the orbitofrontal cortex including the dorsal, rostral and ventral medial prefrontal cortex (mPFC) have been suggested to underpin the emotion reactivity system. The top-down system including the dorsal anterior cingulate cortex (dACC), posterior and dorsolateral PFC (DLPFC) and ventrolateral PFC (VLPFC), along with inferior parietal regions, have been identified as regulators of the bottom-up system (Ochsner & Gross, 2014).

However, first from a functional perspective, such a canonical dual-order conceptualization of emotion regulation is not able to capture the complexity of human behavior: "pure" unregulated emotion or its manifestation in behavior do not exist because emotion reactivity and regulation are conjoined and intertwined from the beginning. Even if emotion ever exists in an unregulated way, it is impossible to observe such phenomenon behaviorally or neutrally (Campos et al., 2004; Thompson, 2011). As Campos and colleagues (2004) noted, regulation takes place at all levels of the emotion process, at all times the emotion is activated, and is evident even before an emotion is manifested. In other words, all forms of emotion expressions/reactivity (as indicated by facial display or other forms of behavior) are a product of regulation to some degree, which may further be lessened, intensified or maintained by individual actions (e.g., the use of different strategies: take a deep breath or punch a wall). Regulation can also take place *before* an emotion occurs. For example, socially anxious children may avoid going to a birthday party as a way to regulate their anticipated anxiety. Therefore, theories and measures of emotion regulation must reflect the fact that while distinct neural circuitry may support the generation and regulation of emotions, this distinction becomes artificial without the consideration that the two processes are dynamically and constantly interact across time (Calkins & Perry, 2016). As a result, when studying emotion regulation, capturing *both* dimensions (i.e., reactivity and regulation) with *both* behavioral (i.e., emotional expression) and physiological (i.e., cortisol reactivity) indices of regulation is essential for achieving an integrative understanding of emotion regulation in children. Second, the lack of incorporating a developmental perspective in understanding how extrinsic inputs including socialization (Eisenberg et al., 2012) and context (Aldao, 2012) may shape the expression and regulation of emotions is a limitation in prior definitions of emotion regulation.

Conceptual framework of emotion regulation

With this in mind, I conceptualize emotion regulation as a *complex system* (See Figure 1 for Conceptual Model) that involves dynamic regulation of behavioral (e.g., direct displays of emotions), experiential and physiological (e.g., HPA axis) responses to internal and external stimuli (Gross, 2015). This complex system is supported by intrinsic regulatory inputs, including both a) top-down (i.e., regulation strategies such as masking) and b) bottom-up processes (i.e., emotion reactivity) (Ochsner & Gross, 2014), and is influenced by extrinsic environmental inputs, including c) socialization (Eisenberg et al., 2004) and d) contexts guiding what, when and how emotions are expressed, and what types of regulation strategies are being implemented. My overall goal is to understand how *cultural priorities*, defined as collective beliefs, values and practices that are salient and essential for becoming successful members within a cultural group, may shape different "pieces" in this complex system.

Chapter II

Why Is It Important to Study Emotion Regulation in a Cultural Context?

In this chapter, I argue that understanding how cultural contexts influence children's emotion regulation is not just crucial but *essential* towards advancing our scientific understanding of the development of children's emotion regulation. To begin, I will briefly describe current approaches to the assessment of emotion regulation in young children and corresponding challenges. Then, I will explain the indispensable role of situational and cultural contexts when studying emotion regulation and conclude with how I will address these gaps in knowledge in my three studies.

Methods of assessing emotion regulation in young children

Measures of emotion regulation can be classified into four types: 1) self-report; 2) reports from other informants (i.e., parents and teachers); 3) behavioral observations (lab-based experimental tasks etc.) and 4) physiological methods.

Emotion regulation studies of adults and adolescents have often relied on asking participants to self-report the use of different emotion regulation strategies (e.g. emotion regulation checklist; Gross & John, 2003; DRES; Gratz & Roemer, 2004). Also, studies have used standardized film clips or pictures for the elicitation of affect (Gross & Levenson, 1995; IAPS); then instructed participants to implement certain ER strategies (e.g., suppression, distraction, reappraisal) to observe physiological differences (Mauss et al., 2005).

In contrast, infants and young children are often not capable of articulating or recalling their specific emotional experiences (Zeman et al., 2006), have limited self-awareness of emotion

experiences, and have not fully developed the cognitive and linguistic ability to conceptualize ER strategies (Cole et al., 2004; Dennis & Hajcak, 2009). With limited logical reasoning and abilities to manipulate mental information (Piaget, 1964), young children tend to use more behaviorally based strategies (e.g., emotional expressions, avoiding a situation, shifting away their attention) than cognitive-based/internal strategies (e.g., appraisal) when compared to older children and adolescents (Calkins & Perry, 2016). Therefore, observational assessments of emotional and behavioral responses to an emotional-eliciting situation are considered the "gold standard" for studying emotion regulation in young children (Adrian, Zeman, & Veits, 2011; Calkins & Perry, 2016; Cole et al., 2004). Specifically, experimental paradigms (e.g., Laboratory Temperament Assessment Battery; Lab-TAB; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995) are commonly used to elicit a variety of negative emotions in children by stimulating challenging situations. A frequently used experimental paradigm is the disappointment task (Cole, 1986). This task involves a structured procedure in which an experimenter promises a child that he or she would receive a favorite toy (e.g., a fire truck), but instead another unfamiliar experimenter gives the child a gift that he or she previously ranked as the most undesirable (e.g., a paper clip). Children's emotional expressions (e.g., sadness and anger) to this challenging situation are then coded as a proxy of emotion regulation (or dysregulation).

Adrian and colleagues (2011) conducted a 35-year review across 157 studies of assessments of children's emotion regulation. Not surprisingly, the study revealed that current published studies of ER with school-age children and adolescents tended to rely on self-report methodology, whereas observational methods were more prevalent with infant and toddler samples. Yet surprisingly, over the past 35 years, 61.1% of published research relied on *one* method of assessing ER, with only 15.3% using three or more methods. In other words, most of

our current knowledge of children's emotion regulation is limited to studies using a single measure or measures in one domain as a representation of children's overall emotion regulation across contexts. Why and how is this approach problematic?

Context defines what is adaptive regulation

Previous investigators have long emphasized the importance of regulating negative emotions (e.g., anger, sadness and fear), and have a tendency to characterize ER as adaptive versus maladaptive (Cole et al., 2008). Relatedly, there has been a tendency to view negative expressions as maladaptive and positive expressions as adaptive. However, conceptually, emotion itself does not entail an adaptive or maladaptive meaning (Frijda, 1986). It is when a particular emotion occurs in the *wrong* situational context, and/or in a wrong quality (too much or too little intensity, too long or not enough latency) that give rise to maladaptive outcomes. For example, expressing high levels of excitement during a sporting event is considered normal, whereas expressing the same levels of excitement during a funeral is considered inappropriate.

In fact, from evolutionary and functional viewpoints, negative emotions are adaptively designed to accomplish goals (Dennis et al., 2009; Thompson, 2011). For example, children's increased levels of anxiety and sadness signal needs for caregiving that are adaptive in dangerous situations. But when children show the same intense anxiety and sadness to a situational context that does not appear to be dangerous (i.e., a birthday party), it becomes maladaptive. Therefore, what defines adaptive vs maladaptive emotion regulation is based on the goals of the individual and the situational contexts in which they are trying to regulate emotions (Cole et al., 2004; Thompson, 2011). As a result, the hallmark of adaptive emotion regulation is the ability to adjust the intensity or valence of one's affective responses to situational challenges across *different situational contexts*. To illustrate, anxious children may able to perform well in a laboratory

paradigm that consists of regulating frustration alone, yet their ability to regulate frustration maybe different in a peer interaction setting. In fact, emerging theories have urged researchers to consider the role of situational contexts in the study of emotion regulation (Aldao, 2013), yet empirical studies are lacking; We know little about how children regulate their emotions across multiple situational contexts because most studies use only one measure or measures derived from one context (Adrian et al., 2011).

Culture defines what is the "right" regulation-context pairing

While situational context and quality of regulation govern the meaning of adaptive regulation, culture dictates the meaning of appropriate regulation-context coupling. Through the establishment of social norms, culture as a shared belief system determines which behaviors are deemed as appropriate and which are not in certain situational contexts. For example, expressing anger through aggressive behavior or using drugs to cope with a stressful situation are often deemed as inappropriate/maladaptive forms of regulation because they violate social norms. Cultural variations in social norms also drive differences in caregivers' concepts and perceptions of adaptive child regulatory behaviors (Bornstein, Putnick, & Lansford, 2011; Chen, 2000; Miller, Fung, Lin, Chen, & Boldt, 2012). For example, North American cultural norms key to the value of emotional expressivity. Shyness and temperamentally- inhibited behaviors are often viewed negatively as signs of social incompetence. In contrast, traditional Chinese cultural norms value emotional constraint. Shy-inhibited behaviors that promote social harmony are considered acceptable and even a sign of maturity/adaptive indicator in contexts of social cooperation (e.g., modesty; reluctance to initiate conflict; Chen, Wang, & DeSouza, 2006). Correspondingly, shyness has been associated with peer rejection within North American culture (Rubin et al., 2009), whereas it has been associated with social acceptance within Chinese

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culture, particularly among individuals who espouse traditional cultural values (Xu et al., 2007), although the promotion of shyness behaviors has been changing over the years (Chen, 2019).

Relatedly, cultural differences in expression of internal states have been associated with teachers' perceptions of children's social competence in school settings. Louie and colleagues (2015) found that for Korean and Asian American preschoolers, higher levels of anger expression (observed during a sharing task) were associated with lower teachers' evaluations of peer acceptance and prosocial behavior, but this relationship was not found among their European American counterparts. For European American preschoolers, displays of positive emotion such as happiness (observed during a bubble task) were associated with higher levels of reported social competence. Yet, Korean children's observed happiness was related to *higher* levels of teacher rated antisocial behavior (Louie et al., 2015). These findings thus highlight how cultural norms (or violations of cultural norms) can shape adults' perceptions of adaptive vs maladaptive emotion expression/regulation in children.

Indeed, even within the United States, the expression of aggressiveness in certain contexts is not always perceived as maladaptive. In her study of toddlers growing up in Baltimore, Miller & Sperry (1987) documented how mothers socialize their toddlers to engage in hostile behavior in the interest of self-defense in their dangerous neighborhoods. Yet if the child showed such behavior in other contexts that mothers deemed inappropriate, they called the toddlers spoiled. The point here is that the mothers of these children had values that differed in significant ways from those of the majority culture, suggesting the importance of understanding the underlying *cultural meanings* of socialization goals in different situational contexts that shape children's emotion regulation.

In sum, it is impossible to understand adaptive emotion regulation without taking culture by context interactions into consideration because cultural meanings underlying emotional expression/regulation in a particular context direct the definition of adaptive vs maladaptive emotion regulation. Yet, there has been a death of research incorporating cultural contexts in the study of ER in young children. Not surprisingly, the majority of these studies used samples consisting solely of Caucasian children living in the United States. And when investigators have examined ER in other ethnic groups and cultures, they have used measures or paradigms that have been developed in North American cultures (e.g., Camras, Bakeman, Chen, Norris, & Cain, 2006; Eisenberg et al., 2007; Garrett-Peters & Fox, 2007; Louie et al., 2015) without explicitly taking differing *cultural priorities* into consideration (Cole & Jacobs, 2018), particularly whether tasks being used are culturally salient or relevant to a particular cultural group. Why is this problematic?

A new direction: cultural priorities may shape which contexts need to be regulated in the first place

In the end of last chapter, I defined *cultural priorities* as collective beliefs, values and experiences that are salient to members within a cultural group. To understand how cultural priorities may play a role in shaping emotion regulation, I first draw on Gross' (2015) extended model of emotion regulation to explain the temporal dynamics of how emotion regulation is processed. Accordingly, regulation begins with a perception of a psychologically relevant situation. Whether it is external (a car is running towards me) or internal (I may be hit by this car), situations are attended to and evaluated in terms of their meaning in light of the individuals' currently active goals. It is this contextually-based evaluation that gives rise to changes in experiential, behavioral and physiological response systems that characterize emotions. If an

evaluation of an event is relevant to regulate, this initial perception of an emotion activates a goal to regulate, then goal activation leads to strategy selection, and finally to the implementation of a particular emotion regulation tactic, which may alter the perpetual input to the initial valuation system.

Although Gross's ER model has not yet emphasized the importance of cultural priorities, contextually-based evaluations that give rise to regulation are strongly influenced by the degree to which the context is salient or motivationally relevant to an individual (Gross, 2015). A context that is more emotionally or motivationally significant (or threatening) to an individual may trigger this evaluation system to elicit greater changes in experiential, behavioral and physiological regulation to that specific context; culture provides a strong guiding principal for which context an individual should prioritize and evaluate as salient. In other words, individuals attend, react to and regulate certain issues more than others based on their priorities.

From a developmental niche framework, culture shapes the course of development through three subsystems: 1) children's physical and social environments; 2) caregivers' ethnotheories (folk and intuitive beliefs); and 3) cultural customs and practices of child rearing (Super & Harkness, 1999). These subsystems operate together to serve as a guiding principal for children to learn about the cultural priorities, including beliefs, values, practices that are essential for the course of development. Thus, children may most strongly react to and regulate emotion challenging paradigms/contexts that are salient to their cultural priorities.

Despite this, we know little about how cultural priorities affect emotion regulation in children, in part because most existing investigators have used measurement paradigms that were developed in the Western society to compare children's emotion expression/regulation across cultures. Yet the psychometric validity of a task does not mean that it has *cultural validity* (Olson

et al., 2019). Imposing Western models/paradigms to the study of cultural influences in emotion regulation assumes that physical events can elicit the same quality and types of emotions in children across cultures. However, we cannot use an environmental event as a proxy for an expected emotional outcome (Campos et al., 2004; Saarni, 1979). As Sroufe (1997) noted, it is the meaning of the event, not its physical composition, that determines the emotion. Culture provides guiding principles for how a behavior, event or context should be interpreted that are in line with its cultural meanings and priorities.

Three studies

Guided by my conceptual framework that emotion regulation is a complex system (Figure 1), I designed three studies to address how contexts and cultural priorities may influence emotion expression and regulation among children living in three cultures: China, US and Japan. Every study features a multi-contextual and multi-level approach.

Study 1 (entitled "Emotion expression and regulation in three cultures: Chinese, Japanese and U.S preschoolers' reactions to disappointment") aims to examine cross-cultural similarities and differences on the emotional displays to disappointment, as measured by the disappointing gift paradigm (Cole, 1986) that was developed and validated based on children growing up in North America. This paradigm involves both social and nonsocial situational contexts and therefore has the potential to identify culture- and context-specific variation in a) direct displays of emotions as well as b) masking of emotions (i.e., masking is an emotion regulation strategy that requires top-down control process). Specifically, four questions were addressed:

1) Is the disappointing gift paradigm valid in eliciting *direct* expressions of negative emotions across cultures?

2) Could we observe cross-cultural differences in emotional displays?

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3) Do children mask their disappointment (e.g. "fake smile") in social contexts *and* are there are cross-cultural differences in masking?

4) Are there any subtle differences in emotional displays among chidlren from different "Eastern" (Chinese and Japanese) cultures?

Study 2 (entitled "Are preschoolers' neurobiological stress responses sensitive to culture?") aims to understand how cultural contexts/priorities may shape children's bottom-up processes of regulation by examining whether preschoolers' neurobiological responses to stress (as indexed by cortisol reactivity) are activated and responsive to psychosocial stressors most relevant to their cultural priorities using there paradigms designed to induce challenges relevant to differing contexts. Specifically, two questions were addressed:

1) Are there differences in the overall levels of cortisol reactivity to our stress paradigms across cultures?

2) Do children show higher levels of cortisol reactivity to stress paradigms that are differentially relevant to their cultural priorities?

Study 3 (entitled "Emotional expressions and physiological reactivity across contexts: A multi-contextual and multi-level study of emotion regulation with US and Chinese preschoolers") synthesizes Studies 1 and 2 to address how cultural priorities may influence emotion regulation at both behavioral (emotional displays) and physiological (cortisol reactivity) levels by using a multi-contextual/paradigms approach. Unlike the first two studies, Study 3 only focuses on preschoolers living in the US and China because the study did not collect both behavioral and physiological data for Japanese children. Specifically, five questions were addressed:

1) Are there cross-cultural differences in overall emotional displays (regardless of contexts/paradigms)?

2) Are there any cross-cultural differences in emotional displays based on different contexts?

3) To what extent would children show higher changes of cortisol reactivity in contexts that are more relevant their everyday lives (i.e., cultural priorities)?

4) Are there cross-cultural differences in cortisol reactivity based on different contexts?

5) Are children's emotion expressions (both positive and negative) associated with their cortisol levels in each culture?

My dissertation focuses on preschoolers because they a) have had more exposure to cultural display rules than infants or younger children (Boyer, 2012; Friedlmeier et al., 2011; Tardif et al., 2009); b) are actively learning and applying such norms to manage their emotions under challenging conditions (Cole, Martin, & Dennis, 2004); and c) have achieved significant social and cognitive developmental milestones in terms of emotion understanding (Denham et al., 2003), theory of mind (Wellman et al., 2001) and the ability to use different emotion regulation strategies (Davis, Levine, Lench, & Quas, 2010).

Chapter III

Study 1: Emotion Expression and Regulation in Three Cultures: Chinese, Japanese and U.S Preschoolers' Reactions to Disappointment

Disappointment occurs universally across cultures and, in general, strong norms exist for how and when it can be expressed (Matsumoto et al., 2008). In the United States, children as young as 3 years old can control their expression of disappointment by displaying less negative and more positive affect (e.g., smiling) when they are in the presence of others (Cole, 1986). Emotion expressions are bounded by display rules, which refer to when and how one might be able to express a particular emotion or set of emotions. According to Ekman and colleagues, (1969), display rules (i.e., masking of emotions) can be seen in different forms, including intensification (e.g., exaggerated smile), minimization (e.g., reduce negative displays even when negative), neutralization (e.g., "poker face") and/or substitution (e.g., "fake smile") such that facial displays depend on contextual demands and social norms. Display rules often serve the purpose of preserving politeness and social harmony within a social and cultural context (Matsumoto et al., 2008). Children's knowledge of display rules and reactions to disappointment are important indicators of social and emotional competence (Liew et al., 2004; McDowell & Parke, 2000). Nonetheless, little is known about cultural variations in preschoolers' outward displays of disappointment, about their tendencies to display disappointment in culturally normative ways, or how these might vary across social vs. non-social contexts (cf. Garrett-Peters & Fox, 2007). To address this gap in knowledge, we examined cross-cultural differences in preschoolers' emotion expression and regulation (i.e., masking) of disappointment in three countries: China, Japan, and the U.S.

Emotion regulation and the disappointing gift paradigm

According to Cole and colleagues (2004, p. 320), emotion regulation refers to "changes associated with activated emotions" in response to situational challenges. Changes in children's facial expressions have been argued to reflect both the *direct expression* of emotions, as well as attempts to *regulate* their emotions (Campos et al., 2004). Under this framework, *masking* of emotional expressions are strategies of emotion regulation and, given the right contexts, may be observed alongside direct expressions of emotions (Cole, 1986; Gross & John, 2003; Hwang & Matsumoto, 2012). Displays of emotion have been observed in early childhood through the use of the "disappointing gift" paradigm. In this paradigm, a child is asked to select a preferred gift, waits to receive it, is given the wrong/undesired gift, and is then told there has been a mistake and is allowed to trade for the preferred gift (Cole, 1986; Saarni, 1984). Disappointment typically occurs when people encounter experiences that fail to meet their expectations. Expressions of negative affect such as sadness are often elicited during disappointment and have been observed in this paradigm with US preschoolers (Cole, 1986). However, there is little information on whether this task also elicits disappointment in other cultures and how children from different countries would respond to the situation. Our first goal was to examine whether this task elicits disappointment, expressed as negative affect, among preschoolers in different cultures.

Interestingly, this paradigm involves both social and non-social contexts and could involve either the same, or different interactional partners across various phases of the task (see below and Method for details). Thus, this task has the potential to be a unique tool for identifying culture- and context-specific emotion displays. In the context of this paradigm, to examine *direct* displays of emotion, children should display positive emotions when choosing the gift, and

decreased positive and *increased negative* displays of emotion once they receive the undesirable (disappointing) gift. They should then return to baseline or display positive emotions once the desirable/preferred gift is given. There are three ways to operationalize *masking* of disappointment in this paradigm: 1) *no change (or even increased)* in *neutral* expressions (e.g., "poker face") when receiving the disappointing gift compared to baseline (e.g., when they are waiting in the room *before* receiving the gift); 2) *reduced negative* facial displays (e.g., "minimize") in front of the examiner when compared to when they are alone, waiting in the room *after* receiving the disappointing gift; and/or 3) *increased positive* displays (e.g., "fake smile") in front of examiner when compared to when they are alone, waiting in the room *after* they receive the disappointing gift.

Cultural differences in emotion displays of preschoolers

Chinese and U.S. comparisons

Children from cultures that promote interdependence (i.e., Chinese, Japanese, Asian American) are generally found to be less emotionally expressive than children from cultures that promote individualism (e.g., European American, African American, German - Ahadi, Rothbart, & Ye, 1993; Camras et al., 2006; Friedlmeier & Trommsdorff, 1999; Lewis, Takai-Kawakami, Kawakami, & Sullivan, 2010; Louie et al., 2015; Wilson, Raval, Salvina, Raval, & Panchal, 2012). In the only cross-cultural study of the disappointment task, Garrett-Peters and Fox (2007) found that Chinese-American children showed *fewer overt positive expressions* (i.e., direct expressions) than their age-matched European-American counterparts, regardless of age (4-year-olds vs. 7-year-olds). Moreover, Chinese-American children also tended to show *more negative emotions* when receiving the disappointing gift than European-American children, but only in the older age group (7-year-olds). The authors concluded that displays of more positive (and less

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negative) expressions found in European-American children may reflect a unique *North American* phenomenon of masking disappointment with positive expressions. However, this study only examined children's emotion displays in the social condition (receiving the disappointing gift in front of an experimenter) and did not examine how social vs. non-social (when waiting alone in the room) contexts may influence children's emotion displays. Similarly, the authors did not differentiate various phases surrounding the actual receipt of the disappointing gift (i.e., when children were waiting alone in the room *before* receiving the gift vs. when waiting alone in the room *after* receiving the undesired gift or when the experimenter comes back and apologizes to the child and he/she offers to exchange the disappointing gift with the preferred gift). It is therefore unknown whether the observed differences were consistent across contexts.

