## Title
The Role of Bilingualism and Emotion Regulation on Hispanic Children's Anxiety Development



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# The Role of Bilingualism and Emotion Regulation on Hispanic Children's Anxiety Development

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of the requirements for the degree of

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in

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by

Laura E. Quiñones-Camacho

June 2018

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## Dedication

A Migdalia Camacho Hernández (aka Mami), gracias por ser, por estar, por hacerme mejor persona. Tu apoyo incondicional ha sido esencial a través de estos años. Tu resiliencia me da fuerzas. Eres mi maestra de vida, y no pude haber tenido una mejor.

ABSTRACT OF THE DISSERTATION

The Role of Bilingualism and Emotion Regulation on Hispanic Children's Anxiety Development

by

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Doctor of Philosophy, Graduate Program in Psychology
University of California, Riverside, June 2018
Dr. Elizabeth Davis, Chairperson

Anxiety symptoms are considered one of the most common psychopathological symptoms in children (Anderson, Williams, McGee, & Silva, 1987) and often predict anxiety symptoms throughout life (Bosquet & Egeland, 2006), as well as other mood disorders in adulthood (Roza, Hofstra, van der Ende, & Verhulst, 2003). Because anxiety symptoms emerge early in life and seem to remain stable throughout development, it is essential that we understand the specific processes that maintain, exacerbate, or protect against the effects of anxiety symptoms. Hispanics are the largest minority group in the U.S., making up about 25% of school-aged children (and up to 50% in California; US Department of Education, 2015). Hispanic children have a higher likelihood of experiencing depression, anxiety, and related mental disorders compared to other minority children (Canino, Gould, Prupis, & Shaffer, 1986). Few studies have addressed potential risk and protective factors that could help us better understand the development of symptoms in this group (Flores et al., 2002). Thus, greater emphasis is needed to understand what aspects of these children's environments might predict their anxiety symptoms. The goal of this dissertation was to assess whether and how emotion regulation relates to anxiety symptoms in Hispanic children, to identify protective and risk factors for this understudied population.

This dissertation study explored the link between emotion regulation, bilingualism, and anxiety symptoms in 78 Hispanic children between the ages of 8-11 (*M* = 9.91, *SD* = 1.14; 39 girls). The main questions guiding this dissertation were: 1) Are there differences in executive functions based on Hispanic children's level of bilingualism? 2) Are there differences in emotion regulation abilities based on Hispanic children's level of bilingualism? and 3) Which aspects of emotion regulation (Context Sensitivity, Repertoire, and Implementation) are linked to anxiety symptoms for Hispanic children? Results suggest that bilingualism was associated with inhibitory control, cognitive flexibility, emotional attention, and context sensitivity, but not with the other measures of executive functions and emotion regulation. Context sensitivity emerged as the only aspect of emotion regulation that predicted anxiety symptoms. Implications for our understanding of Hispanic children's anxiety and directions for future work are discussed.

**Table of Contents**

## List of Tables

## List of Figures

# CHAPTER 1

# Introduction

*Anxiety in Childhood*

Approximately one in eight children will experience diagnosable symptoms of an anxiety disorder (Child Mind Institute Children's Mental Health Report, 2015). Although anxiety disorders are extremely common in childhood, more research is needed to understand protective and risk factors for the emergence and maintenance of anxiety disorders (Donovan & Spence, 2000). Additionally, anxiety symptoms in childhood have been linked with other problems such as dysregulated patterns of stress physiology, poor emotion regulation, and a myriad of concurrent and longitudinal problems, including difficulty with social situations (Cisler, Olatunji, Feldner, & Forsyth, 2010; Monk et al., 2001; Schmitz, Krämer, Tuschen-Caffier, Heinrichs, & Blechert, 2011). Research with adults has shown that environmental factors, such as education level, socioeconomic status, parental history of psychopathology, and parent-child interactions, among others, are associated with an increased likelihood of experiencing anxiety symptoms (Ford, Goodman, & Meltzer, 2004; Hidalgo et al., 2001; Hudson & Rapee, 2001; Rapee & Spence, 2004). Thus, research on anxiety in childhood would benefit from a greater understanding of the risk and protective factors that result in some children going on to experience meaningful levels of anxiety symptoms and some children never developing symptoms.

Though most work on anxiety disorders in childhood has focused on white/caucasian children, there is a growing body of evidence pointing at how minority children, and hispanic children in particular, are at a hightened risk of experiencing anxiety disorders (Anderson & Mayes, 2010; Ginsburg & Silverman, 1996; McLaughlin, Hilt, & Nolen-Hoeksema, 2007; Pina & Silverman, 2004). Hispanic children often report more symptoms of separation anxiety (Ginsburg & Silverman, 1996) as well as more somatic symptoms (Pina & Silverman, 2004) than non-Hispanic white children. Studies with Hispanic youths have also found higher levels of worry among Hispanic children (Varela et al., 2004). Hispanic adolescents report higher levels of separation anxiety and worry than white/caucasian and black adolescents (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). Hispanic women seem to be at a particularly high risk of experiencing clinical levels of symptoms as they tend to report the highest levels of anxiety symptoms across these ethnic groups, especially for global anxiety symptoms and physical symptoms of anxiety (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). Research looking at risk and protective factors for Hispanics suggests that differences in anxiety symptoms among Hispanics and other ethnic groups might stem from difficulties meeting basic needs, as Hispanics often have low-levels of education and are low-income (Hernandez, Plant, Saches-Ericsson, & Joiner, 2005). Moreover, a study looking at how parental characteristics (a known risk factor for anxiety symptoms) influence anxiety symptoms in Hispanic/Latino children found that although parental control was associated with anxiety symptoms as would have been expected from research on white/caucasian children, low levels of parental acceptance were not (Varela et al., 2013). Thus, more research is needed to understand the emergence of anxiety symptoms in Hispanic children, and risk and protective factors for this group.

Anxiety disorders are typically marked by difficulties with emotion processes, such as experiencing emotions quickly and with high intensity, as well as having difficulty with the regulation of emotion (Mennin, Turk, Heimberg, Carmin, 2004). Studies with adults suggest that anxiety is associated with the use of maladaptive strategies, such as expressive suppression (Werner, Goldin, Ball, Heimberg, & Gross, 2011). Several studies with children have also found that problems with emotion regulation are implicated in the development of anxiety disorders, even when controlling for emotional reactivity (Cisler, Olatunji, Feldner, & Forsyth, 2010). Suveg and Zeman (2004) found that 8-12-year-olds with clinical levels of anxiety had impaired emotion regulation skills compared to same-age children without anxiety. Zeman, Shipman, and Suveg (2002) found that emotion dysregulation, like the inability to identify emotional states, the inability to inhibit anger, the dysregulated expression of anger and sadness, and maladaptive anger coping were all significant predictors of internalizing symptoms in elementary school-age children. Thus, there is evidence that emotion regulation is linked to anxiety disorders at least in non-minority populations.

*Emotion Regulation*

In the past couple of decades, many studies have taken a functionalist theoretical approach to the study of emotion and emotion regulation processes. Under this view, emotions are thought of as being goal oriented and contextually bound reactions (e.g., to aid in the achievement of a goal; Campos, Mumme, Kermoian, &

Campos, 1994). Emotions offer us information about our environment as it relates to our goals and motivations. Emotions are any attempt to maintain, change, establish, or terminate our relation to the environment in service of our goals and motivations (Campos, Mumme, Kermoian, & Campos, 1994; Thompson, 1994). These goals might be central to the person (e.g., related to their self-concept) or peripheral (e.g., wanting an object), and can happen at a conscious or unconscious level (Gross, 2008). Emotions include cognitions, physiological responses, and behavior and are greatly influenced by how we think about a situation. Theoretically, emotions are adaptive because they move us to do something whenever a goal is threatened (Campos, Frankel, & Camras, 2004). At the heart of this functionalist view of emotion is the idea that emotions are somewhat discrete entities that have different causes and different consequences in later behavior (Campos, Dahl, & He, 2010; Izard et al., 2011). Under this view, one experiences sadness because a goal is lost and must be relinquished, and one experiences fear when a goal is threatened but it is not clear if it will be lost.

Although emotions are broadly considered to be adaptive, people must often change or regulate emotional responses. We regulate our emotions to avoid, displace, transform, minimize, inhibit, or intensify an emotion. We do this by forecasting situations and predicting what will happen, reconciling conflicting emotions stemming from conflicting goals, or selecting responses that are acceptable to the social group to which one belongs (Campos, Frankel, & Camras, 2004). We can regulate at many levels by manipulating the input we get, by changing how we process and deal with information, and by changing our responses to the event (Campos, Mumme, Kermoian, & Campos, 1994).

Emotion regulation strategies are the things we do to change how we feel about a situation. James Gross and other researchers have argued that emotion regulation strategies impact different points in the emotional process and should thus be implemented at different point of the emotional experience (e.g., Sheppes & Gross, 2011; Sheppes, Scheibe, Suri, & Gross, 2011; Gross, 2015). To account for these differences in timing, Gross proposed five families of regulatory processes in his process model of emotion regulation: situation selection, situation modification, attentional deployment, cognitive change, and response modulation, all of which affect the emotional experience at different points in the process (Gross & Thompson, 2007; Gross, 2015). Under this model, emotional processing has four stages (situation, attention, appraisal, and response) and these groups of regulatory strategies influence different stages of this process (Gross & Thompson, 2007). For example, suppression is considered a response modulation strategy, thus, it can only be implemented at the last stage of emotional processing (response); in comparison, reappraisal is considered a cognitive change strategy and can be implemented earlier in the emotional process (appraisal). These groups of strategies can be further grouped into antecedent-focused (strategy is deployed before an emotional response is generated) and response-focused (strategy is deployed after an emotional response is generated) responses. The extended process model proposed more recently (Gross, 2015), highlights how emotion regulation is a temporally extended process that requires strong sensitivity to changing environmental demands. This stronger consideration of context in emotion regulation processes is important as it can give us a more nuanced understanding of why people choose to change how they feel in the ways they do. Some of these strategies, such as attentional deployment (e.g., redirecting attention – Distraction), have been seen even in early childhood, others, however, such as cognitive change (e.g., thinking in a different way about something – Cognitive Reappraisal), are not seen until later in development. Although there is some evidence that children use some of these strategies from early in life, few studies have attempted to understand how different types of strategies relate to healthy development in childhood.

A meta-analysis by Webb, Miles, and Sheeran (2012) explored the effectiveness of various emotion regulation strategies by using 306 experimental comparisons of different emotion regulation strategies. They found that attentional deployment had no effect on emotional outcomes, response modulation strategies had a small effect, and cognitive change strategies had a small to medium effect (and were the most effective type of strategy). These findings suggest that cognitive strategies are more effective at modulating emotion in adults compared to other types of strategies. Within these broad categories, however, are many strategies that might differ in their effectiveness. Looking within type of strategy, Webb and colleagues (2012) found that distraction was, in fact, an effective attention deployment strategy, whereas concentration (focusing on what generated the emotion) was not. They also found that reappraising the emotional stimulus or using perspective taking was more effective at reducing emotionality than reappraising the emotional response to the event.

Emotional experiences are often complex and influenced by people's goals and motivations, which in turn shape the subsequent cognitions and behavioral responses that are associated with that experience. It has been hypothesized that the effectiveness of these strategies should vary by emotional context. For example, a functionalist theory of emotion suggests that someone experiences sadness when a goal is lost, if a goal is lost (e.g., the family dog died, and you will not be able to play with it again) changing how you feel about that lost goal (e.g., "we got to spend many happy years together") might be more adaptive than trying to take action to change the initial problem (e.g., going back to the veterinarian to get medicine for the dog). In the previously described meta-analysis, many characteristics of the emotional experience seemed to moderate these effects. Emotion regulation strategies seemed to have a larger effect on sadness than on other emotions, supporting the idea that discrete emotional context matters when thinking about the effectiveness (and appropriateness) of these emotion regulation strategies.

*Emotion Regulation Strategies in Childhood*

Early studies in the development of emotion regulation have shown that even infants can engage in rudimentary forms of regulation, such as attention shifting and self-soothing (Braungart & Stifter, 1991; Fox, 1989). Some of these studies have also shown that individual differences in self-regulation can be present even during this developmental period (Braungart & Stifter, 1991; Fox & Calkins, 2003; Kopp, 1989). Other studies have emphasized more external forms of regulation such as comfort behaviors from a caregiver, again, showing that even in infancy children can engage in these regulatory behaviors (Connell & Thompson, 1986; Gaensbauer, Connell, & Schultz, 1983). Although much research on emotion regulation strategy use early in life has focused on attention shifting and comfort seeking as the primary ways in which children regulate their emotions, there is a consensus that the form of regulation changes and becomes more complex throughout development.

As children develop, emotion regulation moves from mainly external sources of regulation, and behavioral forms of self-regulation, to more cognitive ways of dealing with emotions. In the first few years of life, many capacities emerge, such as effortful control, sustained attention, and the understanding that there are social expectations for how one is supposed to behave (Grolnik, Bridges, & Connell, 1996). Emotion regulation evolves as these skills develop throughout development (Calkins, 1994). These capacities, in turn, not only allow children to regulate arousal in different ways, but also in more complex ways. Thus, as children become older, the repertoire of strategies they can use to regulate emotions becomes more extensive and sophisticated.

The use of behavioral strategies seems to remain relatively stable throughout life (Heckhausen, Wrosch, & Schulz, 2010), so even if these more complex strategies do not replace the previously used ones, they do offer a bigger repertoire from which to draw. As we develop, we build on the repertoire of strategies we know how to use, become better able to implement the strategies we possess, and develop a more refined understanding of when to implement these strategies. Shifts in regulatory choices to more cognitive ways of dealing with feelings have been thought to be driven by gains in the understanding of how goals, thoughts, and emotions relate to each other and how changing how one thinks about something and what one's goals are can result in changes in one's emotions (Levine, Kaplan, & Davis, 2013). Although this shift is considered to happen early in childhood, with some studies finding that children as young as three have a rudimentary understanding that remembering and forgetting emotional situations can influence someone's emotions (Lagattuta, Wellman, & Flavell, 1997), studies with children younger than eight have found mixed results. Some studies have found that children younger than eight mention cognitive ways of regulating their emotions infrequently when asked about someone else's emotions (Flavell, Flavell, & Green, 2001), but studies that have used autobiographical approaches often find that when children are asked about their emotions they report cognitive strategies from an earlier age (Davis, Levine, Lench, & Quas, 2010).

**Emotion Regulation Strategy Knowledge.** Studies on emotion regulation strategies in children have often used interviews and questionnaires to assess children's knowledge of emotion regulation strategies and their understanding of the effectiveness of specific emotion regulation strategies across contexts. When looking at children's understanding of the effectiveness of strategies, by age 3-4 children understand that strategies such as cognitive distraction and behavioral distraction are effective ways of regulating emotions, but they overestimate the effectiveness of less adaptive strategies such as rumination (Dennis & Kelemen, 2009). By age 6-9 children show more marked emotion regulation choices for emotional contexts. In general, 6- and 9-year-olds consider strategies to be more effective to regulate sadness than anger, but their perception of the effectiveness of strategies for one emotion is related to the perception of their effectiveness for other emotions (Waters & Thompson, 2014). For example, children rate problem-solving as more effective for anger and seeking adult support and venting as more effective for sadness (Waters & Thompson, 2014). Additionally, 6-year-olds endorse venting emotion and doing nothing as more effective than 9-year-olds, suggesting a shift across childhood in children's understanding of the effectiveness of some strategies. It is interesting that Waters and Thompson's (2014) study did not find an age effect on cognitive reappraisal even though some studies have found that 6-year-olds sometimes have problems implementing this strategy. It is possible, however, that by age six children understand that reappraisal is an effective way of regulating emotions but are not always able to successfully implement it. It is also possible that by age six children have added rudimentary forms of most of these strategies into their repertoires but lack the sophistication to know exactly in which contexts to implement them (e.g., for sadness but not anger) and the experience to be able to effectively implement these strategies. The fact that younger children rated sophisticated strategies like cognitive reappraisal to be effective, as did older children, but rated less sophisticated strategies like doing nothing as more effective than did older children seems to support this idea.

In late childhood, 10-13-year-olds rate positive reappraisal and problem-focused strategies as the most commonly used and most effective strategies for interpersonal and intrapersonal (achievement) events (Reijntjes, Stegge, Terwogt, & Hurkens, 2007). When looking at context, children endorsed being more likely to use passive behavior, cognitive disengagement and goal displacement for achievement related events, and more cognitive analysis for interpersonal situations. Children in this study said positive reappraisal, mental distraction, goal displacement, and cognitive disengagement would be more effective at making them feel better during achievement events rather than interpersonal events. Children endorsed using a strategy more often the more they thought the strategy would make them feel better. Unsurprisingly, by age 10 (and older) children are tailoring their emotion regulation choices to reflect their beliefs about the effectiveness of the strategies, more often choosing strategies they consider to be most effective. It is important to mention that in this study positive reappraisal was one of the two most endorsed strategies among 10-13-year-olds. This highlights how emotion regulation strategy use changes across development, shifting from basic forms of behavioral regulation to more complex forms of cognitive regulation. Additionally, children in this study seemed to have a complex understanding of the effectiveness of each strategy and calibrated their regulation choice according to this knowledge.

**Emotion Regulation Strategy Awareness and Context Sensitivity.**

Understanding that a strategy could be used to effectively modulate an emotion is not the same as deploying and being able to effectively implement a strategy. In the past few years, the study of emotion regulation has started to move towards a more focused study of emotion regulation choice, strategy repertoire, and flexibility as indicators of adaptive regulatory abilities (Bonanno & Burton, 2013; Sheppes & Levin, 2013; Sheppes, Scheibe, Suri, Radu, Blechert, & Gross, 2014). Studies on emotion regulation choice have shown that in high-intensity contexts, people prefer to choose strategies that are more easily implemented, such as distraction, compared to more complex strategies such as reappraisal (Shafir, Thiruchselvam, Suri, Gross, & Sheppes, 2016; Sheppes, Scheibe, Suri, Radu, Blechert, & Gross, 2014). This suggests that understanding the context of an emotional experience would be a more appropriate way of understanding people's regulatory choices.

Studies looking at strategy generation (or strategy awareness) show that by age 3-6 children report using problem-focused strategies, social support, behavioral distraction, cognitive distraction, reframing, suppression, goal reinstatement, goal substitution, goal forfeiture, agent-focused reactions, avoidance, attentional deployment, and other strategies aimed at changing thoughts such as reappraisal and forgetting for sadness, fear, and anger (Davis, Levine, Lench, & Quas, 2010; Dias, Vikan, & Gravas, 2000; Endrerud & Vikan, 2007; Sala, Pons, & Molina, 2014; Vikan, Karstad, & Dias, 2012) reflecting the growing repertoire of strategies. The variety of strategies that any given child reports using also increases from ages 3 to 6 (Sala, Pons, & Molina, 2014) which serves as stronger evidence of the growth during these ages. Children between 5-6 report some emotion-related preferences in emotion regulation strategy use such as using goal reinstatement more frequently for anger than for sadness, using agent-focused reactions more often for anger than for fear, and seeking social support more often for fear than for sadness and anger (Davis, Levine, Lench, & Quas, 2010). Changing goal strategies were preferentially used for sadness compared to anger, whereas changing thoughts strategies (e.g., cognitive distraction, reappraisal) seemed to be preferentially used for fear compared to anger. From 5 to 9 years-old, children continue increasing the use of putatively adaptive strategies (e.g., cognitive distraction), and decreasing the use of maladaptive strategies (e.g., forgetting; Dias, Vikan, & Gravas, 2000). By 9-11, additional to the previously mentioned strategies, children describe just experiencing the emotion without trying to change it, venting, and self-evaluation as ways of dealing with their feelings (Bárcenas & Martínez, 2005). Overall, the pattern seems to be that as children age, their choices move towards more metacognitive strategies and active coping strategies (e.g., problem-focused), showing greater strategy differentiation for emotional contexts at later ages.

For example, in a study with 5-6 year-olds, Davis, Levine, Lench, and Quas (2010) assessed the types of strategies that children generated when asked what a child could do to alleviate sadness, anger, and fear after hearing stories about a child protagonist experiencing a negative event (study 1) or after recalling an autobiographical event (study 2). In study 1, the authors found that the type of strategies children mentioned varied, but that the strategies generated did not differ by emotion. In general, goal reinstatement and goal substitution were the most commonly reported strategies. Metacognitive strategies (e.g., "he can imagine he has some ice cream"), were the next most common strategies, followed by goal forfeiture and seeking social support. A closer look at the metacognitive strategies revealed that children reported changing thoughts strategies more often than changing goals, but that this did not vary based on emotional context. Findings from study one suggest that children do indeed understand that there are many ways in which a person can regulate negative emotions, even if they have not developed yet an understanding that some strategies might be more useful in some contexts than others.

In study 2, Davis and colleagues (2010) assessed emotion regulation strategies to an autobiographical event, again looking at various discrete negative emotions. They found that when talking about an event they had actually experienced in the past, children were able to better focus their emotion regulation choice, as evidenced by the fact that children reported reinstating their goal more often for anger than sadness, agent-focused strategies more often for anger than fear, and seeking social support from another person more for fear than sadness or anger, and more for sadness than anger. Around 69% of the children reported using metacognitive strategies at least once, using these more often for sadness than anger, and more often for fear than anger. As in study 1, children reported changing thoughts strategies more often than changing goals, but contrary to study 1, this pattern varied by emotion. Children used changing goals more often for sadness than anger and changing thoughts more often for fear than anger. Findings from study 2 suggest that although the use of multiple strategies can be seen in either approach (hypothetical or autobiographical), when children are asked about emotional events they are better able to show more flexible use of strategies when talking about autobiographical events than when they are talking about an event that someone else experienced, highlighting the importance of considering multiple assessments of emotion regulation when trying to understand emotion regulation strategy use in children.

**Emotion Regulation Strategy Repertoires and Flexibility.** The types of strategies children can use (i.e., strategy repertoire) and their ability to adaptively shift among them are important aspects of children's growing emotion regulation that should be predictive of healthy development. A growing body of theoretical accounts posit regulatory flexibility (i.e., being able to modify responses at the behavioral, cognitive, or emotional levels for the service of one's goals) as a more important aspect of emotion regulation when thinking about why and how emotion regulation relates to well-being (Bonanno & Burton, 2013; De France & Hollenstein, 2017; Dixon-Gordon, Aldao, & De Los Reyes, 2015; Reed, Cameron, & Ameral, 2017). Supporting this idea, greater flexibility has been linked to enhanced adaptation to environmental demands, better mental health, and other positive outcomes (Aldao, Sheppes, & Gross, 2015). Additionally, greater flexibility has also been linked with lower levels of depression in adult samples (Zhu & Bonanno, 2017). Bonanno and Burton's (2013) model of regulatory flexibility suggests the existence of three sequential components to regulatory flexibility: context sensitivity, repertoire, and response feedback. Although all three aspects of flexibility are important to consider, this dissertation study focused on strategy repertoire and children's sensitivity to context (as indexed by their rating of the effectiveness of various strategies across emotional contexts) as measures of flexibility in childhood. To understand regulatory flexibility, it is necessary to move from perspectives that dichotomize strategies as adaptive or maladaptive towards a view of emotion regulation that focuses on the emotional context. Some studies looking at the use of coping strategies across situations seem to suggest that cross-situational consistency is usually low, but that the examination of flexible deployment of different strategies in different contexts results in a complete understanding of regulatory processes (Bonanno et. al., 2004; Cheng, 2001).

Developmental models of socioemotional flexibility have emerged in the past few years and capitalize on some of the core features of dynamic systems approaches. (Hollenstein, Lichtwarck-Aschoff, & Potworowski, 2013). Following a dynamic systems perspective, variability (or flexibility) across context and time are highlighted as essential processes of an organism through which adaptive functioning and transitional periods can be identified. Few developmental studies have looked at regulatory flexibility in childhood and adolescence in the context of emotion regulation. One study of strategy repertoire in adolescence found that having a limited (and rigid) emotion regulation repertoire was related to maladaptive outcomes, such as more internalizing symptoms (Lougheed & Hollenstein, 2012), suggesting the importance of understanding emotion regulation choice, flexibility, and repertoire in the early years. Another study with adults found that people who had a repertoire of strategies that mainly consisted of putatively maladaptive strategies (e.g., self-criticism, expressive suppression) and people who used many strategies (i.e., were not adapting strategies based on context) often had more psychopathology symptoms than people who preferred other combinations of strategies (e.g., people who reported using maladaptive strategies infrequently; Dixon-Gordon, Aldao, & De Los Reyes, 2015). The findings from these two studies suggest that looking at measures of repertoire might be particularly informative in the study of how emotion regulation relates to psychopathology.

Tan (2011) explored the role of children's strategy flexibility (switching across strategies within an emotional context) on adaptive outcomes in a sample of children at ages 3 and 4. Strategy flexibility at both time points predicted global rating of parent-reported emotion regulation ability. With few to no other studies to compare Lougheed and Hollenstein (2012) study, the issue of emotion regulation flexibility in children remains an open question. Theoretically, flexibility should be present and be a sign of adaptive responding even early in life, but little research has focused on understanding this.

To address some of the gaps in our understanding of how emotion regulation repertoires relate to adaptive functioning, we assessed how emotion regulation repertoires for discrete emotional contexts related to psychopathology in children between the ages of 7-11 (Quinones-Camacho & Davis, 2018). We found that children's repertoire for regulating anger (i.e., the total number of emotion-specific adaptive strategies that children reported using to regulate anger) was associated with externalizing symptoms, such that smaller repertoires for anger were associated with more externalizing symptoms. We found a similar pattern for anxiety, with smaller repertoires for fear predicting more anxiety symptoms. These findings are novel and highlight the importance of considering other measures of emotion regulation (rather than broad measures of emotion dysregulation) as well as a careful consideration of context to understand how emotion regulation relates to psychopathology.