Context matters, and it matters especially when trying to understand similarities and differences across cultures in how emotions are displayed (Aldao, 2013; Zeman & Garber, 1996). To illustrate the importance of examining context, when doing a frustrating tower-building task, Chinese-American children (aged 5 – 7 years) were found to be less expressive when alone (and aware that they were being observed) but equally expressive as their European American counterparts when in the presence of their mothers (Liu, 2008).

Japanese and U.S. comparisons

Fewer studies have contrasted U.S. and Japanese preschool-age children, particularly with regard to observed emotions. While no study has yet compared U.S. and Japanese children's reaction to disappointment, one study found that American children showed more positive (direct) displays than Japanese children (temporarily residing in the U.S) when interacting with their mothers during free play and waiting tasks in the laboratory (Dennis et al.,

2002). However, the authors did not examine the child's behavior alone, nor with an unfamiliar person who may elicit different reactions than a parent or more familiar person. In a more recent observational study, Lewis et al. (2010) compared Japanese nationals temporarily residing in the U.S. and European- and African- American preschoolers in a timed picture-matching task. They found that Japanese children were again less expressive than either group of U.S. children, particularly for expressions of sadness and shame (Lewis et al., 2010).

Are there differences across Asian cultures?

To our knowledge, no investigators have used cross-national samples to compare preschoolers' emotion displays across different Asian samples. Studying children of immigrants may elucidate the impact of western acculturation and assimilation on emotion expression and is useful for understanding some aspects of cultural differences in emotion expression (Camras et al., 2006). However, the very fact of immigration may involve both selection factors and *changes* in emotion processing, given that immigrant children may have to "adjust" their emotion expressions based on the display rules of the society to which they have immigrated (Camras et al., 2006; Garrett-Peters & Fox, 2007). One of our central goals, therefore, was to examine cross-cultural similarities and differences in emotion expressions *across* Asian cultures by comparing Chinese and Japanese preschoolers living in China and Japan, in addition to comparisons between children from Asian countries vs. non-Asian American children residing in the US.

Chinese and Japanese cultural values and socialization practices

Both Chinese and Japanese cultures value social harmony and emotional control, yet there may be subtle differences in the underlying cultural meanings and methods to achieving social harmony and emotional control in these two cultures. Even during the preschool years Chinese culture highlights educational preparation, mastery and self-improvement (Li, 2005;

Parmar et al., 2004) and strong displays of emotion are viewed as signs of immaturity as well as psychological and physiological imbalance (Chen & Swartzman, 2001; Russell & Yik, 1996) Thus, not surprisingly, Chinese and Chinese-American mothers have been shown to actively discourage overt (direct) emotion expression across a number of situations when asked about child-rearing practices and goals (Chen, 2000; Lin & Fu, 1990). Socialization practices also shape Chinese (Taiwanese) preschoolers' preference for more calm expressions (e.g., calm smiles), whereas European-American preschoolers prefer excited smiles and exciting activities more than their Chinese counterparts (Tsai et al., 2007).

Across development, Japanese cultural practices emphasize relatedness, symbiotic harmony and self-adaptation to accommodate others' needs (Rothbaum et al., 2000). As with studies of Chinese parents, interviews with mothers of Japanese children have suggested that overt expressions of emotions are discouraged (Denham, Caal, Bassett, Benga, & Geangu, 2004). Japanese parents, however, do not view displays of emotion as signs of imbalance but instead value emotional contentment and feelings of relatedness (Behrens, 2004; Dennis et al., 2002). Moreover, they encourage expressions of sadness to convey the need to depend on others ("*amae*"; Behrens, 2004). Japanese preschoolers are encouraged to cultivate social connections, especially the development of empathy (*omoiyari*), as well as obligations and responsibility to others (*ki ga tsuku*) (Rothbaum et al., 2000; Tobin et al., 2009, p. 240). In contrast to US mothers, Japanese mothers were more likely to designate social insensitivity and uncooperativeness as the most undesirable behavioral characteristics in young children (Olson et al., 2001). Correspondingly, direct observations of preschools in Japan have shown that teachers promoted social connections, the ability to change one's behavior according to the context

(*kejime*), social-mindedness (*shudan-shugi*) and empathy (*omoiyari*) (Hayashi et al., 2009; Tobin et al., 2009, p. 240).

US cultural values and socialization practices

In contrast, for positive emotions U.S. European American parents place greater value on high (enthusiastic and excited), rather than low (calm and peaceful) arousal (Tsai et al., 2007), and encourage children to express their individual needs directly, acknowledging that they may feel differently from others (Tobin et al., 2009, p. 196 - 198). Correspondingly, U.S. Anglo-European parents tend to focus on maintaining and expressing a higher intensity of positive and excited emotion states in their children, and place importance on "talking about" both positive and negative emotion states (Kitayama, Markus, & Kurokawa, 2000; Wang, 2001).

Study Goals and Hypotheses

Our first aim was to examine the validity of the disappointing gift paradigm in eliciting *direct* expressions of negative emotions across cultures. Specifically, we expected (H1) that most children would report feeling negative and would exhibit more negative and less positive displays when receiving an undesired gift relative to the waiting/expecting phase, indicating that this task could elicit disappointment among preschoolers across all three cultures. To test this hypothesis, we chose to examine children's emotion displays across contexts that differed only in the receipt of the gift itself. Thus, we compared positive (i.e., Happy and Surprise) and negative (i.e., Anger, Fear, Disgust, Confusion and Shame) displays between two phases: when the children were alone *before* receiving the gift (Phase 2- Child Waiting) vs. when they were alone *after* receiving the undesired gift (Phase 4: Undesired Gift- alone) in each culture. Given that this task has been used to elicit disappointment among American children (Cole, 1986), we expected that among different negative emotions (e.g., sadness, angry, fear), expressions of sadness would

be the most common when children receive an undesired gift, as sadness has been theorized to be an emotion that relates to appraisals of loss or failure to achieve a goal (Frijda, 1986).

Second, we examined cross-cultural differences in emotional displays. We expected (H2) U.S. children to be more expressive of both positive and negative emotions than Chinese and Japanese preschoolers during the disappointment task (Garrett-Peters & Fox, 2007; Lewis et al., 2010).

Third, we examined whether children would mask their disappointment by displaying *increased positive* displays ("fake smile") in social situations by examining the *chang*e between positive and negative emotions across diffferent contexts of the task. Specifically, we expected (H3) that all children would mask their negative emotions by decreased negative expressions *and* increased positive expressions during social contexts (in front of both unfamiliar and familiar examiners; Phase 3: Undesired Gift-Unfamiliar Examiner and Phase 5: Undesired Gift-Familiar Examiner) relative to the solitary context (i.e., Phase 4: Undesired Gift-Alone). Nonetheless, we hypothesized (H3) that Japanese (and Chinese) children might show a stronger masking effect with positive displays ("fake smile") in social situations (i.e., Phase 3: Undesired Gift-Unfamiliar Examiner and Phase 5: Undesired Gift-Familiar Examiner) than U.S. children (H3). This is because among those with interdependent self-construals (i.e., Chinese and Japanese cultures), positive expressions frequently serve the purpose of maintaining interpersonal harmony rather than reflecting "true" inner feelings of self (Markus & Kitayama, 1991). Indeed, adult studies show that Asian Americans were more like to modify their expressions in social situations (e.g., masking with joy) than Caucasian Americans (Hwang & Matsumoto, 2012).

Our last aim was to explore whether there were differences in emotional displays of disappointment among children from Chinese and Japanese cultures. Given that few studies have

examined heterogeneity across "Eastern" cultures, this aim is exploratory in nature and thus we did not have specific predictions for these differences.

Method

Participants

Children were recruited primarily from full-time university and community preschools in suburban communities of Beijing, China and Tokyo, Japan, as well as in suburban areas of southeastern Michigan, United States. Institutional Review Board approval as well as signed parental consent and oral child assent was obtained at each location. Children were pre-screened for major health issues and we excluded children who had a history of significant developmental or health concerns (N = 3 for U.S. only) and having Asian ethnic background (N = 7) for the U.S. sample. Table 1 presents demographic data for families from all three cultures (additional details below).

China. In China, 60 children were recruited from three preschools in the Northern, Southern, and Western districts of Beijing and there was a total of 59 children with usable data. Because of China's single child policy at the time the children were born, only two of the children (a pair of twins) were reported to have siblings. Children were, on average, 52 months old (range: 47- 61 months), mothers were an average of 33 years old (range: 28-44 years), and fathers were an average of 35 years old (range: 29-44 years). Parental education ranged from middle school to graduate-level training for both mothers and fathers.

Japan. In Japan, 55 children were recruited from two preschools in Musashino-shi and Suginami-ku, primarily residential middle-class neighborhoods in northwestern Tokyo with many single-family homes. Usable data were available for 46 children. Children were an average of 53 months old (range: 40-68 months), mothers 36 years old (range: 27-45 years), and fathers

38 years old (range: 27-57 years). Parental education ranged from middle school to graduate-level training for both mothers and fathers. Fewer of the Japanese mothers reported working full-time than in the other countries (see Table 1).

United States. In the U.S., 55 children (usable data for analysis available for 45) were recruited from 15 preschools in and around Ann Arbor, Michigan, a mid-sized urban area. Children were an average of 54 months old (range: 44-63 months); mothers 36 years old (range: 24-48 years), and fathers 37 years old (range: 24-58 years). 73.3% of the children were Caucasian, 13.3% were African American, and 11.1% were mixed race. Note that all Asian- or Asian-American children (N=7) were excluded from the sample. Parental education ranged from high school to graduate-level for both mothers and fathers. Fewer of the U.S. fathers reported working full-time than fathers in other countries, and fewer of the U.S. parents reported being married than those in other countries (see Table 1).

Procedure

Children participated in study activities for a two-hour period on three consecutive days. Activities occurred in the morning, before lunch, or in the afternoon, after naptime. Most children in the U.S. and China were tested at the child's preschool with some tested at the child-behavior laboratory at each participating university. All of the children in Japan were tested at the child-behavior laboratory at the participating university. On each study day, children began project activities with 30 minutes of quiet play with a research assistant. The children then engaged in a series of tasks with this familiar examiner, including the emotionally challenging "disappointment" task, followed by some quiet time watching an age appropriate "calming" cartoon (e.g., Caillou) and completing individual psychological assessments (e.g., IQ testing). The entire session was videotaped. All procedures were administered in the child's home

language, and examiners were native adult speakers from each country who were trained on each part of the protocol by the study PI. No child reported difficulty understanding the protocol. The disappointment task, which is the focus of the current report, is described below.

Disappointing gift paradigm. The disappointing gift paradigm was used to assess the child's response to an undesired gift (Cole, et al., 1994; Saarni, 1984). There were multiple task phases of interest. First, a "familiar examiner," who had introduced the study to the child then spent at least one full two-hour session on a preceding day and at least 30 minutes on the day of the study, presented the child with five objects (e.g., toy car or bubbles, pencil, eraser, bottle cap, broken comb) and asked the child to rate them from most to least desired (Phase 1: Gift Ranking). The "familiar examiner" told the child that she had to go answer a phone call and that a second examiner would return and bring his or her first-choice gift, and then left the room while the child waited for 60 seconds (Phase 2: Child Waiting). Another examiner, who was unfamiliar to the child, then entered the room and gave the child his or her least desired choice, and remained in the room in close proximity to the child, but was instructed to simply read from a book and interact only minimally with the child (Phase 3: Undesired Gift-Unfamiliar Examiner). After 60 seconds, the second examiner left the room and the child remained in the room, alone, with the least desired gift for an additional 60 seconds (Phase 4: Undesired Gift-Alone). The original ("familiar") examiner then returned to the room, asked the child 1) if he or she had received a gift that he or she wanted (i.e., the "favorite" toy), looked at the gift the child received, and apologized when the child said "no" or did not respond. The familiar examiner also noted that the unfamiliar examiner must have made a mistake and asked how the child felt after receiving the gift and if the unfamiliar examiner knew how he/she felt. The familiar examiner then asked the child whether he or she would like to switch the gift (Phase 5: Undesired Gift-

Familiar Examiner) and, if the child agreed to switch, the child was then allowed to switch the least-desired for most-desired gift (Phase 6: Best Gift). Examiner 2 ("unfamiliar" examiner) then entered and apologized to the child as well. The entire task was videotaped for later coding.

Specifically, we are interested in children's expression of disappointment in three contexts: 1) an unfamiliar-social context in which an unfamiliar examiner gave a child an undesired gift despite he/she had previously ranked as the least preferred gift, and the child had to react to this situation in front of the unfamiliar examiner (Phase 3: Undesired Gift-Unfamiliar Examiner); followed by 2) an alone context in which the child was left alone in the room after receiving the undesired gift (Phase 4: Undesired Gift-Alone); followed by 3) a familiar-social context involving the child's reunion with the familiar examiner who asked the child if he/she had received his/her favorite gift and apologized when the child said "no" or did not respond (Phase 5: Undesired Gift-Familiar Examiner).

Measures and coding

Child emotion expressions were coded using The Observer behavioral coding software program (Noldus Technologies 2006). This program allowed "time locked" coding of facial expressions on a frame-by-frame basis. Task Phases were documented using start/stop time points in the protocol that were observed from the videos and standardized across all three countries. Each point was based on a discrete key word or event during the task protocol (e.g., examiner places gift on table). All emotions were coded in a mutually exclusive system (i.e., the child could not be coded as being in two different emotion states at once) and emotion states were coded continuously throughout all phases of the Disappointment Task procedure.

Emotion codes were based on Izard's AFFEX system (Izard, 1994). We chose this coding system because it included many different emotion states, anchored with specific configurations

of facial muscles, and we wished to remain open to possibilities that children from each country might express a wide range of emotions. Thus, emotion states coded included Happy/Joy, Sadness, Anger, Fear/Anxiety, Disgust, Confusion, Surprise, and Shame. Times when children were not expressing an emotion were coded as Neutral. Facial indicators used to assess emotion expressions included mouth movement (e.g., corners of mouth drawn back in a smile vs. lip pout or drawn down in a frown) and eyebrow position (e.g., relaxed vs. inner corners raised, indicating Sadness), as well as behavioral cues such as laughing or crying.

Emotion variables were calculated to represent the proportion of time spent expressing each emotion during each Task Phase. Proportion duration was used in order to compare Task Phases of unequal time length. We also computed a variable to indicate the proportion of time children spent expressing any emotion other than Neutral (Overall Expressivity). Coding was performed by independent coders of U.S., Chinese, and Japanese descent (blind to study hypotheses). In order to ensure uniformity of coding across children and across cultures, all coding took place at the US research site because we had a researcher trained in and highly experienced with the AFFEX coding system across different preschool-aged populations in the US. This researcher trained and supervised all of the coders who were required to reach a particular reliability criterion (ICC>.90) on 2 sample tapes from each culture that had been coded by the primary researcher in collaboration with the PI's from each of the three cultures studied. Ongoing reliability was calculated using an intra-class correlation (ICC) to account for agreement among multiple coders. About 37% of the total sample (*N*=55) was used to calculate reliability, consisting of 20 Chinese, 12 Japanese, and 23 U.S. children. Weekly coding meetings were held with all coders and disagreements on codes were discussed amongst the coders of the

tape, other coders, and the primary researcher who trained them. The agreed-upon code was then used as a final code.

Across all three countries only two emotions were expressed greater than 10% of the total time spent during the task (Table 2): Happy (Total ICC=.76) and Sad (Total ICC=.63). The frequencies (in terms of percentage of total time spent) of all other emotions were very low (=< 0.6%; see Table 2), and therefore we were unable to calculate inter-rater reliability. Nonetheless, all coding, regardless of frequency, was discussed in a weekly coders' meeting that all coders attended so that any discrepancies in coding could be resolved through joint discussion amongst the coders. The frequencies reported and analyzed in this paper are final codes, after resolution of discrepancies.

Children's verbal and behavioral responses were also coded when the "familiar" examiner returned to the room and asked 1) if the child had received a prize that he or she wanted (i.e., Yes, No or Others [e.g., I don't know or no response]); 2) how he/she felt after receiving the gift (i.e., Positive [e.g., good, happy], Negative [e.g., sad, bad, angry], Neutral [e.g., OK, feel nothing] and Others [e.g., I don't know or no response], and 3) if the unfamiliar examiner knew how he/she felt (i.e., Yes, No, Others [e.g., I don't know or no response].

Preliminary data analysis

We first examined demographic differences across the three countries using ANOVAs and follow-up t-test comparisons with Bonferroni corrections. After that, we examined the mean proportion of time spent expressing each emotion across all phases and compared children's expression of each emotion across the three countries using ANOVAs and follow-up t-test comparisons. We then examined the relations between facial expressions and the demographic variables using Pearson correlations.

Data analysis for hypotheses

For H1 and H2 regarding differences in emotion expression across cultures and across the different task phases, we conducted Generalized Estimating Equation (GEE) analyses (Liang & Zeger, 1986). GEE analyses were chosen because of the ability to draw more robust inferences regarding possible variance-covariance matrixes by choosing working correlation matrixes with better Goodness of Fit (Liang & Zeger, 1986). For the present data, two separate GEE models were performed with Country (U.S., China, Japan), Task Phase (Gift Ranking; Child Waiting; Undesired Gift-Unfamiliar Examiner; Undesired Gift-Alone; Undesired Gift-Familiar Examiner; Best Gift), Gender, and interactions of Country X Task Phase and Country X Gender were entered as predictors to estimate children's (1) Negative Expressions (summing across Sadness, Anger, Fear, Disgust, Confusion and Shame) and (2) Positive Expressions (summing across Happiness and Surprise) respectively. We summed across all positive and negative emotions for the GEE analyses because of the low frequency of each emotion and to increase power (Prior to combing all positive and negative emotions, we ran separate GEE models with only Happiness and Sadness without combining across other positive/negative emotions and the results were similar). Nonetheless our results were mostly driven by Happiness and Sadness expressions. Verbal responses were compared across cultures using a Chi-square test.

For H3 regarding masking disappointment with positive displays, we conducted a GEE model of Emotion Type (Positive vs Negative) X Social/Alone Context (i.e., Undesired Gift – Alone, Undesired Gift – Unfamiliar Examiner, Undesired Gift – Familiar Examiner) X Country (US, China, Japan) X Gender, using maternal age and education as covariates.

In addition to positive and negative emotion displays, we explored the display of *neutral* expressions across cultures and task phases to better understand whether there were differences

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in emotional displays of disappointment among children from different "Eastern" cultures. Specifically, we conducted a GEE model to examine Country (U.S., China, Japan), Task Phase (Gift Ranking; Child Waiting; Undesired Gift-Unfamiliar Examiner; Undesired Gift-Alone; Undesired Gift-Familiar Examiner; Best Gift), Gender, and interactions of Country X Task Phase and Country X Gender and Country X Task Phase X Gender were entered as predictors (maternal age and education as covariates) to estimate children's Neutral expressions. Goodness of fit (as indexed by QIC and QICC) was used to select working correlation matrixes for each model. Results indicated that a compound symmetry covariance structure had the best fit was used for all GEE analyses.

Results

Demographics

Although we chose the samples to be as comparable as possible, there were a number of demographic differences between samples that were reflective of cross-national differences in these countries as a whole. As shown in Table 1, Chinese mothers were younger than Japanese and U.S. mothers, U.S. mothers also had higher levels of education than Japanese and Chinese mothers. A higher percentage of Chinese and U.S. mothers were employed full-time, whereas a higher percentage of Chinese and Japanese (relative to U.S.) fathers were employed full-time. U.S. children had the highest number of siblings, followed by Japanese, and then Chinese children (who were mostly singletons, per China's one child policy). Higher percentages of Chinese and Japanese than U.S. parents were married. Thus, where relevant, we controlled for maternal age and education, but because marital status did not correlate with any of our measures, we did not consider this in our analyses.

Mean proportion of time spent expressing each emotion across all phases

Table 2 summarizes the mean proportion of time children displayed each emotion across all phases by country. The mean length of the entire task was 6 minutes (SD = 1.5 minutes) and, overall, children spent more time *not* expressing their emotions than they spent expressing specific emotions, with a cross-cultural average of 61.8% of the time spent in a "neutral" state.

Overall, children displayed Happy expressions for longer durations than Surprised expressions. As shown in Table 2. U.S. displayed Happy expressions for the longest durations, followed by Chinese preschoolers and the least for Japanese preschoolers. For negative emotions, children displayed more Sadness than the other negative expressions of emotion (Anger, Fear, Disgust, Confusion and Shame). Chinese and Japanese children expressed less Sadness, overall, than U.S. children. Disgust was also expressed less for Chinese and Japanese children than U.S. children, although the proportion of time spent in Disgust expressions was low across all three samples.

Correlations between displayed emotions and demographic variables

Mother's age and education were slightly positively associated with overall displays of Sadness (age: r = .09, $p < .01$, education: r = 15, $p < .001$) and inversely associated with Neutral expressions (age: r = -.10, $p < .01$, education: -.10, $p < .01$). Mother's age and education were therefore entered as covariates in subsequent analyses.

Cross-cultural differences in direct expressions of emotion

For both Negative (NA) and Positive (PA) expressions, generalized estimating equation (GEE) revealed that there were significant main effects of Country (NA: W(2) = 23.03, $p < .001$; PA: W(2) = 18.25, $p < .001$), Task Phase (NA: W(5) = 127.46, $p < .001$; PA: W(5) = 158.32, $p < .001$) and 2-way interactions of Country X Task Phase (NA: W(10) =20.89, $p = .02$; PA: W(10) = 24.28, $p = .007$) after controlling for maternal age and education. No other significant

interactions (e.g., gender) were found. Figures 2a and 3 depict the interaction effects for

Negative and Positive expressions, respectively.

H1. The disappointing gift paradigm would elicit direct negative expressions (i.e.,

disappointment) across cultures.