**Emotion Regulation Strategy Implementation.** Following substantial research on the effect of implementing emotion regulation strategies such as reappraisal in adults (for a review of some of these findings see: Buhle et al., 2014; Cutuli, 2014; McRae, 2016) some studies have attempted to assess whether children are able to implement emotion regulation strategies when instructed to do so in a laboratory setting. Moreover, children's implementation of emotion regulation strategies in a laboratory setting has been linked to different patterns of physiological responding. We have previously shown that even 5-6 year-olds can implement cognitive strategies such as distraction and reappraisal –when instructed to do so in a laboratory setting – as evidenced by changes in physiological responding (assessed by RSA; Davis, Quiñones-Camacho, & Buss, 2016), suggesting that physiological measures enable assessment of the effectiveness of strategy implementation in childhood.

Other studies have also shown that specific emotion regulation strategies are associated with physiological responding using self-report measures of emotion regulation in a laboratory setting. For example, Veld, Riksen-Walraven, and Weerth (2012) found that 9-11-year-olds self-reported using suppression and reappraisal in response to a stressful situation (in a laboratory context). However, the use of these two strategies was differentially related to physiological responses to the task. Greater use of suppression was associated with lower cortisol reactivity in girls and lower alpha-amylase reactivity in all children, whereas reappraisal was not related to the physiological measures. The findings from this study suggest that suppression in the context of a psychosocial task might have been an effective way to reduce the physiological stress response. It is interesting to note that the findings in this study contrast with studies using adult samples where reappraisal is often associated with reductions in physiological responding, whereas suppression is associated with increases. More studies need to assess the relation between strategy use and physiological responding, especially under varying emotional contexts, to better understand how they are related. Taken together, findings from laboratory contexts have shown that children are able to use multiple strategies to change how they feel about an emotional event and that the implementation of these strategies is reflected in their physiological responding.

The Late Positive Potential (LPP). Event-related potentials (ERPs) are electrical potentials in the brain that are time-locked to an event and are derived from electroencephalogram (EEG) signals. The late positive potential (LPP; a slow positive deflection in the EEG waveform that appears approximately 400ms after an affective stimulus is presented) is emerging as an important ERP component for the study of emotional processes (Brown et al., 2012; Hajcak, MacNamara, & Olvet, 2010). The LPP is larger in response to emotional compared to neutral stimuli (Dunning & Hajcak, 2009; Hajcak & Dennis, 2009; Hajcak & Nieuwenhuis, 2006), suggesting that the LPP is sensitive to stimuli salience. More importantly, the LPP can be reliably measured in childhood (Dennis & Hajcak, 2009; Dennis, Malone, & Chen, 2009; Hajcak & Dennis, 2009; Hua, Han, Yang, Zhou, & Hu, 2014; Kujawa, Klein, & Hajcak, 2012). Additionally, studies looking at the stability of the LPP in childhood and adolescence have shown moderate-to-high reliability, suggesting that the LPP is a stable and reliable measure of emotional processing throughout childhood and adolescence (Bondy et al., 2017; Kujawa, Klein, & Proudfit, 2013). Crucially, the effective implementation of ER strategies in response to affective stimuli reduces the amplitude of the LPP (Dunning & Hajcak, 2009; Foti & Hajcak, 2008; Hajcak & Nieuwenhuis, 2006), highlighting the utility of this ERP component for examining putative dysregulation in the specific emotion regulation processes (e.g., emotion regulation strategy use) that are the focus of this dissertation study. Most studies investigating LPP modulation by emotion regulation strategies have examined adult participants. Some studies have examined modulation of the LPP by reappraisal in childhood, often finding that children's ability to use reappraisal (as evidenced by modulation of the LPP) varies by age, with older children showing greater reduction of the LPP after being instructed to use reappraisal (DeCicco, O'Toole, & Dennis, 2014; DeCicco, Solomon, & Dennis, 2012; Van Cawenberge, Leeuwen, Hoppenbrouwers, & Wiersema, 2017). Studies looking at modulation of the LPP by emotion regulation strategies have only examined the use of reappraisal, leaving many questions unanswered about children's ability to implement strategies as evidenced by the LPP.

More importantly, greater reductions in LPP amplitudes after being instructed to reappraise in 5-7-year-olds has been linked to greater use of adaptive strategies concurrently and two years later (Babkirk, Rios, & Dennis, 2015), supporting the idea that LPP modulation is a useful neural index of ER ability in children. Babkirk and colleagues (2015) looked at the use of 8 strategies (self-comforting, prohibited object engagement, social engagement, distraction, alternative activities, instrumental behaviors, object engagement, and passive withdrawal) during a disappointing task and a frustrating task in a sample of 5-7 year-olds who were later followed up at 7-9 years-old (Babkirk, Rios, & Dennis, 2015). During the first visit, children completed an ERP emotion regulation task where they were instructed to use reappraisal to regulate the negative emotions elicited by the task. Changes in the LPP were measured. The authors found that children who showed a greater effect of reappraisal on the LPP at time-1 (i.e., greater modulation by the emotion regulation strategy) used more alternative activities during the frustrating task at time-1 and in the disappointment task at time-2. Findings suggest that being able to effectively implement an adaptive strategy such as reappraisal early in childhood (participants were 5-7 at time-1) was associated with the concurrent and longitudinal use of other adaptive strategies across various emotional contexts. Although participants in this study were all instructed to use reappraisal, there were some differences in how effectively children between 5-7 years old were able to implement this strategy as measured by changes in LPP. Even though they did not find the expected effect for all children, the finding that the effective use of an adaptive strategy, when instructed, was also related to the spontaneous use of another adaptive strategy two years later highlights the importance of understanding the early use of emotion regulation strategies for the potential longitudinal effects that early strategy use might have in later development.

*Emotion Regulation and Anxiety Symptoms*

Emotion dysregulation has consistently been associated with anxiety in longitudinal studies (Bosquet & Egeland, 2006; Wirtz, Hofmann, Riper, Berking, 2004) and substantial empirical evidence suggests that emotion regulation is a key psychological process involved in anxiety maintenance or discontinuation (Amstadter, 2008; Asbrand, Svaldi, Krämer, Breuninger, & Tuschen-Caffier, 2016; Hofmann, Sawyer, Fang, & Asnaani, 2012; Keil, Asbrand, Tushen-Caffier, & Schmitz, 2017;

Mennin, Heimberg, Turk, & Fresco, 2002; Sendzik, Schäfer, Samson, Naumann, & Tuschen-Caffier, 2017; Schneider, Arch, Landy, & Hankin, 2016; Wirtz, Hofmann, Riper, & Berking, 2014). Anxious children tend to have a limited skill set for modifying their emotional responses and are often less able to implement effective emotion regulation strategies compared to same-age peers without psychopathological symptoms (Braet et al., 2014; Folk, Zeman, Poon, & Dallaire, 2014; Suveg & Zeman, 2004). Children between the ages of 8- and 12-years-old with clinical levels of anxiety have been found to have impaired emotion regulation skills compared to same-age children without anxiety (Suveg & Zeman, 2004). This impairment manifests as the use of more maladaptive avoidant strategies, less use of adaptive strategies like reframing, and the perception of adaptive strategies as less effective compared to the perceptions of non-anxious children (Carthy, Horesh, Apter, & Gross, 2010).

Specifically, the habitual use of putatively adaptive strategies such as cognitive reappraisal, problem-solving, and acceptance is associated with fewer symptoms, whereas the use of putatively maladaptive strategies such as avoidance, suppression, and rumination is associated with greater symptomatology (Schäfer, Naumann, Holmes, Tuschen-Caffier, & Samson, 2016). This growing body of knowledge highlights the importance of emotion regulation for our understanding of anxiety development; focusing on emotion regulation strategies is a promising way to refine and improve the effectiveness of anxiety treatments in childhood (Hannesdottir & Ollendick, 2007). However, methodological limitations of previous work (e.g., a focus on parent-report of child emotion regulation ability) have constrained our understanding of children's emotion regulation abilities (Cisler, Olatunji, Feldner, & Forsyth, 2010).

We know that general emotion regulation abilities are developing in childhood and have been linked to anxiety symptoms, but we know little about the specific dysregulated emotional processes that are responsible for these associations across development. One way to address this gap would be to focus on children's use of emotion regulation strategies. Identifying specific difficulties with emotion regulation strategies rather than focusing on broadly-defined emotion dysregulation enables us to more precisely locate targets for intervention (e.g., training children to use specific strategies) instead of simply describing maladaptive trajectories. A meta-analysis of the relations between specific emotion regulation strategies and psychopathological disorders in adults supports the idea that dysregulated strategy use would be an important marker of psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Greater use of avoidance, suppression, and rumination, and less use of problem-solving and reappraisal appear to be associated with more psychopathological symptoms (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Given that children's emotion regulation abilities are still developing, identifying and ameliorating maladaptive emotion regulation processes would have far-reaching benefits for children.

A recent meta-analysis of 48 studies (and 157 effect sizes) assessed how the use of cognitive reappraisal and expressive suppression relate to mental health (Hu, Zhang, Wang, Mistry, Ran, & Wang, 2014). Unsurprisingly, reappraisal was positively correlated with positive indicators of mental health and negatively with negative indicators, whereas suppression was negatively correlated with positive indicators of mental health and positively correlated with negative indicators. Although this review did not focus on childhood, the associations found between the use of emotion regulation strategies (one putatively adaptive, one putatively maladaptive) and mental health indicators highlights the need to understand how emotion regulation strategy use develops early in life, to map how this early use relates to mental health and the potential longitudinal associations related to it.

When looking at cultural values as a moderator of this relation, the authors found that although western and eastern cultures did not vary in how reappraisal was related to mental health, cultures did differ in how suppression related to mental health. Expressive suppression was not related to indicators of mental health in eastern cultures, but it was in western cultures, such that the use of expressive suppression was more strongly associated with worse mental health for western cultures. The fact that culture emerged as a moderator of the relation between expressive suppression and mental health, calls for a stronger consideration of culture (and related processes) in emotion regulation even in early childhood. Moreover, this meta-analysis focused on expressive suppression and cognitive reappraisal, possibly the most studied emotion regulation strategies, ignoring that there are many other strategies that might relate to mental health, such as rumination and distraction.

Although distraction is considered an adaptive strategy, it is not fully clear if it would be as adaptive in the context of high anxiety. People experiencing high levels of anxiety symptoms tend to avoid and withdraw from situations that they believe would elicit anxiety (Mash & Wolfe, 2002). In this case, distraction might promote experiential avoidance and over time, worsen or reinforce anxious symptomatology. In contrast, the ability to reframe a negative experience in a more positive way (reappraisal) might be particularly beneficial in the context of greater anxiety, as children with high levels of anxious symptoms tend to interpret mildly negative or even neutral events as negative (Hannesdottir & Ollendick, 2007). The idea that context, including a person's characteristics that influence regulatory choices is important for understanding the effectiveness of emotion regulation strategies is not new (Aldao & Tull, 2015), this study extends research on this by examining how distraction and reappraisal relate to anxiety symptoms early in life. Doing this will help better address questions about the effectiveness of these emotion regulation strategies for treatment.

While we know less about the link between emotion regulation strategies and psychopathology in childhood, there is some evidence that dysregulated patterns of strategy use relate to psychopathological symptoms even in childhood. In a study of 10-13-year-olds, depressive symptoms were associated with the kind of strategies children said they would use for two different emotion-eliciting vignettes (one for an interpersonal problem, one for poor academic achievement; Reijntjes, Stegge, Terwogt, & Hurkens, 2007). Children with high depressive symptoms were less likely to endorse using problem-focused behavior and positive reappraisal and were more likely to endorse engaging in passive behavior. Depressive symptoms were also related to how effective children thought various strategies would be to make them feel better. Higher depressive symptoms were negatively associated with the perceived effectiveness of problem-focused, positive reappraisal, and cognitive analysis strategies, but positively related to goal displacement. Finally, higher depressive symptoms in late childhood were associated with lower beliefs of self-efficacy in being successful at navigating a difficult situation. Findings from this paper offer insight into emotion dysregulation in late childhood and what this emotion dysregulation looks like, suggesting that paying greater attention to the strategies children use will likely offer important information into maladaptive patterns of regulation across childhood as they relate to psychopathology.

Modifications of various psychotherapies that focus on emotion regulation training more explicitly have started to emerge (e.g., De Witte, Sütterlin, Braet, & Mueller, 2017; Renna, Quintero, Fresco, & Mennin, 2017). Preliminary findings from studies looking at these trainings seem to suggest that Emotion Regulation Therapy (ERT) might be particularly beneficial for anxiety disorders (Renna, Seeley, Heimberg, Etkin, Fresco, & Mennin, 2017). Moreover, anxious children and adolescents have been found to be able to effectively implement advanced emotion regulation strategies such as cognitive reappraisal following training, and that this increase in emotion regulation ability is in turn associated with a decreased in symptomatology (De Witte, Sütterlin, Braet, & Mueller, 2017). Although research in the utility of emotion regulation strategy components in therapy is still new, the results of the current studies are promising, as they show the utility of thinking about emotion regulation strategy choices when trying to understand anxiety emergence and maintenance, especially during childhood.

Some studies have begun to examine how psychopathology relates to these patterns of neural activation, often showing dysregulated patterns of neural activity during emotional tasks (Bunford et al., 2016; Wauthia & Rossignol, 2016). This dysregulated pattern of neural activity has also been linked with differential effects of psychotherapy on symptomatology (Klumpp, Roberts, Kennedy, Shankman, Langenecker, Gross, & Phan, 2017) highlighting the importance of exploring the neural underpinning of emotion dysregulation on people experiencing meaningful levels of symptoms. In childhood, anxiety symptoms have been associated with stronger basic visual processing of emotional faces, as indexed by the P100 ERP component, suggesting that children with anxious symptoms use more attentional resources and experience heightened arousal during exposure to emotional stimuli (Hum, Manassis, & Lewis, 2013). Anxiety symptoms and dispositional fearfulness have also been associated with LPP amplitudes to affective stimuli (including emotional faces), and larger differences in LPP amplitude between unpleasant and neutral stimuli have been associated with greater observed fearful behavior (Chronaki et al., 2018; Dennis, Malone, & Chen, 2009; Kujawa, MacNamara, Fitzgerald, Monk, & Phan, 2015).

In adults, there is *some* evidence that treatment for anxiety can alter the functional connectivity of the neural circuitry for emotion regulation (Young et al., 2017). Further supporting the role of the LPP as an important neural marker of emotion processes in psychopathology, LPP amplitudes before Cognitive Behavioral Therapy (CBT) have been associated with response to CBT, such that people who showed greater LPP amplitudes pre-treatment demonstrated the greatest reductions in symptoms after CBT, suggesting that this treatment was more effective for this group (Stange, MacNamara, Barnas, Kennedy, Hajcak, Phan, & Klumpp, 2016). A similar pattern has been found when also considering behavior, with greater brain-behavioral adaptability being associated with a higher likelihood of responding to treatment (Stange, MacNamara, Kennedy, Hajcak, Phan, & Klumpp, 2017). LPP amplitudes, therefore, might be an important individual difference even within a disorder classification that could be used to assess who might benefit the most from specific treatments.

Studies looking at the LPP and emotion regulation strategy implementation among adults with high trait anxiety suggest that they have difficulty implementing adaptive strategies, as suggested by a lack of modulation of the LPP after the implementation of a strategy compared to adults with low trait anxiety (Qi et al., 2016). Studies with children have shown that larger LPPs when using negative or neutral interpretation of pictures also seem to be associated with more anxious-depressed symptoms and poorer parent-reported emotion regulation, whereas greater modulation of the LPP by neutral interpretations (e.g., greater reduction in LPP amplitude) has been associated with reduced anxious-depressed symptoms (Dennis & Hajcak, 2009). LPP amplitudes have also been associated with somatic anxiety symptoms such as sweaty hands and stomachaches, with smaller changes (a decreased ability to reduce the LPP by using reappraisal) linked to increased somatic anxiety symptoms (DeCicco, O'Toole, & Dennis, 2014). Due to the precise temporal resolution of ERPs, the LPP provides insight into emotion regulation processes that would be impossible to obtain using only behavioral measures (DeCicco, O'Toole, & Dennis, 2014; Dennis & Hajcak, 2009).

*Executive Functions and Emotion Regulation*

Executive function is a macro construct that captures several adaptive processes necessary for higher order goal-directed behavior, such as planning, monitoring, shifting, and inhibition among others (Garon, Bryson, & Smith, 2008; Zelazo, Carter, Reznick, & Frye, 1997). Working memory, inhibition, and cognitive flexibility are some of the most studied aspects of executive functions with the last developing slightly later in childhood and considered to be somewhat dependent on the other two (Chevalier et al., 2012). Although there is substantial improvement in executive function early in life (Carlson & Wang, 2007; Davidson, Amso, Anderson, & Diamon, 2006; Diamond, 2006; Garon, Bryson, & Smith, 2008) this ability continues to increase across childhood (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003) and is an important predictor of positive outcomes such as better emotion regulation, concentration, and self-control among others, even into adolescence (Carlson & Wang, 2007; Mischel, Shoda, & Rodriguez, 1989; Zelazo & Carlson, 2012).

Because executive functions involve the ability to create flexible representations, organize and plan sequences of thoughts or actions, execute planned sequences, evaluate results as well as inhibit responses (Zelazo, Carter, Reznick, & Frye, 1997), both executive function as a whole, and these specific components of executive function should aid effective modulation of emotional responses. For example, inhibitory control (i.e., the ability to control or suppress salient thoughts and actions that are not immediately relevant to the current goal; Rothbart, Ellis, & Posner, 2004) allows people to avoid the display of inappropriate behaviors, including inappropriate behaviors that are the result of an emotional situation (e.g., punching a child who stole a favorite toy).

Many studies have documented how executive functions relates to the ability to regulate emotional states, often showing that better executive functions are associated with better emotion regulation (Carlson & Wang, 2007). For instance, Carlson and Wang (2007) found that children with better inhibitory control also tended to have better emotion regulation abilities, independent of age and verbal ability, supporting the idea that better executive functions are associated with better emotion regulation. Because of the importance of executive functions for healthy functioning, it is imperative that we understand factors that might hinder or potentiate the development of these abilities. There is research to suggest that aspects of the family context, such as parental support during problem-solving and a bilingual environment potentiate the development of executive functions (Barreto, de Miguel, Ibarluzea, Andiarena, & Arranz, 2017; Zeytinoglu, Calkins, & Leerkes, 2018) but more research is needed to better understand the effects of these characteristics on children's developing executive functions.

*Bilingualism in Childhood*

Although various factors have started to be considered to aid our understanding of individual differences in children's performance on executive function tasks, bilingualism has emerged in several studies as an indicator of more advanced performance on these tasks in both children and adults (Adesope, Lavin, Thompson, & Ungerleider, 2010; Barac, Bialystok, Castro, & Sanchez, 2014; Baumgart & Billick, 2017; Carlson & Meltzoff, 2008). Bilinguals are considered to have an advantage in executive functions that stems from the continuous handling of multiple linguistic codes (Kroll, Bobb, & Hoshino, 2014). Models of inhibitory control processes in bilinguals, such as Green's (1998) inhibitory control model, propose that language production in bilinguals is a top-down process driven by executive functions. More specifically, this model assumes that both languages are active when a bilingual is producing an utterance and that it is through executive function processes that one language is inhibited so the target language can be effectively used. It is through this continual activation of inhibitory processes that bilinguals might train executive functions, resulting in greater advantages in tasks that use these processes.

Although previous studies have focused on understanding the limits of this advantage in bilingual adults (Bobb, Wodniecka, & Kroll, 2013), fewer studies have explored the presence of a cognitive advantage in bilingual children. The studies that have focused on children support the idea that young bilinguals also have an advantage in executive functions (Bialystok, 1999; Martin-Rhee & Bialystok, 2008; Mehrani & Zabihi, 2017; Morales, Calvo, & Bialystok, 2013; White & Greenfield, 2017). Bilingual children perform better than monolingual children on tasks tapping cognitive flexibility (Bialystok, 1999), selective attention (Bialystok, 1999), working memory (Morales, Calvo, & Bialystok, 2013), and inhibitory control (Martin-Rhee & Bialystok, 2008; Santillan & Khurana, 2017), with greater bilingual advantages seen in tasks that require greater executive functions or that impose multiple demands on these processes (Martin-Rhee & Bialystok, 2008). This advantage is particularly noticeable in tasks that have dual-modality conditions which tend to be more complex and tap bilingual children's ability to manage two sets of linguistic codes (Bialystok, 2011). Additionally, these advantages have been found at the behavioral and physiological level (e.g., larger P3 amplitudes on a go/no-go task; Barac, Moreno, Bialystok, 2016). Possibly more impressive is the fact that these advantages have been found even in infants (Brito, Sebastián-Gallés, & Barr, 2015) and are maintained across the lifespan into late adulthood (Bialystok, Abutalebi, Bak, Burke, & Kroll, 2016).

Around 43% of school-aged children in California are bilingual, 84% of which are English-Spanish bilinguals (California Department of Education, 2016), making it crucial to understand this potential cognitive advantage in this population. There is some evidence that Spanish-English bilingual children also show this cognitive advantage (Carlson & Meltzoff, 2008), but considering that this group of children also face other factors that can influence the development of executive functions (e.g., poverty) it is important to identify the protective effects of bilingualism in the context of these other factors. Studies looking at these associations have found that the degree of children's bilingualism has been associated with executive functions, such that more balanced proficiency in two languages was associated with more enhanced cognitive functions even when controlling for socioeconomic status (SES; Thomas-Sunesson, Hakuta, & Bialystok, 2016). In a nationally representative sample of 18,200 children tracked from ages 5 to 7, bilingualism was associated with better performance in inhibition and shifting, as well as with better self-regulatory behaviors in the classroom (Hartano, Wei, & Yang, 2018). Perhaps more important, bilingualism moderated the effects of SES ameliorating the detrimental consequences of SES on executive functions and self-regulation, suggesting that bilingualism might be a mechanism through which disparities in executive functions and self-regulation across SES can be narrowed (Hartano, Wei, & Yang, 2018). This is particularly important for Hispanic children, as Hispanic bilingual children often come from lower SES households. The fact that these advantages are found independent of SES (Calvo & Bialystok, 2014) and even seem to buffer children against the negative effects of low SES (Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012; Hartano, Wei, & Yang, 2018) on executive functions is important, especially when considering that these children often show smaller vocabularies than their monolingual counterparts (Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012). Overall, the results of these studies suggest a strong protective role of bilingualism in children's developing regulatory processes, particularly driven by their increased inhibitory and attentional control abilities (Bialystok, 2015). If this protective factor is indeed present in this population, then not only should they still outperform monolingual children in executive function tasks, but they might also be particularly protected from negative environmental influences on the development of executive functions.

<u>Emotional Processing.</u> Research and theoretical accounts suggest that emotion-related processes differ for mono- and bilingual speakers and across cultures (Ford & Mauss, 2015; Kitayama & Markus, 1994; Murata, Moser, & Kitayama, 2013). One study compared LPP amplitudes of European American and Asian adults after instructions to suppress their emotional response to an unpleasant picture. LPP

amplitudes changed for Asians (demonstrating an effect of suppression) but not for European Americans (Murata, Moser, & Kitayama, 2013; Kitayama & Markus, 1994), suggesting that cultural differences in emotional processing can be seen at the neural level. Bilingualism and emotion knowledge in young children also predict socio-emotional outcomes (Chen, Kennedy, & Zhou, 2012; Guhn, Milbrath, & Hertzman, 2016; Ren, Wyver, Xu, Rattanasone, & Demuth, 2015; Vañó & Pennebaker, 1997). For example, greater disparities between Spanish and English emotion vocabularies in school-age Spanish-English bilingual children have been associated with acting out behavior at school (Carlson & Meltzoff, 2008). Bilinguals outperform monolingual children in school-readiness assessments including social and emotional measures (Guhn, Milbrath, & Hertzman, 2016). Moreover, fluent bilingual children have also been seen to show slower increases in behavioral problems compared to monolingual children (Han & Huang, 2010). Because these cognitive and socioemotional processes have been consistently associated with effective emotion regulation processes in samples of adults and children (Carlson & Wang, 2007; Ren, Wyver, Xu, Rattanasone, & Demuth, 2015), greater executive functions in bilingual children may also predict more effective implementation of emotion regulation strategies that require skills such as changing what or how one thinks about an emotional stimulus.

*The Current Study*

The overarching goal of this dissertation was to clarify how the use of emotion regulation strategies was linked to anxiety symptoms in Hispanic children while also considering their level of bilingualism. Much of what we know about emotion regulation strategy use, especially in relation to anxiety, has been derived from studies with adults (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Amstadter, 2008), limiting our understanding of these processes and trajectories in childhood. Moreover, most of these studies have relied on homogenous, white, middle-class samples, so the findings may not generalize to the changing demographics of the US. This dissertation examined seventy-eight 8- to 11-year-old Hispanic children to address a gap in our knowledge about emotion regulation-anxiety relations in a phase of development when cognitive emotion regulation skills are improving, and anxiety symptoms become more common. Addressing the neurophysiological patterns that mark effective emotion regulation strategy use provides additional insight into the risk/protective mechanisms for this understudied (and rapidly growing) segment of the population. Although research on potential interventions has shown that cognitive behavioral therapy (CBT) is an effective treatment for anxiety disorders (Ollendick & King, 1998), 30-40% of children who undergo this treatment do not see significant improvements in symptoms (Kendall, Hudson, Choudhury, Webb, & Pimentel, 1996), suggesting that there are some characteristics of anxiety disorders that are not being fully addressed with current treatment. Identifying specific psychological mechanisms (e.g., emotion regulation processes) implicated in anxiety development that can be modified will provide an empirical basis for the development of future targeted interventions that address emotion regulation more comprehensively. Examination of these processes in Hispanic children with exposure to a second language, who may differ in executive function skills, provides valuable information about which children would benefit most from such interventions. Thus, the current study contributes to our understanding by providing knowledge about 1) ineffective emotion regulation strategy use as a specific form of emotional dysregulation, 2) the developing relations between emotion regulation and childhood anxiety, and 3) differences in these processes based on children's level of bilingualism.

Although this study focused on the relation between emotion regulation and anxiety, there are many other aspects of a child's environment that might relate to emotion regulation and anxiety development and maintenance. For example, maternal use of suppression seems to predict children's use of suppression among 9-19-year-olds (Bariola, Hughes, & Gullone, 2012). Gunzenhauser, Fasche, Friedlmeier, & von Suchodoletz (2014) found that when looking at various aspects of parental emotion socialization, parental modeling of reappraisal and suppression was associated with children's use of both strategies. Parents' supportive reactions to children's negative emotions were also related to children's use of reappraisal, but not suppression, such that engaging in more supportive reactions was associated with more use of reappraisal by the child. On the other hand, parental non-supportive reactions were related to children's use of suppression, but not reappraisal, suggesting that parental socialization of emotion regulation and parents' emotion regulation choices might influence children's emotion regulation strategy use (Asbrand, Svaldi, Krämer, Breuninger, & Tuschen-Caffier, 2016). Parental psychopathology has also been linked to children's psychopathological symptoms (Spence, Najman, Bor, O'Callaghan, & Williams, 2002) and children's emotion regulation (Kudinova, James, & Gibb, 2017). For example, parents' anxiety symptoms have been linked to the emergence of anxiety symptoms in childhood (Wichstrøm, Belsky, & Berg-Nielsen, 2013). Therefore, parents' psychopathological symptoms are also an important environmental factor associated with the experience of anxiety in childhood. Moreover, there is some evidence that children from parents with a history of depression show different patterns of LPP activity (Kujawa, Hajcak, Torpey, Kim, & Klein, 2012) suggesting that parents' psychopathology might relate to child mental health through various mechanisms, including the processing of emotional information. Lastly, children's socioeconomic status (SES) has also been linked to more psychopathological symptoms and related problems (Spence, Najman, Bor, O'Callaghan, & Williams, 2002). This is particularly relevant for this study as Hispanic children often come from low SES families (Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012) and are, therefore, at a greater risk of experiencing difficulties throughout childhood. These aspects of children's environments were considered when modeling the relation between emotion regulation and anxiety symptoms in this group to better capture the role of emotion regulation in anxiety development.

The overall aim of this dissertation study was to explore the link between emotion regulation and anxiety symptoms in 8-11-year-old Hispanic children while considering bilingualism as a putatively important individual difference among these children.

**Aim 1.** Examine whether there are differences in executive functions for Hispanic children based on their level of bilingualism. I hypothesized that balanced bilingual children would outperform less proficient bilingual children on executive functions.

**Aim 2.** Examine whether there are differences in emotion regulation abilities for Hispanic children based on level of bilingualism. In general, I hypothesized that balanced bilingual children would show more advanced emotion regulation abilities than monolingual or less proficient bilingual children, though this would differ depending on the specific facet of emotion regulation examined.

**Aim 2a.** Are there differences in emotion regulation strategy *context sensitivity* based on level of bilingualism? I hypothesized that balanced bilinguals would be able to better fit their regulatory choices to contextual damnds than less proficient bilingual children.

**Aim2b.** Are there differences in emotion regulation strategy *repertoires* based on level of bilingualism? I hypothesized that children would not differ in the size of their repertoires based on their level of bilingualism.

**Aim 2c.** Are there differences in how Hispanic children *implement* distraction and reappraisal based on level of bilingualism? I hypothesized that all children would be able to effectively implement distraction, but that balanced bilingual children would be better at implementing reappraisal than less proficient bilingual children.

**Aim 3.** Examine which aspects of emotion regulation (Context Sensitivity, Repertoire, and Implementation) are linked to anxiety symptoms for Hispanic children while also considering their level of bilingualism. I hypothesized that all three aspects of emotion regulation would independently predict anxiety symptoms above and beyond the other measures of emotion regulation for all children.

## CHAPTER 2

## Method

### Participants

A total of 78 (50% girls) Hispanic or part Hispanic children between the ages 8.00 – 11.92 years were recruited for this study ($Mean_{\text{age}}$ = 9.91; $SD_{\text{age}}$ = 1.14). Participants were recruited from a database of families interested in research studies and from community events in the Inland Empire region of Southern California. Because of the inclusion criteria (being Hispanic or part Hispanic) all children were considered at least part Hispanic, with 74% being endorsed by their parents as only Hispanic, and 26% being endorsed as Hispanic and another ethnic group. Families were primarily low- to middle-SES, with 16% reporting a household income below $15,000, 28% reporting an income between $15,000-$30,000, 19% between $30,000-$50,000, and 37% reporting an income higher than $50,000. Only one caregiver was asked to participate, resulting in 71 mothers and 7 fathers taking an active part in this study (in some cases an additional caregiver came to the laboratory but did not take part in the study tasks). Parents' level of education varied. A total of 24% of fathers did not finish high school, 24% indicated having a high school diploma, 37% indicated having some college, 4% indicated finishing college, and 7% indicated having some graduate training or a graduate degree, 4% of fathers did not have education data. In the case of mothers, 22% did not finish high school, 12% had a high school diploma, 31% indicated having some college, 9% indicated finishing college, and 15% indicated having some graduate training or a graduate degree, 11% of mothers did not have educational information (Table 1). Study procedures were approved by the institutional review board (HRRB code: HS-17-124). Written consent was obtained from the participating caregiver and written and verbal assent were obtained from the child before any procedures took place. At the end of the study, families were debriefed, thanked, given a $40 compensation for their participation, and children received a small toy of their choosing.

**Table 1.** Means and standard deviations of general family characteristics

| | **Mean** | **SD** | **Min-Max** |
|---|---|---|---|
| Child age | 9.91 | 1.14 | 8.00 - 11.92 |
| Child level of bilingualism | 86.54 | 6.00 | 70.00 – 99.00 |
| English Fluency | 17.46 | 4.91 | 3.00 – 30.00 |
| Spanish Fluency | 4.00 | 4.52 | 0.00 – 19.00 |
| Father's years of schooling | 12.36 | 3.15 | 6.00 – 20.00 |
| Mother's years of schooling | 13.35 | 3.44 | 5.00 – 20.00 |
| Family income | 4.47 | 2.46 | 1.00 – 8.00 |

**Design**

This study used a 2 condition (emotion regulation strategy implementation instructions: distraction, reappraisal; between-subject) experimental design. Children were randomly assigned to one of two conditions, in which they would receive instructions to use either distraction or reappraisal emotion regulation strategies.

## Procedure

Families came to the lab for a 3-hour visit. After consent and assent was obtained, parents provided information about their family (e.g., income, languages spoken in the home), themselves (e.g., psychopathology symptoms, emotion regulation, level of education), and the participating child (e.g., anxiety, emotion regulation) via questionnaires. Parents were also asked to complete a battery of executive function tasks (described below) near the end of the study. Children's level of bilingualism was assessed using a Spanish and an English verbal fluency task. A battery of executive function tasks was given to the child at the beginning of the study, with accuracy and reaction times for each task recorded for analyses. Following these tasks children completed measures of anxiety and depression (42 children read the questionnaires themselves, and the other 36 asked to have the questions read to them by the experimenter). After the questionnaires, children completed an autobiographical emotion interview (to assess strategy repertoire), and an interview about emotion regulation strategies (to assess context sensitivity). An emotional picture-viewing task was used during the second half of the study to assess the LPP to emotional pictures and implementation of instructed emotion regulation strategies. The amplitude of the LPP was assessed for each trial, and trials for each block (described below) were averaged to create an aggregate waveform. English and Spanish versions of all the procedures, tasks, and questionnaires were available, and caregivers were given the option to complete their part of the study in the language they felt more comfortable speaking and reading, 21% of caregivers chose to complete the study in Spanish. All children completed the procedures in English.

**Stimuli and measures**

**Family Characteristics.** Characteristics of the home environment, such as family household income, number of people living in the household, parents' education, as well as other important family characteristics were assessed by asking the participating parent to report on the family's characteristics.

*Bilingual Switching Questionnaire.* A modified version of this questionnaire was used for this study to assess parents' mixing and switching of both languages (Appendix A1; Rodriguez-Fornells, Krämer, Lorenzo-Seva, Festman, & Münte, 2012). The questionnaire includes 12 items assessing the frequency of code-switching and language interference. Items include questions such as, "*I tend to switch languages during a conversation*." Code-switching is common among bilinguals and reflects a sophisticated linguistic and cognitive strategy (Kroll & Dussias, 2016) that might be related to performance on executive function tasks, therefore, it was used in analyses as a covariate to give a more nuanced understanding of bilingual children's executive function performance. Parents responded using a 5-point scale (4 = *always*; 0 = *never*). Higher scores indicate more switching. The internal consistency for this scale was good ($\alpha = .79$).

*Language and Social Background Questionnaire (LSBQ).* A modified version of this questionnaire was used to assess parents' and children's language, ethnic, and socioeconomic background, and home language environment (Appendix A2; Luk & Bialystok, 2013). The LSBQ has a total of 23 items that assess multiple aspects of someone's environment, including the use of a language other than English, participants' dominant language, household use of the second language for speaking, reading, watching tv, and related household environments. The questionnaire includes questions such as "*What is your dominant language for the past 5 years?*" This questionnaire was used for descriptive purposes and is not included in analyses.

**Verbal Fluency Task.** Both a Spanish and an English verbal fluency task were given to children at the beginning of the study to assess children's level of bilingualism by measuring their vocabulary in each of the languages. Similar approaches to assess children's level of bilingualism have been used in past studies (Thomas-Sunesson, Hakuta, & Bialystok, 2016). The entire task took about 8 minutes. Children were always asked about Spanish first, and then English as children were in general expected to perform better in English than in Spanish. For the first part, children were asked to say all the Spanish words they could think of in 60 seconds, for the following minute, children were asked to say all the animals they could think of in Spanish, lastly, for the third minute, children were asked to say all the feeling and emotion words they could think of. The same procedure and order was used for the English part. For this study, only the words mentioned during the second minute when children could say any animal word was used for analyses. This was done to better assess children's knowledge of Spanish as almost all children experienced at least indirect exposure to the language given the area from where children were recruited. Two trained research assistants counted the total unique words mentioned in the appropriate language during the 60 seconds. Reliability was calculated on 30% of the files, agreement was reached when the scores differed by no more than one word. Reliability was excellent (percent agreement Spanish = 96%; percent agreement English = 92%).

The total number of unique words the child said during the 60 second period were counted and used to calculate children's level of bilingualism. Following the procedures from a previous study (Thomas-Sunesson, Hakuta, & Bialystok, 2016) children's level of bilingualism was calculated as a ratio by using the absolute difference between the total unique words described in English minus the total unique words in Spanish. The absolute difference was then multiplied by -1 to reverse the order of scores (i.e., so larger scores would indicate more balanced used of both languages), and a constant of a 100 was added to the score so that a score of 100 would indicate perfect balance between both languages (i.e., a child said 20 unique words for Spanish and 20 unique words for English), and decreasing scores would indicate less balanced bilingualism (e.g., child said 10 unique words for Spanish and 30 unique words for English, *or* 0 unique words for Spanish and 10 unique words for English). The resulting formula was:

**Level of bilingualism = [100 + (-1 * Abs(English-Spanish))]**

**Executive Function Tasks.** A battery of behavioral executive functions (EF) tasks were given to children at the beginning of the study (before any emotion-eliciting tasks took place) to assess various EF processes where bilingual children typically outperform monolingual children. The entire battery took about 25 minutes. The same EF battery was given to the caregivers during the second half of the study.

*Flanker.* An age-appropriate version of the Eriksen Flanker Task was used to assess EF processes associated with conflict resolution (Appendix B1; Christ, Kestler, Bodner, & Miles, 2011; Eriksen & Eriksen, 1974) in 144 trials across two experimental blocks. The task was programmed in E-Prime and presented on a laptop computer in the laboratory. Each trial began with a fixation cross presented for 500ms, followed by the presentation of a target array composed of a target (center) fish and four (or six) flanking fishes for a total of 1,000ms. Children indicated the direction the target (center) fish was facing by pressing the corresponding key as fast as possible. On congruent trials, the target fish appears amid flanking fishes facing the same direction as the target; during incongruent trials, the target fish appears amid flanking fishes facing the opposite direction. On control trials, the target fish appeared by itself. From those 144 trials, 16 were control trials, and the other 128 trials were divided into 64 congruent and 64 incongruent trials. To increase the difficulty of this task, to get a more accurate range of children's performance on a conflict resolution task, congruent and incongruent trials were further subdivided into 32 normal (4 flanking fishes) and 32 hard (6 flanking fishes) trials. All trials were randomly presented. Accuracy and reaction times were used in analyses.

The parent version of the task was virtually the same as the child version of the task. The parent version of the task consisted of 144 trials, just like the child version, that were subdivided in the same way as the child version of the task was. The only difference was the speed of presentation of the target. In the adult version of the task the target was presented for only 750ms.

Wisconsin Card Sorting Task. This commonly used task to assess cognitive flexibility in people age 7 years and older was administered to children and caregivers in this study (Appendix B2). Participants were asked to sort cards into groups according to several rules (i.e., color, shape, or number). Participants had to guess what the first sorting rule was and after figuring out the first rule, they continued to sort cards based on that initial rule. After some time, the rule changed, and participants had to figure out what the new rule was. A 60-card version of the task was used for the study. Particular attention was given to the kind of mistakes participants make, with perseverative errors (i.e., continuing to use a rule even after getting feedback that the rule is not the correct rule) being the most used measure derived from this task. Participants completed a computerized version of the task presented on PsyToolkit. PsyToolkit is a novel web-based freely available software package that allows for the programing of open-source experimental tasks using Linux (Stoet, 2010; Stoet, 2017). PsyToolkit includes a library of pre-programmed tasks including the WCST (and Corsi) task(s) used in this study. Children and caregivers completed the same version of the task.

Corsi Task. The child and the participating caregiver completed a quick working memory task that has often been used to assess non-verbal working memory (Appendix B3; Corsi, 1972; Kemps, De Rammelaere, & Desmet, 2000). Participants completed a computerized version of this task presented on PsyToolkit (described above). Participants were asked to recall the sequence in which a series of blocks lit up on the screen. During the first trial, only two blocks light up, if the participant recalls correctly the blocks that lit up, a more complex sequence is presented (e.g., 3 blocks), up to a total of 9 blocks. If a participant failed to correctly recall a sequence, a different sequence with the same number of blocks was given, if the participant failed the second attempt, the task finished. Working memory was assessed as the total number of blocks of the most complex sequence completed, therefore, possible working memory scores ranged from 0-9 with higher numbers representing better working memory.

*Go/No-go.* Children completed a go/no-go task as part of the EF battery (Appendix B4). For this task, children played a short computer game presented in E-Prime (E-Prime 2.0, 2012). Children were shown cartoon images of Pokémon and were told to press the space bar as quickly as possible when a Pokémon character appears (the "go" stimuli) but to refrain from pressing the spacebar whenever a specific Pokémon (Meowth) appeared (the "no-go" stimulus). Specifically, children were told, "*You are trying to capture the Pokémon into the Pokéball. Press the space bar to capture any Pokémon figure, except Meowth. When Meowth pops up, don't press the space bar. Remember, do NOT press the space bar when you see Meowth*." A photo of Meowth and the text for the instructions was presented to ensure all children knew what the no-go stimulus looked like. Children were given five practice trials, including go and no-go trials, to ensure their comprehension of the game's rules. After the practice trials, the task began. The task consisted of a total of 75 trials (12 NoGo trials and 63 Go trials) presented on a single block. For each trial, children saw a Pokéball first for 2,500ms and were then presented with the target for a total of 500ms. General accuracy, as well as accuracy for Go and NoGo trials, and response times to correct go trials were automatically recorded for later analyses.

The parent version of this task was similar to the child version. This version of the task consisted of 170 trials divided into two blocks of 85 trials each. Each block consisted of 21 NoGo trials and 64 Go trials. The Pokéball appeared first for 2,500ms and were then presented with the target for a total of 500ms. Parents received the same instructions as the child and were also given 5 practice trials before officially starting the task. Accuracy and reaction times were recorded for later analyses.

<u>Dot Probe.</u> After completing the previous tasks, children completed a Dot Probe task (Appendix B5). The task consisted of 8 practice trials and 160 experimental trials that were randomly presented. Each trial began with a fixation cross for 500ms followed by a pair of faces that were presented side-by-side for another 500ms. One of the two faces was replaced after the 500ms with a target that stayed on screen for another 1,000ms. Children were asked to indicate, as quickly and accurate as possible, on which side of the screen the target appeared. This was followed by a varying inter-trial interval of 300-750ms. Three combinations of faces were presented: angry-neutral (40 trials), angry-angry (40 trials), and neutral-neutral (40 trials). The remaining 40 trials only had a fixation cross and no faces were presented. Images from ten different actors (5 females) were selected from NimStim face stimulus set (Tottenham et al., 2009). In congruent trials, the target replaced the affective face, in incongruent trials it replaced the neutral face. Accuracy and reaction time were recorded for each trial. An attention bias score was calculated as in previous studies (Morales, Pérez-Edgar, & Buss, 2014; Pérez-Edgar et al., 2011) by subtracting the mean reaction time for congruent trials from the mean reaction time for incongruent trials. Positive values suggest a bias

towards the emotional stimuli, whereas negative values suggest a bias away from the emotional stimuli.

The parent version of this task was similar to the child version. This version had the same amount of trials as the child version (160 trials) divided in the same way. As in the child version, the fixation before the faces also appeared for 500ms, followed by a pair of faces for another 500ms, then followed by a probe for 1,000ms. Both accuracy and reaction times were saved for later use and an attention bias score for the parent was calculated in the same way as for the child.

**Autobiographical Emotion Interview (AEI).** After the EF battery, but before the EEG task took place, children were interviewed by an experimenter (always a female) about past autobiographical events that made them feel fear, sadness, and anger using a protocol developed in our laboratory. Specifically, the experimenter said, "*We are interested in how people think and feel about different things. So now I am going to ask you about times that you felt certain ways. First, I'd like to know about a time recently that you felt VERY [scared/sad/angry]. Please take a few moments to think about and remember a time recently when you felt VERY [scared/sad/angry]. Think about what happened and about all of the little details you can remember about it.*" Children were given a minute to think about the event and were offered a piece of paper and writing/drawing implements to use if they liked. Children were asked the same question for each emotion separately. After children gave all the details they could remember about the event, the experimenter asked them to report what they did to make themselves feel better by saying, "*When you felt that way, what did you try to do or* *think about to make yourself feel LESS [scared/sad/angry]?*" Two prompts for additional information were provided (e.g., "*What else did you do?*", "*What other things did you do or think about?*"), so children were asked to provide information about strategy use three times for each discrete emotion phase of the interview but could say as many things as they wanted.

Responses were transcribed offline, and strategies were coded using a coding scheme modeled after similar investigations (e.g., Davis et al., 2010; Quiñones-Camacho & Davis, 2018; Appendix C1). The coding scheme consists of five broad categories: problem-solving, changing thoughts, changing goals, social support, and "experiencing the emotion without trying to change it." Each category contains multiple strategies. For example, the changing thoughts category would include strategies such as cognitive reframing, cognitive distraction, thought suppression, sleep/change mental state, rumination, telling yourself to calm down, and imagined social support. Two trained research assistants coded children's responses using this coding scheme. Reliability for the coding was calculated on 30% of the files and was excellent (Percent of absolute agreement = 93%).

From the children's responses, a measure of emotion regulation strategy repertoire was calculated. Strategy repertoire was operationalized as the number of unique strategies used, and emotion-specific, as well as general repertoire scores, were created. If a child endorsed the same strategy more than once during a single emotion phase (e.g., fear), it counted only once toward the repertoire measure for that emotion (e.g., fear repertoire). Although the coding scheme included many strategies, some of these strategies are considered to be more adaptive than others, thus, strategies that are typically considered to be adaptive for the given emotion were used in the calculation of each repertoire measure. Following previous conceptualizations of adaptive discrete emotion regulation repertoires (e.g., Quiñones-Camacho & Davis, 2018), strategies that would be expected to work well in any of the discrete emotion contexts were summed: cognitive distraction, behavioral distraction, imagined social support, seeking social support, and calming down. After this, strategies that have been found to be preferentially used by children for a specific emotion were added to that emotion repertoire only. The fear repertoire included cognitive reframing, cognitive distraction, imagined social support, behavioral distraction, seeking social support, calming down, and problem solving. The sadness repertoire was very similar with the exceptions that it did not include problem solving but it did include acceptance. Finally, the anger repertoire was identical to the fear repertoire except for the fact that it did not include cognitive reframing.

A general repertoire score was also created (i.e., the number of unique strategies endorsed across any phase of the interview, independent of emotion context) with all the possible adaptive strategies across emotions. For example, a child who described using only cognitive distraction for anger, no strategies for sadness, and both cognitive distraction and cognitive reframing for fear had a general repertoire score of 2 (representing the two distinct strategies across emotion contexts), an anger repertoire of 1 (cognitive distraction only for anger), a sadness repertoire of 0 (no strategy), and a fear repertoire of 2 (cognitive distraction and cognitive reframing for fear). Because children could respond by saying they did not do anything, some children had a score of 0 even if they completed the interview. A total of 10 children said they did not do anything for fear, 12 for sadness, and 5 children said the same for anger and 1 said they could not remember if they had done something to feel less angry.

**Filler task.** Children were asked to complete a word puzzle after the end of AEI and before starting EREI. This filler task served as a recovery period between the two emotion regulation interviews and is not considered in analyses.

**Emotion Regulation Strategy Effectiveness Interview (EREI).** Three emotion-eliciting vignettes were developed for this study using approaches similar to published studies (Appendix C2; Dennis & Kelemen, 2009; Reijntjes, Stegge, Terwogt, Hurkens, 2007; Waters & Thompson, 2014). One vignette described a scary event, one described a sad event, and one describe an angry event. The vignettes were designed to represent common experiences that children of the target age would likely experience and that would be expected to evoke fear, sadness, or anger, among this group. Vignettes were piloted using two 10-year-olds to confirm that children of this age experienced the target emotion for each vignette. Each vignette consisted of a brief written paragraph describing a hypothetical situation. Participants were instructed to listen to each vignette carefully and to imagine that they were in the situation themselves. After each vignette, participants were asked to describe all the things they think they would do or think about to make themselves feel better if they were in that situation, specifically, they were asked "*Sometimes, when we experience this kind of situation, we do things to change how we feel. If you were in that situation and felt very* *scared, what would you do to make yourself feel better*?". This prompt was followed by two additional follow-up questions, for example "*What else would you do to make yourself feel better?*" After these open-ended prompts, children were asked a series of questions about 10 emotion regulation strategies they could potentially use to make themselves feel better if they were experiencing that situation. The strategies children heard were: Problem Solving, Cognitive Reappraisal, Cognitive Distraction, Rumination, Thought Suppression, Behavioral Distraction, Seeking Social Support, Avoidance, Acceptance, and Breathing/Calming Down. For each strategy, children were asked to report 1) their likelihood of using each strategy, and 2) their perceived effectiveness of each strategy to change their mood. Participants were asked to do this for each strategy and for each vignette.

*Emotion Regulation strategy use likelihood.* A description of each of the 10 emotion regulation strategies followed each vignette. For each of the strategies, participants were asked to rate, on a scale ranging from 1 (*definitely would not*) to 5 (*definitely would*), how likely they would be to use that strategy if they were in that situation. For example, participants were asked to report how likely they were to use cognitive reappraisal (i.e., thinking about the situation in a different way) during a sad event, a child who considered themselves as very likely to reappraise would have given a score of 5 for reappraisal for the sadness vignette.

*Emotion Regulation strategy effectiveness.* Children were then asked to rate on a scale ranging from 1 (*definitely would not be*) to 5 (*definitely would be*) how effective they think that strategy would be to change how they felt if they were experiencing that event. Participants were asked to do this for each strategy and each vignette. For example, after a description of the sad event, and after saying how likely they were to use each emotion regulation strategy, children said how effective they believe the strategies were, so a child who believed cognitive reappraisal would be very effective for regulating sadness, would have given a score of 5 to cognitive reappraisal in the sad vignette.

*Context Sensitivity Score.* A score of children's sensitivity to context in their selection of emotion regulation strategies was calculated from this interview. A set of appropriate strategies to use for each of the discrete emotion contexts was derived from previous studies on emotion regulation strategy knowledge and use in childhood (Davis et al., 2010; Dennis & Kelemen, 2009; Quiñones-Camacho & Davis, 2018; Waters & Thompson, 2014). Specifically, the fear context appropriate sum score included the strategies problem-solving, cognitive reappraisal, thought suppression, and breath/calm-down. The sadness context appropriate sum score included the strategies cognitive reappraisal, behavioral distraction, social support, and acceptance. Lastly, the anger context appropriate sum score included the strategies cognitive distraction, problem-solving, behavioral distraction, and breath/calm-down. Strategies rated by the child as being likely to be used in that situation (a likelihood score of 4 or 5) were summed into a single score of children's hypothetical use of emotion regulation strategies. Based on the discrete emotion appropriate strategies, a second sum score was created including only the discrete emotion appropriate strategies the child endorsed as likely to be used in that situation. A proportion scored was then created by dividing the appropriate strategy sum scored by the total sum score as follows:

$$\textbf{Discrete Emotion Context Sensitivity} = \frac{\textbf{Appropriate strategies endorsed}}{\textbf{Total strategies endorsed}}$$

A larger proportion score indicates greater use of discrete emotion appropriate strategies for each emotion, in other words, greater context sensitivity. A general context sensitivity score was then calculated by averaging all proportion scores from the three discrete emotion vignettes (sad, fear, and anger) to indicate children's general context sensitivity. Both the discrete emotion and the general score were used in analyses.