First, analyses of the children's verbal responses indicated that when the "familiar"

examiner returned to the room and asked the child had received his/her favorite gift, the majority

(83.3%) of the children indicated that they did not receive the gift that they wanted and there

were no cultural differences for this response (No: Chinese = 83.1%, US = 77.8%, Japanese =

89.1%; Yes = Chinese = 16.9%, US = 17.8%, Japanese = 8.7%, Chi-square (4) = 4.51, p = .34).

Moreover, the majority of the children (66.6%) reported feeling sadness or other negative

emotion states (e.g., bad) when asked directly "How do you feel?" Chinese and Japanese

preschoolers were more likely to report feeling negative than US children (Chinese = 76.8%,

Japanese = 71.0%, US = 49.0%), whereas US children were more likely to report feeling neutral

(Chinese = 4.4%, Japanese = 3.5%, US = 17.5%) or produce other responses such as no response

or remark on some other aspect of the study (Chinese = 0%, Japanese = 9.3%, US = 22.2%, Chi-

square (6) = 142.98, p < .001). No difference was found for positive emotions (Chinese = 18.8%,

Japanese = 16.2%, US = 11.0%). Taken together, these results suggest that, regardless of culture,

most children indicated they felt disappointed/not happy when they received an undesirable toy.

As shown in Figure 2a, preschoolers from all countries also displayed longer durations of

negative expressions and shorter durations of positive expressions after they received the

undesired gift and were left alone (Phase 4: Undesired Gift –Alone), compared to when waiting

for the gift alone (Phase 2: Child Waiting - Alone), suggesting that children in all countries

exhibit change of emotional experiences (i.e., feel disappointed) after receiving the undesired gift.

We also conducted post-hoc conducted to examine the patterns of negative expressions across contexts among children who self-reported feeling negative when asked by the experimenter. As shown in Figure 2b, regardless of culture, children who self-reported feeling negative had a similar pattern of negative expressions relative to the whole sample, suggesting that our overall findings of children's facial expressions are consistent with children's subjective reporting of disappointment across cultures.

H2. U.S. children would be more expressive than Chinese and Japanese children.

Overall U.S. preschoolers showed longer durations of negative expressions than Chinese or Japanese preschoolers. U.S. preschoolers also displayed more positive expressions across phases than Japanese *but* not Chinese preschoolers (except during the best gift phase). Thus, H2 was fully supported for Negative emotions, but only partially supported for Positive emotions (See Figures 2a - 3).

H3. Masking of emotions with positive displays

GEE analyses revealed significant main effects for Emotion type ($W(1) = 35.11$, $p < .001$), Country ($W(2) = 31.28$, $p < .001$), and significant 2-way interactions of Emotion Type X Country ($W(2) = 15.60$, $p < .001$) and Emotion Type X Task Phase ($W(2) = 35.31$, $p < .001$) after controlling for maternal age and education. No other 3- or 4-way interactions were found.

Chinese and Japanese children would engage in more masking of disappointment with positive displays ("fake smile") than US children during social contexts.

Children from all countries displayed more positive expressions during social contexts with "unfamiliar" ($M = .07$, $SE = .01$) and "familiar" examiners ($M = .15$, $SE = .02$) relative to

alone when receiving a disappointing gift (M = .04, SE = .01), indicating an effect of masking with positive affect in social contexts. They also displayed fewer negative expressions in front of the "familiar" examiner (M = .16, SE = .01) relative to alone (M = .23, SE = .02) when receiving the disappointing gift. All children also displayed more positive and fewer negative expressions in social situations with the "familiar," relative to unfamiliar examiner, which also coincided with reuniting with the familiar examiner and receiving the preferred gift. We found no gender or culture differences in change of emotion displays for positive and negative expressions.

Exploratory: Do Chinese and Japanese children show differences in patterns of emotion expression?

GEE analyses revealed significant main effects for Country (W(2) = 37.60, *p* < .001), Task Phase (W(5) = 31.02, *p* < .001), and 2-way interactions of Country X Task Phase (W(10) = 53.04, *p* < .001) after controlling for maternal age and education. No other interaction effect was found.

Across cultures, we observed similar levels of neutral expressions among Japanese and Chinese preschoolers that were significantly higher than those of US preschoolers once they received the disappointing gift (Figure 4). Within culture, both US and Japanese children showed a decrease in neutral expressions once they received the disappointing gift (they were more negatively expressive). However, Chinese children showed no change in neutral expressions across the different phases of the task and no change once the disappointing gift was received (Figure 4). Moreover, verbal analyses indicated that Chinese preschoolers were more likely to report that the "unfamiliar" examiner did *not* know how they felt (76.4%), followed by US (56.4%) and Japanese preschoolers (45.1%. Chi-square (4) = 72.72, *p* < .001), when receiving

the undesirable gift. This, too, is consistent with the possibility that Chinese children may be more likely to exert emotional control (e.g., "poker face") across contexts.

Discussion

Our main goal was to compare children's reactions to disappointment in three cultures: China, Japan, and the U.S. First, we examined the validity of the disappointing gift paradigm in eliciting negative affect among all preschoolers (H1). Second, we examined cross-cultural differences in emotional displays (H2). Third, we examined whether children would *mask* their negative emotions with positive displays ("fake smile") in social situations (H3). Finally, we explored whether we might find cultural differences in more "neutral" forms of masking, particularly in the disappointment phases of the task.

Validation of task paradigm across cultures

As expected, most children reported that they received an undesirable prize and felt negative, indicating that the disappointing gift paradigm can elicit negative emotions among preschoolers living in China, Japan and US. Supporting this, preschoolers across all three cultures displayed higher negative (mostly sadness) and lower positive expressions after they received the undesired gift and were left alone compared to when waiting for the gift alone (Figures 2a and 3). High cross-cultural consistency on the expressions of sadness relative to other type of negative expressions (e.g., anger) when reacting to this disappointing gift paradigm also suggests that preschoolers across cultures appraised this situation similarly as a loss or failure to achieve a goal, which in our context involved receiving an undesirable gift when they expected to receive the gift they had just ranked as their "favorite." However, we do not know whether children's expressions of sadness (or anger) as a signal for caregivers' support are

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consistent across cultures, or whether the social functions of negative emotional displays vary across contexts (e.g., in front of strangers) and cultures in young children.

Cross-cultural comparisons of emotional displays

We had hypothesized (H2) that U.S. children would show greater emotion expression than Chinese and Japanese children, respectively. Our findings partially supported this hypothesis, with some interesting differences across task phases and cultures. Overall, the U.S. children were more expressive than others. However, when compared to the Chinese children, the U.S. children displayed more negative expressions only, whereas they displayed both more negative and more positive expressions in almost every task phase than the Japanese children. Much to our surprise, the Chinese children displayed almost identical amounts of positive expressions as the U.S. children and displayed more positive expressions than the Japanese children, *except* during the final phase of the task when children received their most preferred gift.

The overall differences between preschoolers from the U.S. and the two Asian countries in the display of negative emotional expressions may be attributed to differences in the socialization of emotion expression across cultures (Friedlmeier et al., 2011). In the U.S., making one's needs known and expressing one's true emotions, whether positive or negative, is highly valued. Dampening one's negative emotions is considered less important in these cultures if such dampening is in conflict with the attainment of individual social and psychological goals (Triandis, 2001). In contrast, in more group-oriented (i.e., Chinese and Japanese) cultures, emotional control of negative emotions is highly valued, because expressing strong negative emotions does not bode well for mutual support and cohesiveness in the group (Chen, 2000), although that may be changing as a consequence of globalization (Chen et al., 2005). Thus, it is

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not surprising that Chinese and Japanese preschoolers, who are actively being socialized into the social and emotional norms of their cultures, displayed significantly less sadness and other negative expressions than U.S. children in almost every phase of the task.

Notably, US children also exhibited higher positive and less neutral emotions than both Japanese and Chinese children in the positive phase of this task (i.e., when children received their most preferred gift). This is consistent with prior adult studies suggesting that Westerners generally want to savor positive emotions, whereas Easterners tend to dampen their positive experiences (Miyamoto & Ma, 2011).

Masking of disappointment with positive displays across cultures

We had hypothesized (H3) that all children would show signs of masking their disappointment by displaying fewer negative emotions and more positive emotions during social (i.e., with familiar and unfamiliar examiners) relative to alone contexts. We also hypothesized (H3) that Japanese and Chinese children might show stronger masking effects during social situations, given their cultural norms of minimizing one's expression of emotions as it relates to the comfort of the social other (Lebra, 1976; Shimizu & LeVine, 2001). Our findings partially supported this hypothesis. Specifically, preschoolers showed signs of masking their disappointment by displaying more positive emotions during social, relative to alone, situations across all cultures. While studies of Asian American adults found that they were more likely to mask their expressions with positive displays when compared to European Americans (Hwang & Matsumoto, 2012), we did not find this cultural difference in our preschool-age sample. It is possible that children at this age are still learning their emotion display rules, and have not fully interalized the cultural norms for masking of disappointment during this age. However, there were differences in how much "neutral" expressions were displayed such that both Japanese and

Chinese preschoolers displayed higher neutral expressions than US preschoolers, particularly after receiving the disappointing gift (Figure 4). This may suggest that there are indeed cross-cultural differences in masking at this age, but they are difficult to tease apart from overall differences in expressiveness. Further research is needed to identify the ways in which children develop culturally specific patterns of emotional masking.

Emotion displays among "Eastern" cultures

Both US and Japanese children showed a decrease in neutral expressions after they received the disappointing gift, but this effect was not found in Chinese children who showed similar levels of neutral expressions ("poker face") across different contexts (Figure 4). This is intriguing because most Chinese children (78.6%) reported feeling sad or other negative emotions when asked. These findings may suggest that Chinese children tend to exert high levels of emotional control of negative experiences, which may reflect cultural norms and socialization of emotional control (Chen, 2000; Russell & Yik, 1996; Tsai, 2007). Alternatively, the observed findings may also be attributed to Chinese preschoolers being less reactive to this situation and/or experiencing less intense negative emotions (or a combination of all these reasons). Future studies that incorporate a multi-level approach incorporating both behavioral, physiological (e.g., cortisol, heart rate etc.) and subjective measures would be better able to explain these findings.

Japanese preschoolers were more likely to report that the unfamiliar examiner knew how they felt when compared to their Chinese and US counterparts. Thus, it is possible that Japanese children thought that they did not adequately "hide" their emotions in front of the examiner, and/or that Japanese adults would be able to infer the child's emotion from the context such that the child would not need to tell or show the adult how they feel. Further study is needed to

examine these questions, but it is an intriguing mismatch that is suggestive of cultural

explanations.

Our findings highlight the critical role of examining cultural meanings *beyond* the broad

distinctions of cultural orientations (e.g., independent vs interdependent self-construals)

underlying socialization, customs and practices (Super & Harkness, 1999) to understand

variations of display behaviors in preschoolers.

Strengths and limitations

To our knowledge, this is the first study to examine Japanese preschoolers' responses to

the disappointment task, and the only one to compare responses across Chinese, Japanese, and

U.S. preschoolers, or to examine emotion expressions across multiple phases of this task across

cultures. Yet, several limitations must be acknowledged. First, the study's conclusions are

limited by a relatively small sample size, which allowed for comparisons across cultures, but not

extensive explorations of associations between variables within and across cultures. Relatedly,

there is a heterogeneity of values and socialization even within a culture and thus our findings

may not be representative or generalized into sub-groups within a culture. Although it is beyond

the scope of our study, future research can be benefited by examining individual and sub-group

heterogeneity of emotion expression and factors underlying these variations within a culture.

Second, our study examined children with different experiential histories at a single point in time

and is unable to infer longitudinal associations or causality regarding *how* culture shapes emotion

expressions. Third, our study only includes measures of facial coding, overt behavioral

expressions that indicated emotions (e.g., crying, laughing) and speech coding after children

received the gift, but did not incorporate coding of specific gestures because not all of our coders

were trained to differentiate unique behavioral expressions of the country they were coding and

to do so would have resulted in culturally-specific coding systems, which would go beyond the scope of the current study. It is possible that behavioral expressions such as body movement could provide unique insight into cultural variations of how children respond to our disappointment gift paradigm. Therefore, further examination that incorporates these non-facial and culturally-specific expressions would be important not just to corroborate the findings from our study, but to also begin to understand how different aspects of emotion display and expression might be related to each other, within and across cultures. Fourth, our study only assesses the presence or absence of children's emotional displays at a given moment. Although studies have demonstrated the relation between spontaneous emotion expression and self-report of internal emotion experience (Mauss et al., 2005), it is possible that outward displays we observe do not reflect their internal experience of emotions and/or that the internal experiences continue beyond the moments in which we measured the external displays. Fifth, due to the fact that our study only examined children's reaction to disappointment, we observed only very low frequencies of basic emotions other than sadness and happiness. Developmentally, prototypical facial displays of discreet negative emotions (i.e., sadness, anger, fear) are not observed in infancy (rather they expressed distress) and the perception of anger and sadness displays are often difficult to differentiate even in older children (Camras, Castro, Halberstadt, & Shuster, 2017). While our study found cross-cultural consistency of sadness expressions, it remains possible that other specific negative discrete expressions (shame, disgust, guilt etc.) may not be observed until later in development. Future study that uses paradigms that are designed to elicit other emotions (e.g., toy removal to elicit anger) are needed to understand the cultural and developmental impact on specific positive or negative expressions. Nonetheless, our study offers new insight that the disappointment paradigm, which is widely used in developmental research in

Western cultures, can be adapted to assess children's expressions of sadness and happiness in other cultures, but is less effective at eliciting expressions of other emotions.

Conclusions

The current study utilized a paradigm that assessed how likely children are to show their emotions to an outside observer, as well as to display them in the absence of another person and is unique in its consideration of the role of culture with respect to this process. Our findings highlight how cultural values at the macro level can be highlighted in short glimpses of behavior. Our findings are also important for helping us identify unique situational as well as cultural influences on children's ability to regulate their emotions, and to consider culture-in-context. Finally, the current study takes an important step in the direction toward incorporating cross-cultural perspectives into the study of developmental processes (Nielsen & Haun, 2016), which has strong implications in understanding cultural variations in adaptive (vs maladaptive) social-emotional development (Olson et al., 2019).

Chapter IV

Study 2: Are Preschoolers' Neurobiological Stress Responses Sensitive to Contexts?

When an animal is confronted with acute potential threats in its environment, survival is enhanced by increasing its vigilance, arousal and sensitivity toward detecting those threats in order to react quickly and appropriately, even if they turn out to be false alarms. This "fight or flight" reaction is supported by a cascade of physiological events triggered in the sympathetic nervous system and the hypothalamic-pituitary-adrenocortical (HPA) axis (Sapolsky, Romero, & Munck, 2000). Glucocorticoids (i.e., cortisol in humans), the end-product of HPA axis activation are indicators of stress responses for modulating (e.g., facilitating the recovery of homeostasis) and preparative (e.g., adapting to chronic stressors) actions (Sapolsky et al., 2000), regardless of whether the stressor is a physical or psychological one. Cortisol increases in response to a psychosocial stressor (Dickerson & Kemeny, 2004) may take minutes to hours to be produced (Sapolsky et al., 2000). Despite the prevalent use of salivary cortisol as a biological indicator of stress and regulation, findings have been inconsistent as to whether children respond to laboratory-induced stressors with an increase in cortisol. Indeed, most psychosocial stressors do *not* appear to successfully evoke a change in salivary cortisol in typically developing young children in the United States (Gunnar, Talge, & Herrera, 2009; Tolep & Dougherty, 2014). Some studies have even found a *decrease* in mean cortisol levels following a laboratory stressor in young children (Dougherty et al., 2011; Hankin et al., 2010; Leppert et al., 2016; Luby et al., 2003). However, children exhibited elevated cortisol to stress paradigms when samples were

collected in the laboratory (i.e., a novel environment) relative to a home setting, even when they were obtained at the same time of day (Gunnar & Talge, 2007).

While psychosocial stressors trigger the activation of physiological responses designed to ensure survival of the organism (e.g., fight or flight responses), the extent to which stressors are perceived as potential threats are influenced by both context and cultural learning (Lazarus & Folkman, 1984). Over generations, cultural norms establish a set of values, practices and behavioral routines that are essential for helping individuals to become a successful member of the society, find desirable mates, and thereby achieve biological adaptation (Kitayama & Uskul, 2011). To acquire these cultural norms, children may have to develop sensitivity towards potential stressors (or threats) that can jeopardize their ability to perform or act in accordance with these norms. To support cultural learning at the biological level, neurobiological stress systems (e.g., HPA axis) need to become sensitive to contexts that pose challenges to one's ability to respond in culturally normative ways and those be potentially threatening to one's concept self or a benevolent other (Dickerson & Kemeny, 2004). Stress responses might therefore be activated and most responsive to stressors that are most relevant to specific cultural norms/contexts. Supporting this hypothesis, an adult study found that Caucasian American participants showed greater amygdala activation to African American faces when compared to Caucasian faces due to cultural knowledge of negative stereotypes about African Americans in US cultural environments (Lieberman et al., 2005). While no study has yet examined whether typically-developing young children's HPA axes are also sensitive to potential stressors that are salient to one's culture, early adversity studies in rodent models have demonstrated that neurobiological responses to stress are highly sensitive to early experiences (McGowan et al., 2009). Collectively, these findings suggest that our HPA axes (as indexed by cortisol responses)

may also develop sensitivities to stressors that are salient to one's culture if they are perceived as such by the individual. Nonetheless, it is not clear when or whether young children's neurobiological stress responses become sensitive to cultural norms.

To examine these questions, we examined cortisol reactivity among 136 preschoolers (aged 4 – 6) living in US (N = 42), China (N = 58) and Japan (N = 36) using three different stress paradigms designed to induce challenges relevant to differing contexts. The first stress paradigm was an envelope-sorting task designed as a control task irrelevant to any cultural emphasis, but could in fact elicit a stress response since it was always conducted on the first day of the three-day study and was the first time the child was left alone in the room to complete a task. The second paradigm was a frustrating computer task designed to make children fail at what they previously experienced as an easy game. This task was designed to induce frustration due to the impossibility of achieving the desired goal and presented an achievement-related stressor. The third paradigm was a "disappointing" prize task in which an unfamiliar adult presented an undesirable "prize" after the child was told by a familiar adult experimenter that he or she would receive the prize they ranked as most desirable. This last paradigm elicits disappointment in a social context that has the potential to disrupt interpersonal harmony, given that the child had previously ranked that prize as the least desirable and was led to expect a different outcome by a responsible experimenter. Thus, it presents an interpersonal relations-related stressor. We focus on preschoolers because a) they have had more exposure to cultural norms than infants (Friedlmeier, Corapci, & Cole, 2011); and b) they are actively learning to internalize such norms to manage their stress under challenging conditions such as preschool which includes adjusting one's reactions in interactions with peers and unfamiliar adults (Cole et al., 2004). Although

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early childhood is a period in which sensitivity to culture is increasing, it unclear whether it would be observed at a neurobiological level.

Traditionally, Chinese cultures have emphasized the importance of self-improvement and achievement from an early age (Chao & Tseng, 2002; Stevenson et al., 1990; Li, 2002). More recently, direct preschool observations in China find that teachers continue to stress the importance of self-improvement through direction instruction and criticism (Tobin et al., 2009). The Confucian emphasis on improving oneself also shapes contemporary parental beliefs regarding success and failure. With high expectations and standards for achievement, Chinese parents downplay children's successes and emphasize children's failures, whereas US parents do the opposite (Miller et al., 2012; Ng et al., 2007). Relatedly, Chinese parents have higher involvement in their children's homework, relative to American and Japanese families (Stevenson et al., 1990). Correspondingly, Chinese children feel more negatively about their achievement failures and US children feel more positively about their successes (Ng et al., 2007). If the HPA axis is sensitive to cultural contexts and these cultural contexts have become salient by the preschool age, we may expect that Chinese preschoolers would show higher levels of cortisol reactivity to an achievement-related stress paradigm. Alternatively, if the HPA axis is *not* responsive to culture, we may observe activation that shows sensitivity to individual differences amongst children, but not to contextual manipulations.

Japanese children may also be sensitive to achievement-related contexts, but there has been less research on achievement emphasis in young children and more research on the importance of interpersonal relationships at this age in Japanese culture (Hayashi, Karasawa, & Tobin, 2009). Several studies have found that a central tenet during the preschool years is the cultivation of *interdependency* (e.g., expression of lonliness to promote a desire for social

connection) and responsibility to others' needs (Hayashi et al., 2009; Rothbaum, Nagaoka, &

Ponte, 2006). Direct preschool observations in Japan have also shown that Japanese teachers,

relative to Chinese and US teachers, promoted the desirability of social connections (Tobin et al.,

2009). In some schools, learning how to anticipate the needs of others is built into the preschool

curriculum for toddlers (Tobin et al., 2009). Given the strong cultural emphasis on

interdependency and understanding the needs of others, we may expect that Japanese

preschoolers would be particularly sensitive to contexts that involve disruption in social

connection (e.g., violating the needs of others) and show higher levels of cortisol reactivity to an

interpersonal relationship-related stressor, relative to other potentially stress-inducing paradigms.

In contrast, the developmental goal during the preschool years in the US is to cultivate

self-esteem, self-expression and *individual* agency (Miller et al., 2012). Ethnographic interviews

of US mothers found that the promotion of self-esteem to foster positive self-regard is a key

childrearing goal during early childhood (Miller et al., 2012). Direct preschool observations in

the US revealed that teachers also promoted the importance of individual choices in group

settings (Tobin et al., 2009). Moreover, the expression of self in US-individualistic cultures is

often invariant across contexts, whereas the expression of self in interdependent cultures (i.e.,

Chinese and Japanese) is situation-bound (Markus & Kitayama, 1991). Given this, we may

expect that US preschoolers would show less reactivity to achievement-related or interpersonal-

related stressors or variability to contexts when compared to a baseline (control) stress-inducing

paradigm, as these values are not emphasized during the US preschool years.

Method

Participants

Participants are from the same study as Study 1. In China, one participant had a diurnal cortisol more than 4SD above the mean and was removed as outliner. A total of 58 children were included (33 males; M = 52.41 months; SE = .44). In Japan, 36 children with available cortisol data were included (22 males; M = 51.72 months; SE = .08). In the United States, 13 children were excluded due to 1) conditions that would influence cortisol levels (e.g. asthma, medications), 2) children of Asian backgrounds, and 3) a diurnal cortisol greater than 4SD above the mean. The final US sample included 44 children (29 males; M = 54.16 months; SE = .72), of which 86.7% were Caucasian and 13.3% were African American.