**Emotion Regulation Strategy Implementation Task**

**Capping.** After the previously described tasks were done, children were taken to the CALLA lab in Olmsted Hall, an adjacent building, where they did the EEG part of the study. Children were told that they would be playing new computer games but that they would need to wear a "funny hat" during the tasks so we could see how their brain behaved. Children were then capped with 32 active electrodes using the 10-20 system (an internationally recognized method of electrode positioning for EEG studies). Children were told to ask any questions they had about the electrodes and the cap and were given thorough instructions on what they needed to do during this part of the study (e.g., try hard not to move too much or blink). After this, children were given a couple of minutes to acclimate to wearing the electrodes and the chamber before the EEG picture viewing task began.

**Passive Picture-viewing task.** The picture-viewing task was designed after similar LPP tasks and was presented using E-Prime (Psychology Software Tools, 2012; Appendix C3). Children were told that they would be playing a game and to pay close attention to the screen. A total of 80 trials were presented, 20 for each emotion (neutral, sad, fear, happy). This number of trials was selected based on research showing that for large ERP components, such as the LPP, usually around 8 trials is sufficient to get a reliable ERP, but the ability to detect significant effects increases with more trials (Bodewyn et al., 2017; Huffmeijeretal et al., 2014). Each trial began with a white fixation cross in the center of a black screen for 2000ms, followed by an instruction cue (view) for 2500ms. During view trials, children were instructed to "*pay attention to the pictures*." These trials were intended to elicit natural, uncontrolled emotional responses. Each image appeared on the full-screen after instruction offset and remained on screen for 3500ms. Children were asked to indicate the intensity of feelings they experienced (using an age appropriate scale) at the end of each block (Appendix C4). Using a 4-point scale, children were asked to report how sad, angry, scared, and happy they felt after each block (4 = *very*; 1 = *not at all*).

Stimuli selection. 160 images were chosen from the International Affective Picture System (IAPS; Lang, Bradley, Cuthbert, 2008) and the Nencki Affective Picture System (NAPS; Marchewka, Żurawski, Jednoróg, & Grabowska, 2014) to create four categories of stimuli (fear, sad, neutral, and happy) with 40 images in each category. I have previously used a similar approach to assess LPP amplitudes for discrete emotions in adults (Quiñones-Camacho, Wu, & Davis, 2018). Images were selected from two different picture systems due to the lack of appropriate images for each discrete emotional contexts in IAPS. Two 10-year-olds pilot rated the images for emotional type and intensity, and all selected images were appropriate for children. In addition, the parents of the two children who piloted the study were asked to view the images and rate their appropriateness.

**Emotion Regulation (ER) strategy training.** Following the passive viewing task and after a short break, the experimenter explained the emotion regulation instructions to the child (corresponding to assigned condition: reappraise or distract) before the ER task began (Appendix C5). Children were guided through 5 practice trials using images that did not appear on either one of the tasks to ensure their understanding of the ER instructions (Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011). The experimenter gave careful instructions and examples of how to implement the strategy, asked children to explain how they would use the strategy during each practice trial, and provided feedback after each regulatory attempt. All children completed the 5 practice trials even if they got the instructions right on the first attempt. Children were told that they would see instructions to "change" (i.e., reappraise or distract) their thoughts about each image, and that they should wait to implement the ER strategy on change trials until the picture appears on the screen. The task did not start until children correctly described using the instructed strategy on at least two consecutive practice trials. If needed, up to three additional practice trials were given. All children correctly described the strategy they were being asked to use during this part of the study.

**ER Picture Viewing Task.** This task follows the same format as the passive viewing task. Each of the 80 trials began with a white fixation cross in the center of a black screen for 2000ms, followed by an instruction cue (change) for 2500ms. Each image appeared on screen after instruction offset using 75% of the screen and remained on screen for 3500ms. Children were asked to indicate the intensity of feelings they experienced during this task as well (using the same age appropriate scale) at the end of each block. Each of the three picture types (fear, sad, neutral, happy) were presented in separate blocks. Each block consisted of 20 change (distraction or reappraisal) trials. The sequence of pictures within each block was randomized, as well as the order of blocks (except for the neutral block, which was always presented first). Children were given a resting period between blocks to allow time for affective recovery and to blink and relax. During the change trials, half of the participants were told to "reappraise" and half were told to "distract" (all children saw the word "change"). For the reappraise group, participants were instructed to feel neutral in response to the images by thinking about the image in a different way, such as by "thinking how the image is not real." For distraction, participants were instructed to feel neutral in response to the image by "thinking of something boring instead of the picture" (Davis, Parsafar, Quiñones-Camacho, & Shih, 2017). Difference scores for trials in which children were or were not asked to regulate were created to assess how effectively distraction and reappraisal modulated the LPP.

**EEG recording and LPP calculation.** Continuous EEG recordings were made using the Brain Vision system. Offline processing of EEG data was carried out using

Brain Vision Analyzer 2. The EEG data was sampled at 500 Hz. The left earlobe was used as the reference during recording. For analyses, all data were re-referenced to the average of both earlobes and band-pass filtered using 0.1 Hz (high pass) and 30 Hz (low pass) cutoffs with a 60 Hz notch filter. Eye movements and blinks were corrected using the Gratton, Coles and Donchin (1983) method, commonly used in LPP research (Hajcak, MacNamara, Foti, Ferri, & Keil, 2013; Thiruchselvam, Blechert, Sheppes, Rydstrom, Gross, 2011). Event-locked EEG epochs were extracted starting 750ms pre-stimulus onset (standard 20% of the trial duration) and continuing for the entire duration of the trial (3,500ms). Segments were baseline corrected using the first 750ms pre-stimulus. Artifact rejection was performed semi-automatically for all EEG data by using the following criteria: a voltage step of more than 50 μV between sample points, a voltage difference within a trial greater than 300 μV, a maximal voltage difference smaller than .50 μV within a 100ms interval, and an amplitude ± 100 μV within a 100ms interval (Hajcak et al., 2013; Quiñones-Camacho, Wu, & Davis, 2018; Weinberg & Hajcak, 2011). Any trials with excessive physiological artifacts (e.g., excessive movement) identified with the previously described criteria were rejected before averaging the segments for each block. Participants were required to have a minimum of 9 trials for each block to be included in analyses. After artifact rejection, the remaining segments were averaged to create the ERPs of interest for each emotion type. Based on previous research with children, the LPP was defined as the average activity of the PO7, PO8, O1, O2, and Oz electrodes (DeCicco, O'Toole, & Dennis, 2014; Van Cauwenberge et al., 2017). LPP was defined as the maximum electrical activity in the

300-3,500ms time window following picture onset (similar approaches have been used in other studies with children; DeCicco, O'Toole, & Dennis, 2014; Dennis & Hajcak, 2009). After EEG data have been processed, and preliminary analyses have been conducted, a difference score was created with the LPP amplitudes by subtracting the 'change' trials from the 'view' trials (LPP view – LPP change). Larger scores suggest more effective modulation of the LPP when using distraction or reappraisal (i.e., better regulation). This variable will be used in analyses to assess differences in strategy implementation based on level of bilingualism.

**Anxiety symptoms.** Children's anxiety was measured using the Screen for Child Anxiety Related Disorders (SCARED; Birmaher, Khetarpal, Brent, Cully, Balach, Kaufman, & Neer, 1997). Caregivers and children both completed versions of this measure (caregivers completed the questionnaire while the children did other tasks with the experimenter; children completed the questionnaire after the EF battery but before other tasks). The SCARED consists of 41 items yielding a total (or general) score, and 5 subscales, that represent specific subtypes of anxiety (Panic Disorder, Generalized Anxiety Disorder, Separation Anxiety, Social Anxiety, Significant School Avoidance). For this study, the total score was used. Participants responded on a 3-point scale how much each statement is true of/like their child or themselves (2 = *very true or often true*; 0 = *not true or hardly ever true*). The total score and the score for each scale are computed by summing the items. Reliability for the subscales for the parent version of the questionnaire was good ($\alpha = .69$-$.93$). Reliability for the subscales for the child version of the questionnaire varied from poor (school avoidance $\alpha = .33$) to good (total score α = .88). To generate a more complete picture of children's anxiety, the average score of the caregiver and child questionnaires was used in analyses. Higher scores indicate more anxiety and a child with a score of over 25 is considered to have meaningful levels of anxiety. Based on this cutoff, 39 children self-reported having meaningful anxiety symptoms, but only 26 parents reported their children as having meaningful levels of anxiety. For the average score used in analyses, 29 children were above this threshold. This total score has been shown to have good internal consistency in previous studies with children. (α = .74 - .93; Birmaher, Khetarpal, Brent, Cully, Balach, Kaufman, & Neer, 1997) and had good reliability in this sample, for both the child version (α = .88) and the caregiver version (α = .93).

**Other psychopathological symptoms.** Children reported on their depressive symptoms using the Center for Epidemiological Studies-Depression Scale for Children (CES-DC; Weissman et al., 1980). The CES-DC consists of 20 items that assess depressive mood in children. Score is calculated by summing responses to the items. Possible scores range from 0-60, with higher scores indicating more symptoms. A child with a score above 15 is considered to have meaningful depressive symptoms. Children reported how much each item describes the way they felt in the past week with a 4-point scale (3 = *a lot*; 0 = *not at all*). The CES-DC has been seen to have good internal consistency in studies with children and adolescents (α = .89; Fendrich, Weissman, & Warner, 1990) and had good reliability in this sample (α = .85).

Caregivers reported on children's externalizing symptoms and general well-being with the MacArthur Health and Behavior Questionnaire (HBQ; Essex et al., 2002), which consists of 170 items assessing mental and physical health, social functioning, and school functioning with multiple subscales. Parents were asked to indicate the extent to which a given statement was true for their child using a 3-point scale (2 = *often or very true*; 0 = *never or not true*). The externalizing subscale consists of 31 items (e.g., "Defiant, talks back to adults"). This was the only subscale used in analyses. An average score was created for each subscale; higher values represent greater symptoms. This measure has been found to have good internal consistency using parent report of children's characteristics in community samples of children ($\alpha$ = .57 - .84; Ablow et al., 1999) and showed good reliability in this sample ($\alpha$ = .89).

**Parental psychopathology symptoms.** Parental psychopathology symptoms were assessed using two measures: The Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977), and the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

The CES-D consists of 20 items that assess depressive mood. A total score was calculated by summing responses to all items. Possible scores range from 0-60, with higher scores indicating more symptoms. A person with a score above 16 is considered meaningfully depressed. Caregivers reported how much each item described the way they felt in the past six months with a 4-point scale (3 = *most or all of the time*; 0 = *rarely or none of the time*). This scale has great internal consistency in community and clinical samples ($\alpha > .85$; Radloff, 1977) and had excellent reliability in this sample ($\alpha$ = .94).

The STAI is a 40-item measure of state and trait levels of anxiety and yields two subscales: state anxiety and trait anxiety. The state anxiety subscale consists of 20 items such as "I am tense; I am worried" and the trait subscale consists of 20 items such as "I worry too much over something that really doesn't matter." Items are rated on a 4-point scale (4 = *almost always*; 1 = *almost never*). Scores for each subscale are added to make one final state anxiety and one trait anxiety score. Higher scores indicate more anxiety. Both the state and the trait subscales have been found to have good internal consistency (State $\alpha = .65$-.96; Trait $\alpha = .72$ - .96; Barnes, Harp, & Jung, 2002). The internal consistency in this sample was also good (State $\alpha = .91$; Trait $\alpha = .94$).

**Parental emotion regulation.** Parental emotion dysregulation was assessed with the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), which consists of 36 items, yielding one general dysregulation score and six subscales: Nonacceptance of Emotional Responses (e.g., "When I'm upset, I feel guilty for feeling that way"); Difficulties Engaging in Goal-Directed Behavior (e.g., " When I'm upset, I have difficulty concentrating".); Impulse Control Difficulties (e.g., "When I'm upset, I feel out of control"); Lack of Emotional Awareness (e.g., "I am attentive to my feelings"; reversed scored); Limited Access to Emotion Regulation Strategies (e.g., "When I'm upset, my emotions feel overwhelming"); and Lack of Emotional Clarity (e.g., "I have no idea how I'm feeling"). Parents reported on how characteristic each statement was of their emotion regulation behavior on a 5-point scale (5 = *almost always*; 1 = *almost never*). Responses are summed to yield scores for each scale, and higher scores represent greater dysregulation. This scale has been widely used in emotion (dys)regulation research and has good internal consistency (α = .93; Gratz & Roemer, 2004). The reliability for this sample was excellent (α = .95).

**Analytic plan**

Studies using an experimental ER manipulation on the LPP have reported large effects (for a review, see: Hajcak, MacNamara, & Olvet, 2010) and samples of around 24 participants are typically sufficient to detect medium to large effects in ERP studies. By collecting data from 78 children, 39 children were assigned to use each ER strategy, ensuring an adequate sample size to test primary research questions even with some anticipated missing data (typical of this kind of work with children; missingness for this study is described in the results section).

**Aim 1:** *Are there differences in executive functions based on children's level of bilingualism?* I hypothesized that balanced bilingual children would outperform other children on executive functions. Regressions were conducted for each EF measure (working memory, conflict resolution, inhibitory control, cognitive flexibility, and emotional selective attention) to assess the role of level of bilingualism on EF while controlling for age, gender, parent's performance on the same EF task, and parent's tendency to code-switch. A main effect of level of bilingualism would confirm my hypothesis that children vary in their performance on the executive function tasks depending on their level of bilingualism.

**Aim 2:** *Are there differences in emotion regulation abilities based on children's level of bilingualism?* I hypothesized that more balanced bilingualism would be associated with more advanced emotion regulation abilities. Regressions were conducted to assess whether level of bilingualism predicted children's emotion regulation (context sensitivity, repertoire, and implementation), while controlling for age, gender, and parent's self-reported emotion regulation ability. A main effect of level of bilingualism would indicate differences in emotion regulation ability based on children's level of bilingualism. A significant effect in some but not all three regressions would support the idea that the bilingual advantage would be seen only in some measures (e.g., implementation and context sensitivity, but not repertoire).

**Aim 3:** *Are these different aspects of emotion regulation (context sensitivity, repertoire, and implementation) differentially linked to anxiety symptoms and does children's level of bilingualism play a role in this?* I hypothesized that all three aspects of emotion regulation would independently predict anxiety symptoms above and beyond the other measures for all children. A hierarchical regression was used to assess the effects of context sensitivity, strategy repertoire, strategy implementation, and level of bilingualism on children's anxiety symptoms while controlling for gender, parents' symptomatology, and children's symptoms of other psychopathologies. Two-way interactions were used to assess the potential interactive role of these different measures of emotion regulation on anxiety symptoms. Significant coefficients for all three measures of emotion regulation would confirm my hypothesis that these various aspects of emotion regulation are all independently important for understanding anxiety symptoms in childhood.

# CHAPTER 3

# Results

## Overview of results

The results section is divided into five sub-sections. Handling of missing data is presented first. Second, descriptive statistics are presented, followed by preliminary analyses in section three. In the fourth section, bivariate associations were explored. Lastly, primary analyses are described in the last section.

## Missing Data

There was some missing data in this study. Missingness was due primarily to the child not having usable EEG data. A total of 3 children refused to do the EEG part of the study, one child did the first task (i.e., passive viewing) but refused to do the second task (i.e., active regulation), another child completed both tasks but refused to see the scary pictures, and 9 children completed both tasks but had too many artifacts that resulted in too few trials to be included in analyses. For 4 children, a level of bilingualism variable could not be created due to the audio of the video recording cutting out. Due to this same issue, 3 children were also missing strategy repertoire data. A multiple imputations approach was used to handle the missigness. All variables with missing data were multiply imputed using 10 data sets, with the exception of the EEG variables. Because EEG data were not imputed, analyses that do not include these variables include all 78 participants, analyses that include the EEG variables were carried out with the available data (and thus, differ in sample size from other analyses).

**Descriptive Statistics**

Means, standard deviations, and other descriptive statistics are presented in Tables 2-4. Table 2 contains descriptive information for child EF tasks, Table 3 contains descriptive information for parent EF tasks, Table 4 contains information on children's ER and psychopathology, and Table 5 contains information on parent's ER and psychopathology.

**Table 2.** Means and standard deviations of child EF data

| | Mean | SD | Min-Max |
|---|---|---|---|
| Corsi span | 3.17 | 2.59 | 0.00 – 8.00 |
| Flanker general accuracy | 82.31 | 15.75 | 22.92 – 100.00 |
| Flanker accuracy congruent | 85.89 | 14.91 | 25.00 – 100.00 |
| Flanker accuracy incongruent | 78.29 | 19.54 | 20.31 – 100.00 |
| Flanker average RT | 627.64 | 74.50 | 415.91 – 784.61 |
| Flanker RT congruent | 626.18 | 73.19 | 460.27 – 810.40 |
| Flanker RT incongruent | 644.80 | 76.80 | 468.06 – 850.67 |
| WCST error% | 38.00 | 14.78 | 10.00 – 76.67 |
| WCST perseverative error% | 22.47 | 7.96 | 8.33 – 43.33 |
| WCST proportion errors | .62 | .13 | .25 – 1.00 |
| GoNogo general accuracy | 50.05 | 17.30 | 17.33 – 85.33 |
| GoNogo "Go" accuracy | 46.14 | 21.89 | 3.17 – 87.30 |
| GoNogo "Nogo" accuracy | 70.72 | 16.80 | 33.33 – 100.00 |
| GoNogo RT | 422.97 | 26.73 | 294.28 – 472.00 |
| Dot Probe general accuracy | 69.08 | 27.62 | 4.17 – 98.33 |
| Dot probe accuracy congruent | 68.61 | 27.69 | 10.00 – 100.00 |
| Dot Probe accuracy incongruent | 69.44 | 28.10 | 0.00 – 100.00 |
| Dot Probe attention bias score | 23.33 | 97.39 | -205.13 – 606.25 |

*Note*. Values for the original data before multiple imputation; RT = Reaction Time.

**Table 3.** Means and standard deviations of parent EF data

| | **Mean** | **SD** | **Min-Max** |
|---|---|---|---|
| Corsi span | 4.25 | 2.08 | 0.00 – 8.00 |
| Flanker general accuracy | 90.32 | 10.56 | 46.53 – 99.31 |
| Flanker accuracy congruent | 92.69 | 7.76 | 59.38 – 100.00 |
| Flanker accuracy incongruent | 87.31 | 16.29 | 7.81 – 100.00 |
| Flanker RT | 519.01 | 49.75 | 428.07 – 629.22 |
| Flanker RT congruent | 515.95 | 50.33 | 417.20 – 625.37 |
| Flanker RT incongruent | 529.44 | 51.09 | 445.41 – 677.03 |
| WCST error% | 25.97 | 12.48 | 10.00 – 61.67 |
| WCST perseverative error% | 16.55 | 7.29 | 8.33 – 33.33 |
| WCST proportion errors | .66 | .15 | .35 – 1.00 |
| GoNogo general accuracy | 55.59 | 16.22 | 25.44 – 88.60 |
| GoNogo "Go" accuracy | 45.03 | 23.12 | 1.16 – 89.53 |
| GoNogo "Nogo" accuracy | 87.34 | 12.88 | 35.71 – 100.00 |
| GoNogo RT | 438.19 | 23.69 | 383.93 – 484.86 |
| Dot Probe general accuracy | 96.55 | 6.12 | 65.00 – 100.00 |
| Dot probe accuracy congruent | 96.72 | 7.24 | 62.50 – 100.00 |
| Dot Probe accuracy incongruent | 96.32 | 6.27 | 65.00 – 100.00 |
| Dot Probe attention bias score | 1.62 | 25.90 | -55.74 – 82.77 |

*Note*. Values for the original data before multiple imputation; RT = Reaction Time

Children reported an average of 2.80 strategies during AEI. Children also reported on average being likely to use 5.51 strategies during all EREI vignettes. When looking at context specific strategies, children reported on average being likely to use 2.5 context appropriate strategies across EREI vignettes. 39 children reported being able to use the ER strategy given to them during the ER implementation EEG task and 9 reported not being able to use it (30 children chose not to answer this question). Out of these 39, 18 were in the reappraisal group and 21 were in the distraction group. When looking at the LPP, 64% showed a reduction on their LPP after implementation instructions.

**Table 4.** Means and standard deviations of child and parent ER and psychopathology

| | Mean | SD | Min-Max |
|---|---|---|---|
| Average context sensitivity | .43 | .08 | .17 - .61 |
| Context sensitivity fear | .44 | .14 | 0.00 – 1.00 |
| Context sensitivity sadness | .37 | .16 | 0.00 - .75 |
| Context sensitivity anger | .49 | .19 | 0.00 – 1.00 |
| General strategy repertoire | 2.80 | 1.38 | 0.00 – 6.00 |
| Strategy repertoire fear | 0.99 | 0.80 | 0.00 – 3.00 |
| Strategy repertoire sadness | 0.94 | 0.79 | 0.00 – 3.00 |
| Strategy repertoire anger | 0.69 | 0.64 | 0.00 – 2.00 |
| Average implementation – behavioral | .25 | .73 | -1.50 – 2.00 |
| Implementation fear – behavioral | .44 | 1.04 | -2.00 – 3.00 |
| Implementation sadness – behavioral | .08 | .90 | -3.00 – 3.00 |
| Average implementation – LPP | -1.37 | 5.94 | -17.06 – 11.86 |
| Implementation fear – LPP | -.19 | 11.21 | -24.14 – 29.86 |
| Implementation sadness – LPP | -1.87 | 5.83 | -15.74 – 11.48 |
| Parent emotion regulation** | 70.73 | 22.73 | 36.00 – 146.00 |
| Child anxiety self-report | 26.05 | 11.66 | .00 – 52.00 |
| Child anxiety parent-report | 17.44 | 12.68 | 0.00 – 67.00 |
| Child anxiety average score | 21.74 | 8.29 | 5.00 – 41.50 |
| Parent anxiety | 36.96 | 12.79 | 20.00 – 71.00 |

*Note*. Values for the original data before multiple imputation; * smaller values indicate better emotion regulation

**Preliminary Analyses**

Preliminary analyses were conducted to explore any potential gender differences, age differences, differences based on income, and differences between fully Hispanic and part-Hispanic children.

Gender differences. There were significant gender differences in children's self-report of anxiety symptoms $t_{75} = 2.730$, $p = .008$, $d = .624$, such that girls ($M = 29.58$; $SD = 10.11$) self-reported more anxiety symptoms than boys ($M = 22.61$; $SD = 12.15$). This gender difference was still present in the averaged anxiety score $t_{76} = 2.449$, $p = .017$, $d = .555$, in which girls ($M = 23.97$; $SD = 7.72$) showed more anxiety symptoms than boys ($M = 19.51$; $SD = 8.33$). However, there were no gender differences in parents' report of child anxiety symptoms $t_{76} = .712$, $p = .479$, $d = .163$. There were also gender differences in children's self-report of depressive symptoms $t_{74} = 2.356$, $p = .021$, $d = .538$, with girls ($M = 17.04$; $SD = 10.96$) self-reporting more depressive symptoms than boys ($M = 12.00$; $SD = 7.46$). There were no child gender differences in parents' report of their own anxiety $t_{76} = .088$, $p = .930$, $d = .020$, between boys ($M = 36.83$; $SD = 11.98$) and girls ($M = 37.09$; $SD = 13.72$). Gender differences also emerged for children's proportion scores for the EREI interview for fear only $t_{76} = 2.137$, $p = .036$, $d = .500$, in this case, boys ($M = .47$; $SD = .14$) used a higher proportion of context appropriate strategies for fear than girls ($M = .40$; $SD = .14$). There were no gender differences in strategy repertoires all $t$s $< 1.505$, $p$s $> .137$.

Age differences. Age was associated with performance on the Corsi task ($r = .277$, $p = .015$) such that children's corsi spans became larger with increasing age. Age was also associated with better performance on the Flanker task, specifically with general accuracy on the Flanker task ($r = .439$, $p < .001$), accuracy for congruent Flanker trials ($r = .427$, $p < .001$), accuracy for incongruent Flanker trials ($r = .408$, $p < .001$), reaction times to congruent trials ($r = -.546$, $p < .001$), and reaction times to incongruent trials ($r = -.433$, $p < .001$). Unsurprisingly, increasing age was also associated with better performance on the WCST task (accuracy: $r = .242$, $p = .036$; percent of errors made: $r = -.269$, $p = .020$), and with performance on the GoNogo task (General accuracy: $r = .273$, $p = .017$; NoGo trial accuracy: $r = .307$, $p = .007$). For the dot probe task, age was associated with attention bias score ($r = -.250$, $p = .027$), such that children showed smaller attention biases to threat the older they were. There were no other associations with age.

Ethnic group differences. Children from fully Hispanic families only differed from children from mixed families in two characteristics. These two groups differed on average parental level of education (the average of father's and mother's schooling) $t_{75} = 2.671$, $p = .009$, $d = .733$, such that parent's from fully Hispanic families ($M_{\text{years of schooling}} = 12.37$; $SD = 2.86$) were, on average, less educated than those from mixed families ($M_{\text{years of schooling}} = 14.25$; $SD = 2.23$). There were also group differences in parent's tendency to code-switch $t_{75} = 2.279$, $p = .026$, $d = .611$, with parents of fully Hispanic families ($M = 18.19$; $SD = 8.44$) being more likely to code-switch in their everyday life than mixed families ($M = 13.35$; $SD = 7.36$). There were no other differences based on whether children were from fully Hispanic or mixed families.

Because level of education was controlled for in analyses and code-switching was not included in the final analyses, this characteristic is not considered further.

Income. Income was associated with parental report of child anxiety ($r$ = -.316, $p$ = .009), such that children were reported by their parent's as having more symptoms the lower their family income was. This was also true of the average child anxiety score ($r$ = -.279, $p$ = .021), but not of the child self-report score ($r$ = -.054, $p$ = .665). Income was also associated with performance on the Corsi task ($r$ = .256, $p$ = .038), such that children from higher income families had larger Corsi spans. Unsurprisingly, lower family income was associated with more parental emotion dysregulation ($r$ = -.332, $p$ = .007). Income was marginally associated with children's level of bilingualism ($r$ = -.244, $p$ = .052), such that higher income was associated with less balanced bilingualism. Lastly, higher income was associated with the context sensitivity score for the sad EREI vignette ($r$ = .302, $p$ = .012), such that having higher income was associated with better sad context sensitivity. Surprisingly, higher income was associated with more parent trait anxiety in our sample ($r$ = .254, $p$ = .037). There were no other associations with income.

**Bivariate relations among variables of interest**

Before conducting primary analyses to test the study hypotheses, bivariate associations between study variables were assessed. To streamline the results, these are presented in sections (section 1: child EF tasks; section 2: parent and child EF; section 3: child ER and parent ER; section 4: child ER and child EF; section 5: child anxiety symptoms with all variables of interest; section 6: level of bilingualism and all other variables of interest) and can be found in tables 5-7.

Child EF. Performance on the Corsi task was correlated with performance on the WCST, such that a larger Corsi span was associated with greater accuracy for the WCST task ($r$ = .281, $p$ = .015), fewer errors ($r$ = -.320, $p$ = .005), and fewer perseveration errors ($r$ = -.294, $p$ = .010). A larger Corsi span was also associated with greater accuracy to NoGo trials ($r$ = .355, $p$ = .002). Better general accuracy for the Flanker task was associated with faster reaction times during the same task ($r$ = -.515, $p$ < .001), with fewer perseveration errors during WCST ($r$ = -.242, $p$ = .037), with better general accuracy for the GoNogo task ($r$ = .334, $p$ = .003), as well as for Go ($r$ = .273, $p$ = .017), and NoGo ($r$ = .292, $p$ = .011) trials, and with accuracy for the dot probe task (general: $r$ = .325, $p$ = .004; congruent: $r$ = .328, $p$ = .004; incongruent: $r$ = .300, $p$ = .008). Children's perseverative errors during the WCST were significantly correlated with general accuracy for the GoNogo task ($r$ = -.319, $p$ = .006), as well as accuracy to Go trials ($r$ = -.295, $p$ = .011), but not to NoGo trials ($r$ = -.012, $p$ = .920). Perseverative errors during the WCST were also correlated with accuracy to congruent trials in the Dot Probe task ($r$ = -.235, $p$ = .042), but not to incongruent trials ($r$ = -.178, $p$ = .128). General accuracy for the GoNogo task was associated with general accuracy for the Dot Probe task ($r$ = .249, $p$ = .030) and children's attention bias score ($r$ = -.340, $p$ = .003).

**Table 5a.** Bivariate correlations among child and parent EF measures: Working memory and Cognitive flexibility

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|---|
| *Child* | | | | | | | | |
| 1. Corsi span | - | | | | | | | |
| 2. WCST error% | **-.320** | - | | | | | | |
| 3. WCST perseverative error% | **-.294** | **.855** | - | | | | | |
| 4. WCST proportion errors | -.050 | .043 | -.023 | - | | | | |
| *Parent* | | | | | | | | |
| 5. Corsi span | *.219* | -.105 | -.139 | -.074 | - | | | |
| 6. WCST error% | **-.291** | **.255** | .150 | -.156 | **-.269** | - | | |
| 7. WCST perseverative error% | **-.310** | .191 | .183 | -.159 | **-.254** | **.875** | - | |
| 8. WCST proportion errors | **-.237** | .104 | .074 | **.375** | -.037 | .085 | .104 | - |

*Note. Italics* = $p < .08$; **bold** = $p < .05$

Parent EF. Better performance on the Corsi task was associated with faster reaction times during congruent trials in the Flanker task ($r = -.264$, $p = .025$) and fewer perseveration errors during the WCST ($r = -.254$, $p = .029$). Parents' general accuracy for the Flanker task was associated with perseveration errors during the WCST ($r = -.409$, $p < .001$) and with general accuracy to the GoNogo task ($r = .233$, $p = .049$). Perseveration errors during the WCST were associated with accuracy during the Dot Probe task (general: $r = -.389$, $p = .005$; congruent: $r = -.433$, $p = .002$; incongruent: $r =$

-.353, *p* = .011). Parents' accuracy during the WCST task was associated with their attention bias to threat (*r* = -.342, *p* = .014). Better general accuracy for the GoNogo task was associated with better general accuracy for the Dot Probe task (*r* = .282, *p* = .045).

**Table 5b.** Bivariate correlations among child and parent EF measures: Conflict resolution

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| *Child* | | | | | | |
| 1. Flanker general accuracy | - | | | | | |
| 2. Flanker RT congruent | **-.527** | - | | | | |
| 3. Flanker RT incongruent | **-.354** | **.835** | - | | | |
| *Parent* | | | | | | |
| 4. Flanker general accuracy | .117 | .007 | .003 | - | | |
| 5. Flanker RT congruent | .026 | -.125 | -.182 | **-.662** | - | |
| 6. Flanker RT incongruent | .005 | -.102 | -.116 | **-.660** | **.929** | - |

*Note.* **bold** = $p < .05$

Parent and Child EF. Parents' performance on the Corsi task was marginally associated with children's performance on the task (*r* = .219, *p* = .059). Children's accuracy for the WCST task was associated with parent accuracy for the same task (*r* = .281, *p* = .016), as was parents' and children's percentage of errors committed during the WCST task (*r* = .255, *p* = .030), however, children's perseverative errors during the WCST were not associated with parents' perseverative errors (*r* = .183, *p* = .122). Parents' performance on the Flanker task was not associated with children's performance on this task (all rs < .190, ps > .109). Parent's performance on the GoNogo task was not associated with children's performance on the task (all rs < .154, ps > .186). Parents' accuracy to congruent trials for the Dot Probe task was associated with children's general accuracy ($r = .292$, $p = .037$), and children's accuracy to congruent trials ($r = .310$, $p = .027$). Because parent performance was associated with child performance for several EF outcomes, these measures were retained for analyses.

**Table 5c.** Bivariate correlations among child and parent EF measures: Inhibitory control

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| *Child* | | | | | | | | |
| 1. GoNogo general accuracy | - | | | | | | | |
| 2. GoNogo "Go" accuracy | **.990** | - | | | | | | |
| 3. GoNogo "Nogo" accuracy | **-.330** | **-.458** | - | | | | | |
| 4. GoNogo RT | **-.399** | **-.432** | **.377** | - | | | | |
| *Parent* | | | | | | | | |
| 5. GoNogo general accuracy | .147 | .146 | -.073 | -.026 | - | | | |
| 6. GoNogo "Go" accuracy | .121 | .122 | -.078 | -.058 | .987 | - | | |
| 7. GoNogo "Nogo" accuracy | .089 | .076 | .067 | .154 | -.24 | **-.380** | - | |
| 8. GoNogo RT | -.009 | -.001 | -.025 | .042 | -.610 | **-.666** | **.596** | - |

*Note.* **bold** = $p < .05$

**Table 5d.** Bivariate correlations among child and parent EF measures: Selective attention

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| *Child* | | | | | | | | |
| 1. Dot Probe general accuracy | - | | | | | | | |
| 2. Dot probe accuracy congruent | **.982** | - | | | | | | |
| 3. Dot Probe accuracy incongruent | **.986** | **.950** | - | | | | | |
| 4. Dot Probe attention bias score | **-.265** | **-.248** | **-.290** | - | | | | |
| *Parent* | | | | | | | | |
| 5. Dot Probe general accuracy | *.254* | *.274* | .207 | -.126 | - | | | |
| 6. Dot probe accuracy congruent | **.292** | **.310** | *.250* | -.019 | **.955** | - | | |
| 7. Dot Probe accuracy incongruent | *.266* | **.284** | .223 | -.146 | **.954** | **.874** | - | |
| 8. Dot Probe attention bias score | .079 | .051 | .124 | -.226 | -.171 | -.126 | -.142 | - |

*Note. Italics* = $p < .08$; **bold** = $p < .05$

Child and Parent ER. Parents' emotion dysregulation was associated with children's averaged context sensitivity across all three discrete emotion contexts ($r = -.234$, $p = .046$). But, it was not associated with children's implementation of emotion regulation strategies ($r$s < .214, $p$s > .087) or with children's strategy repertoires ($r$s < -.132, $p$s > .278).

**Table 6.** Bivariate correlations among child ER measures

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Context sensitivity | - | | | | | | | | | | | | | | |
| 2. Context sensitivity fear | **.338** | - | | | | | | | | | | | | | |
| 3. Context sensitivity sadness | **.458** | **-.248** | - | | | | | | | | | | | | |
| 4. Context sensitivity anger | **.670** | -.109 | -.048 | - | | | | | | | | | | | |
| 5. General strategy repertoire | -.194 | -.153 | -.008 | -.135 | - | | | | | | | | | | |
| 6. Strategy repertoire fear | -.091 | -.090 | .009 | -.061 | **.720** | - | | | | | | | | | |
| 7. Strategy repertoire sadness | -.155 | -.078 | *-.211* | .032 | **.548** | **.430** | - | | | | | | | | |
| 8. Strategy repertoire anger | -.047 | -.055 | .023 | -.040 | **.497** | .178 | .021 | - | | | | | | | |
| 9. Implementation – Behavioral | *.231* | .138 | **.265** | -.020 | -.191 | -.164 | -.173 | -.098 | - | | | | | | |
| 10. Implementation fear – behavioral | .047 | .011 | .193 | -.103 | .025 | .036 | -.020 | .075 | **.793** | - | | | | | |
| 11. Implementation sadness – behavioral | **.290** | *.207* | .176 | .083 | **-.289** | *-.232* | -.198 | **-.225** | **.736** | .171 | - | | | | |
| 12. Implementation – LPP | -.007 | .010 | **-.312** | .217 | -.083 | -.084 | .150 | -.041 | -.030 | .024 | -.079 | - | | | |
| 13. Implementation fear – LPP | -.143 | -.021 | *-.402* | .147 | -.038 | -.060 | **.285** | -.167 | -.229 | *-.269* | -.096 | **.856** | - | | |
| 14. Implementation sadness – LPP | .073 | -.114 | .048 | .123 | .035 | .015 | -.05 | **.299** | .126 | **.325** | -.162 | **.522** | -.066 | - | |
| 15. Parent emotion regulation | **-.236** | -.054 | -.101 | -.184 | .021 | -.080 | -.132 | .082 | -.076 | .020 | -.130 | -.057 | -.128 | .093 | - |

*Note. Italics* = $p < .08$; **bold** = $p < .05$

Child EF and Child ER. There was a significant association between children's Corsi span and children's context sensitivity to the sad vignette (*r* = .251, *p* = .029), such that better working memory (i.e., a larger Corsi span) was associated with better context sensitivity to the sad vignette (i.e., a larger proportion of strategies endorsed for sadness were context appropriate). Children's reaction time during correct congruent trials on the Flanker task were associated with greater self-described regulatory success during the implementation task (*r* = .292, *p* = .047). Children's perseverative errors during the WCST were associated with context sensitivity for anger (*r* = .333, *p* = .004), such that making more perseverative errors during this task was associated with showing greater context sensitivity only for the anger vignette. Accuracy during NoGo trials for the GoNogo task was associated with self-reported regulatory success during the implementation task (*r* = .319, *p* = .031), such that being better able to inhibit responses to NoGo trials was associated with better self-described ability to regulate emotions in a laboratory task. The same was true for reaction times for correct Go trials in this task (*r* = .391, *p* = .007). Reaction times for correct Go trials were also associated with better context sensitivity (anger: *r* = .296, *p* = .009; average: *r* = .305, *p* = .007). Accuracy scores from the Dot Probe task were also associated with better context sensitivity (sad: *r* = .359, *p* = .001; average: *r* = .328, *p* = .003), such that being more accurate during the emotional selective attention task was associated with showing greater context sensitivity. Reaction times for the Flanker task were associated with children's ability to implement an instructed emotion regulation strategy (*r* = -.278, *p* = .029) such that faster reaction times to correct trials were associated with a greater ability to implement these strategies. Children's attention bias score was associated with strategy repertoires for anger ($r = .251$, $p = .030$) such that a greater bias towards threatening faces was associated with larger strategy repertoires for anger only.

Child Anxiety. Children's general accuracy for the Flanker task was associated with child self-reported anxiety symptoms ($r = -.226$, $p = .049$), such that better performance on this conflict resolution task was associated with fewer self-reported symptoms of anxiety. Correlations with accuracy to congruent and incongruent trials independently, revealed this was only true for accuracy to congruent trials ($r = -.270$, $p = .018$). The same was not true for parent-reported anxiety symptoms ($r = -.025$, $p = .829$) or for the average anxiety score ($r = -.178$, $p = .122$). Reaction times during correct incongruent trials were associated with more anxiety symptoms (average anxiety: $r = .235$, $p = .040$). Better accuracy to NoGo trials for the GoNogo task was associated with fewer child self-reported anxiety symptoms ($r = -.264$, $p = .022$), such that a greater ability to inhibit a response during this task was associated with self-reporting fewer symptoms of anxiety. Child anxiety symptoms were associated with parental emotion dysregulation (child report: $r = .258$, $p = .028$; parent report $r = .457$, $p < .001$; average score: $r = .530$, $p < .001$). Child anxiety symptoms were also associated with child self-reported depressive symptoms (child report $r = .593$, $p < .001$; average score: $r = .373$, $p = .001$). Parent anxiety was not associated with child anxiety symptoms (all $r$s < -.067, $p$s > .560). Children's ability to implement instructed emotion regulation strategies was associated with children's average anxiety ($r = .255$, $p = .046$), such that more anxiety was associated with greater difficulty implementing these strategies, but for sadness only. Strategy repertoires were not associated with anxiety symptoms (all *r*s < -.152, *p*s > .195).

<u>Level of bilingualism.</u> Children's level of bilingualism was associated with their performance on the Flanker task (general accuracy: *r* = .280, *p* = .016), such that being a more balanced bilingual was associated with better conflict resolution. But it was not related to working memory (Corsi span: *r* = -.043, *p* = .723), inhibitory control (general accuracy: *r* = .113, *p* = .345), or cognitive flexibility (perseveration errors: *r* = -.077, *p* = .526). Level of bilingualism was marginally associated with the attention bias score (*r* = .225, *p* = .054), such that more balanced bilingualism was marginally associated with greater attentional biases toward threat. Level of bilingualism was not associated with context sensitivity (all rs < .140, ps > .234), with self-reported regulatory success during the implementation task (*r* = .221, *p* = .132), or with behavioral performance on the implementation task (all rs < .136, p > .272). It was also not associated with children's ability to implement emotion regulation strategies as measured by the LPP (all *r*s < -.141, *p* > .291). Lastly, level of bilingualism was not associated with children's strategy repertoires (all *r*s < .172, *p* > .152).

**Table 7.** Bivariate correlations with child anxiety

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Child anxiety symptoms* | - | | | | | | | | |
| 2. Child level of bilingualism | .185 | - | | | | | | | |
| 3. Child depressive symptoms | **.373** | .044 | - | | | | | | |
| 4. Child externalizing symptoms | -.117 | .044 | -.005 | - | | | | | |
| 5. Parent Anxiety symptoms | -.067 | -.064 | -.012 | **.256** | - | | | | |
| 6. Parent emotion regulation | **.530** | .099 | **.319** | .153 | .155 | - | | | |
| 7. Average context sensitivity | -.102 | .076 | .014 | *.211* | -.164 | **-.234** | - | | |
| 8. General strategy repertoire | -.011 | .127 | -.001 | -.039 | -.015 | .021 | -.194 | - | |
| 9. Average strategy implementation - LPP | .174 | .062 | .048 | -.130 | -.102 | -.057 | -.007 | -.083 | - |

*Note*. *Average of parent and child reports; *Italics* = $p < .08$; **bold** = $p < .05$;

**Primary Analyses**

This section describes the primary analyses conducted to test the study hypotheses. It is further subdivided into three sub-sections corresponding to each aim of this dissertation study. The sections for each aim are further divided into smaller sections to fully explore the study aims.

**Aim 1.** *Are there differences in executive functions based on children's level of bilingualism?* A regression was conducted for each EF measure (working memory, conflict resolution, inhibitory control, and cognitive flexibility; as well as for the measure of emotional selective attention) to assess the role of level of bilingualism on cognitive processes. In step 1 age, gender, and parent's performance on the specific measure being assessed were entered. Parental code-switching was not included in analyses as it was not related to any of the executive function measures, however, given the almost significant association between level of bilingualism and income, as well as research showing the particularly protective role of bilingualism for children of low income household, income was included in analyses at this step. At step 2, level of bilingualism was entered. At step 3, the interaction of bilingualism and income was entered to test the hypothesis that balanced bilingualism would be particularly beneficial for children from low income households.

Follow-up regression analyses were conducted to more fully explore how children's experience with two languages was associated with their executive functions by exploring associations between each fluency measure (i.e., English and Spanish fluency scores) and specific executive function measures. Step 1 of these models was identical to the previous models and is thus, not described for the fluency models. On step 2, instead of entering one level of bilingualism score, two independent measures of children's verbal fluency in Spanish and English were entered. On step 3, an interaction between Spanish and English fluency scores was entered, as well as the interaction of each of these two fluency measures with income.

***1a.*** *Working memory*. The first step of the model was significant $F(4, 73) = 3.618$, $p = .013$, $R^2 = .165$ (Table 8a). Children's working memory was predicted by their age ($b = .637$, $t = 2.476$, 95% CI [.132, 1.143]). The second step of the model resulted in a non-significant change to the model $F\Delta\ (1, 72) = .270$, $p = .662$, $R^2\Delta = .003$. Children's level of bilingualism was not significantly associated with their working memory ($b = -.017$, $t = -.312$, 95% CI [-.124, .090]). The third step of the model also resulted in a non-significant change to the model $F\Delta\ (1, 71) = 1.174$, $p = .481$, $R^2\Delta = .013$. Level of bilingualism did not interact with household income to predict working memory ($b = .016$, $t = .681$, 95% CI [-.031, .062]).

Working memory predicted by fluency scores. The second step of the model resulted in a non-significant change to the model $F\Delta\ (1, 72) = .187$, $p = .845$, $R^2\Delta = .004$ (Table 8b). The third step of the model also resulted in a non-significant change to the model $F\Delta\ (1, 71) = 1.708$, $p = .325$, $R^2\Delta = .057$.

**Table 8a.** Regression for child working memory predicted by level of bilingualism

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| **Step 1** | **.165** | **.165** | **3.618** | **.0134** | | | |
| Age | | | | | **.637** | **.258** | **.013** |
| Parental Education | | | | | .032 | .125 | .797 |
| Family Income | | | | | .146 | .153 | .343 |
| Parent Corsi Span | | | | | *.236* | *.142* | *.097* |
| **Step 2** | .169 | .003 | .270 | .662 | | | |
| Level of bilingualism | | | | | -.017 | .054 | .755 |
| **Step 3** | .182 | .013 | 1.174 | .481 | | | |
| Level of bilingualism X Income | | | | | .016 | .023 | .498 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = *p* < .08*;* **bold** = *p* < .05.

**Table 8b.** Regression for child working memory predicted by English and Spanish fluency

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| **Step 2** | .170 | .004 | .187 | .845 | | | |
| English fluency | | | | | .020 | .068 | .767 |
| Spanish fluency | | | | | -.003 | .075 | .972 |
| **Step 3** | .227 | .057 | 1.708 | .325 | | | |
| English fluency X Spanish fluency | | | | | .002 | .015 | .874 |
| English fluency X Income | | | | | -.045 | .032 | .162 |
| Spanish fluency X Income | | | | | -.003 | .031 | .916 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = *p* < .08*;* **bold** = *p* < .05.

***1b.*** *Conflict resolution.* Because general accuracy for this task was very highly correlated with accuracy during congruent ($r$ = .916, $p$ < .001) and incongruent trials ($r$ = .941, $p$ < .001), only general accuracy is considered in these analyses. Additionally, the average reaction times of congruent and incongruent trials were also used in analyses.

Flanker general accuracy. The first step of the model was significant $F(4, 73) = 4.593$, $p = .002$, $R^2 = .210$ (Table 9a-1). Children's conflict resolution was predicted by their age ($b = 6.111$, $t = 4.175$, 95% CI [3.242, 8.978]). The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 1.071, $p = .335$, $R^2\Delta = .011$. Children's level of bilingualism was not significantly associated with conflict resolution ($b = .309$, $t = .965$, 95% CI [-.319, .936]). The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.665, $p = .212$, $R^2\Delta = .018$. Children's level of bilingualism did not interact with household income to predict children's ability to correctly perform on a conflict resolution task ($b = -.145$, $t = -1.251$, 95% CI [-.372, .082]).

Flanker general accuracy predicted by fluency scores. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .498, $p = .616$, $R^2\Delta = .011$ (Table 9b-1). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.936, $p = .141$, $R^2\Delta = .061$.

Average RT congruent and incongruent trials. The first step of the model was significant $F(4, 73) = 6.886$, $p < .001$, $R^2 = .274$ (Table 9a-2). Children's conflict resolution was predicted by their age ($b = -30.914$, $t = -4.777$, 95% CI [-43.598, -18.231]). The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 1.786, $p = .234$, $R^2\Delta = .018$. Children's level of bilingualism was not significantly associated with conflict resolution (*b* = 1.735, *t* = 1.195, 95% CI [-1.117, 4.588]). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = 2.869, *p* = .177, $R^2\Delta$ = .027. Children's level of bilingualism did not interact with household income to predict the speed with which children responded on a conflict resolution task (*b* = .759, *t* = 1.321, 95% CI [-.380, 1.897]).

**Table 9a.** Regression for child conflict resolution predicted by level of bilingualism

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *1. Accuracy* | | | | | | | |
| **Step 1** | **.210** | **.210** | **4.593** | **.002** | | | |
| Age | | | | | **5.996** | **1.466** | **< .001** |
| Parental Education | | | | | -.189 | .783 | .810 |
| Family Income | | | | | -.235 | .846 | .782 |
| Parent Accuracy | | | | | .147 | .173 | .393 |
| **Step 2** | .221 | .011 | 1.071 | .335 | | | |
| Level of bilingualism | | | | | .322 | .325 | .322 |
| **Step 3** | .239 | .018 | 1.665 | .212 | | | |
| Level of bilingualism X Income | | | | | -.170 | .119 | .154 |
| *2. Reaction Time (RT)* | | | | | | | |
| **Step 1** | **.274** | **.274** | **6.886** | **< .001** | | | |
| Age | | | | | **-30.914** | **6.471** | **< .001** |
| Parental Education | | | | | -2.033 | 3.362 | .545 |
| Family Income | | | | | 2.746 | 4.058 | .500 |
| Parent RT | | | | | -.182 | .163 | .266 |
| **Step 2** | .292 | .018 | 1.786 | .232 | | | |
| Level of bilingualism | | | | | 1.735 | 1.452 | .233 |
| **Step 3** | .319 | .027 | 2.869 | .177 | | | |
| Level of bilingualism X Income | | | | | .759 | .574 | .189 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = *p* < .08; **bold** = *p* < .05

**Table 9b.** Regression for child Conflict Resolution predicted by English and Spanish fluency

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *1. <u>Accuracy</u>* | | | | | | | |
| **Step 2** | .221 | .011 | .498 | .616 | | | |
| English fluency | | | | | -.254 | .392 | .516 |
| Spanish fluency | | | | | .365 | .420 | .384 |
| **Step 3** | .282 | .061 | 1.936 | .142 | | | |
| English fluency X Spanish fluency | | | | | *.137* | *.082* | *.095* |
| English fluency X Income | | | | | .205 | .153 | .183 |
| Spanish fluency X Income | | | | | -.105 | .176 | .550 |
| *2. <u>Reaction Time (RT)</u>* | | | | | | | |
| **Step 2** | .304 | .030 | 1.549 | .280 | | | |
| English fluency | | | | | -2.755 | 1.872 | .143 |
| Spanish fluency | | | | | .752 | 1.888 | .691 |
| **Step 3** | .348 | .044 | 1.570 | .259 | | | |
| English fluency X Spanish fluency | | | | | -.146 | .348 | .676 |
| English fluency X Income | | | | | -.959 | .693 | .167 |
| Spanish fluency X Income | | | | | .925 | .790 | .242 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

<u>Average RT congruent and incongruent trials predicted by fluency scores.</u> The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 1.549, $p = .277$, $R^2\Delta = .030$ (Table 9b-2). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.570, $p = .259$, $R^2\Delta = .044$.

***1c.*** *Inhibitory control.* Because general accuracy for this task was correlated with accuracy during Go trials ($r = .990$, $p < .001$), and NoGo trials ($r = -.330$, $p =$

.004), analyses were carried out for the general accuracy score only (Table 10). A second model was carried out to assess the effect of level of bilingualism on children's reaction times to Go trials (i.e., only trials that required a response).

General accuracy. The first step of the model was significant $F(4, 73) = 3.141$, $p = .042$, $R^2 = .147$ (Table 10a-1). Children's inhibitory control was predicted by their age ($b = 4.204$, $t = 2.398$, 95% CI [.766, 7.642]). The second step of the model resulted in a marginal change to the model $F\Delta$ (1, 72) = 3.465, $p = .079$, $R^2\Delta = .039$. Children's level of bilingualism was marginally associated with inhibitory control ($b = -.627$, $t = -1.762$, 95% CI [-1.326, .071]), such that more balanced bilingualism was marginally associated with poorer accuracy during the task. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = .815, $p = .410$, $R^2\Delta = .009$. Children's level of bilingualism did not interact with household income to predict children's ability to correctly respond during an inhibitory control task ($b = -.096$, $t = -.691$, 95% CI [-.369, .177]).

GoNogo general accuracy predicted by fluency scores. The second step of the model resulted in a marginal change to the model $F\Delta$ (1, 72) = 2.949, $p = .0646$, $R^2\Delta = .066$ (Table 10b-1). Children's English fluency predicted accuracy in this task ($b = 1.001$, $t = 2.371$, 95% CI [.173, 1.828]), such that better English fluency was associated with better inhibitory control. The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = 2.251, $p = .101$, $R^2\Delta = .071$.