There were no child gender differences across cultures (Chi-square (2) = 2.99, p = .22). US preschoolers were slightly older than Japanese preschoolers (F = 3.67, p < .05) and US and Japanese mothers were slightly older than Chinese mothers (F = 11.94, p < .001). US mothers also reported significantly higher education than Japanese and Chinese mothers (F = 15.94, p < .001), although there were no differences in father's education. Thus, all analyses were controlled for child's age, mother's age and education to eliminate potential confounds due to cross-cultural differences.

Procedure

Same procedure as Study 1.

Measures

Envelope task (control). All children completed an envelope task designed as a control task that was hypothesized to be irrelevant to cultural emphasis on the first day of the three-day study. During this task, children were shown a pile of envelopes and a pile of papers and were instructed to help the experimenter stuff each envelope with one sheet of paper (*Phase 1: Examiner asks for help*) while the experimenter leaves the room for a few (three) minutes (*Phase*

2: Examiner leaves) and that children were told that if they helped the experimenter by stuffing as many envelopes as they could, they would get to choose a prize. Examiners returns after three minutes (*Phase 3: Examiner returns*) and choose a prize from an attractive grab-bag (*Phase 4: Child chooses prize from grab-bag*).

Computer task (achievement-related). During the 2nd or 3rd day of testing (counter-balanced across participants in each culture), children played a computer game that was initially easy but then became impossible to win, thus inducing a sense of failure due to an inability to complete the task. Children were first shown the computer game and instructed to "lasso" cattle that strayed from a path leading to corrals in a barn. If the child did not lasso the straying cattle, the cattle headed off into a stream instead of to the corrals. During the practice session, the experimenter instructed (*Phase 1: Instruction*) and played the game with the child to ensure that he/she won the game, regardless of how long it took (*Phase 2: Practice game*). The child was told that he/she would receive a prize if he/she successfully won the game by getting cattle into the corrals instead of the stream (i.e., if three cattle strayed into the stream, the child would lose the game.). The child then was left alone to play the game (*Phase 3: Practice ends and real game begins*). Initially, the game worked fine, but it became progressively more difficult and was covertly activated into '"no-win" mode such that the button used to "lasso" the cattle stopped working intermittently. At the end of the game, a loud buzzer beeped, and a large, red 'frowny' face symbol appeared on the screen to signify that the child had lost (*Phase 4: Losing game (buzzer)*). This phase of the task took approximately 2-3 minutes. 60s after hearing the loud "game over" buzzer, the experimenter returned and asked the child if he/she won the game and expressed concern if the child said no (*Phase 5: Examiner returns*). A second experimenter then entered the room and told the first experimenter that the game was broken and needed to be

fixed, and that she/he should not have used that game. The first experimenter then apologized to the child for using the wrong game and gave the child his/her present anyhow (*Phase 6: Examiner apologizes*).

Disappointing Prize task. During the 2nd or 3rd day of testing (counter-balanced across participants), children completed the disappointing prize task (Cole, 1986) designed to elicit threat/distress due to a violation of interpersonal harmony. More details on task description can be found in Study 1.

Cortisol sampling of stress paradigms

Salivary cortisol was collected using Salivettes (Salimetrics, LLC State College, PA) 30 minutes prior to the beginning of each task, and then at 0, 10, 20, 30, 40, 50, 60, 75, and 90 minutes after each stress paradigm. The purpose of taking a sample 30 minutes prior to the onset of each stressful paradigm was to observe cortisol levels and to better identify baseline cortisol sample that were not "contaminated" by potentially arousing activities that took place in the children's preschool settings prior to the study, as well as any anticipatory anxiety (i.e., separation distress) or excitement the children might have prior to each stress paradigm (Lopez-Duran et al., 2009).

Following a standard procedure, a minimum of 200 ul. of saliva absorbed in cotton dental rolls (without flavoring or stimulant to avoid chemical interference) was collected for each sample by asking children to gently chew the dental rolls for 60 seconds. Research assistants chewed dental rolls in parallel with the children and used sticker charts and pretended that the cotton roll was their favorite ice cream flavor or food as motivation to ensure compliance in collecting the samples. The cotton dental rolls were then inserted into a plastic Salivette and refrigerated until centrifuged. Each sample was centrifuged at 3000 rpm for 5 minutes within 24

hours of collection and stored at -20 C until assayed. All samples were assayed in duplicate using commercial kits (High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit, Salimetrics, LLC State College, PA) at all project sites. Inter-assay variability was less than 5% across all sites. Ten samples were assayed in all locations to determine inter-site reliability, and the Pearson correlation for sample values across both US and China was .95, with no systematic variation in cortisol levels among the two sites.

Missing cortisol *data imputation*. The fraction of missing cortisol data for the cortisol responses was small (1.5%) with a few subjects having incomplete data in different tasks. We imputed missing values and used the complete data set for all the analyses. Missing cortisol data were imputed using the IVEWARE24 SAS macro following a multivariate regression model with missing values imputed sequentially based on the observed values within and across tasks. Data were log transformed for the imputation process to improve normality and transformed back to the original scale after imputation. Because of overall differences in the mean cortisol values across each country, the imputation was performed separately by country.

Diurnal morning cortisol and timing of stress paradigm as covariates

Children's diurnal morning (AM) cortisol samples collected at 30 minutes after waking at home and the onset time of each stress task were measured on Days 1, 2, and 3 following same procedure and model of assay kit. Day (Days 1, 2 and 3) X Culture (US, Chinese, Japanese) ANOVAs were conducted to examine potential within and between cultural differences on 1) AM cortisol levels and 2) onset time of each stress paradigm across 3 days. Children's AM cortisol did not differ across days ($F = 1.08$, $p = .34$), cultures ($F = 1.69$, $p = .19$) and there was no Day X Culture interaction ($F = .13$, $p = .97$). While the onset time of each stress paradigm did not vary by days within each culture ($F = .20$, $p = .77$), Japanese children had a later onset time

on the stress paradigms than their US and Chinese counterparts ($F = 10.51$, $p = .000$), but there was no Day X Culture interaction ($F = .10$, $p = .97$). Although we found no difference on child's AM cortisol and timing of task across 3 days by each culture (Table 3), to be conservative, we included children's AM cortisol and onset timing of stress paradigms as covariates in our analyses (see below) given their potential confounding effects.

Preliminary data and data analytical plan

Substantial skewness was found in the cortisol data. A natural log transformation was performed and used in all analyses as recommended by Tabachnick and colleague (2007). Nonetheless, additional analyses revealed that all results were consistent with or without log transformation. For ease of interpretation, untransformed cortisol values are presented in the Tables and Figures.

To minimize and to ensure that baseline cortisol was not inflated by high levels of cortisol due to physiological reactivity to novelty or pre-task' activities during acclimation period, cortisol obtained at 10 minutes post-task was used as baseline (instead of the sample obtained at time 0) for all analyses. Separate analyses were conducted to examine pre-task cortisol (-30 to 0 minute) changes in each day by culture (see below).

Total cortisol output. To examine total cortisol output for each paradigm by culture, area under the curve with respect to ground (AUCg) was computed based on established formulas and guidelines (Pruessner et al., 2003). AUCg is assumed to index total hormonal output, and therefore higher AUCg indicated higher cortisol output (Fekedulegn et al., 2007). AUCg was calculated based on the time window between 10 minutes to 90 minutes post-task. Comparison was conducted using a Culture (US, Japanese and Chinese) X Task (Envelope, Computer and

Prize tasks) X Gender ANCOVA with child's age, mother's age, mother's education, child's AM cortisol, timing of the task and task order entered as covariates.

Stress paradigm-induced changes in cortisol. Our primary goal was to understand how children's HPA axes (as indexed by cortisol reactivity) in each culture would react to stress paradigms relevant to particular stress-eliciting situations (i.e., achievement-related versus interpersonal-related). To take full advantage of the multiple sampling time points, generalized estimating equation (GEE) models were conducted in SPSS to identify time points with cortisol changes (relative to baseline), and to identify specific paradigms (within the same model) that could elicit cortisol changes for each culture. The GEE model was chosen over repeated measures ANOVA because unlike ANOVA comparisons, GEE models allow for specification of correlation matrix (e.g., using first-order auto-regressive AR (1) structure) that takes into consideration the non-independent and inter-correlated nature of different sampling points. It thus allows us to draw more robust inferences regarding the variance-covariance matrix with better Goodness of Fit (Liang & Zeger, 1986). First, to examine whether there would be a significant interaction effect between culture and stress paradigm on cortisol reactivity, we conducted a GEE model with Culture (US, Japanese and Chinese), Task (Envelope, Computer and Prize tasks), Time Point (10 – 90 minutes), child's gender, two-way interactions (Culture X Task, Culture X Time Point, Task X Time Point, Culture X Gender, Task X Gender) and a 3-way interaction of Culture X Task X Time Point entered as predictors to estimate children's cortisol levels. Child's age, mother's age, mother's education, child's AM cortisol, onset time of the stress paradigm and task order were entered as covariates in this model. If the 3-way interaction (Culture X Task X Time Point) was deemed significant, three separate models (one for each culture) were then conducted with Task (Envelope, Computer and Prize tasks), Time

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Point (10 – 90 minutes), and the interactions of Task X Time Point entered as predictors to estimate children's cortisol levels relative to baseline, given that our primary goal was to identify specific stress paradigm's time points *within* each culture that could elicit cortisol changes. Covariates that were not significant from the first model were also dropped to ensure that we have sufficient power to detect the effect of interest. AR(1) correlation matrix was used for all GEE analyses because it has the best Goodness of fit (as indexed by QIC and QICC).

Pre-task- related (acclimation period) changes in cortisol. In addition, we also examined cortisol changes during the *pre-task period* (from -30 to 0 minutes before stress paradigms) by each day and culture to understand how children may react to the beginning of the experiment/novelty. A Culture X Day X Time Point GEE model was conducted to estimate cultural differences in changes of cortisol during the pre-task period. Similarly, child's age, mother's age, mother's education, child's AM cortisol and timing of cortisol were entered as covariates in the model.

Results

Total levels of cortisol (AUCg) by task and culture

There was a significant main effect of task ($F = 4.51$, $p = .01$) and culture ($F = 9.92$, $p < .001$). The computer task elicited higher levels of total cortisol (as indexed by AUCg) than the envelope task. Chinese preschoolers had higher total cortisol levels (across all 3 tasks) than US and Japanese preschoolers (Figure 5).

Stress paradigm-induced changes in cortisol by culture

Our primary goal was to examine whether children in each culture would show higher levels of cortisol reactivity to stress paradigms that are differentially relevant to their cultural contexts. As shown in Table 4, there was a significant main effect of Culture, Time Point,

Culture X Task and Culture X Task X Time Point interactions. Given the significant three-way interaction, three GEE models (one for each culture) were conducted to examine time points in the stress paradigms that would elicit cortisol reactivity within each culture. Child's AM cortisol, the only covariate associated with cortisol level (Table 5), was included in all subsequent analyses. Nevertheless, results did not vary with or without the inclusion of other covariates.

Control (Envelope-stuffing) task. For children in all cultures, the envelope (control) task did not elicit a significant change of cortisol response relative to baseline (10-minute post-task), as can be seen from a non-significant main effect in the GEE model that examined changes in the cortisol trajectory (Table 5; Figures 6 - 8) provide support for the use of the Envelope Task as a control paradigm.

Chinese preschoolers. We hypothesized that Chinese children's neurobiological stress system (i.e., HPA axis) may be particularly sensitive to achievement-related stressors. Supporting this, we found that Chinese preschoolers exhibited a significant increase in cortisol only after the frustrating computer (achievement-related) task, as indexed by a significant main effect of Time Point (Wald Chi-Square (W) = 28.59, $p < .001$) and Task X Time Point interaction (W = 32.23, $p = .004$) in the GEE model. Specifically, the GEE model revealed that Chinese children showed a significant increase in cortisol (relative to baseline) after the computer, but not the prize, task at 30, 40 and 60 minutes, and a marginally increased cortisol response at 20 and 75 minutes post-task (Figure 6; Table 5).

Japanese preschoolers. We hypothesized that Japanese children's HPA axes may be particularly sensitive to interpersonal-related stressors. Consistent with our hypothesis, we found that Japanese preschoolers exhibited a significant increase in cortisol only after the prize (interpersonal harmony-related) task, as indexed by a significant main effect of Task (W = 7.88,

p = .02), Time Point (W = 18.44, *p* = .01) and Task X Time Point interaction (W = 55.76, *p* <

.001). Specifically, the GEE model revealed that Japanese children showed a significant increase

in cortisol (relative to baseline) after performing the prize (but not the computer) task at 50 and

60 minutes post-prize task (Figure 7; Table 5).

      US preschoolers. Finally, given previous studies using laboratory-induced stressors with

US preschoolers, we hypothesized that US preschoolers would be less likely react to our

laboratory-based paradigms, and that their cortisol reactivity would not differ across the three

different laboratory-induced stressors in our study, as these contexts are not salient to their

cultural emphases during the preschool years. Supporting this, we found no significant increase

in cortisol reactivity in any of the stress paradigms among US preschoolers (Figure 8, Table 5).

Pre-task-related (acclimation period) changes in cortisol

      Intriguingly, while our initial purpose of including a pre-task (-30 minutes to 0)

acclimation period was to account for physiological reactivity due to anticipatory stress (i.e.,

separating from caregivers or established school environments), we found that both Japanese and

US preschoolers consistently reacted during this anticipatory period across all three days of

testing. Moreover, US preschoolers reacted more strongly (larger slope) than either the Chinese

or the Japanese preschoolers (See Figure 9). Specifically, each GEE model (one for each day)

revealed a significant main effect of Culture (Wald Chi-Square (W) = 12.01, *p* = .007 for Day 1;

W = 24.18, *p* < .001 for Day 2; W = 15.61, *p* = .001 for Day 3) and Culture X Time point

interaction (Wald Chi-Square (W) = 12.01, *p* = .007 for Day 1; W = 24.18, *p* < .001 for Day 2;

W = 15.61, *p* = .001 for Day 3).

Discussion

Our results suggest that the HPA axis may be a critical biological system that reacts to culturally specific stressors, reflecting a biological adaptation to culture occurs early in development. With the cultural priority of self-improvement and achievement from an early age (Chao & Tseng, 2002; Stevenson et al., 1990), an achievement-related stressor elicited an increased cortisol response among Chinese preschoolers, suggesting that Chinese children may have already internalized achievement failure as a salient threat to core representations of self. Similarly, with a cultural priority of social connectedness, an interpersonal-related stressor elicited an increased cortisol response among Japanese preschoolers. This finding is consistent with adult literature on the importance of interdependent self-construct in Japanese culture (Markus & Kitayama, 1991), suggesting that Japanese children may have already internalized this value.

We found that Chinese preschoolers had higher total cortisol levels (across all 3 tasks) than US and Japanese preschoolers (Figure 5). Some possibilities for the higher overall cortisol levels among Chinese preschoolers may be attributed to quality and number of children in the daycare environment (Geoffroy et al., 2006) and longer commuting times or parental socialization (Doan et al., 2017) but these factors were not systematically measured in this study.

We did not find significant increase in cortisol across tasks for US preschoolers, but they were reactive to anticipatory stress (i.e., separation from caregiver and exposure to novel experimental settings) during the acclimation period which may inflate the baseline cortisol level given that elevated cortisol levels may require prolonged period for recovery (Liu et al., 2017). Consistent with our findings, when controlling for cortisol levels upon arrival, Lopez-Duran et al., (2009) found that typically-developing US children showed a decrease from 30 minutes prior to the stressor (at time 0), and did *not* show change in cortisol from 0 to 60 minutes after the

fear- or frustration-based stressors. Indeed, US children showed higher cortisol levels when samples were collected in a novel laboratory setting, relative to the home environment (Gunnar & Talge, 2007), and an increased cortisol response in the laboratory *only* when the stress paradigm was administrated with an unfamiliar and unfriendly experimenter (Roos et al., 2017). They also exhibited increased levels of cortisol in day-care settings which were positively correlated with their anxiety levels (Gunnar, Kryzer, Van Ryzin, & Phillips, 2010). It remains possible that US preschoolers react to novelty and/or anticipatory stress to a greater extent that Chinese and Japanese children who live in much denser environments and may be more used to seeing and interacting with people outside their immediate family or preschool. Further research is needed to identify culturally-relevant stress paradigms that could elicit cortisol reactivity among US preschoolers.

Our findings offer five implications. First, children's HPA axes may be critical biological systems that are more reactive to psychosocial stressors are relevant to the sociocultural emphases in children's everyday lives. Children's biological sensitivity to culturally-relevant stressors suggest that culture is deeply "embedded" in our biological systems (Kitayama & Salvador, 2017) such that it shapes the HPA axis response and furthers our potential for cultural learning. Moreover, children as early as preschoolers may have already internalized cultural customs and practices salient to their daily environment. Second, our findings demonstrate that contexts matter in understanding stress responses. It also highlights the need to understand the *underlying meaning* of these contexts when designing stress-inducing paradigms critical to elicit a stress response of the HPA axis during the preschool period (Gunnar et al., 2007). Third, cultural heterogeneity exists even within so-called "Eastern" cultures, highlighting the importance of going beyond the prevailing East versus West, interdependence versus

independence distinction in order to capture the complexities and subtleties of cultural norms and

socialization processes driving cultural phenomena (Super & Harkness, 1999). Fourth, educators

and practitioners must be aware that children from different cultural backgrounds may be

differentially reactive to psychosocial stressors that are salient to their cultural upbringings.

Finally, providing well-established routines, especially around separation and reunion, may help

US preschoolers to alleviate cortisol elicited during day-care and school setting.

Chapter V

Study 3: Emotional Expressions and Physiological Reactivity Across Contexts: A Multi-contextual and Multi-level Study of Emotion Regulation with US and Chinese Preschoolers

Cultural variations in emotion regulation have been observed across development from infancy onward (Camras, 1992, p. 199). Using behavioral paradigms, most cross-cultural studies found that children from interdependent cultures (e.g., Chinese, Japanese, Indian, Asian American) are less expressive (both positive and negative emotions) than children from independent cultures (e.g., European American, African American, German; Ahadi, Rothbart, & Ye, 1993; Camras et al., 2006; Friedlmeier & Trommsdorff, 1999; Garrett-Peters & Fox, 2007; Lewis, Takai-Kawakami, Kawakami, & Sullivan, 2010; Louie et al., 2015; Wilson, Raval, Salvina, Raval, & Panchal, 2012). The lower levels of emotional expression among children from "Eastern" cultures is often explained by cultural orientation (e.g., independent-interdependent; Marcus & Kitayama, 1991) differences in the propensity to express strong emotions and to make one's own desires known in "Western" cultures that value independence, in contrast to the tendency to *suppress* them in order not to create trouble or discomfort for the group in "Eastern" cultures that value social harmony (Matsumoto et al., 2008; Tsai et al., 2006). Traditional, Chinese cultural value and socialization of emotional constraint/suppression (Chen & Swartzman, 2001; Russell & Yik, 1996) is thought necessary for strengthening desirable moral traits (Chen et al., 2006). However, prior cross-cultural studies have yet to use multi-level and multi-contextual approaches to understand how *cultural priorities* – collective beliefs, values, and practices that are salient and essential for

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becoming successful members with a society - can influence children's emotion expression and regulation at different levels of processing.

As Campos and colleagues (2004) noted, emotion reactivity and regulation are intertwined, and regulation takes place at all levels of the emotion process, at all times the emotion is activated, and is evident even before an emotion is manifested. We therefore conceptualize emotion regulation (ER) is a *complex system* that involves dynamic regulation of behavioral (e.g., direct displays of emotions), experiential and physiological (e.g., HPA axis) responses to internal and external stimuli (Gross, 2015). This complex system is supported by intrinsic regulatory inputs, including both a) top-down (i.e., regulation strategies such as suppression) and b) bottom-up processes (i.e., emotion reactivity) (Ochsner & Gross, 2014), and is influenced by extrinsic environmental inputs, including c) socialization (Eisenberg et al., 1998) and d) contexts guiding what, when and how emotions are expressed, and what types of regulation strategies are being implemented. Through socialization, culture as a shared beliefs system provides "rules" for the types of regulation (i.e., emotional control), experience preferences (i.e., calm versus excitement) that are deemed to be "appropriate" and contexts that are salient to an individual. Guided by this framework, we addressed three critical gaps in knowledge by examining children's emotional expressions and cortisol reactivity to three paradigms designed to induce challenges relevant to differing contexts among preschoolers living in the US and China.

First, young children are limited in the capacity to subjectively report their "inner" emotional experiences. Therefore, most prior cross-cultural studies used behavioral paradigms to compare changes in children's emotion expressions that are associated with activated emotions in response to situational challenges (Calkins & Perry, 2016; Cole et al., 2004). Yet solely relying on behavioral observation obscures whether the observed cross-cultural differences are

driven by top-down regulation (i.e., emotional control) versus bottom-up emotion reactivity (Campos et al., 2004; Thompson, 2011). In other words, prior findings of lower expressivity among Asian children may be due to higher emotional control, or alternatively, lower reactivity (or not feeling stress) towards the "challenging" paradigms. To address this issue, we used a multi-level approach to examine children's emotion regulation to "challenging" paradigms at both behavioral (emotional expression) and physiological (cortisol reactivity) levels.

Second, most cross-cultural studies of emotion displays only relied on *one* method (e.g., the "disappointing" gift paradigm) or measure from one context. Indeed, Adrian et al., (2011) conducted a 35-year review across 157 studies of ER assessments of children and found that 61.1% of published ER research relied on *one* method of assessing ER, and only 15.3% using three or more methods. In other words, most of our current knowledge of children's emotion expression and regulation is limited to studies using a single measure or measures in one domain as a representation of children's overall emotion regulation across contexts. However, context matters and it matters especially when trying to understand similarities and differences across cultures in how emotions are displayed (Aldao, 2013; Liu, 2008). To address this gap, our study used a multi-contextual approach to assess children's ER by using three paradigms designed to elicit "challenges" relevant for preschoolers in three different contexts (i.e., interpersonal-related, achievement-related and neutral).