**Table 10a.** Regression for child inhibitory control predicted by level of bilingualism

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *1. Accuracy* | | | | | | | |
| **Step 1** | **.147** | **.147** | **3.141** | **.042** | | | |
| Age | | | | | **4.204** | **1.753** | **.017** |
| Parental Education | | | | | 1.323 | .922 | .152 |
| Family Income | | | | | -.152 | 1.030 | .883 |
| Parent Accuracy | | | | | .113 | .131 | .389 |
| **Step 2** | *.186* | *.039* | *3.466* | *.080* | | | |
| Level of bilingualism | | | | | *-.627* | *.356* | *.078* |
| **Step 3** | .195 | .009 | .815 | .410 | | | |
| Level of bilingualism X Income | | | | | -.096 | .139 | .490 |
| *2. Reaction Time (RT)* | | | | | | | |
| **Step 1** | .083 | .083 | 1.666 | .193 | | | |
| Age | | | | | -3.453 | 2.701 | .201 |
| Parental Education | | | | | -1.630 | 1.399 | .244 |
| Family Income | | | | | **3.262** | **1.576** | **.039** |
| Parent RT | | | | | .087 | .128 | .496 |
| **Step 2** | **.146** | **.063** | **5.339** | **.026** | | | |
| Level of bilingualism | | | | | **1.222** | **.541** | **.024** |
| **Step 3** | .150 | .004 | .361 | .607 | | | |
| Level of bilingualism X Income | | | | | -.075 | .217 | .730 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

RT Go trials. The first step of the model was not significant $F(4, 73) = 1.666$, $p = .193$, $R^2 = .083$ (Table 10a-2). The second step of the model resulted in a significant change to the model $F\Delta$ (1, 72) = 5.339, $p = .026$, $R^2\Delta = .063$. Children's level of bilingualism was associated with inhibitory control response speed ($b = 1.222$, $t = 2.260$, 95% CI [.162, 2.282]), such that more balanced bilingualism was associated with longer reaction times during the task. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = .361, $p$ = .607, $R^2\Delta$ = .004. Children's level of bilingualism did not interact with household income to predict the speed with which children responded on an inhibitory control task ($b$ = -.075, $t$ = -.346, 95% CI [-.503, .353]).

**Table 10b.** Regression for child inhibitory control predicted by English and Spanish fluency

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *1. <u>Accuracy</u>* | | | | | | | |
| **Step 2** | *.213* | *.066* | *2.949* | *.064* | | | |
| English fluency | | | | | **1.001** | **.422** | **.018** |
| Spanish fluency | | | | | -.228 | .455 | .617 |
| **Step 3** | .284 | .071 | 2.251 | .101 | | | |
| English fluency X Spanish fluency | | | | | **.191** | **.090** | **.034** |
| English fluency X Income | | | | | .172 | .182 | .344 |
| Spanish fluency X Income | | | | | -.009 | .216 | .968 |
| *2. <u>Reaction Time (RT)</u>* | | | | | | | |
| **Step 2** | *.143* | *.060* | *2.467* | *.098* | | | |
| English fluency | | | | | **-1.351** | **.679** | **.047** |
| Spanish fluency | | | | | .930 | .746 | .213 |
| **Step 3** | .150 | .007 | .197 | .891 | | | |
| English fluency X Spanish fluency | | | | | -.040 | .150 | .791 |
| English fluency X Income | | | | | .026 | .307 | .931 |
| Spanish fluency X Income | | | | | -.046 | .352 | .897 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

<u>RT Go trials predicted by fluency scores.</u> The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 2.467, $p$ = .100,

$R^2\Delta$ = .060 (table 10b-2). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = .197, $p$ = .891, $R^2\Delta$ = .007.

***1d.*** *Cognitive Flexibility.* Although measures of perseverative errors in the WCST are the most commonly used measure of cognitive flexibility in this task, studies sometimes use other measures to more fully assess cognitive flexibility. Analyses were carried out on the percentage of trials that were perseverative errors (i.e., the child continued to use the incorrect rule after being told that the rule they had just attempted was wrong), and the proportion of errors that were perseverative errors (Table 11).

Percentage of perseverative errors. The first step of the model was marginally significant $F$(4, 73) = 2.541, $p$ = .055, $R^2$ = .122 (Table 11a-1). The second step of the model resulted in a significant change to the model $F\Delta$ (1, 72) = 5.315, $p$ = .047, $R^2\Delta$ = .060. Children's level of bilingualism was marginally associated with cognitive flexibility ($b$ = .352, $t$ = 1.992, 95% CI [.004, .700]), such that more balanced bilingualism was associated with making more perseverative errors during the task. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = .709, $p$ = .613, $R^2\Delta$ = .008. Children's level of bilingualism did not interact with household income to predict children's cognitive flexibility ($b$ = .015, $t$ = .204, 95% CI [-.135, .165]).

Percentage of perseverative errors predicted by fluency scores. The second step of the model resulted in a marginally significant change to the model $F\Delta$ (1, 72) = 3.161, $p$ = .087, $R^2\Delta$ = .071 (Table 11b-1). Children's English fluency was associated with cognitive flexibility ($b$ = -.472, $t$ = -2.169, 95% CI [-.901, -.044]), such that greater English fluency was associated fewer perseverative errors during the task. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = .397, $p$ = .757, $R^2\Delta$ = .014.

**Table 11a.** Regression for child cognitive flexibility predicted by level of bilingualism

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *1. Perseverative errors %* | | | | | | | |
| **Step 1** | *.122* | *.122* | *2.541* | *.055* | | | |
| Age | | | | | -1.257 | .791 | .112 |
| Parental Education | | | | | -.603 | .443 | .174 |
| Family Income | | | | | -.085 | .470 | .857 |
| Parent error % | | | | | .093 | .139 | .502 |
| **Step 2** | **.182** | **.060** | **5.315** | **.047** | | | |
| Level of bilingualism | | | | | **.352** | **.176** | **.048** |
| **Step 3** | .190 | .008 | .709 | .613 | | | |
| Level of bilingualism X Income | | | | | .015 | .075 | .839 |
| *2. Proportion perseverative errors* | | | | | | | |
| **Step 1** | **.202** | **.202** | **4.606** | **.004** | | | |
| Age | | | | | .006 | .013 | .626 |
| Parental Education | | | | | **.014** | **.006** | **.028** |
| Family Income | | | | | -.010 | .007 | .140 |
| Parent proportion errors | | | | | **.310** | **.096** | **.001** |
| **Step 2** | .203 | .001 | .111 | .822 | | | |
| Level of bilingualism | | | | | < .001 | .003 | .965 |
| **Step 3** | .216 | .013 | 1.220 | .454 | | | |
| Level of bilingualism X Income | | | | | -.001 | .001 | .454 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

Proportion of perseverative errors. The first step of the model was significant $F(4, 73) = 4.606$, $p = .004$, $R^2 = .202$ (Table 11a-2). Parents' performance on the task predicted children's difficulty with cognitive flexibility as measured by the proportion of errors made that were perseverative errors ($b$ = .310, $t$ = 3.214, 95% CI [.121, .499]), parental education also significantly predicted children's cognitive flexibility ($b$ = .014, $t$ = 2.199, 95% CI [.002, .027]). The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .111, $p$ = .822, $R^2\Delta$ = .001. Children's level of bilingualism was not associated with cognitive flexibility ($b$ = .000, $t$ = .044, 95% CI [-.005, .005]). The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.220, $p$ = .454, $R^2\Delta$ = .013. Children's level of bilingualism did not interact with household income to predict children's cognitive flexibility ($b$ = -.001, $t$ = -.752, 95% CI [-.003, .001]).

<u>Proportion of perseverative errors predicted by fluency scores.</u> The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .252, $p$ = .812, $R^2\Delta$ = .006 (table 11b-2). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.108, $p$ = .429, $R^2\Delta$ = .036.

**Table 11b.** Regression for child cognitive flexibility predicted by English and Spanish fluency

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| 1. *Perseverative errors %* | | | | | | | |
| **Step 2** | .193 | .071 | 3.161 | .087 | | | |
| English fluency | | | | | -.472 | .218 | .031 |
| Spanish fluency | | | | | .136 | .228 | .553 |
| **Step 3** | .207 | .014 | .397 | .757 | | | |
| English fluency X Spanish fluency | | | | | .013 | .044 | .765 |
| English fluency X Income | | | | | -.049 | .088 | .581 |
| Spanish fluency X Income | | | | | -.005 | .106 | .960 |
| 2. *Proportion perseverative errors* | | | | | | | |
| **Step 2** | .208 | .006 | .252 | .812 | | | |
| English fluency | | | | | -.001 | .004 | .841 |
| Spanish fluency | | | | | -.001 | .004 | .844 |
| **Step 3** | .244 | .036 | 1.108 | .429 | | | |
| English fluency X Spanish fluency | | | | | .001 | .001 | .520 |
| English fluency X Income | | | | | .001 | .001 | .684 |
| Spanish fluency X Income | | | | | -.002 | .002 | .283 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets.

***1e.*** *Attention Bias to threat*. Because studies looking at cognitive performance in bilingual children have often ignored cognitive processes that are also emotional processes in nature, children's performance on an attention bias (or emotional selective attention) task was also assessed. Additional to the traditional attention bias score derived from this task, a measure of children's general accuracy during the task was assessed (Table 12).

Attention bias score. The first step of the model was significant $F(4, 73) = 5.533$, $p = .004$, $R^2 = .227$ (Table 12a-1). Children's age significantly predicted children's biases towards threat ($b = -22.063$, $t = -2.315$, 95% CI [-40.782, -3.345]), such that younger children showed larger biases towards threat. Parent's attentional bias also predicted children's biases ($b = -1.180$, $t = -2.806$, 95% CI [-2.023, -.337]), such that children with larger biases to threat had parents with smaller biases. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 1.083, $p = .375$, $R^2\Delta = .012$. Children's level of bilingualism was not associated with their attentional biases ($b = 1.716$, $t = .878$, 95% CI [-2.123, 5.555]). The third step of the model resulted in a non-significant change $F\Delta$ (1, 71) = 1.986, $p = .204$, $R^2\Delta = .021$. Children's level of bilingualism did not interact with household income to predict children's attentional bias to threat ($b = .934$, $t = 1.262$, 95% CI [-.519, 2.386]).

Attention bias predicted by fluency scores. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = 1.308, $p = .301$, $R^2\Delta = .032$ (Table 12b-1). The third step of the model resulted in a significant change to the model $F\Delta$ (1, 71) = 5.121, $p = .004$, $R^2\Delta = .156$. The interaction of children's Spanish fluency and household income was marginal ($b = 2.064$, $t = 1.806$, 95% CI [-.187, 4.315]) and the interaction of Spanish fluency with English fluency was significant ($b = -1.511$, $t = -3.045$, 95% CI [-2.486, -.536]). To probe this interaction (Figure 1), simple slopes were plotted at +/-1SD (corresponding to low and high levels) points from the mean (Aiken & West, 1991). A look at the simple slopes revealed that for children with low English fluency ($b$ = 5.132, $t$ = 1.655, $p$ = .102) level of Spanish fluency was not associated with their biases towards (or away) from threat, however, for children with high English fluency ($b$ = 9.260, $t$ = 3.358, $p$ = .001) greater Spanish fluency was associated with a stronger bias *towards* threat.

**Table 12a.** Regression for child attention bias predicted by level of bilingualism

| | **$R^2$** | **$\Delta R^2$** | **$\Delta F$** | **p** | **b** | **SEb** | **p** |
|---|---|---|---|---|---|---|---|
| *a. Attention bias score* | | | | | | | |
| **Step 1** | **.227** | **.227** | **5.533** | **.004** | | | |
| Age | | | | | **-22.063** | **9.529** | **.021** |
| Parental Education | | | | | -2.598 | 4.815 | .590 |
| Family Income | | | | | 3.849 | 5.479 | .483 |
| Parent attention bias score | | | | | **-1.180** | **.421** | **.007** |
| **Step 2** | .239 | .012 | 1.083 | .375 | | | |
| Level of bilingualism | | | | | 1.716 | 1.954 | .380 |
| **Step 3** | .260 | .021 | 1.986 | .204 | | | |
| Level of bilingualism X Income | | | | | .934 | .739 | .207 |
| *b. Accuracy* | | | | | | | |
| **Step 1** | .079 | .079 | 1.574 | .227 | | | |
| Age | | | | | 3.465 | 2.807 | .217 |
| Parental Education | | | | | -2.018 | 1.375 | .143 |
| Family Income | | | | | 1.302 | 1.601 | .416 |
| Parent Accuracy | | | | | .837 | .641 | .194 |
| **Step 2** | **.139** | **.060** | **4.993** | **.031** | | | |
| Level of bilingualism | | | | | **-1.185** | **.544** | **.029** |
| **Step 3** | **.232** | **.093** | **8.662** | **.006** | | | |
| Level of bilingualism X Income | | | | | **-.572** | **.206** | **.006** |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; **bold** = $p < .05$.

General accuracy. The first step of the model was not significant $F(4, 73) = 1.574$, $p = .227$, $R^2 = .079$ (Table 12a-2). The second step of the model resulted in a significant change to the model $F\Delta\ (1, 72) = 4.993$, $p = .031$, $R^2\Delta = .060$. Level of bilingualism predicted children's ability to correctly perform during this task ($b = -1.185$, $t = -2.179$, 95% CI [-2.251, -.119]), such that more balanced bilingualism was associated with more difficulty correctly performing in an emotional selective attention task. The third step of the model resulted in a significant change $F\Delta\ (1, 71) = 8.662$, $p = .006$, $R^2\Delta = .093$. Children's level of bilingualism interacted with household income to predict children's performance on the task ($b = -.572$, $t = -2.777$, 95% CI [-.976, -.168]).

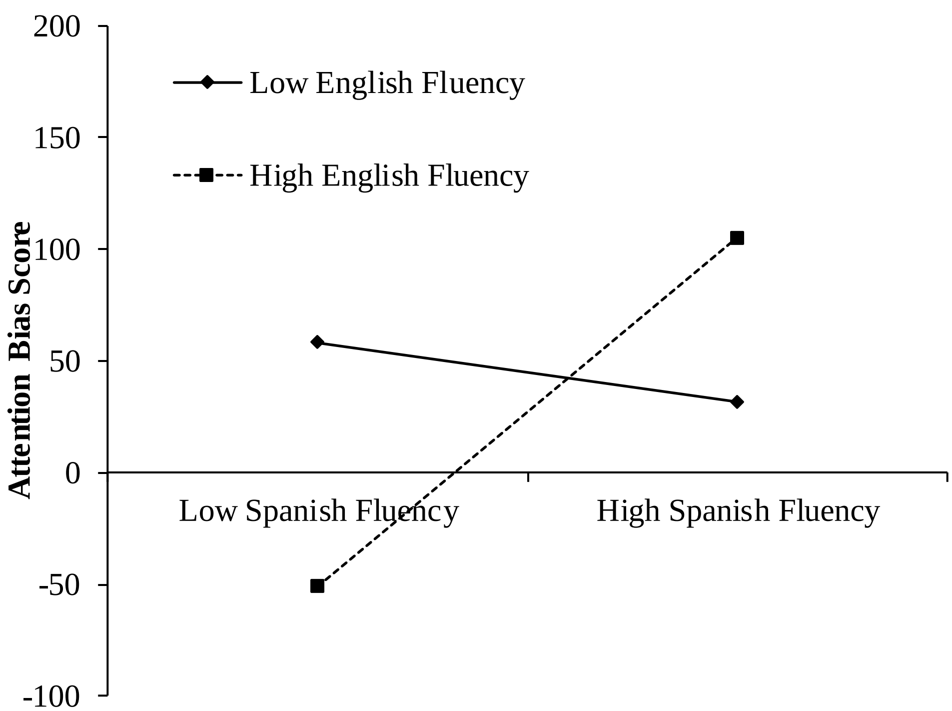


**Figure 1.** Interaction of Spanish and English fluency on children's attention bias score.

A closer look at the simple slopes (Figure 2) revealed that for children from lower income households, level of bilingualism was not associated with their accuracy ($b$ = -.682, $t$ = -.790, $p$ = .432), on the other hand, for children from higher income, less balanced bilingualism was associated with better performance on this task ($b$ = -1.826, $t$ = -2.126, $p$ = .037).

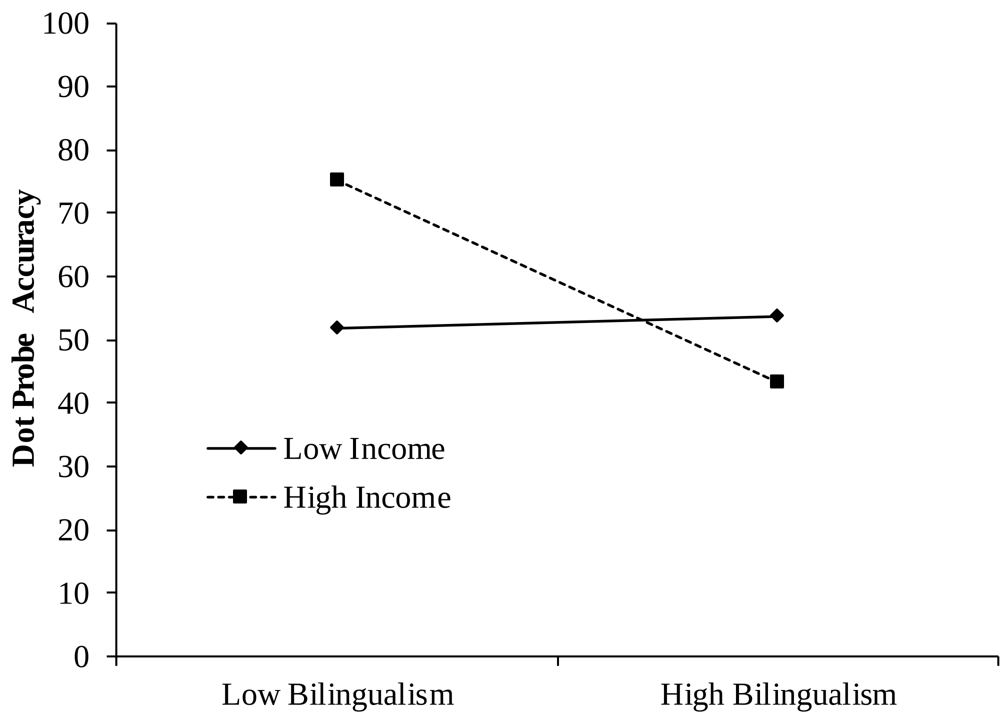


**Figure 2.** Interaction between level of bilingualism and income predicting accuracy for the Dot Probe task.

<u>Dot Probe general accuracy predicted by fluency scores.</u> The second step of the model resulted in a significant change to the model $F\Delta$ (1, 72) = 3.814, $p$ = .041, $R^2\Delta$ = .087 (Table 12b-2). Spanish fluency was significantly associated with accuracy on this task ($b$ = -1.939, $t$ = -2.350, 95% CI [-3.566, -.313]), such that less fluency in Spanish was associated with better performance on an

emotional selective attention task. The third step of the model also resulted in a significant change to the model $F\Delta$ (1, 71) = 4.163, $p$ = .019, $R^2\Delta$ = .126. The interactions of English fluency and income ($b$ = .476, $t$ = 1.694, 95% CI [-.080, 1.031]) and Spanish fluency and income ($b$ = -.532, $t$ = -1.728, 95% CI [-1.137, .073]) were both marginal. The interaction of Spanish and English fluency was significant ($b$ = .311, $t$ = 2.187, 95% CI [.031, .590]).

**Table 12b.** Regression for child attention bias predicted by English and Spanish fluency

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *b. Attention bias score* | | | | | | | |
| **Step 2** | .259 | .032 | 1.308 | .301 | | | |
| English fluency | | | | | -1.518 | 2.391 | .526 |
| Spanish fluency | | | | | 4.050 | 2.768 | .144 |
| **Step 3** | .415 | .156 | 5.121 | .004 | | | |
| English fluency X Spanish fluency | | | | | **-1.511** | **.496** | **.002** |
| English fluency X Income | | | | | -.441 | .916 | .630 |
| Spanish fluency X Income | | | | | *2.064* | *1.143* | *.072* |
| *a. Accuracy* | | | | | | | |
| **Step 2** | **.166** | **.087** | **3.814** | **.041** | | | |
| English fluency | | | | | .774 | .723 | .285 |
| Spanish fluency | | | | | **-1.939** | **.825** | **.020** |
| **Step 3** | **.292** | **.126** | **4.163** | **.019** | | | |
| English fluency X Spanish fluency | | | | | **.311** | **.142** | **.029** |
| English fluency X Income | | | | | .476 | .281 | .093 |
| Spanish fluency X Income | | | | | -.532 | .308 | .085 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p$ < .08; **bold** = $p$ < .05.

A look at the interaction of English and Spanish fluency (Figure 3) revealed that for children with high English fluency ($b$ = -2.232, $t$ = -1.884, $p$ = .064) level of Spanish fluency was only marginally associated with their accuracy on the task, however, for children with low English fluency ($b$ = -2.854, $t$ = -2.205, $p$ = .031) more Spanish fluency was associated with poorer performance on this task.

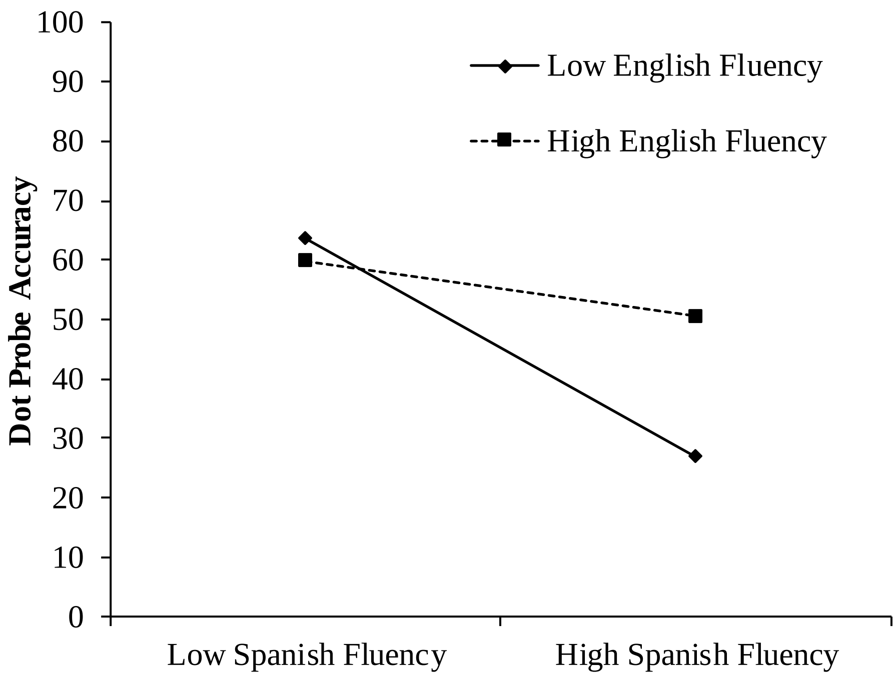


**Figure 3.** Interaction of English and Spanish fluency on children's accuracy for an emotional selective attention task.

*Summary.* Children's level of bilingualism predicted performance on an inhibitory control task, a cognitive flexibility task, and an emotional selective attention task. Contrary to hypothesis, however, more balanced bilingualism was associated with poorer performance on these tasks. Specifically, more balanced bilingualism was associated with poorer accuracy on the inhibitory control task, more perseverative errors on the cognitive flexibility task, and poorer accuracy on an emotional attention task. When exploring the role of the two individual fluency measures. Greater English fluency was associated with better accuracy on the inhibitory control task and fewer perseverative errors in the cognitive flexibility task. In other words, greater English fluency was associated with more advanced EF, but only for inhibitory control and cognitive flexibility. Lastly, the effects of bilingualism on emotional selective attention were moderated by household income, such that more balanced bilingualism was associated with poorer accuracy on this task only for children from higher income families.

**Aim 2.** *Are there differences in emotion regulation abilities based on children's level of bilingualism?* A set of regressions were conducted to assess whether level of bilingualism predicted children's emotion regulation (context sensitivity, repertoire, and implementation) beyond what age, gender, and parent's self-reported emotion regulation could predict. At step 1 age, gender, and parent's emotion regulation were entered. At step 2, level of bilingualism was entered.

***2a.*** *Context sensitivity.* Children's context sensitivity was assessed using proportion scores. A total of four proportion scores were used for analyses: average proportion across emotion contexts, proportion for fear, proportion for sadness, and proportion for anger. First, a repeated-measures ANOVA was conducted to assess differences in proportion of context appropriate strategies across emotional contexts. Following this, four regression models were carried out to test the predictive effect of level of bilingualism on context sensitivity. At the first step, child's gender, age, and parent's emotion regulation were entered. At the second step, level of bilingualism was entered. At the third step, children's accuracy on the attention bias task was added as it was related in correlation analyses with the context sensitivity score. Lastly, at the fourth step, an interaction between child's level of bilingualism and Dot Probe accuracy was entered.

Context Sensitivity differences across discrete emotions. A repeated-measures ANOVA with only one within-person factor (the three discrete emotion proportion scores was carried out for this; Figure 4). The within person effect of emotional context was significant $F(2,154) = 8.520$, $p < .0001$, $\eta^2 = .100$, suggesting that the proportion of context appropriate strategies out of all strategies endorsed varied by emotional context. Follow-up paired-sample t-tests revealed that children showed better context sensitivity for fear ($M = .439$; $SD = .142$) compared to sadness ($M = .374$; $SD = .157$), $t_{75} = 2.436$, $p = .017$, $d = .434$. Better context sensitivity for anger ($M = .488$; $SD = .187$) compared to sadness ($M = .374$; $SD = .157$), $t_{75} = 4.0266$, $p < .001$, $d = .660$. Lastly, children showed marginally better context sensitivity for anger ($M = .488$; $SD = .187$) compared to fear ($M = .439$; $SD = .142$), $t_{75} = 1.741$, $p = .086$, $d = .295$.

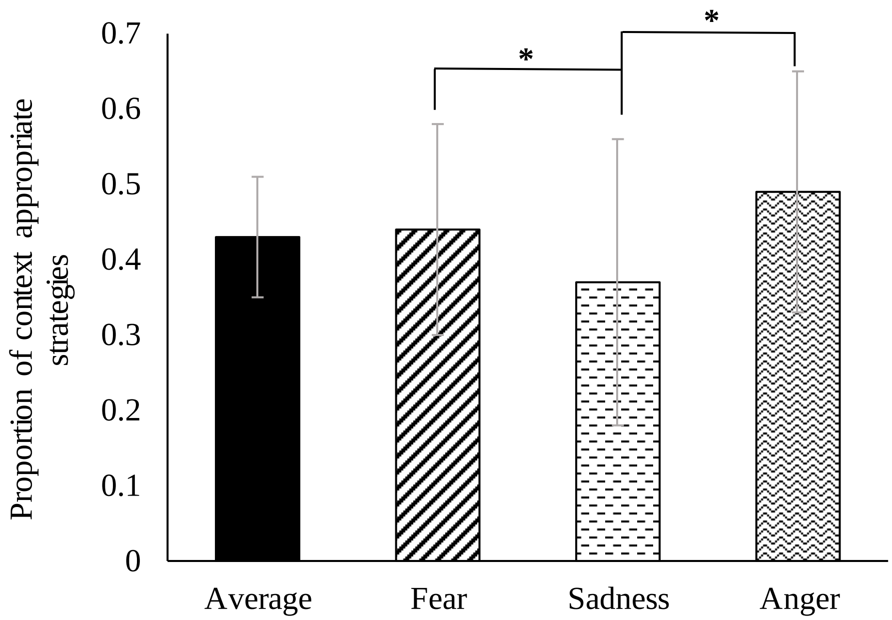


**Figure 4.** Context Sensitivity differences across discrete emotions.

Average context sensitivity. The first step of the model was not significant $F(3, 74) = 1.559$, $p = .211$, $R^2 = .059$. The second step of the model resulted in a non-significant change to the model $F\Delta\ (1, 73) = .897$, $p = .351$, $R^2\Delta = .010$. Children's level of bilingualism did not predict average context sensitivity ($b = .002$, $t = .938$, 95% CI [-.002, .005]). The third step of the model resulted in a significant change to the model $F\Delta\ (1, 72) = 8.803$, $p = .004$, $R^2\Delta = .101$. Children's accuracy on the Dot Probe task was a significant predictor of their average context sensitivity ($b = .001$, $t = 2.957$, 95% CI [.000, .002]), such that greater accuracy in an emotional selective attention task was associated with better context sensitivity. The fourth step of the model also resulted in a significant change to the model $F\Delta\ (1, 71) = 6.628$, $p = .013$, $R^2\Delta = .071$. The interaction between level of bilingualism and accuracy on the Dot Probe task was significant ($b = -.0001$, $t = -2.538$, 95% CI [-.0002, -.00003]). A closer look at the simple slopes (Figure 5) revealed that better accuracy in the task was associated with context sensitivity more strongly for children who were less balanced bilinguals ($b = .001$, $t = 3.454$, $p = .001$) compared to children who were more balanced bilinguals ($b = .001$, $t = 2.917$, $p = .005$).

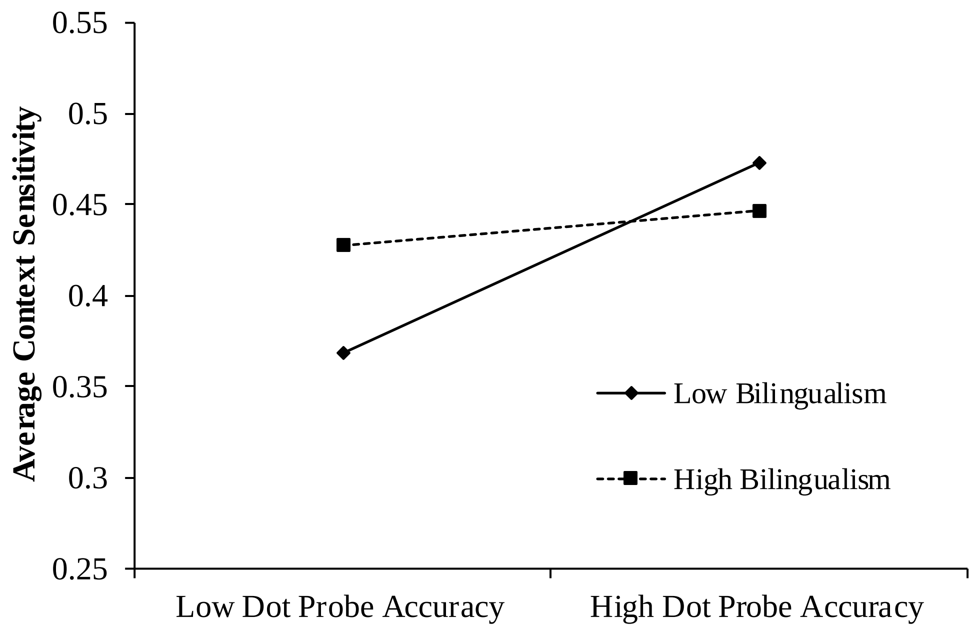


**Figure 5.** Interaction of level of bilingualism and accuracy for the dot probe task on children's average context sensitivity.

**Table 13.** Regressions for child context sensitivity outcomes

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *a. Average* | | | | | | | |
| **Step 1** | .059 | .059 | 1.559 | .211 | | | |
| Age | | | | | .006 | .008 | .433 |
| Gender | | | | | -.009 | .019 | .642 |
| Parent emotion regulation | | | | | *-.001* | *.000* | *.072* |
| **Step 2** | .069 | .010 | .897 | .351 | | | |
| Level of bilingualism | | | | | .002 | .002 | .348 |
| **Step 3** | **.170** | **.101** | **8.803** | **.004** | | | |
| Selective attention accuracy | | | | | **.001** | **.000** | **.003** |
| **Step 4** | .241 | **.071** | **6.628** | **.013** | | | |
| Level of bilingualism X Selective attention accuracy | | | | | **-.0001** | **.000** | **.011** |
| *b. Fear* | | | | | | | |
| **Step 1** | .065 | .065 | 1.708 | .173 | | | |
| Age | | | | | .011 | .014 | .425 |
| Gender | | | | | **-.069** | **.033** | **.037** |
| Parent emotion regulation | | | | | -.000 | .001 | .982 |
| **Step 2** | .071 | .006 | .493 | .498 | | | |
| Level of bilingualism | | | | | -.002 | .003 | .497 |
| **Step 3** | .072 | .001 | .010 | .922 | | | |
| Selective attention accuracy | | | | | .000 | .001 | .921 |
| **Step 4** | .072 | .000 | .026 | .895 | | | |
| Level of bilingualism X Selective attention accuracy | | | | | -.000 | .000 | .969 |
| *c. Sad* | | | | | | | |
| **Step 1** | .033 | .033 | .846 | .474 | | | |
| Age | | | | | .018 | .016 | .249 |
| Gender | | | | | .023 | .037 | .531 |
| Parent emotion regulation | | | | | -.001 | .001 | .281 |
| **Step 2** | .047 | .014 | 1.045 | .318 | | | |
| Level of bilingualism | | | | | -.003 | .003 | .316 |
| **Step 3** | **.150** | **.103** | **8.720** | **.004** | | | |
| Selective attention accuracy | | | | | **.002** | **.001** | **.003** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Step 4** | **.228** | **.078** | **7.141** | **.010** | | | |
| Level of bilingualism X Selective attention accuracy | | | | | **-.0003** | **.000** | **.009** |
| *d. Anger* | | | | | | | |
| **Step 1** | .033 | .033 | .840 | .485 | | | |
| Age | | | | | -.010 | .019 | .585 |
| Gender | | | | | .019 | .044 | .664 |
| Parent emotion regulation | | | | | -.001 | .001 | .161 |
| **Step 2** | **.140** | **.107** | **7.229** | **.009** | | | |
| Level of bilingualism | | | | | **.010** | **.004** | **.008** |
| **Step 3** | .160 | .020 | 1.646 | .207 | | | |
| Selective attention accuracy | | | | | .001 | .001 | .204 |
| **Step 4** | .173 | .013 | 1.072 | .317 | | | |
| Level of bilingualism X Selective attention accuracy | | | | | .000 | .000 | .315 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

Context sensitivity to fear. The first step of the model was not significant $F(3, 74) = 1.708$, $p = .173$, $R^2 = .065$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) =.493, $p = .498$, $R^2\Delta = .006$. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .010, $p = .922$, $R^2\Delta = .001$. Lastly, the fourth step of the model also resulted in a non-significant change $F\Delta$ (1, 72) = .026, $p = .895$, $R^2\Delta < .001$.

Context sensitivity to sadness. The first step of the model was not significant $F(3, 74) = .846$, $p = .474$, $R^2 = .033$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) = 1.046, $p = .318$, $R^2\Delta = .014$. The third step of the model resulted in a significant change to the model $F\Delta$ (1, 72) = 8.720, $p = .004$, $R^2\Delta = .103$. Children's accuracy on the Dot

Probe task was a significant predictor of their context sensitivity to sadness ($b$ = .002, $t$ = 2.951, 95% CI [.001, .003]). Lastly, the fourth step of the model also resulted in a significant change to the model $F\Delta$ (1, 72) = 7.141, $p$ = .010, $R^2\Delta$ = .078. The interaction between level of bilingualism and accuracy on the Dot Probe task was significant ($b$ = -.0003, $t$ = -2.625, 95% CI [-.0005, -.00007]). A closer look at the simple slopes (Figure 6) revealed that better accuracy in an emotional selective attention task was associated with context sensitivity more strongly for children who were less balanced bilinguals ($b$ = .002, $t$ = 3.529, $p$ = .001) compared to children who were more balanced bilinguals ($b$ = .002, $t$ = 2.954, $p$ = .004).

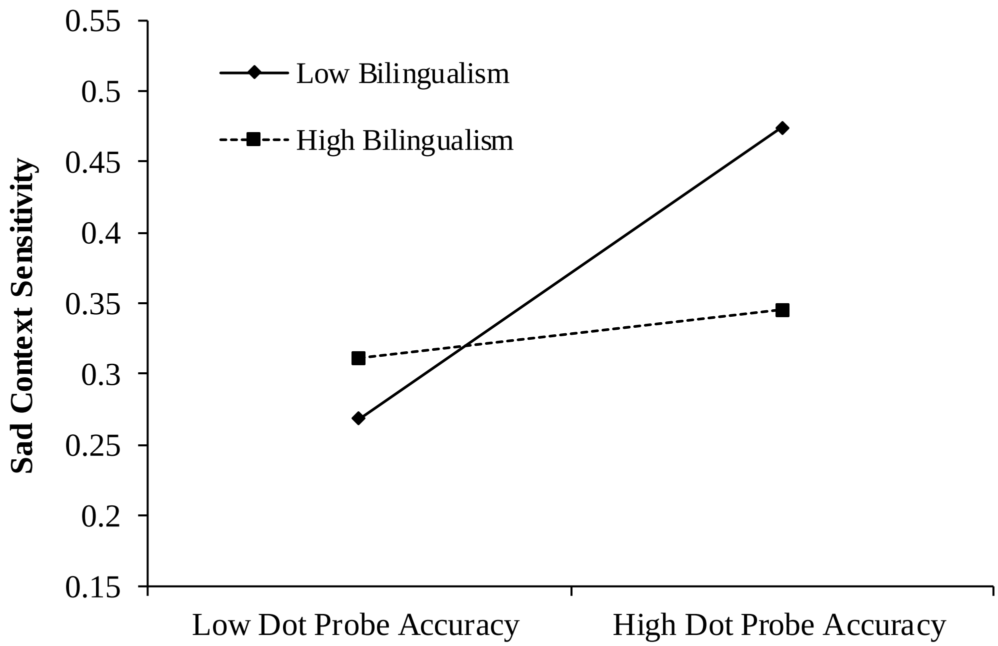


**Figure 6.** Interaction of level of bilingualism and accuracy for the dot probe task predicting children's context sensitivity to sadness.

Context sensitivity to anger. The first step of the model was not significant $F(3, 74) = .840$, $p = .485$, $R^2 = .033$. The second step of the model resulted in a significant change to the model $F\Delta\ (1, 73) = 7.229$, $p = .009$, $R^2\Delta = .107$. Children's bilingualism predicted their context sensitivity to anger ($b = .010$, $t = 2.665$, 95% CI [.003, .018]), such that being a more balanced bilingual was associated with more context sensitivity for anger. The third step of the model resulted in a non-significant change to the model $F\Delta\ (1, 72) = 1.646$, $p = .207$, $R^2\Delta = .020$. Lastly, the fourth step of the model also resulted in a non-significant change to the model $F\Delta\ (1, 72) = 1.072$, $p = .317$, $R^2\Delta = .013$.

***2b.*** *Strategy Repertoires*. Children's strategy repertoires were assessed using sum scores of unique strategies endorsed during AEI. A total of four sum scores were used for analyses: general strategy repertoire (i.e., number of unique strategies across all three emotions), fear strategy repertoire (i.e., number of unique strategies for the fear prompts), sad strategy repertoire (i.e., number of unique strategies for the sad prompts), and anger strategy repertoire (i.e., number of unique strategies for the anger prompts). First, a repeated-measures ANOVA was conducted to assess differences in number of unique strategies across emotional contexts. Following this, four regression models were carried out to test the predictive effect of level of bilingualism on strategy repertoires. At the first step, child's gender, age, and parent's emotion regulation was entered. At the second step, level of bilingualism was entered.

Repertoire differences across discrete emotions. A repeated-measures ANOVA with only one within-person factor (the three discrete emotion strategy scores) was carried out (Figure 7). The within person effect of emotional context was not significant $F$ (2,154) = 1.716, $p$ = .231, $\eta^2$ = .022, suggesting that the total number of strategies endorsed did not vary by emotional context.

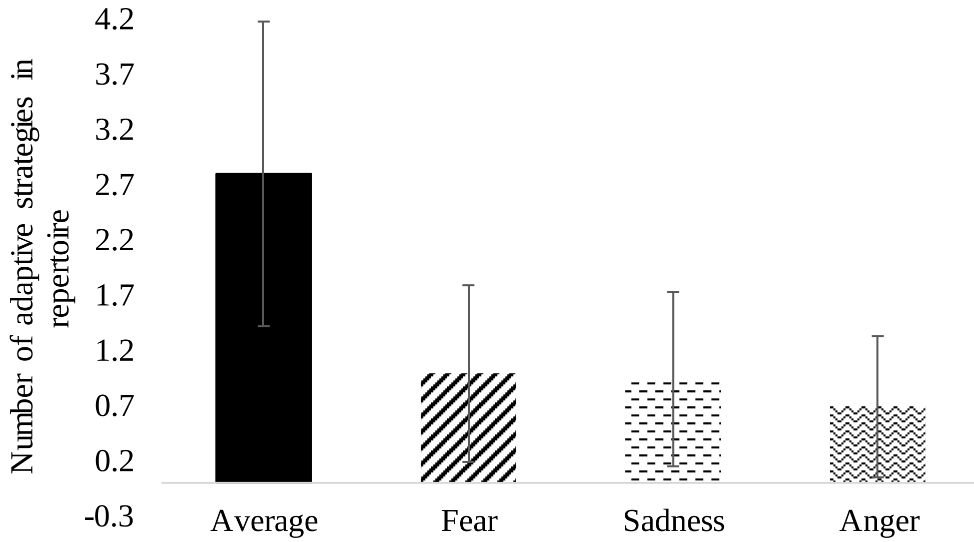


**Figure 7.** Repertoire differences across discrete emotions.

General Strategy Repertoire. The first step of the model was not significant $F(3, 74) = .506$, $p = .681$, $R^2 = .020$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) = 3.786, $p = .107$, $R^2\Delta = .048$. Children's level of bilingualism did not predict the size of their general repertoire ($b = .055$, $t = 1.620$, 95% CI [-.012, .122]).

**Table 14.** Regressions for child strategy repertoire outcomes

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *a. General* | | | | | | | |
| **Step 1** | .020 | .020 | .506 | .681 | | | |
| Age | | | | | .062 | .154 | .690 |
| Gender | | | | | .301 | .383 | .432 |
| Parent emotion regulation | | | | | .002 | .008 | .827 |
| **Step 2** | .068 | .048 | 3.786 | .107 | | | |
| Level of bilingualism | | | | | .055 | .034 | .108 |
| *b. Fear* | | | | | | | |
| **Step 1** | .018 | .018 | .461 | .718 | | | |
| Age | | | | | .081 | .090 | .364 |
| Gender | | | | | .102 | .217 | .638 |
| Parent emotion regulation | | | | | -.001 | .005 | .824 |
| **Step 2** | .053 | .035 | 2.742 | .122 | | | |
| Level of bilingualism | | | | | .028 | .018 | .128 |
| *c. Sad* | | | | | | | |
| **Step 1** | .055 | .055 | 1.458 | .293 | | | |
| Age | | | | | .139 | .083 | .094 |
| Gender | | | | | -.182 | .204 | .374 |
| Parent emotion regulation | | | | | -.002 | .004 | .670 |
| **Step 2** | .094 | .039 | 3.134 | .146 | | | |
| Level of bilingualism | | | | | .027 | .019 | .157 |
| *d. Anger* | | | | | | | |
| **Step 1** | .031 | .031 | .793 | .540 | | | |
| Age | | | | | .014 | .066 | .828 |
| Gender | | | | | .197 | .164 | .230 |
| Parent emotion regulation | | | | | .001 | .003 | .836 |
| **Step 2** | .070 | .039 | 3.147 | .175 | | | |
| Level of bilingualism | | | | | .021 | .015 | .161 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets

Fear Strategy Repertoire. The first step of the model was not significant $F(3, 74) = .461$, $p = .718$, $R^2 = .018$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) = 2.742, $p$ = .122, $R^2\Delta$ = .035. Children's level of bilingualism did not predict the size of their fear repertoire ($b$ = .028, $t$ = 1.523, 95% CI [-.008, .064]).

Sad Strategy Repertoire. The first step of the model was not significant $F(3, 74)$ = 1.458, $p$ = .293, $R^2$ = .055. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) = 3.134, $p$ = .146, $R^2\Delta$ = .039. Children's level of bilingualism did not predict the size of their sad repertoire ($b$ = .027, $t$ = 1.427, 95% CI [-.010, .064]).

Anger Strategy Repertoire. The first step of the model was not significant $F(3, 74)$ = .793, $p$ = .540, $R^2$ = .031. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 73) = 3.147, $p$ = .145, $R^2\Delta$ = .039. Children's level of bilingualism did not predict the size of their anger repertoire ($b$ = .021, $t$ = 1.413, 95% CI [-.009, .051]).

***2c.*** *Implementation*. The last aspect of emotion regulation that was assessed in this dissertation was children's ability to implement two emotion regulation strategies: distraction and reappraisal. During the task, both behavioral and electrophysiological responses were recorded and were both used for analyses. First, a series of t-tests were conducted with the behavioral and electrophysiological data separately to ensure the experimental task worked as intended. After this, difference scores were created for both behavioral and electrophysiological data to be used in analyses by subtracting children's scores for the regulation task from the passive-viewing task. These analyses consisted of six regression models, one for the average difference from view to regulate tasks, and two for the difference scores for fear and sadness separately. This was done for both behavioral and electrophysiological data independently. At step 1, child's gender, child's age, parental emotion regulation and experimental condition were entered. At step two, level of bilingualism was entered. At step three, the interaction of level of bilingualism and condition was entered to test the hypothesis that children would differ in the implementation of reappraisal but not distraction based on their level of bilingualism.

Manipulation check. First, paired t-tests were conducted to ensure our emotion elicitation manipulation and strategy instructions worked. Children reported significantly more fear $t_{74} = 4.763$, $p < .001$, $d = 650$, after the fear block ($M = 2.027$; $SD = 1.103$) compared to the neutral block ($M = 1.440$; $SD = .642$), and more sadness $t_{74} = 7.557$, $p < .001$, $d = 1.101$, after the sad block ($M = 1.800$; $SD = .915$) compared to the neutral block ($M = 1.053$; $SD = .289$). Children also self-reported experiencing marginally stronger emotions $t_{74} = 1.731$, $p = .088$, $d = .224$, for the fear block ($M = 2.027$; $SD = 1.103$) compared to the sad block ($M = 1.800$; $SD = .915$).

When looking at the regulation instructions (Figure 8), children reported significantly less fear $t_{71} = 3.543$, $p = .001$, $d = .427$, during the regulate fear block ($M = 1.606$; $SD = .902$) compared to the view fear block ($M = 2.027$; $SD = 1.103$), but this was not true for sadness $t_{70} = .786$, $p = .435$, $d = .096$, children did not report less sadness in the regulate sadness block ($M = 1.690$; $SD = .855$) compared to the view sadness block ($M = 1.775$; $SD = .913$). Follow-up paired t-tests for each condition separately revealed that distraction effectively reduced self-report of fear $t_{33} = 3.187$, $p = .003$, $d = .506$ (View: $M = 1.912$; $SD = 1.055$; Distraction: $M = 1.441$; $SD = .786$), as did reappraisal $t_{36} = 2.073$, $p = .045$, $d = .371$ (View: $M = 2.162$; $SD = 1.191$; Reappraisal: $M = 1.757$; $SD = .983$). For sadness, however, distraction significantly reduced self-report of sadness $t_{33} = 3.200$, $p = .003$, $d = .407$ (View: $M = 1.909$; $SD = 1.011$; Distraction: $M = 1.546$; $SD = .754$) but reappraisal did not $t_{37} = .947$, $p = .350$, $d = .181$ (View: $M = 1.658$; $SD = .815$; Reappraisal: $M = 1.816$; $SD = .926$).

After this, a second set of paired t-tests were conducted for the LPP. As expected, children showed a significant increase in positivity to the fear pictures ($M = 6.793$; $SD = 7.735$) compared to the neutral pictures ($M = 3.942$; $SD = 7.547$), $t_{50} = 3.623$, $p = .001$, $d = 1.025$. They also showed greater positivity to the sad pictures ($M = 8.103$; $SD = 6.745$) compared to the neutral pictures ($M = 3.748$; $SD = 7.399$), $t_{47} = 2.979$, $p = .005$, $d = .869$. When looking at the regulation instructions, children's LPP to the fear pictures during the regulation task ($M = 6.435$; $SD = 7.330$) was not significantly smaller than during the view task ($M = 6.793$; $SD = 7.735$), $t_{50} = .228$, $p = .821$, $d = .064$. The same was not true for sadness $t_{59} = 2.303$, $p = .025$, $d = .600$, children's LPP to sad pictures in the regulate task ($M = 9.946$; $SD = 6.808$) was significantly different form the LPP to sad pictures during the view task ($M = 8.241$; $SD = 6.631$). Follow-up paired t-tests for each condition separately revealed that distraction increased the LPP for sadness $t_{29} = 3.363$, $p = .002$, $d = 1.249$ (View: $M = 7.277$; $SD = 6.889$;

Distraction: *M* = 10.903; *SD* = 6.698). No other t-tests were significant (all *t*s < .350; *p*s > .729).

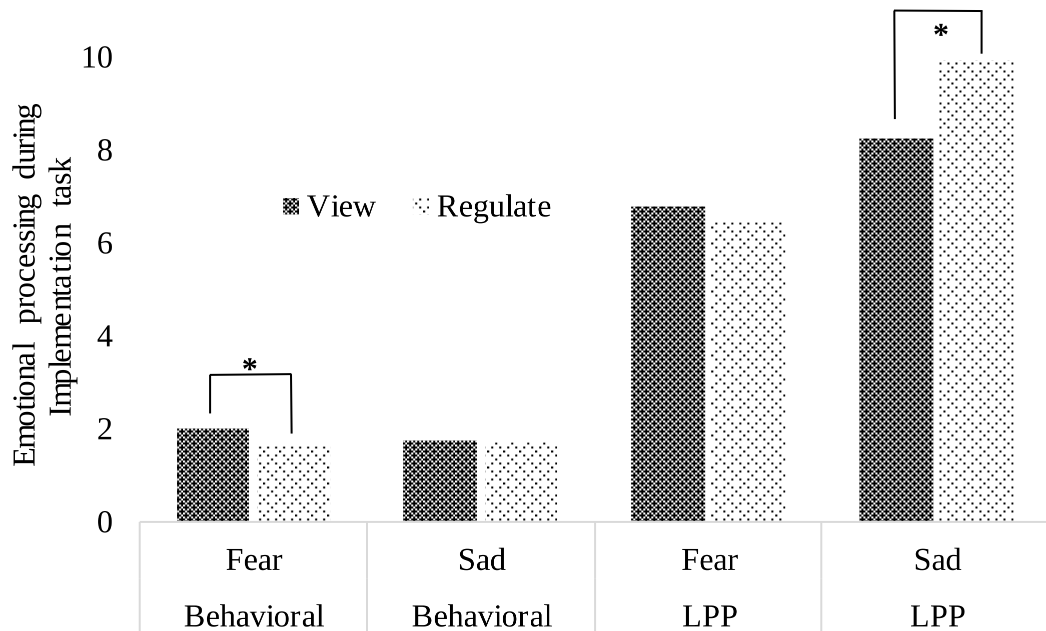


**Figure 8.** Differences in self-report of emotion and emotional processing as measured by the LPP for view and regulate tasks.

<u>Average behavioral difference after implementation.</u> The first step of the model was not significant $F(4, 73) = .851$, $p = .518$, $R^2 = .044$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .479, $p = .600$, $R^2\Delta = .006$. Children's bilingualism did not predict average behavioral strategy implementation (*b* = -.009, *t* = -.531, 95% CI [-.040, .023]). The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = .555, $p = .537$, $R^2\Delta = .007$. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on the average changes of self-report of emotion across tasks (*b* = .019, *t* = .595, 95% CI [-.044, .082]).