Third, from a developmental niche framework, culture shapes the course of development through three subsystems: 1) children's physical and social environments; 2) caregivers' ethnotheories (folk and intuitive beliefs); and 3) cultural customs and practices of child rearing (Super & Harkness, 1999). These subsystems operate together to serve as a guiding principal for children to learn about their *cultural priorities*, including beliefs, values, practices that are essential

for the course of development. Children may most strongly react to emotionally challenging paradigms/contexts that are salient to their *cultural priorities*. In fact, based on Gross (2015)'s extended model of emotion regulation, regulation begins with a perception of a psychologically relevant situation, and evaluated in terms of their meaning in light of the individuals' currently active goals. It is this contextually-based evaluation that gives rise to changes in experiential, behavioral and physiological response systems that characterize emotions. This evaluation is in turn strongly influenced by the degree to which the context is salient or motivationally relevant to an individual. A context that is more emotionally or motivationally significant (or threatening) to an individual may trigger this evaluation system to elicit greater changes in experiential, behavioral and physiological regulation to that specific context; culture provides a strong guiding principal for which context an individual should prioritize and evaluate as salient. Despite this, we know little about how cultural priorities affect emotion regulation in children, in part because most existing investigators have "borrowed" measurement paradigms that were developed in the Western society to compare children's emotion expression/regulation across cultures. Yet the psychometric validity of a task does not mean that it has *cultural validity* (Olson et al., 2019). Imposing Western models/paradigms to the study of cultural influences in emotion regulation assumes that physical events can elicit the same quality and types of emotions in children across cultures. However, we cannot use an environmental event as a proxy for an expected emotional outcome (Campos et al., 2004; Saarni, 1979). As Sroufe (1997) noted, it is the meaning of the event, not its physical composition, that determines the emotion. Our study therefore aims to address this gap by examining how *cultural priorities* may influence children's emotional display and physiological (cortisol) reactivity.

Cultural priorities for Chinese preschoolers

Chinese culture emphasizes the importance of self-improvement and achievement from an early age (Chao & Tseng, 2002; Stevenson et al., 1990; Li, 2005; Parmar, Harkness & Super, 2004). For instance, Chinese parents put pressure on teachers and their children to excel academically and preschool socialization is thought to provide children with an early start and to ensure that they are "not left behind at the starting line" (Tobin et al., 2009, p.39). Similarly, direct observations of Chinese preschools revealed that the practice of critique is encouraged among teachers as a means towards cultivating learning and self-perfection. In contrast, US preschool teachers discouraged the use of direct criticism, believing that it may hurt children's self-esteem (Tobin et al., 2009, p.64 – 69). With high expectations and standards for achievement, Chinese parents downplay children's successes and emphasize children's failures, whereas US parents do the opposite (Miller et al., 2012; Ng et al., 2007). Relatedly, Chinese parents have higher involvement in their children's homework relative to American and Japanese families (Stevenson et al., 1990). Correspondingly, Chinese children feel more negatively about their achievement failures and US children feel more positively about their successes than others (Ng et al., 2007). If cultural priorities affect emotion regulation in children, we may expect that Chinese preschoolers may be more behaviorally expressive and physiologically reactive towards contexts related to achievement relative to contexts that are less relevant to their daily environment. Alternatively, if cultural priorities do not influence emotion regulation, we may expect that children would show similar levels of emotional expression and reactivity across contexts, and also lower emotional expression and reactivity across contexts than US children.

Current study

We aimed to understand how cultural priorities can influence children's emotion regulation at both behavioral (emotion expression) and physiological (cortisol reactivity) levels

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among preschoolers living in the US and China using three stress paradigms designed to induce challenges relevant to differing contexts. The first stress paradigm was an envelope-sorting task designed as a control task irrelevant to any cultural emphasis, but could in fact elicit a challenge since it was always conducted on the first day of the three-day study and was the first time the child was left alone in the room to complete a task. The second paradigm was a "disappointing" prize task (Cole, 1986) developed in the US and have been used to examine cross-cultural variations in emotion displays (Garrett-Peters & Fox, 2007). In this paradigm, an unfamiliar adult presented an undesirable "prize" after the child was told by a familiar adult experimenter that he or she would receive the prize they ranked as most desirable. This paradigm elicits disappointment in a social context that has the potential to disrupt interpersonal harmony, given that the child had previously ranked that prize as the least desirable and was led to expect a different outcome by a responsible experimenter. Thus, it presents an interpersonal relations-related challenge. The last paradigm is the frustrating computer task designed to make children fail at what they previously experienced as an easy game (see method below). This task was designed to induce frustration due to the impossibility of achieving the desired goal and presented an achievement-related challenge.

Aim 1) First, we examined cross-cultural differences in overall emotional expressions (regardless of paradigms). We hypothesized that US children would show higher levels of positive and negative expressions than Chinese children (Camras et al., 2006; Garrett-Peters & Fox, 2007; Louie et al., 2015). Second, we examined whether cross-cultural variations in emotion expression varied according to specific task contexts. We hypothesized that Chinese preschoolers would show similar (or even higher) negative emotional expressions in the

frustrating computer task (which represents the context of achievement-failure) relative to US preschoolers, but not in other paradigms that are less relevant to their cultural priorities.

Aim 2) For cortisol reactivity, we first examined whether children would elicit higher changes of cortisol reactivity in contexts that are more relevant their cultural priorities. We hypothesized that Chinese preschoolers may show higher levels of cortisol in the frustrating computer task – an achievement-related stress paradigm relative to other paradigms that are less relevant to their daily environment. Second, we examined cross-cultural differences in cortisol reactivity, and expected that Chinese preschoolers would show higher levels of cortisol particularly during the frustrating computer task compared to US preschoolers.

Aim 3) Finally, we explored whether children's emotion expressions (both positive and negative) would be associated with their cortisol levels in each culture. While it is generally assumed that physiological and behavioral indices of emotion are interrelated, Quas and colleauges (2000) found that levels of cardiovascular reactivity (i.e., heart rate) and vagal tone were *not* associated levels of concurrent facial expressions in 5-to-6-year-old children. Indeed, some empirical studies have suggested that differences in physiological reactivity do not necessarily correspond to differences in emotional expression (Mauss et al., 2005; Quas et al., 2000). We therefore did not make a prediction due to inconclusive evidence.

Methods

Participants

Same participants as Studies 1 and 2. In China, a total of 58 children were included (33 males; M = 52.41 months; SE = .44) for cortisol analysis, of which a subset of children with available video data were coded for emotional expression (n = 47 for Computer task, n = 57 for Prize task and n = 28 for envelope task). In the US, a total of 44 children (29 males; M = 54.16

months; SE = .72), of which a subset of children with available video data were coded for emotional expression (n = 31 for Computer task, n = 36 for Prize task and n = 28 for envelope task).

Procedure

Same procedure as Studies 1 and 2.

Measures.

Envelope task (control). All children completed an envelope task designed as a control task. See Study 2 for details.

Prize task (interpersonal-related). During the 2nd or 3rd day of testing (counter-balanced across participants), children completed the disappointing prize task (Cole, 1986) designed to elicit challenges due to a violation of interpersonal harmony. See Study 1 for details.

Computer task (achievement-related). During the 2nd or 3rd day of testing (counter-balanced across participants in each culture), children played a computer game that was initially easy but then became impossible to win, thus inducing a sense of failure due to an inability to complete the task. See Study 2 for study details.

Emotion expression coding

Same procedure as Study 1.

Cortisol sampling of stress paradigms

Same procedure as Study 2.

Preliminary data and data analysis plan

Emotional expression. Two separate Generalized estimating equation (GEE) models with Culture (US and Chinese), Task (Envelope, Computer and Prize tasks), Task Phase, two-way interactions (Culture X Task, Culture X Task Phases, Task X Task Phase) and a 3-way

interaction of Culture X Task X Task Phase were entered as predictors to estimate children's (1) positive expressions (summing across Happiness and Surprise) and (2) negative expressions (summing across Sadness, Anger, Fear, Disgust, Confusion and Shame). Children's gender, age, mother's age and mother's education were included as covariates. We summed across all positive and negative emotions for the GEE analyses because of the low frequency of each emotion and to increase power. Nonetheless our results were mostly driven by Happiness and Sadness expressions.

     Cortisol. Substantial skewness was found in the cortisol data. A natural log transformation was performed and used in all analyses as recommended by Tabachnick and colleagues (2007). Nonetheless, additional analyses revealed that all results were consistent with or without log transformation. For ease of interpretation, untransformed cortisol values are presented in the Tables and Figures. To minimize and to ensure that baseline cortisol was not inflated by high levels of cortisol due to physiological reactivity to novelty or pre-task activities during the acclimation period, cortisol obtained at 10 minutes post-task was used as baseline (instead of the sample obtained at time 0) for all analyses.

     To take full advantage of the multiple sampling time points, GEE models were conducted in SPSS to identify time points with cortisol changes (relative to baseline), and to identify specific paradigms (within the same model) that could elicit cortisol changes for each culture. First, to examine whether there would be a significant interaction effect between culture and stress paradigm on cortisol reactivity, we conducted a GEE model with Culture (US and Chinese), Task (Envelope, Computer and Prize tasks), Time Point (10 – 90 minutes), two-way interactions (Culture X Task, Culture X Time Point, Task X Time Point) and a 3-way interaction of Culture X Task X Time Point entered as predictors to estimate children's cortisol levels.

Children's age and gender, mothers' age, mothers' education, children's AM cortisol, onset time of the stress paradigm and task order were entered as covariates in this model. AR(1) correlation matrix was used for all GEE analyses because it has the best Goodness of fit (as indexed by QIC and QICC).

Emotion Expressions and Cortisol. To examine associations between children's emotional expressions and cortisol levels, averaged emotion expressions (in both positive and negative respectively) during the "challenging" phases (bolded in figures) and Area under the curve with respect to ground (AUCg) of each task were computed. AUCg is assumed to index total hormonal output, and therefore higher AUCg indicated higher cortisol output (Fekedulegn et al., 2007). AUCg was computed based on established formulas and guidelines (Pruessner et al., 2003) and based on the time window between 10 minutes to 60 minutes post-task to capture the reactivity period. Four sets of linear regression analyses (Positive Expression and Negative Expression on both Computer and Prize tasks) were run using Hayes's (2012) PROCESS (Model 1) - an extension package in SPSS for analyzing moderation model - to examine the main effect of Culture, Emotion Expressions and the interactive effect of Culture X Expressions on child's cortisol levels (AUCg). Child's age, gender, mother's age, mother's education, child's AM cortisol were included as covariates. Significant interactions were further examined using simple slope analyses within PROCESS.

Results

Emotion Expressions

For children's negative expressions, generalized estimating equation (GEE) analyses revealed significant main effects for Culture ($W(1) = 5.70$, $p = .017$), Task ($W(2) = 79.65$, $p < .001$), Task Phase ($W(7) = 105.86$, $p < .001$), 2-way interactions of Culture X Task ($W(2) =$

13.41, $p = .001$), Task X Task Phase (W(6) = 93.25, $p < .001$) and a marginal significant

interaction of Culture X Task X Task Phase (W(6) = 11.59, $p = .07$) after controlling for child's

gender, age, maternal age and education. For children's positive expressions, GEE revealed

significant main effects for Culture (W(1) = 18.99, $p < .001$), Task Phase (W(7) = 132.15, $p <$

.001), 2-way interactions of Culture X Task (W(2) = 11.10, $p = .004$), Task X Task Phase (W(6)

= 162.60, $p < .001$) and a significant Culture X Task X Task Phase interaction (W(6) = 56.36, p

$< .001$).

As expected, children displayed significantly more negative expressions in both the

Computer (Mean (M) = .13, SE = .01) and Prize (M = .15, SE = .02) tasks than the Envelope

(control) task (M = .02, SE = .00), whereas children displayed similar levels of positive displays

across all tasks (Envelope: M = .13, SE = .01; Computer: M = .15, SE = .01; Prize: M = .15, SE

= .01). These findings corroborate that both the Computer and Prize tasks are challenging tasks

that elicit negative emotions for preschool-aged children. Children also displayed higher

negative expressions during the challenging phases of each task (See Figure 10).

Aim 1a) Are there cross-cultural differences in overall emotion expressions?

As shown in Figure 10, regardless of task contexts, US children displayed higher levels

of negative and positive expressions than Chinese children, consistent with prior studies

suggesting that US children are more expressive than children from contrasting cultures.

Aim 1b) Do children's emotional expression differed based on cultural contexts?

As shown in Figure 11, children exhibited no cultural differences in negative expressions

during the control (Envelope) task and children from both cultures showed low negative

expressions at baseline (control). During the Prize task, Chinese preschoolers displayed lower

levels of negative expressions than US children during the challenging/stressful phases (Figure

11). This finding was consistent with prior studies showing that Asian children have higher levels of emotional control and tend to be less expressive than children from North America. However, during the Computer task, Chinese children expressed just as much negative emotionality as US children (Figure 11). For positive expressions, US children displayed higher levels of positive affect during the non-stressful phases on both the Envelope and Computer tasks (Figures 12) and were able to "bound" back to show relatively higher positive expressions than Chinese children during the /apology debriefing phases. US children showed similar levels of positive expression during the challenging phases of each task compared to Chinese children (Figure 12).

Cortisol.

There were significant main effects for Culture (W(1) = 13.55, *p* < .001) and Time Point (W(8) = 74.64, *p* < .001), as well as significant interactive effects for Culture X Time Point (W(8) = 15.74, *p* =.046) and Culture X Task X Time Point (W(16) = 31.44, *p* =.012). Higher child's AM cortisol, the only significant covariate, positively associated with cortisol level (W(1) = 7.2, *p* = .007).

Aim 2a) In each culture, does children's cortisol reactivity differ by paradigms/contexts?

Control (Envelope-stuffing) task. For all children in all cultures, the Envelope (control) task did not elicit a significant change of cortisol response relative to baseline (10-minute post-task), providing support for the use of the Envelope task as a control paradigm.

Chinese preschoolers. We hypothesized that Chinese children's neurobiological stress system (i.e., HPA axis) may be particularly sensitive to achievement-related stressors. Supporting this, we found that Chinese preschoolers exhibited a significant increase in cortisol *only* after the frustrating Computer (i.e., achievement-related) task. Specifically, Chinese children showed a significant *increase* in cortisol (relative to baseline) after the Computer, but

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not the Prize, task at 20 – 60 minutes post-task (Figure 13). Cortisol levels were similar between the Prize and the Envelope (control) tasks (Figure 13).

US preschoolers. Finally, given previous studies using laboratory-induced stressors with US preschoolers, we hypothesized that US preschoolers would be less likely react to our laboratory-based paradigms, and that their cortisol reactivity would not differ across three different laboratory-induced stressors in our study, as these contexts are not salient to their cultural emphases during the preschool years. Supporting this, we found no significant increase in cortisol reactivity in any of the stress paradigms among US preschoolers (Figure 13). In fact, US preschoolers showed a *decrease* in cortisol levels at 50- and 60-minutes post-task during the Prize task and at 75-minutes post-task during the Computer task relative to baseline. Cortisol levels were similar for both Prize and Computer tasks when compared to the Envelope task, except for Prize task at 50 – 60 minutes and for Computer task at 75 minutes had *lower* cortisol levels than the Envelope task.

Aim 2b) Are there cross-cultural differences in cortisol reactivity?

Overall, Chinese preschoolers had higher total cortisol levels than US preschoolers. As shown in Figure 14, while Chinese preschoolers had higher levels of cortisol than US preschoolers across all three paradigms, the cortisol difference was most pronounced in the Computer task.

Aim 3) Are children's emotion expressions associated with cortisol levels?

Linear regression analyses using PROCESS in SPSS (Hayes, 2012) revealed that there was a significant Culture X Negative Expressions interaction on cortisol levels during the Computer task ($F = 2.50$, $p = .02$, R-square $= .24$). Specifically, post-hoc simple slope analyses indicated that higher negative expressions during the Computer task were associated with higher

cortisol levels (AUCg) among Chinese (B = 3.31, SE = 1.39, p = .02) but not US preschoolers (B = -1.45, SE = 2.00, p = .47). No other significant interaction effects were found.

Discussion

Our study examined cross-cultural variations in emotion expression and reactivity among US and Chinese preschoolers using three stress paradigms that were differentially relevant to their cultural priorities/contexts. Specifically, we examined whether children would differentially express their emotions in response to task contexts that were relevant to their cultural emphasis/priorities. Second, we examined associations between individual differences in children's emotion expressions and cortisol reactivity.

We found that regardless of task context, Chinese preschoolers displayed lower levels of positive and negative expressions relative to their US counterparts (Figure 10). This finding converges with prior studies indicating that Asian/Asian Americans generally display lower levels of positive and negative expressions compared to their Euro-American counterparts (e.g., Ahadi, Rothbart, & Ye, 1993; Camras et al., 2006; Friedlmeier & Trommsdorff, 1999; Lewis, Takai-Kawakami, Kawakami, & Sullivan, 2010; Louie et al., 2015; Wilson, Raval, Salvina, Raval, & Panchal, 2012). Researchers have attributed these findings to cultural orientation (independence – interdependence; Davis et al., 2012; Markus & Kitayama, 1991) or to the observation that children from Eastern cultures are socialized to value emotional constraint (Russell & Yik, 1996) and calm affect (Tsai, 2007). In our study, when we examined emotion displays among Chinese preschoolers using the disappointing Prize task (Cole, 1986) - a commonly-used behavioral paradigm developed in the U.S. to assess display rules of disappontment in front of an examiner (Cole et al., 2004; Liew et al., 2004) - we also found converging evidence that Chinese preschoolers displayed less negative expression across

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different "challenging" phases in both social and solitary conditions compared to US perschoolers (Figure 11A). One potential explanation could be that Chinese children strongly value emotional constraint and may have used "top-down" strategies such as masking or suppression as a way of suppressing their emotions.

However, when taking different task conditions into consideration and using multi-level (behavioral and physiological) analyses, we found striking evidence that Chinese preschoolers displayed just as much negative and positive expressions as their US counterparts during the "challenging" phases on the Computer task (Figure 11C). This task was designed to elicit achievement-related frustration, which is more relevant to the high value placed on individual acvhievement within Chinese culture . Consistently, only the frustrating computer task effectively elicited an increase in cortisol reactivity among Chinese preschoolers (Figure 13) and Chinese preschoolers showed more pronounced cortisol differences than their US counterparts during the Computer task in comparison to other less culturally-relevant stress paradigms (Figure 14). In addition, moderation analyses revealed that Chinese preschooler's negative expressions were associated with higher levels of cortisol only during the Computer task. These findings therefore suggest that Chinese preschoolers were both more behaviorally expressive and physiologically reactive to a challenging task that was related to achievement. Most previous cross-cultural comparative studies have relied solely on behavioral coding and did not explicitly take cultural contexts into consideration. We speculate that prior findings that Asian children were less emotional expressive than others may be partially attributed to study paradigms that were not able to sufficiently elicit higher emotion reactivity among Asian children. These tasks often were developed using children from North American cultures and therefore may not reflect stressful situations in differing cultures (Cole & Jacobs, 2018). Further examination is

needed to understand whether Chinese children are more likely to use top-down strategies such as suppression or masking to regulate their emotions during contexts that are more relevant (versus less) to their cultural priorities. Nevertheless, our findings challenge the suggestion that East Asian children are universally less emotionally expressive than others. Instead, our data demonstrate that emotion expression and regulation have to be understood in contexts that are relevant to the sociocultural emphases in children's everyday lives. In other words, simply translating or adapting a psychometric validated measure without understanding its cultural validity may distort the interpretation of cross-cultural variations (Olson et al., 2019). Our findings also highlight the importance of using a multi-level approach to differentiate reactivity versus regulation in order to understand cultural variations of emotion regulation in young children.

Notably, it is possible that Chinese preschoolers were more likely than US preschoolers to express their emotions differently across tasks. Supporting evidence comes from our finding that Chinese preschoolers showed differentiated emotion expressions between achievement-related and interpersonal-related tasks, but US children were behaviorally expressive but not particularly physiologically reactive across all task contexts. Indeed, we found that US preschoolers showed *decreased* cortisol levels following the Prize and the Computer tasks relative to baseline (Figure 13), which is consistent with prior cortisol studies on US preschoolers showing a non-significant or even a decreased mean cortisol levels following a psychosocial stressor (Gunnar et al., 2009). Moreover, we found no evidence that US children's emotion expressions were associated with their cortisol levels, again in line with prior studies suggesting that differences in reactivity do not necessarily correspond to differences in facial expression (Barrett 2016; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; McGinnis,

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2017; Quas, Hong, Alkon, & Boyce, 2000). For example, McGinnis (2017) found that verbal and non-verbal fear behaviors coded from fear-eliciting tasks (i.e., evaluative speech and fearful snake tasks) were *not* associate with cortisol reactivity in US preschoolers. Cross-cultural studies of adults have shown that individuals in collectivistic/interdependent cultures are more likely to express themselves differently in different social contexts, whereas those in individualistic cultures are less likely to vary their self-expressions according to differing contexts (Marcus & Kitayama, 1991). It remains possible that US children's higher levels of behavioral expressions across contexts may serve as a regulation strategy to down regulate physiological stress. Alternatively, adult studies have shown that cortisol is related to enhanced early processing of social threat (e.g., angry faces), which may reflect increased allocation of cognitive resources (e.g., vigilance) to motivational salient stimuli. The lack of associations between US children's behavioral expressions and cortisol levels could be attributed to the fact that our study paradigms may not be motivationally salient (or threatening) to US children. Nevertheless, our findings suggest that the intricate link between behavioral and physiological regulation may be differed across cultures, highlighting the necessity to use a multi-level approach to understand how culture may shape children's emotion regulation at different levels of processing.

Strengths and limitations

To our knowledge, this is the first study to examine cross-cultural variations in emotion expression and reactivity among children living in the US and China using multiple stress-inducing paradigms. Our multiple cortisol sampling (a total of 10 time points) approach also allowed us to look more closely on how different contexts may shape emotion expression and reactivity and across differing time points during the observations. However, several caveats must be acknowledged. First, small sample size renders our conclusions preliminary, and

replication with a larger sample size will be needed to corroborate these findings. Second, we acknowledge that there is substantial heterogeneity within each culture, therefore our findings do not represent and may not be generalized into other ethnic and sub-cultural groups within China and the United States. On the other hand, examining non-immigrant Chinese children living in China is a strength of our study that eliminates potential confounding effects such as changes of emotional processes related to acculturation and enculturation (Camras et al., 2006). Third, our study did not look at potential moderators (e.g., child temperament) or mediators (e.g., parenting) that were beyond the scope of our study. Fourth, we acknowledge that culture is not static and future studies using a cohort designs may be beneficial to understand how factors such as globalization may shape our findings.

Chapter VI
General Conclusions

My dissertation aims to understand young children's emotion regulation as a complex system by examining how extrinsic inputs including both culture and context may shape children's top-down (i.e., masking as regulation strategies; Study 1) and bottom-up (i.e., emotion reactivity; Studies 2 - 3) processes that support children's emotional displays and regulation across different challenging contexts. To achieve this goal, I studied preschoolers living in the US, China and Japan using a multi-level and multi-contextual approach. To summarize:

Study 1 examined culture and context (social versus non-social) effects on children's emotion displays and top-down regulation (i.e., masking) during disappointment. Results revealed that across the three cultures, children showed more positive expressions of emotion ("fake smile") in the presence of examiners than when they were alone when they received a disappointing gift, suggesting that preschool-age children across cultures tend to mask their disappointment with positive displays in social contexts. However, children's emotion expressions varied across both cultures and contexts. US children were more positively and negatively expressive than Japanese children (Figures 2a and 3), and more negatively expressive than Chinese children. Chinese and Japanese preschoolers verbally reported more negative emotions but showed more neutral expressions than US preschoolers when receiving the disappointing gift. In addition, across different contexts of the task, there were subtle differences in how Chinese and Japanese regulated their emotional expressions, with Chinese children showing similar levels of *neutral* expressions (e.g., "poker-face") across different contexts in the task. These findings converge with prior work showing that Asian/Asian American children are

more likely to exert emotional control than Euro-American children, possibly reflecting

distinctions between individuals from "interdependent" and "independent" cultural backgrounds.

In Study 2 I examined whether young children's bottom-up (i.e., cortisol reactivity) response processes are differentially sensitive to contexts that are relevant to cultural priorities using three different stress paradigms. I found that children's neurobiological stress responses, as indexed by salivary cortisol, were activated and responsive to psychosocial stressors most relevant to their cultural contexts. Specifically, an achievement-related stressor successfully elicited an increased cortisol response among Chinese preschoolers, whereas an interpersonal-related stressor successfully elicited an increased cortisol response among Japanese preschoolers (Figures 6 - 7). Contrastingly, cortisol responses did not differ by condition among US preschoolers but showed a consistent anticipatory response to parental separation at the beginning of each session. These findings suggest that children's neurobiological stress regulation systems may be particularly reactive to contexts that are culturally salient.

In Study 3 I examined culture *by* context effects to understand how cultural priorities may shape children's emotional displays behaviorally and emotion (cortisol) reactivity physiologically using the same three stress paradigms from Study 2. I found that without considering cultural priorities, consistent with Study 1's findings and prior literature, Chinese preschoolers displayed lower levels of negative expressions relative to their US counterparts. However, when were given a task (the achievement-related frustrating computer task) that was relevant to their cultural emphases, Chinese preschoolers displayed similar levels of negative expressions to US children. Moreover, only the frustrating computer task (but not the prize or control tasks) effectively elicited increases in cortisol reactivity among Chinese preschoolers (Figure 6). Similar to previous lab-based studies with U.S. children, no cortisol increase was

observed in any of the paradigms for US preschoolers. Furthermore, higher levels of negative emotional displays were positively associated with higher levels of cortisol during the frustrating computer task among Chinese not but US preschoolers. These findings therefore challenge the suggestion that East Asian children are universally less emotionally expressive than children from different cultures. Instead, our data demonstrates that emotion expression and regulation have to be understood in contexts that are relevant to the sociocultural emphases in children's everyday lives. In particular, Chinese preschoolers were more behaviorally expressive and physiologically reactive to contexts that were related to achievement. American children, in contrast, were behaviorally expressive, but not particularly physiologically reactive, regardless of context. Moreover, the lack of associations between their behavioral expressions and cortisol levels among American children may be attributed to the fact that our study paradigms may not be motivationally salient (or threatening) to US children critical to eliciting an HPA response.

Implications and future considerations

Children's emotion regulation is sensitive to cultural contexts

While children across cultures regulate their emotions, *when and how* they regulate are influenced by situational contexts, and cultural values and socialization give meaning to specific situational contexts. Children are more likely to show higher emotional displays and cortisol reactivity in contexts that are emotionally or motivationally salient based on shared cultural values. This suggests that children as young as preschoolers may have already internalized cultural norms, customs and practices to actively manage their emotions under challenging conditions (Cole, Martin, & Dennis, 2004). My findings further suggest that this can be observed at both behavioral (i.e., display rules) and physiological (i.e., cortisol reactivity) levels. Indeed, as noted in Gross' (2015) extended model of emotion regulation, regulation begins with a

perception of a psychologically relevant context that gives rise to changes in experiential, behavioral and physiological response systems that characterize emotions. My findings suggest that the neurobiological stress regulation systems (HPA axis) may reflect this contextual evaluation by showing differential reactivity to contexts that are more salient/threatening to an individual. This evaluation allows children to learn what is psychological relevant (versus less relevant) based on their cultural environment. Therefore, children's HPA axis may be critical biological mechanisms allowing societal-level cultural phenomena to be "embodied" in individual-level responses, even amongst preschoolers. Yet, it remains unclear the exact timing or whether there is sensitive period for "cultural ebodiment" to occur, or how socialization and other ecological factors may shape this process. Future studies are needed to understand how different parenting practices and ecological stress across cultures may shape children's neurobiololgical responses to different contexts.

Heterogeneity between "Eastern" cultures

In cross-cultural studies of emotion, it is common to combine participants from different Asian cultural backgrounds (i.e., Chinese, Japanese, Korean etc.) in order to compare how "Easterners" are different from "Westerners". This is in part because scholars have argued that cultural orientations for collectivistic/interdependent cultures versus individualistic/self-focused cultures are the source of differences in the propensity to express strong emotions and to make one's desires known versus the tendency to control them in order not to create trouble or discomfort for the group (e.g., Davis et al., 2012; Markus & Kitayama, 1991). However, such broad distinctions may not adequately capture the complexities and subtleties of cultural norms and meanings driving emotion expression across varying "Eastern" cultures (Oyserman et al., 2002). As demonstrated in my findings, while children from both Asian cultures may value

social harmony and emotional control, there were differences between them in in both behavioral and physiological responses to stressful situations. These findings may be attributed to differences in cultural meanings and motivation underlying emotional control, as well as differences in cultural priorities. Due to limitations in study design, Study 3 did not include Japanese preschoolers. Thus, I was unable to examine whether Japanese preschoolers would be more behaviorally expressive and physiologically reactive to an interpersonal-related challenge compared to other contexts/paradigms that are less culturally relevant during the preschool period. My studies also did not address within parenting beliefs and practices within each culture that may mediate the observed behavioral and physiological differences across cultures. Future studies are needed to address these limitations. Nevertheless, my studies highlight the importance of moving beyond the conventional "Eastern" versus "Western" comparisons, and understanding cultural meanings and practices underlying emotion development in early childhood (e.g., see also Chen, 2019).

Culture and cultural priorities are not static

It is important to note that while culture and contexts shape children's emotion regulation, the emphasis on different cultural values can change due to societal changes, modernization and globalization. For example, traditional Chinese culture values shyness as socially adaptive for maintaining group harmony and functioning; in contrast shyness is often viewed as socially undesirable and immature in Western cultures (Chen, 2019). However, with recent economic reforms toward a more capitalistic and competitive market-oriented society in China, assertiveness and self-expression have become more adaptive to modern Chinese society. As a result, Chinese cultural values about shyness have changed in recent years, as indicated by evidence showing that shyness is associated with more negative peer attitudes such as peer

rejection among urban Chinese children during middle childhood to early adolescence (Liu et al., 2015). Another example comes from ethnographic interviews conducted by Tobin and colleagues (2009). In their "Preschool in three cultures, revisited", the authors observed that with rapid economic reform, some preschools in China have shifted from teacher-centered (i.e., focuses on direct instruction to children) to child-centered learning (i.e., focuses on exploratory play) over the years. At the same time, with China's rapid modernization, more working-class and rural parents considered education as a route to social mobility for their children. As a result, Chinese parents increasingly put pressure on teachers to provide more academic preparation in preschool to ensure that their children can excel academically, and "not be left behind at the starting line" (Tobin, Hsueh & Karasawa, 2009, p. 39). High levels of academic pressure starting in modern China may have shaped preschool children's understanding that achievement is essential for them to become successful members within the society. This may explain our findings that Chinese preschoolers were more behaviorally expressive and physiologically reactive to contexts that are related to achievement. Yet, because my studies did not explicitly measure children's perceived academic pressure or cultural priorities, further studies are needed to corroborate this hypothesis. Notably, while we did not find a significant increase in cortisol levels during the achievement-related stress paradigm among Japanese preschoolers (or US children), this pattern may change across development given that achievement (in academic or in other domains) is also highly valued in Japan (and in the US) during adolescence. It is therefore also important to consider cultural changes due to development.

No "gold standard" for assessing emotion regulation

Behavioral observation under "challenging" situations has often been considered the "gold standard" for assessing emotion regulation in young chidren (Calkins & Perry, 2016). Yet,

relying solely on behavioral observation makes it hard to differentiate emotion reactivity versus regulation as they are often intertwined (Campos, Frankel, & Camras, 2004; Thompson, 2007). In order words, observed behavioral outcomes of children could result from 1) exertion of top-down control (e.g., masking), 2) levels of bottom-up reactivity (e.g., children's levels of stress or reactivity towards the "challenging" paradigms), or 3) a combination of both. Despite this, most studies of ER heavily relied on behavioral observation and were therefore unable to distangle emotion reactivity versus regulation.

A second critical gap is that most comparative studies did not explicitly take into the consideration differing performance contexts, esepcially whether the tasks being used to assess emotion expressions were culturally-relevant. Failure to account for contexts may result in dramatically different conclusions (i.e., Study 1 versus Study 3). Therefore, I argue that there is no "gold standard" for assessing emotion regulation in young children. Instead it is important to use a multi-level and multi-contextual approach to carefully partial out different "pieces" within the complex systems that support children's emotion regulation. Moreover, to develop paradigms that are culturally valid, we must first use a bottom-up approach to assess cultural beliefs among parents. And because these beliefs are often implicit and taken-for granted, one must assess directly in ways that allow parents to generate their own culturally grounded beliefs (Olson et al., 2019).

Developmental and gender consideration in the study of emotion regulation

My studies have only focused on emotion regulation in young children. However, children's neurobiological systems (e.g., frontoamygdala circuitry) for emotion regulation are immature and highly sensitive to caregiver's input and their everyday environment. For example, Gee, Humphreys et al., (2013a) revealed that during the transition from childhood to

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adolescence, there is a developmental switch from positive to negative functional connectivity between the amygdala and medial prefrontal cortex (mPFC) – a neural circuitry critical for emotion regulation of negative stimuli. Moreover, children who experienced parental deprivation during infancy exhibited more mature pattern of amygdala-mPFC connectivity (similar to patterns among adolescents), suggesting that early parental deprivation may accelerate the maturation of fronto-amygdala circuitry (Gee et al., 2013b). Although it is beyond the scope of my dissertation, it is important to examine how cultural contexts may influence the dynamic changes of emotion regulation systems during the transition from childhood to adolescence, and how culturally relevant stressors may influence the timing of the maturation of neural circuitry for emotion regulation.

Notably, my studies did not find culture x gender interactive effects on children's behavioral expressions and cortisol reactivity. However, it is well-documented that internalizing symptoms such as fear and anxiety are more common in girls than boys from childhood (Ollendick et al., 2002), and girls are twice as likely as boys to develop internalizing problems through adolescence and into adulthood (Beesdo et al., 2009). While the mechanisms underlying greater propensity for internalizing in girls than boys remain poorly understood, prior work has shown that brain regions (e.g., amygdala) for processing threat and anxiety-provoking stimuli are more sensitive in girls (Lebron-Milad et al., 2012; Stevens & Hamann, 2012). It is unclear whether greater sensitive to threat observed in girls is context specific and thus requires further examination, especially in older children.

Future directions

There are many future directions that are worthy to explore. Here I describe only a few examples. Fist, from both studies 2 and 3 and previous lab-based studies with U.S. children, no

cortisol increase was observed in any of the paradigms for US preschoolers. Therefore, what are cultural priorities for US preschoolers and culturally- and developmentally- appropriate tasks that can elicit an increased mean level of cortisol? Second, my studies suggest that cultural contexts/priorities may shape children's emotion regulation at both behavioral and physiological levels. Yet a limitation that requires future studies is to examine specific socialization and practices that allow children to learn about their cultural priorities in order to better understand mechanisms that may shape children's emotion regulation. Third, our studies mostly focus on how contexts and cultural priorities affect bottom-up cortisol reactivity, I am interested in understanding how cultural priorities may influence *top-down* processes of emotion regulation using a multi-level and multi-contextual approach. For example, how do culture x context interactions affect the use of different emotion regulation strategies (masking versus suppression etc.) among children across cultures? Third, how does emotional acculturation affect emotion regulation among immigrant children, and at what specific contexts and levels of processing? Fourth, Chinese preschoolers were more reactive to contexts that are related to achievement, which may create cultural-relevant manifestations of mental health challenges, such as achievement-related stress and anxiety. Despite this, there has been little research examining early childhood socio-emotional and neurobiological factors underlying these cultural-relevant challenges, which requires future studies.

Conclusion

Emotion regulation has been proposed to be a common foundation for socio-emotional development across cultures. Yet, emotion regulation is a *complex system* that involves intrinsic input consists of both top-down (i.e., masking as regulation strategies; Study 1) and bottom-up (i.e., emotion reactivity; Studies 2 - 3) processes, which is further influenced by extrinsic inputs

consist of cultural socialization and contexts. My dissertation highlights that while young

children across cultures are able to express and regulate their emotions across different contexts,

their behavioral expressiveness and physiological reactivity are sensitive to *specific* cultural

contexts. These data highlight the importance of considering culture by context interactions

when studying emotion regulation. I argue that this can be accomplished through the analysis of

multiple levels and multiple contexts in children's emotion regulation, which represent a first

step towards understanding adaptive versus maladaptive emotion regulation.

*Table 1 **(Study 1)**.* Sociodemographic Characteristics of the Participants

Variables	China		Japan		United States		Pairwise
	M	*SD*	*M*	*SD*	*M*	*SD*	Comparisons
Child age (months)	52.34	3.29	52.98	6.56	53.27	4.64	n.s.
Gender (girls: boys)	28:31		19:27		25:20		n.s.
Mother age in years	33.07	2.74	36.62	4.19	36.27	4.94	CH < JP, U.S.***
	(*n*=55)[1]				(*n*=44)[1]		
Father age in years	35.75	3.35	38.49	6.61	37.16	6.93	n.s
	(*n*=55)[1]				(*n*=38)[1]		
Mother education [1-7][2]	5.40	1.12	5.11	1.02	6.20	.82	CH, JP < U.S.***
	(*n*=55)[1]		(*n*=45)[1]		(*n*=44)[1]		
Father education [1-7][2]	5.64	1.16	5.72	.75	6.03	1.09	n.s.
	(*n*=55)[1]				(*n*=37)[1]		
Mother full-time employment	83%	na	6.5%	na	62.8%	na	JP < CH, U.S.***
	(*n*=54)[1]				(*n*=43)[1]		
Father full-time employment	96.3%	na	100%	na	86.5%	na	U.S. < JP, CH*

	(n=54)[1]		(n=36)[1]		(n=37)[1]		
Number of siblings	.04	.19	.87	.69	1.05	.70	CH < JP <
	(n=54)[1]				(n=42)[1]		U.S.***
Married (%)	100%	na	100%	na	80.5%	na	U.S. < JP, CH***
	(n=54)[1]				(n=41)		

Note: *p <.05. ** p < .01. ***p < .001, [1]Ns are different due to missing demographic data; [2]Education 1= 0 to 3 years of schooling, 2= 4 to 6 years of schooling, 3= 7 to 9 years of schooling, 4= 10 to 12 years of schooling, 5= 2-3-year college or technical School, 6= 4-year university, 7= Post-graduate education.

Table 2 (Study 1). Mean proportion (percentage) of time spent in emotional display across all task phases

Emotions	China Mean (SD)	Japan Mean (SD)	US Mean (SD)	Total Mean (SD)	F	Comparison
Positive Emotions						
Happiness	.126(.187)	.069 (.133)	.163 (.207)	.120 (.183)	18.26***	US > CH > JP
Surprise	.006 (.017)	.004 (.013)	.007 (.014)	.006 (.015)	2.90	n.s
Negative Emotions						
Sadness	.069 (.154)	.100 (.213)	.194 (.270)	.116 (.213)	28.88***	US > CH, JP
Anger	.002 (.009)	.002 (.027)	.004 (.016)	.002 (.018)	1.27	n.s
Fear	.006 (.025)	.005 (.025)	.007 (.023)	.006 (.024)	.53	n.s
Disgust	.001 (.005)	.001 (.009)	.004 (.010)	.002 (.008)	7.43***	US > CH, JP
Confusion	.003 (.012)	.003 (.014)	.004 (.013)	.004 (.013)	.39	n.s
Shame	.000 (.003)	.000 (.000)	.000 (.003)	.000 (.002)	1.06	n.s
Neutral	.668 (.286)	.689 (.279)	.482(.294)	.618 (.300)	42.83***	CH, JP > US

Note. *p* <.05. ** *p* < .01. ***p* < .001

Table 3 (Study 2). Demographics, Diurnal morning cortisol and onset time of stress paradigms on each day by culture

	Chinese		Japanese		US	
	Mean	SE	Mean	SE	Mean	SE
Demographics						
Child's age (in months)	52.41	.44	51.72	.79	54.16	.72
Maternal education	5.41	.15	5.25	.09	6.29	.12
Mother's age (in years)	33.09	.37	36.75	.73	36.10	.71
Diurnal morning (AM) cortisol						
Day 1	.24	.02	.20	.10	.20	.02
Day 2	.24	.02	.21	.02	.20	.02
Day 3	.25	.02	.22	.02	.23	.02
Onset time of stress paradigms						
Envelope	11:31	.38	13:58	.47	11:20	.46
Prize	11:33	.38	13:54	.47	11:18	.46
Computer	11:31	.39	13:54	.48	11:14	.46

*Table 4 (**Study 2**).* Generalized estimating equation (GEE) model predicting children's cortisol levels

Variables	Wald Chi-Square	
Child's age	.40	
Child's gender	.69	
Mother's age	.39	
Mother's education	.20	
Child's AM cortisol	7.09	**
Onset time of the task	.11	
Task order	.00	
Task	2.11	
Culture	15.69	***
Time Points	44.77	***
Task X Gender	3.72	
Task X Culture	9.03	^
Culture X Time Point	17.37	
Task X Time Point	20.16	
Culture X Task X Time Point	55.29	**

Note. ^$p < .08$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 5 (Study 2). Generalized estimating equation (GEE) model predicting children's cortisol levels by each culture

	Chinese	Japanese	US
Variables	B	B	B
Child's AM cortisol	.16***	-.08	.22
Task: Computer	-.06	.07*	.00
Task: Prize	-.03	.01	-.03
Time: 20min	.02	.03	-.02
Time: 30min	-.07*	.03	-.03
Time: 40min	-.04	.01	.02
Time: 50min	-.04	-.03	-.03
Time: 60min	-.03	-.06	-.03
Time: 75min	-.09*	-.02	-.07
Time: 90min	-.07	-.01	-.09*
Computer X Time (20 min)	**.08+**	.04	-.01
Computer X Time (30 min)	**.18****	.02	-.02
Computer X Time (40 min)	**.14***	.05	-.05
Computer X Time (50 min)	.09	.05	-.01
Computer X Time (60 min)	**.12***	.08	-.02
Computer X Time (75 min)	**.11+**	.01	-.03
Computer X Time (90 min)	.03	-.04	-.03
Prize X Time (20 min)	-.03	.02	.05
Prize X Time (30 min)	.07	.01	-.02
Prize X Time (40 min)	.02	.02	-.04
Prize X Time (50 min)	.02	**.12***	-.05
Prize X Time (60 min)	.04	**.12***	-.11
Prize X Time (75 min)	.07	.06	-.03
Prize X Time (90 min)	.02	.02	.04

Note. +*p* < .08, *p* < .05, **p* <.01, ***p* < .001. Envelope task is referenced as the control task.

10 min post-task is the baseline time reference.

Figure 1. Emotion regulation as a complex system conceptual model

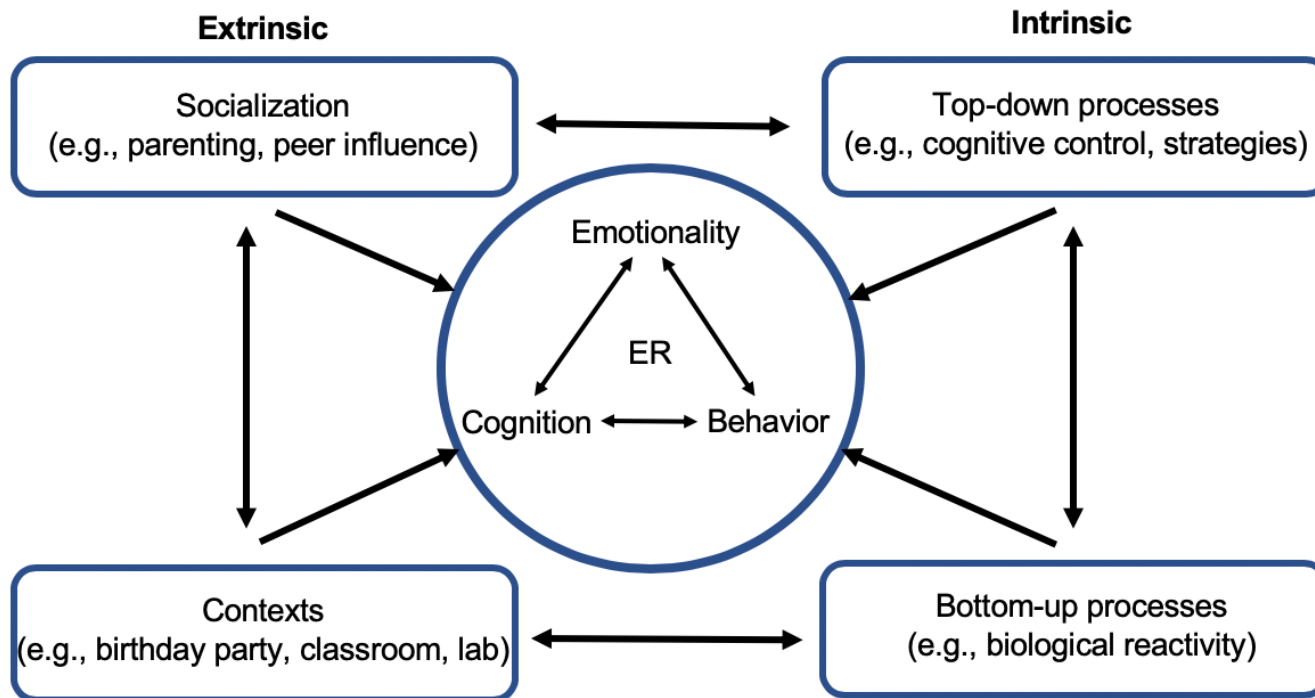**Figure 2a (Study 1).** Task phase effect on children's negative expressions by country

1. Gift Ranking, 2. Child Waiting, 3. Undesirable Gift - Unfamiliar Examiner,
4. Undesirable Gift - Alone, 5. Undesirable Gift - Familiar Examiner, 6. Best Gift

Figure 2b (Study 1). Display of Negative Expressions for Children *who reported feeling negative*

1. Gift Ranking, 2. Child Waiting, 3. Undesirable Gift - Unfamiliar Examiner,
4. Undesirable Gift - Alone, 5. Undesirable Gift - Familiar Examiner, 6. Best Gift
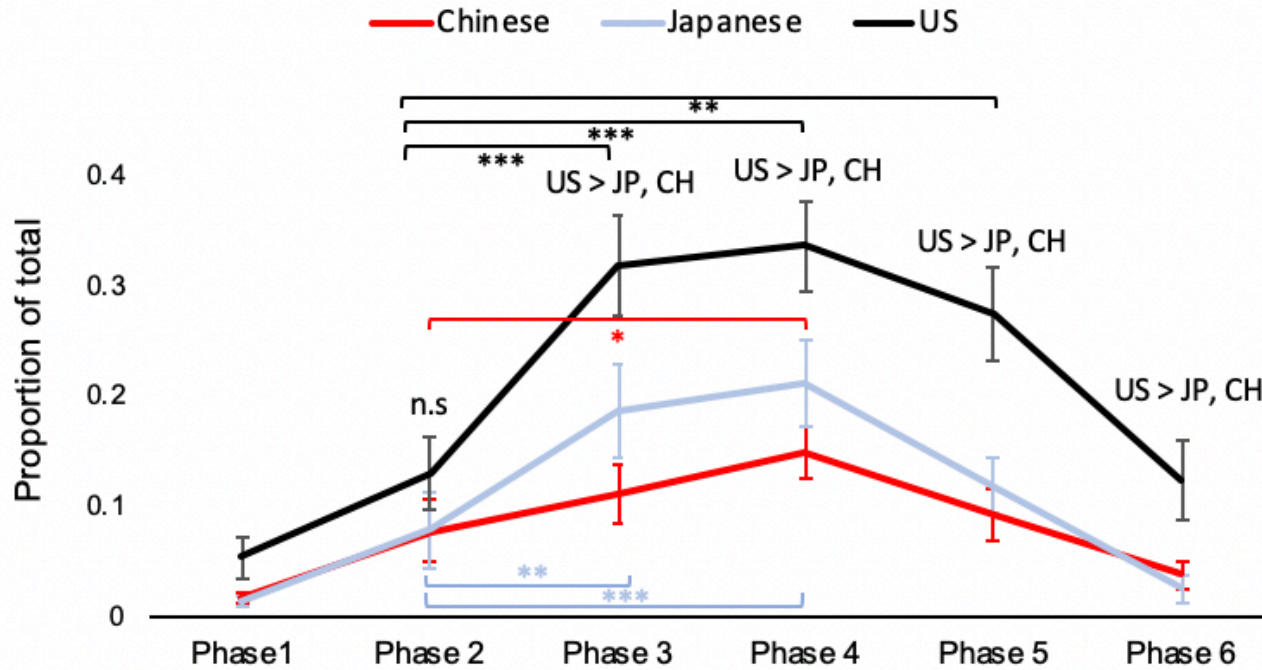
Figure 3 (Study 1). Task phase effect on children's positive expressions by country

1. Gift Ranking, 2. Child Waiting, 3. Undesirable Gift - Unfamiliar Examiner,
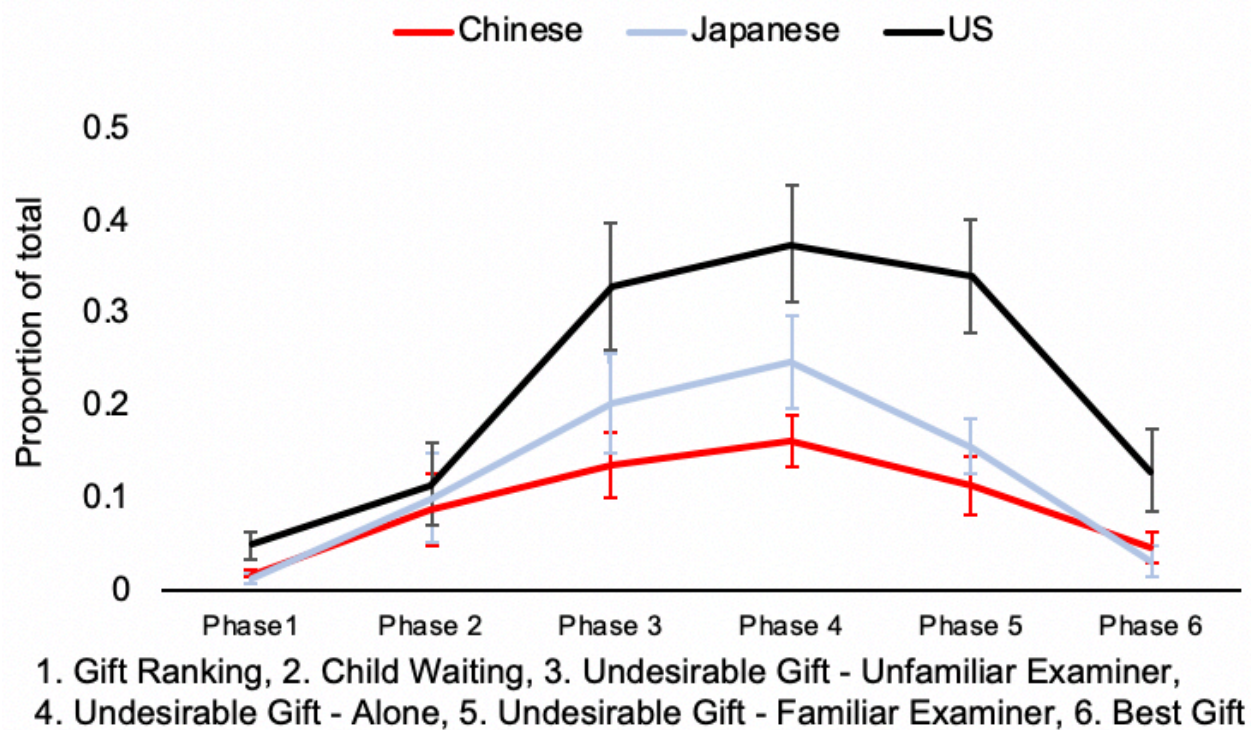4. Undesirable Gift - Alone, 5. Undesirable Gift - Familiar Examiner, 6. Best Gift

Figure 4 (Study 1). Task phase effect on children's neutral expressions by country
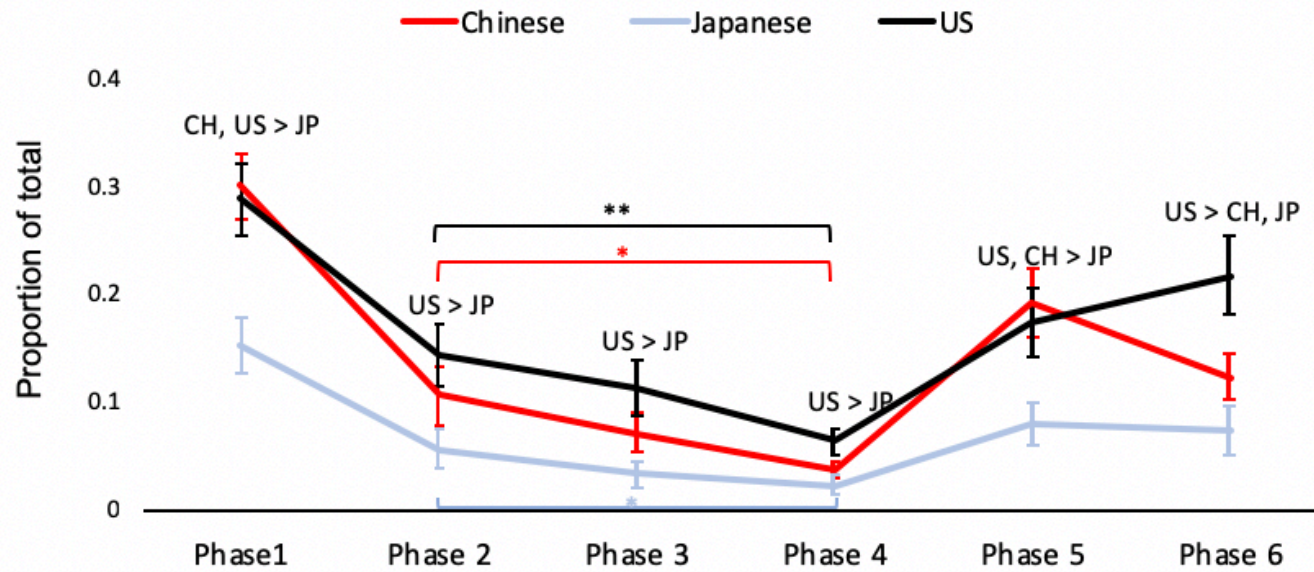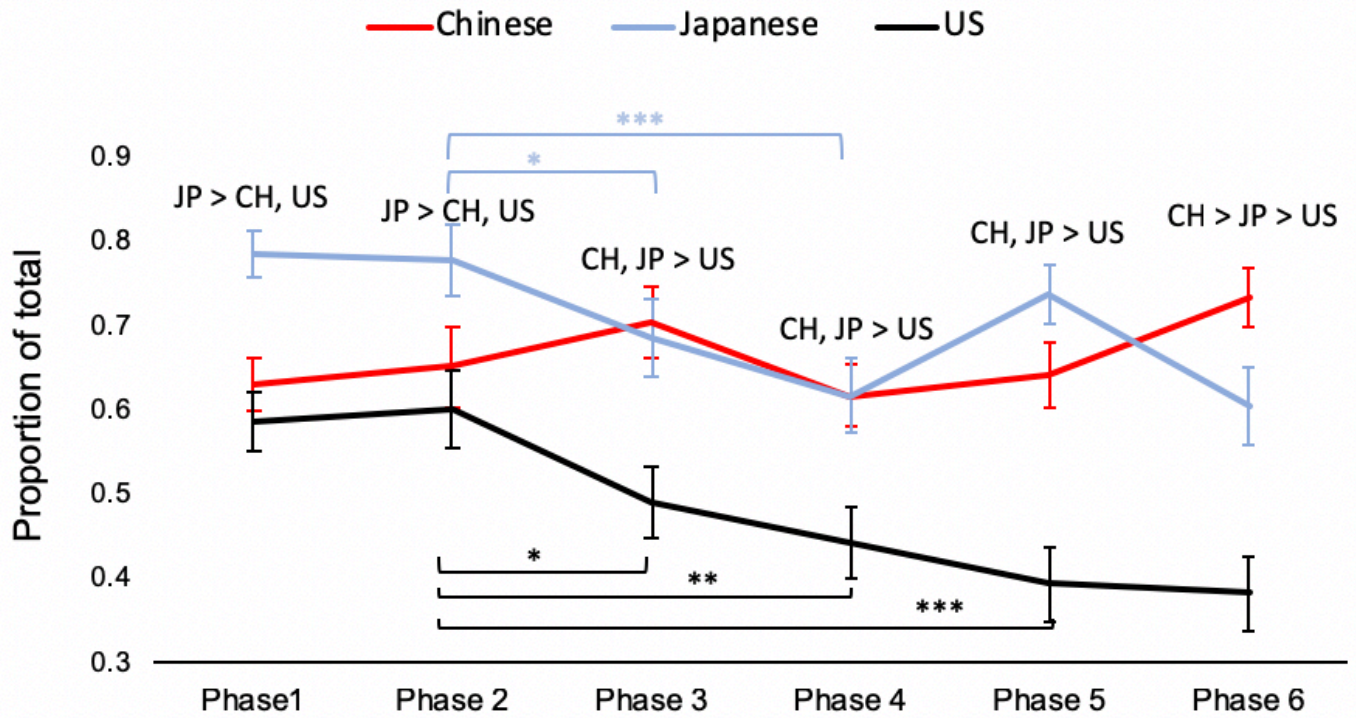

1. Gift Ranking, 2. Child Waiting, 3. Undesirable Gift - Unfamiliar Examiner,
4. Undesirable Gift - Alone, 5. Undesirable Gift - Familiar Examiner, 6. Best Gift

Figure 5 (Study 2). Total cortisol levels (AUCg) by culture. Chinese preschoolers had overall higher levels of cortisol than US and Japanese preschoolers across measures.
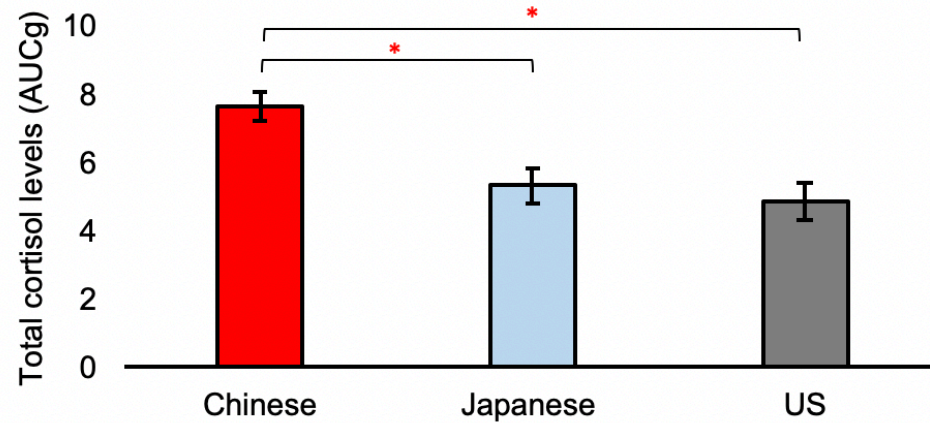
Figure 6 (Study 2). Generalized estimating modeling (GEE) across all post-task cortisol time points and stress paradigms in (a) Chinese preschoolers. Only the computer task –an achievement-related stressor - significantly elicited a change of cortisol response.
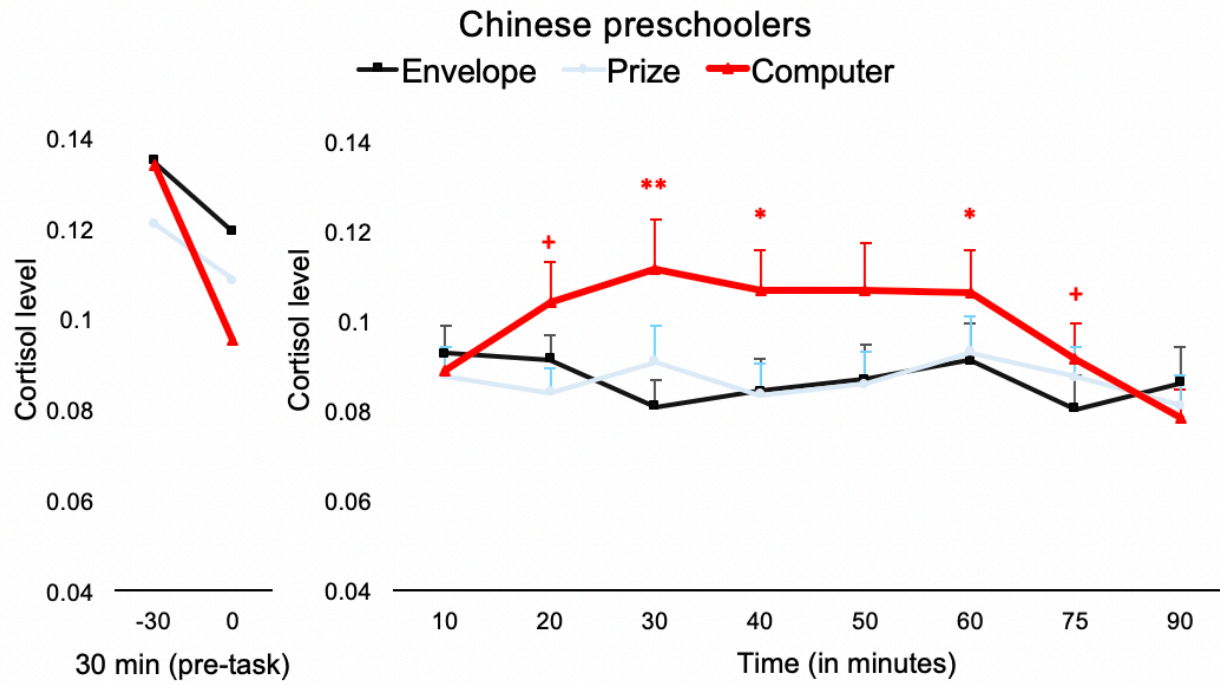
Figure 7 (Study 2). Generalized estimating modeling (GEE) across all post-task cortisol time points and stress paradigms in (b) Japanese preschoolers. Only the prize task – an interpersonal-related stressor - significant elicited a change of cortisol response.
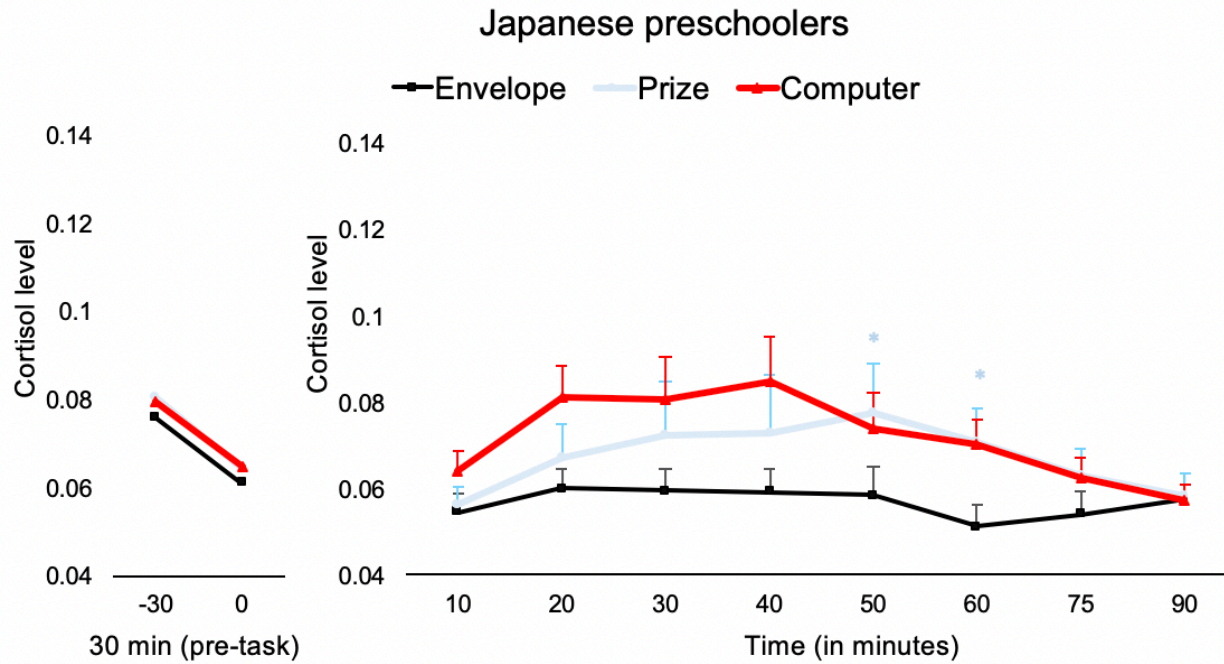
Figure 8 (Study 2). Generalized estimating modeling (GEE) across all post-task cortisol time points and stress paradigms (c) in US preschoolers. No change of cortisol is observed in any stress paradigms.
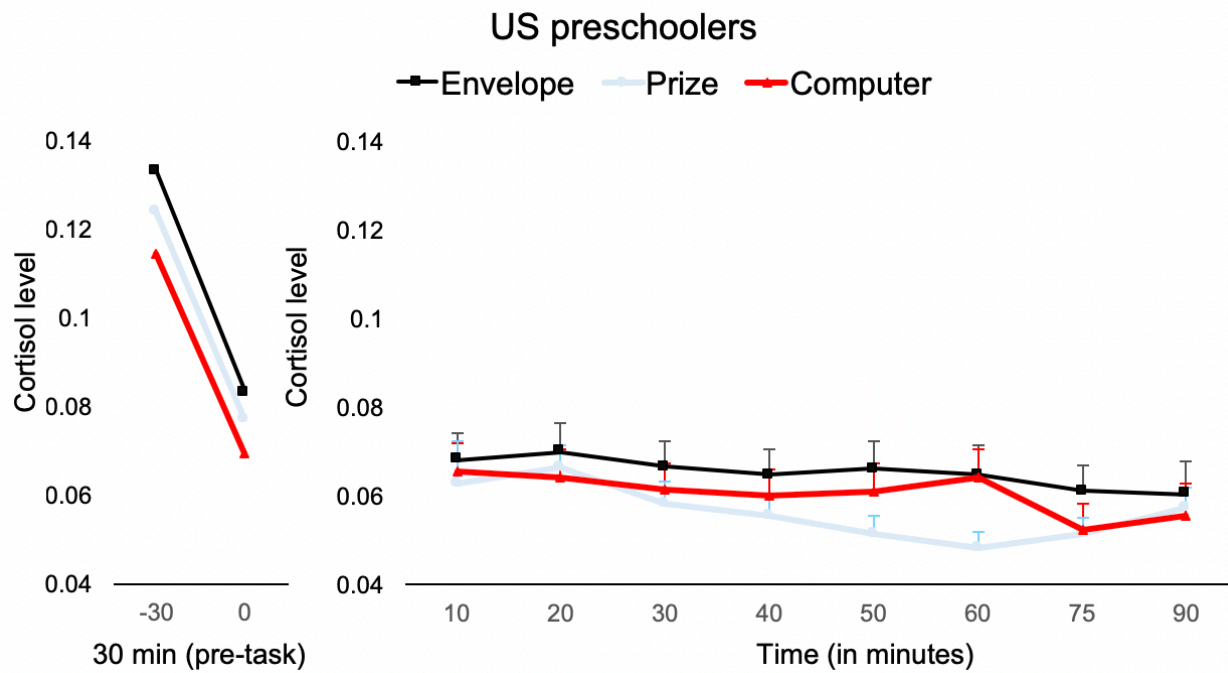
Figure 9 (Study 2). Generalized estimating modeling (GEE) examining changes of cortisol levels at the beginning of each day (30 minutes before the start of each stress paradigm) across cultures.
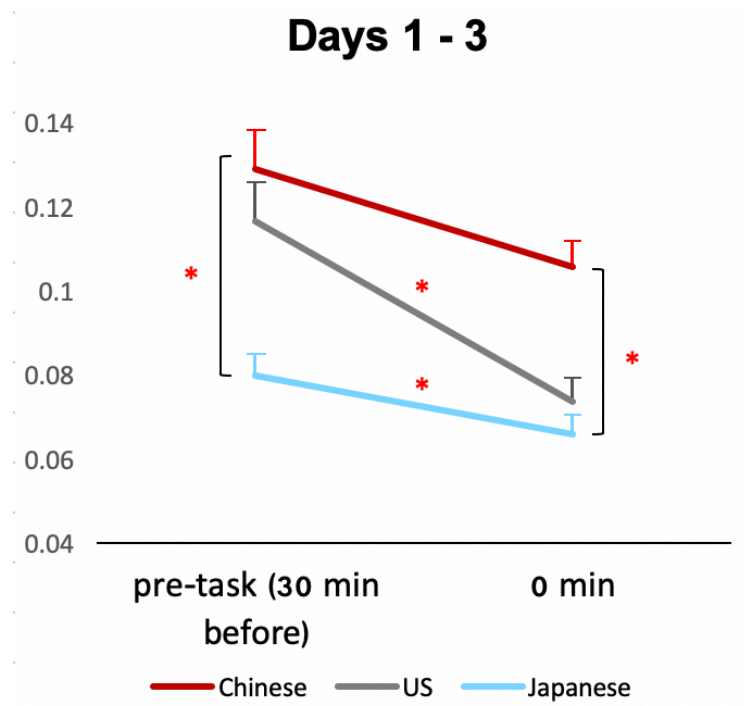
Figure 10 (Study 3). US children have higher negative and positive facial expressions than Chinese children across three tasks.
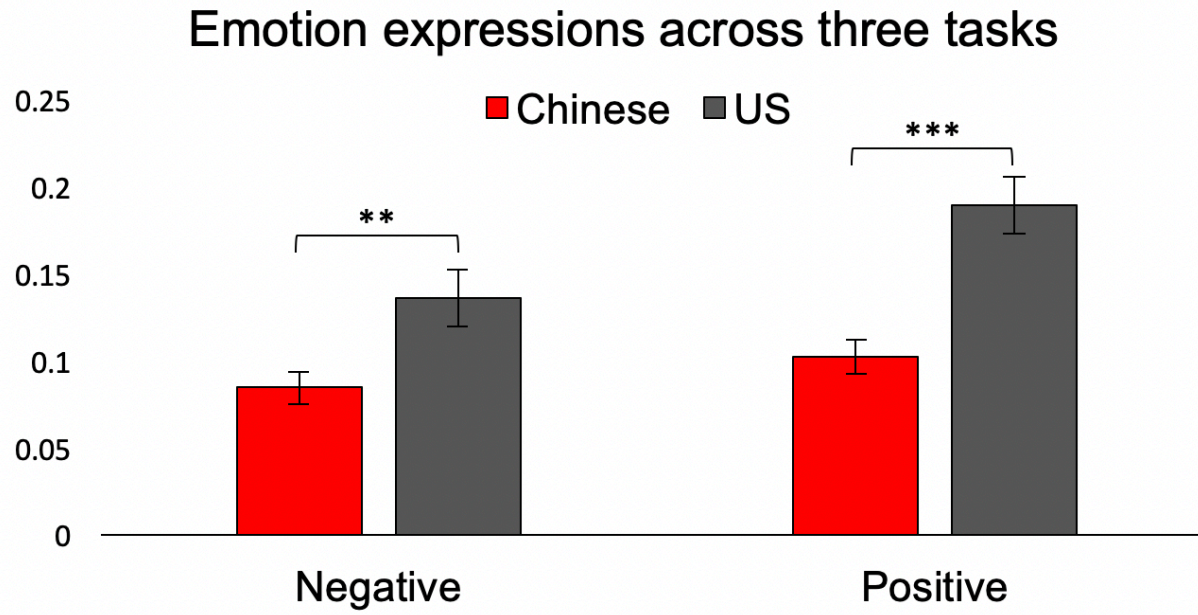
Figure 11 (Study 3). Negative expressions among Chinese and US children in A) Envelope (control task), B) Prize (interpersonal-related), and C) Computer (achievement-related) tasks. Challenging/stressful phases are indicated in **bald.**

A) Envelope Task
1. Examiner asks for help (instruction), **2. Examiner leaves**, 3. Examiner returns, 4. child chooses prize from grab bag

B) Prize Task
1. Gift Ranking 2. Child Waiting **3. Worst Gift - Unfamiliar Examiner 4. Worst Gift - Alone 5. Worst Gift - Familiar Examiner** 6. Best Gift

C) Computer Task
1. Instruction 2. Practice game 3. Practice ends and real game begins **4. Losing game (buzzer)** 5. Examiner enters 6. Examiner apologizes
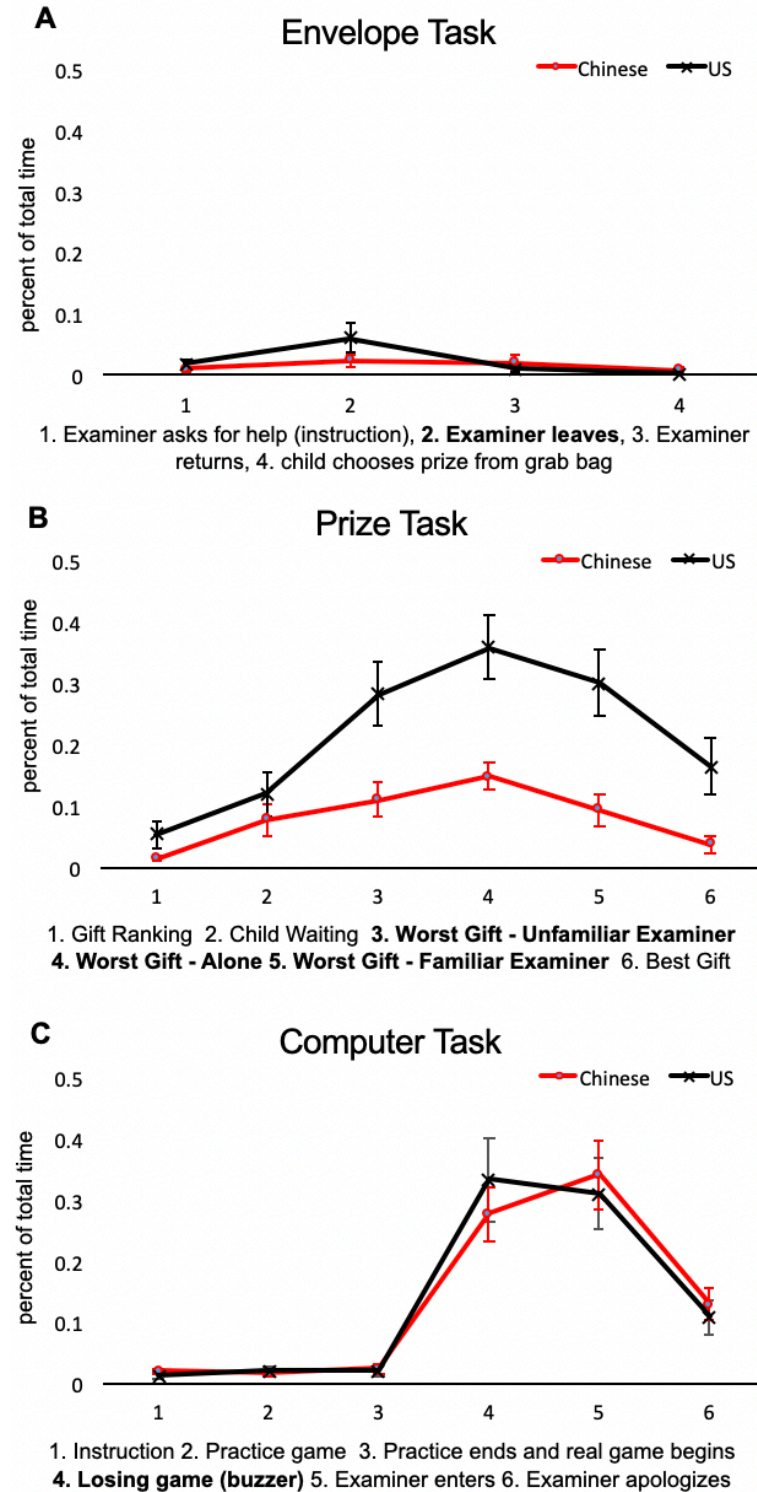
Figure 12 (Study 3). Positive expressions among Chinese and US children in A) Envelope (control task), B) Prize (interpersonal-related), and C) Computer (achievement-related) tasks. Challenging/stressful phases are indicated in **bald.**

A — Envelope Task

1. Examiner asks for help (instruction), **2. Examiner leaves**, 3. Examiner returns, 4. child chooses prize from grab bag

B — Prize Task

1. Gift Ranking 2. Child Waiting **3. Worst Gift - Unfamiliar Examiner 4. Worst Gift - Alone 5. Worst Gift - Familiar Examiner** 6. Best Gift

C — Computer Task

1. Instruction 2. Practice game 3. Practice ends and real game begins **4. Losing game (buzzer)** 5. Examiner enters 6. Examiner apologizes
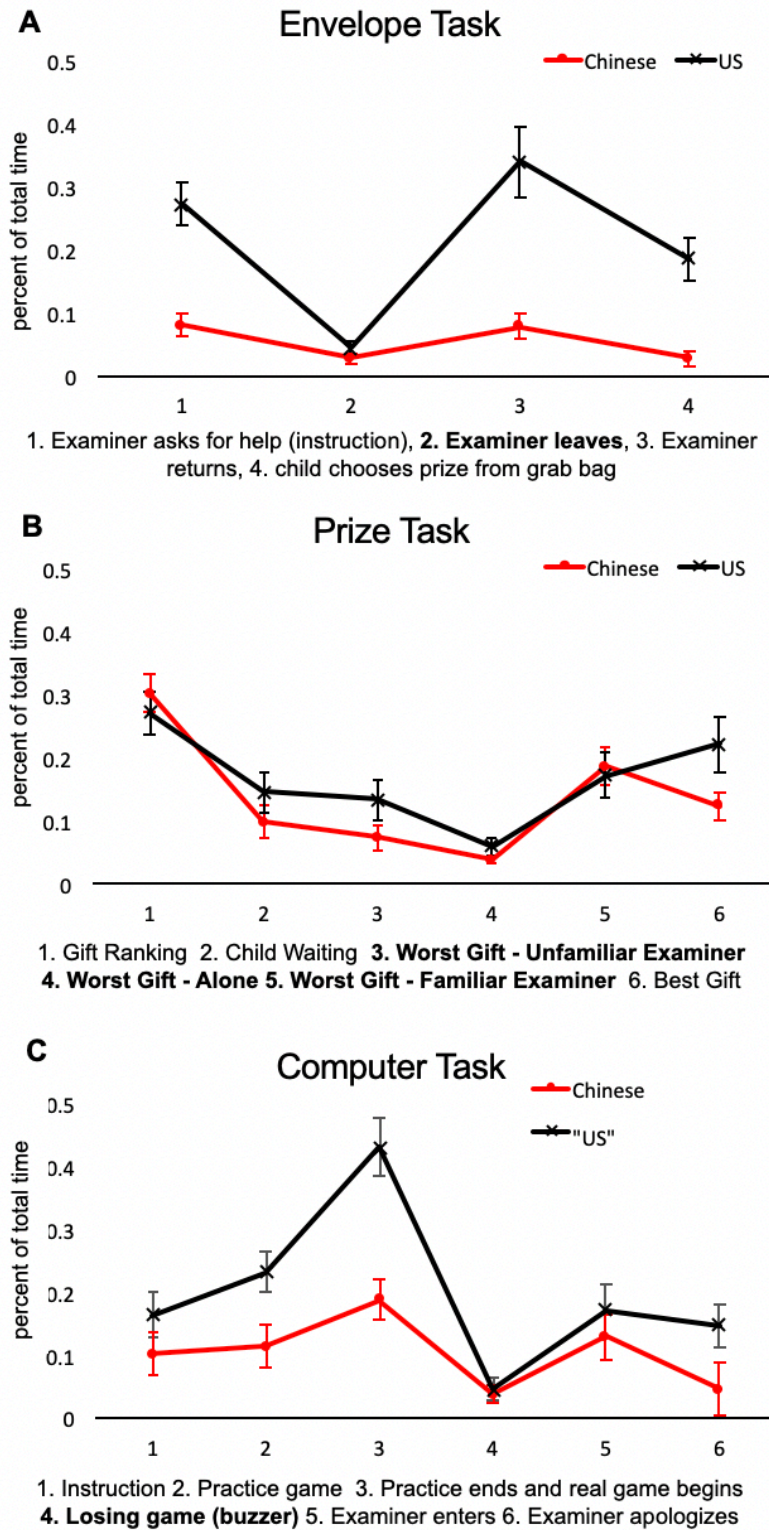
Figure 13 (Study 3). Within culture comparison of cortisol reactivity across three different stress paradigms in A) Chinese preschoolers and B) US preschoolers. *Note*. Cortisol at post-task T = 10 minute is the reference for each task. *$p < .05$, ** $p < .01$, *** $p < .001$.
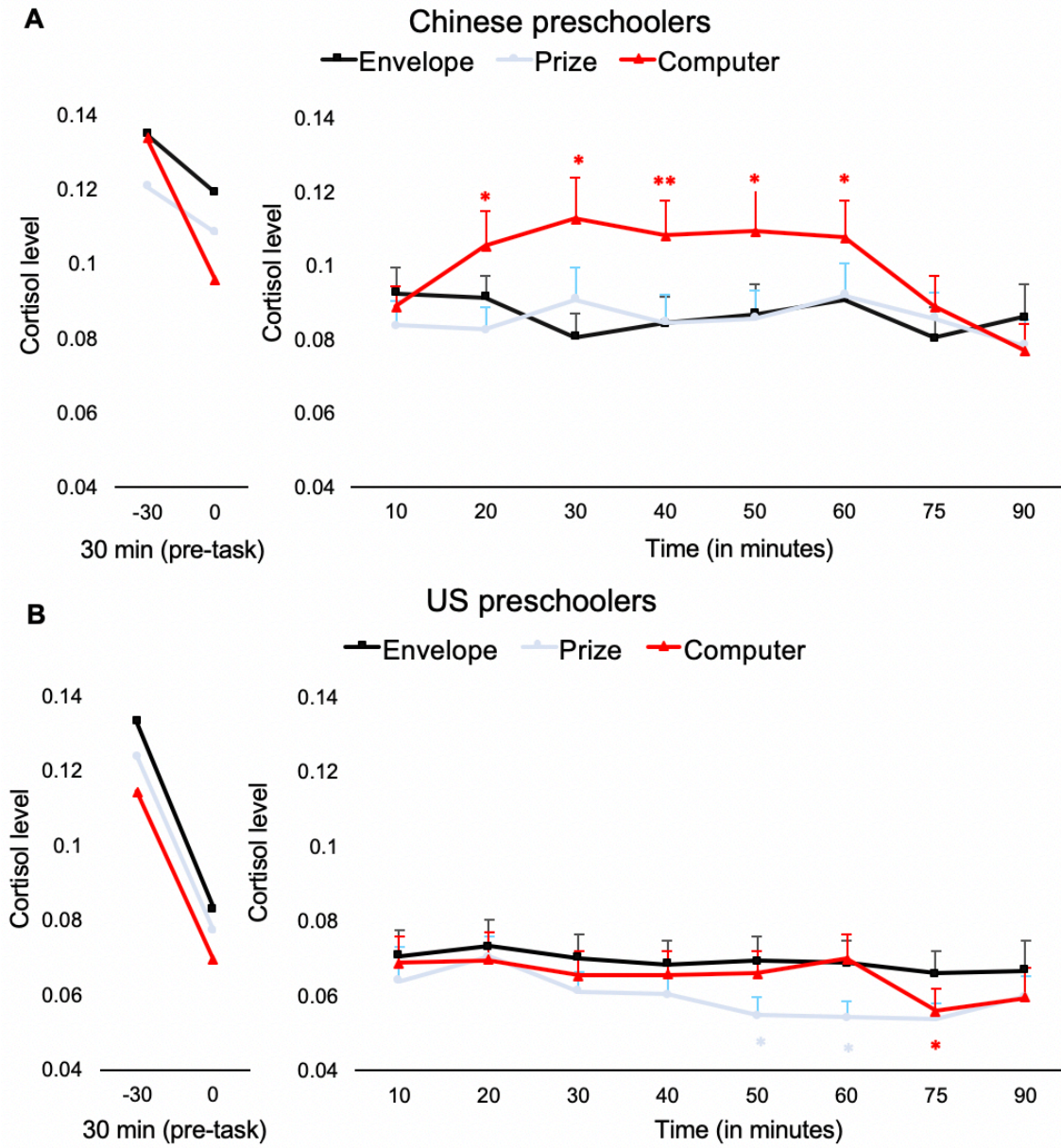
Figure 14 (Study 3). Cross-cultural comparison of cortisol reactivity among Chinese and US children in A) Envelope (control task), B) Prize (interpersonal-related), and C) Computer (achievement-related) tasks.
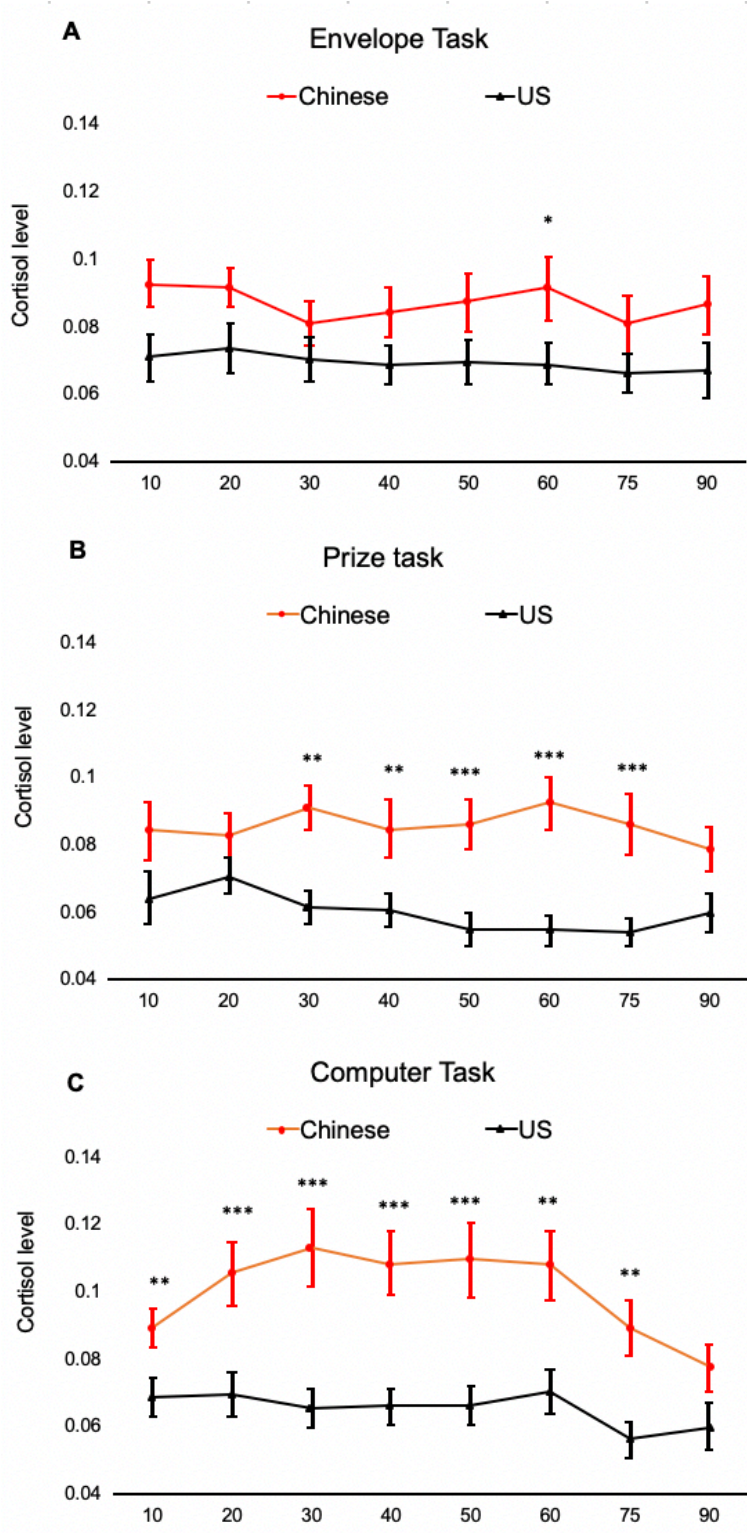
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