Fear behavioral difference after implementation. The first step of the model was not significant $F(4, 73) = .314$, $p = .845$, $R^2 = .018$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .801, $p = .419$, $R^2\Delta = .011$. Children's bilingualism did not predict fear behavioral strategy implementation ($b = .019$, $t = -.805$, 95% CI [-.027, .065]). The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = 2.800, $p = .148$, $R^2\Delta = .037$. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on the changes of self-report of emotion across tasks for fear ($b = .070$, $t = 1.434$, 95% CI [-.026, .165]).

Sad behavioral difference after implementation. The first step of the model was not significant $F(4, 73) = 1.726$, $p = .189$, $R^2 = .086$. The second step of the model resulted in a marginally significant change to the model $F\Delta$ (1, 72) = 3.759, $p = .075$, $R^2\Delta = .045$. Children's bilingualism marginally predicted sad behavioral strategy implementation ($b = -.036$, $t = -1.756$, 95% CI [-.076, .004]), such that being a more balanced bilingual was marginally associated with greater difficulty implementing the emotion regulation strategies. The third step of the model resulted in a non-significant change to the model $F\Delta$ (1, 71) = 1.091, $p = .495$, $R^2\Delta = .013$. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on changes of self-report of emotion across tasks for sadness ($b = -.031$, $t = -.687$, 95% CI [-.123, .060]).

**Table 15.** Regressions for child strategy implementation outcomes

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *a. Average behavioral* | | | | | | | |
| **Step 1** | .044 | .044 | .851 | .518 | | | |
| Age | | | | | -.032 | .078 | .679 |
| Gender | | | | | .060 | .190 | .751 |
| Parent emotion regulation | | | | | -.001 | .004 | .807 |
| Implementation condition | | | | | -.286 | .191 | .136 |
| **Step 2** | .050 | .006 | .479 | .590 | | | |
| Level of bilingualism | | | | | -.009 | .016 | .596 |
| **Step 3** | .057 | .007 | .555 | .537 | | | |
| Level of bilingualism X Implementation condition | | | | | .019 | .032 | .553 |
| *b. Fear behavioral* | | | | | | | |
| **Step 1** | .018 | .018 | .314 | .845 | | | |
| Age | | | | | -.041 | .119 | .729 |
| Gender | | | | | .223 | .279 | .425 |
| Parent emotion regulation | | | | | .000 | .006 | .975 |
| Implementation condition | | | | | -.065 | .294 | .827 |
| **Step 2** | .029 | .011 | .501 | .419 | | | |
| Level of bilingualism | | | | | .019 | .023 | .421 |
| **Step 3** | .066 | .037 | 2.800 | .148 | | | |
| Level of bilingualism X Implementation condition | | | | | .070 | .049 | .153 |
| *b. Sad behavioral* | | | | | | | |
| **Step 1** | .086 | .086 | 1.726 | .189 | | | |
| Age | | | | | -.024 | .103 | .820 |
| Gender | | | | | -.102 | .254 | .687 |
| Parent emotion regulation | | | | | -.002 | .005 | .670 |
| Implementation condition | | | | | **-.507** | **.254** | **.048** |
| **Step 2** | *.131* | *.045* | *3.759* | *.075* | | | |
| Level of bilingualism | | | | | *-.036* | *.021* | *.080* |
| **Step 3** | .144 | .013 | 1.091 | .495 | | | |
| Level of bilingualism X Implementation condition | | | | | -.031 | .046 | .494 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *a. Average LPP* | | | | | | | |
| **Step 1** | .036 | .036 | .535 | .711 | | | |
| Age | | | | | .200 | .737 | .786 |
| Gender | | | | | -1.668 | 1.664 | .316 |
| Parent emotion regulation | | | | | .002 | .039 | .958 |
| Implementation condition | | | | | 1.721 | 1.674 | .304 |
| **Step 2** | .039 | .003 | .150 | .712 | | | |
| Level of bilingualism | | | | | .048 | .130 | .710 |
| **Step 3** | .040 | .001 | .080 | .797 | | | |
| Level of bilingualism X Implementation condition | | | | | -.066 | .261 | .800 |
| *b. Fear LPP* | | | | | | | |
| **Step 1** | .028 | .028 | .348 | .844 | | | |
| Age | | | | | .471 | 1.446 | .744 |
| Gender | | | | | -2.974 | 3369 | .377 |
| Parent emotion regulation | | | | | -.029 | .076 | .701 |
| Implementation condition | | | | | .925 | 3.386 | .785 |
| **Step 2** | .038 | .010 | .522 | .477 | | | |
| Level of bilingualism | | | | | .202 | .282 | .474 |
| **Step 3** | .047 | .009 | .200 | .667 | | | |
| Level of bilingualism X Implementation condition | | | | | -.250 | .577 | .665 |
| *b. Sad LPP* | | | | | | | |
| **Step 1** | .113 | .113 | 1.815 | .140 | | | |
| Age | | | | | -.569 | .690 | .409 |
| Gender | | | | | -1.041 | 1.548 | .501 |
| Parent emotion regulation | | | | | .031 | .035 | .368 |
| Implementation condition | | | | | 2.834 | 1.572 | .071 |
| **Step 2** | .114 | .001 | .044 | .852 | | | |
| Level of bilingualism | | | | | .018 | .124 | .886 |
| **Step 3** | .115 | .001 | .039 | .878 | | | |
| Level of bilingualism X Implementation condition | | | | | .033 | .245 | .893 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

Average LPP difference after implementation. The first step of the model was not significant $F(4, 73) = .535$, $p = .711$, $R^2 = .036$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .150, $p = .712$, $R^2\Delta = .003$. Children's bilingualism did not predict average LPP strategy implementation ($b = .048$, $t = .372$, 95% CI [-.207, .304]). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = .080, $p = .797$, $R^2\Delta = .001$. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on the average change in the LPP from view to regulate tasks ($b = -.066$, $t = -.253$, 95% CI [-.578, .446]).

Fear LPP difference after implementation. The first step of the model was not significant $F(4, 73) = .348$, $p = .844$, $R^2 = .028$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .522, $p = .477$, $R^2\Delta = .010$. Children's bilingualism did not predict LPP strategy implementation for fear ($b = .202$, $t = .716$, 95% CI [-.351, .755]). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = .200, $p = .667$, $R^2\Delta = .009$. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on the change in the LPP from view to regulate tasks for fear ($b = -.250$, $t = -.433$, 95% CI [-1.381, .881]).

Sad LPP difference after implementation. The first step of the model was not significant $F(4, 73) = 1.815$, $p = .140$, $R^2 = .113$. The second step of the model resulted in a non-significant change to the model $F\Delta$ (1, 72) = .044, $p = .852$, $R^2\Delta = .001$. Children's bilingualism did not predict LPP strategy implementation for sadness (*b* = .018, *t* = .143, 95% CI [-.226, .261]). The third step of the model also resulted in a non-significant change to the model $F\Delta$ (1, 71) = .039, *p* = .878, $R^2\Delta$ = .001. Level of bilingualism did not moderate the effect of task condition (i.e., distraction vs. reappraisal) on the average change in the LPP from view to regulate tasks for sadness (*b* = .033, *t* = .134, 95% CI [-.446, .512]).

*Summary*. As hypothesized, children's level of bilingualism was associated with some, but not all, aspects of emotion regulation. As expected, children's level of bilingualism was not associated with strategy repertoires, but it was for context sensitivity. In the case of strategy implementation, as expected, level of bilingualism was not associated with the ability to implement distraction, however, contrary to expectations, it was also not associated with children's ability to implement reappraisal. For context sensitivity, more balanced bilingualism was associated with greater context sensitivity for anger only. In the case of the average context sensitivity score and context sensitivity for sadness, level of bilingualism interacted with emotional selective attention accuracy such that greater accuracy in the task was associated with better context sensitivity only for children who were less balanced bilinguals.

**Aim 3.** *Are these different aspects of emotion regulation (context sensitivity, repertoire, and implementation) differentially linked to anxiety symptoms and does children's level of bilingualism play a role in this?* To test whether level of bilingualism was related to anxiety symptoms above and beyond other known predictors of children's anxiety, a hierarchical linear regression was conducted to test this. At step 1, gender, and children's symptoms of other psychopathologies (i.e., a composite of children's depression and externalizing symptoms) were entered. Children's age and parental psychopathology were not included in these models as these were not significantly related to our anxiety measure. At step 2, level of bilingualism was entered. At step 3, the three ER measures were entered. At step 4, the three 2-way interactions between level of bilingualism and ER were tested (only these interactions were tested due to the small sample size restraining the number of parameters that could be estimated in analyses). Analyses were conducted for the average of the parent and the child anxiety scores only.

The first step of the full model was significant $F(2, 52) = 5.528$, $p = .007$, $R^2 = .167$ (Table 16). Children's psychopathology symptoms were a significant covariate ($b = 4.129$, $t = 2.336$, 95% CI [.665, 7.592]), such that showing more symptoms of depression and externalizing disorders was associated with more anxiety symptoms. The second step of the model resulted in a marginally significant change to the model $F\Delta$ (1, 51) = 3.211, $p = .079$, $R^2\Delta = .047$. Children's level of bilingualism marginally predicted anxiety symptoms ($b = .282$, $t = 1.791$, 95% CI [-.027, .590]), such that being a more balanced bilingual was marginally associated with more anxiety symptoms. The third step resulted in a non-significant change to the model $F\Delta$ (3, 48) = 1.492, $p = .230$, $R^2\Delta = .063$. Thus, including all three ER measures in the same model did not significantly explain more variance in anxiety symptoms. Lastly, the fourth step of the model also resulted in a non-significant change $F\Delta$ (3, 45) = .771, $p = .552$, $R^2\Delta = .033$.

With all variables in the model, bilingualism did not interact with ER to predict anxiety symptoms.

**Table 16.** Regression for child anxiety symptoms with all ER predictors

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| **Step 1** | **.167** | **.167** | **5.528** | **.007** | | | |
| Gender | | | | | 3.509 | 2.090 | .093 |
| Other Psychopathology Symptoms | | | | | **4.129** | **1.767** | **.019** |
| **Step 2** | *.214* | *.047* | *.3.211* | *.079* | | | |
| Level of bilingualism | | | | | *.282* | *.157* | *.073* |
| **Step 3** | .277 | .063 | 1.492 | .230 | | | |
| Context Sensitivity | | | | | -9.583 | 12.393 | .439 |
| Strategy Repertoire | | | | | -.337 | .707 | .634 |
| LPP Strategy Implementation | | | | | *.304* | *.164* | *.064* |
| **Step 4** | .310 | .033 | .771 | .522 | | | |
| Level of bilingualism X Context Sensitivity | | | | | -2.028 | 1.525 | .184 |
| Level of bilingualism X Strategy Repertoire | | | | | .095 | .140 | .497 |
| Level of bilingualism X LPP Strategy Implementation | | | | | -.014 | .031 | .648 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

To follow-up on this model and further contextualize the role of bilingualism and ER on anxiety symptoms in childhood, additional regressions were carried out that included only one emotion regulation measure at a time. To explore the specificity of EF and ER relations, a measure of the most conceptually relevant executive functions construct for each facet of ER was also included in the model (the reasoning for each EF task is provided with the model with the relevant ER measure). Step 1 and 2 were identical to the first model. At step 3, only one ER measure was entered for each of these follow-up models. At step 4, the EF measure most conceptually relevant for the given ER measure was entered. At step 5, the interactions of bilingualism, ER, and EF were entered. For the following three models, only step three to five are described as these are the only two steps that changed from the general model to the more specific models (Table 17).

Context Sensitivity only. For this model a measure of cognitive flexibility was added as both represent an ability to modulate responses to external demands based on information and feedback from the environment (Table 17a). The third step of this model including only children's general context sensitivity resulted in a non-significant change to the model $F\Delta$ (1, 73) = .310, $p$ = .561, $R^2\Delta$ = .004. The fourth step of the model including the cognitive flexibility measure also resulted in a non-significant change $F\Delta$ (1, 72) = .100, $p$ = .794, $R^2\Delta$ = .001. Lastly, the fifth step of the model resulted in a significant change to the model $F\Delta$ (3, 69) = 3.931, $p$ = .022, $R^2\Delta$ = .124. The interaction of children's cognitive flexibility and bilingualism was marginal ($b$ = 2.400, $t$ = 1.825, 95% CI [-.196, 4.995]), whereas the interaction of cognitive flexibility and context sensitivity was significant ($b$ = 2.332, $t$ = 2.177, 95% CI [.231, 4.432]).

A closer look at the interaction between cognitive flexibility and context sensitivity (Figure 9) revealed that for children with low cognitive flexibility context sensitivity did not predict their anxiety symptoms ($b$ = .618, $t$ = .477, $p$ = .635), but for children with high cognitive flexibility higher context sensitivity was associated with fewer symptoms of anxiety ($b$ = -4.046, $t$ = -2.330, $p$ = .023).

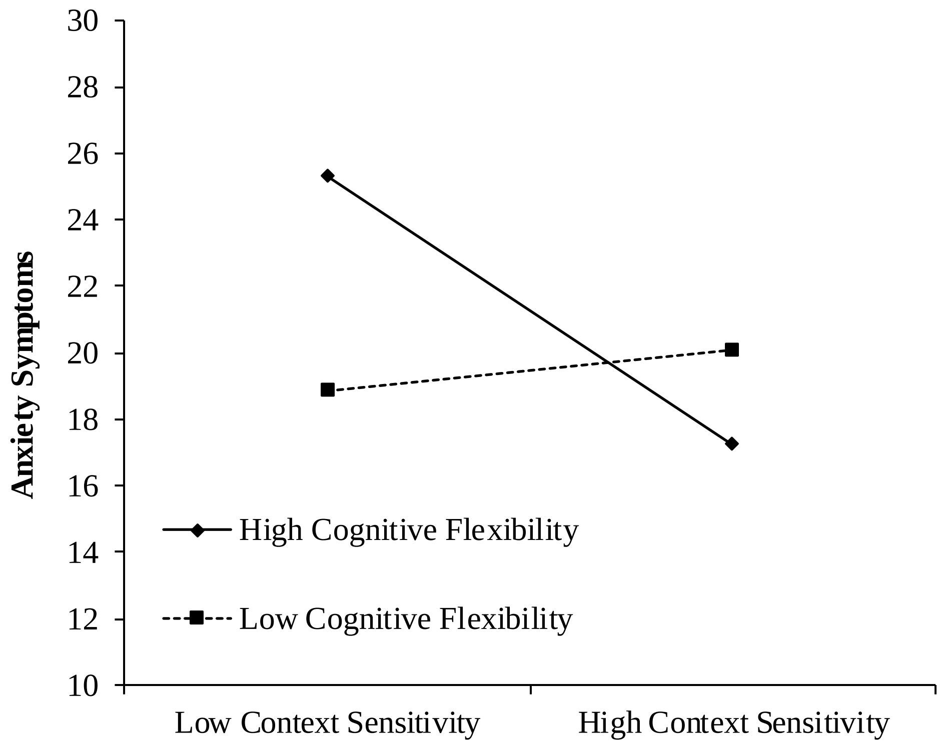


**Figure 9.** Interaction of context sensitivity and cognitive flexibility predicting anxiety symptoms.

A look at the marginal interaction between bilingualism and cognitive flexibility (Figure 10) revealed that for children with high cognitive flexibility bilingualism was not associated with their anxiety symptoms ($b$ = -2.074, $t$ = -1.632, $p$ = .107), but for children with low cognitive flexibility more balanced bilingualism was associated with more symptoms of anxiety ($b$ = 2.726, $t$ = 2.158, $p$ = .034).

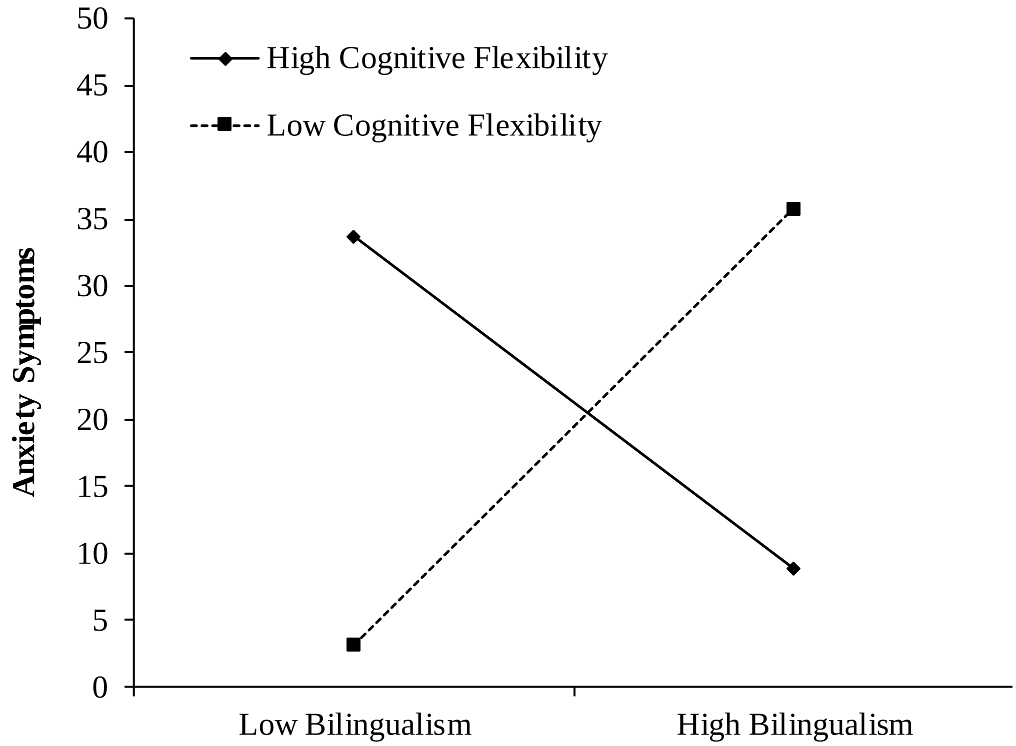


**Figure 10.** Marginal interaction of bilingualism and cognitive flexibility predicting anxiety symptoms.

Strategy Repertoire only. For this model a measure of working memory was added as these measures both represent an ability for meta-awareness that might be particularly relevant for children's ability to describe what they to do change how they feel (Table 17b). The third step of this model including only children's general strategy repertoire resulted in a non-significant change to the model $F\Delta$ (1, 73) = .077, $p$ = .840, $R^2\Delta$ = .001. The fourth step of the model including the working memory measure also resulted in a non-significant change $F\Delta$ (1, 72) = .113, $p$ = .757, $R^2\Delta$ = .001. Lastly, the fifth step of the model including the interactions resulted in a non-significant change to the model $F\Delta$ (3, 69) = 1.037, $p$ = .391, $R^2\Delta$ = .041.

Implementation only. For this model a measure of inhibitory control was added as both represent most clearly an ability to change a prepotent or already initiated response in the service of a goal. The third step of this model including only children's average LPP implementation resulted in a non-significant change to the model $F\Delta$ (1, 73) = 2.695, $p$ = .110, $R^2\Delta$ = .040. The fourth step of the model including the inhibitory control measure also resulted in a non-significant change $F\Delta$ (1, 72) = .014, $p$ = .919, $R^2\Delta$ < .001. Lastly, the fifth step of the model including the interactions also resulted in a non-significant change to the model $F\Delta$ (3, 69) = .198, $p$ = .897, $R^2\Delta$ = .009.

*Summary*. It was hypothesized that all three aspects of emotion regulation: context sensitivity, strategy repertoire, and strategy implementation would be associated with anxiety symptoms. Contrary to expectations, children's general strategy repertoire and strategy implementation as measured by the LPP did not predict anxiety symptoms. In line with hypotheses, greater context sensitivity was associated with fewer anxiety symptoms, but this was only true for children with high cognitive flexibility. Level of bilingualism did not moderate the effects of any of the emotion regulation variables on anxiety symptoms.

**Table 17.** Regressions for child anxiety symptoms by individual ER predictors

| | $R^2$ | $\Delta R^2$ | $\Delta F$ | p | b | SEb | p |
|---|---|---|---|---|---|---|---|
| *a. Context Sensitivity as predictor* | | | | | | | |
| **Step 3** | .229 | .012 | 1.045 | .310 | | | |
| Context Sensitivity | | | | | -.940 | .920 | .307 |
| **Step 4** | .230 | .001 | .100 | .794 | | | |
| Cognitive flexibility | | | | | -.127 | .954 | .894 |
| **Step 5** | **.354** | **.124** | **3.931** | **.022** | | | |
| Level of bilingualism X Context Sensitivity | | | | | 2.502 | 2.374 | .295 |
| Level of bilingualism X Cognitive flexibility | | | | | *2.400* | *1.315* | *.070* |
| Context Sensitivity X Cognitive flexibility | | | | | **2.332** | **1.071** | **.030** |
| *a. Strategy repertoire as predictor* | | | | | | | |
| **Step 3** | .218 | .001 | .077 | .840 | | | |
| Strategy repertoire | | | | | -.092 | .677 | .892 |
| **Step 4** | .219 | .001 | .113 | .757 | | | |
| Working memory | | | | | .110 | .354 | .756 |
| **Step 5** | .260 | .041 | 1.037 | .391 | | | |
| Level of bilingualism X Strategy repertoire | | | | | .012 | .136 | .932 |
| Level of bilingualism X Working memory | | | | | -.055 | .067 | .407 |
| Strategy repertoire X Working memory | | | | | -.310 | .291 | .288 |
| *a. LPP Strategy Implementation as predictor* | | | | | | | |
| **Step 3** | .257 | .040 | 2.695 | .109 | | | |
| LPP strategy implementation | | | | | .263 | .161 | .103 |
| **Step 4** | .257 | .000 | .014 | .919 | | | |
| Inhibitory control | | | | | -.003 | .061 | .961 |
| **Step 5** | .266 | .009 | .198 | .897 | | | |
| Level of bilingualism X LPP strategy implementation | | | | | -.012 | .034 | .732 |
| Level of bilingualism X Inhibitory control | | | | | .003 | .010 | .761 |
| LPP strategy implementation X Inhibitory control | | | | | .006 | .011 | .566 |

**Note.** Steps include variables in previous steps of the model; Results with imputed datasets; *Italics* = $p < .08$; **bold** = $p < .05$.

# CHAPTER 4

## Discussion

The current study used a comprehensive multi-level approach to understanding links between Hispanic children's bilingualism, emotion regulation, and symptoms of anxiety. It extends research on this topic by highlighting the complex and interactive nature of the relations between bilingualism, executive functions, emotion regulation, and anxiety for this population. A total of seventy-eight 8-11-year-old children were recruited from the Inland Empire area, a region with a predominantly Hispanic or part Hispanic population. These children are a representative sample of the children growing in this community and the issues they face. In this section, findings are discussed in depth as they pertain to children's developing emotion regulation, children's predictors of anxiety symptoms, and the developmental context that surrounds Hispanic children that might be linked to the emergence and maintenance of symptoms in this population, with an emphasis on bilingualism.

Results partially supported the study hypotheses and offer support for the importance of both executive functions and emotion regulation on Hispanic children's anxiety development. The first aim of the study was to explore the role of level of bilingualism on Hispanic children's executive functions. I hypothesized that more balanced bilingualism would be associated with better executive functions for all measures studied. Contrary to my hypothesis, level of bilingualism did not emerge as a clear protective factor for the executive functions measures used in the study, as it predicted more errors on the cognitive flexibility task and poorer accuracy on an inhibitory control task. The second aim of the study was to explore the role of level of bilingualism on Hispanic children's emotion regulation. I hypothesized that more balanced bilingualism would be associated with better context sensitivity and implementation of reappraisal, but that it would not matter for strategy repertories and implementation of distraction. As expected, level of bilingualism was associated with context sensitivity, but not with the implementation of distraction or with strategy repertoires. Contrary to expectations, however, bilingualism was not associated with the implementation of reappraisal. Lastly, the third aim of the study was to explore which aspects of emotion regulation (context sensitivity, strategy repertoires, and implementation) were associated with anxiety symptoms while also considering children's level of bilingualism. I hypothesized that all three aspects of emotion regulation would be important for understanding anxiety symptoms. Contrary to hypotheses, only context sensitivity emerged as a significant predictor of anxiety symptoms in this sample. These findings are discussed in more detailed below as they relate to anxiety development, emotion regulation, and bilingualism more broadly.

*Is level of bilingualism a protective or risk factor for this population?*

Although the current study hypotheses were focused on understanding children's level of bilingualism as a protective factor for Hispanic children, the patterns found in this study suggest a more complex relation between bilingualism and executive functions. At times, findings seemed to point to a more balanced bilingualism being negatively associated with some aspects of executive functions, as it was the case for inhibitory control and cognitive flexibility. The patterns that emerged in the data, however, suggest a more complex relation than bilingualism being merely a protective or risk factor for this group. For example, although level of bilingualism was not associated with conflict resolution in the regression models, it was associated with conflict resolution in correlations and in the expected direction (i.e., more balanced bilingualism was associated with better conflict resolution). The fact that this pattern was not present in the regression models points to other aspects of Hispanic children's experiences being, perhaps, more important for understanding their performance on this task (e.g., their age).

This lack of a consistent protective effect was surprising as previous studies with Spanish-English bilingual families from low SES contexts (i.e., a similar sample to the one included in this study), have found an advantage of level of bilingualism on aspects of executive functions such as working memory and conflict resolution (Thomas-Sunesson, Hakuta, & Bialystok, 2016). However, the lack of clear benefits for inhibitory control is not surprising as other studies have also failed to find an advantage for inhibitory control tasks (Carlson & Meltzoff 2008; Engel de Abreu et al. 2012; Martin-Rhee & Bialystok 2008).

The lack of a benefit for working memory and conflict resolution here might have something to do with the type of task/trials used for analyses. For example, the current study used a simple Corsi task to assess working memory, but other studies looking at working memory advantages in bilingual children have often used more complex tasks that could be broken down into multiple ways of conceptualizing working memory (e.g., Thomas-Sunesson, Hakuta, & Bialystok, 2016), something the current data did not allow. In terms of conflict resolution, it is possible that the effect could be present only on the hard trials (additional to the typical congruent and incongruent trials, the task also had “normal” and “hard” trials), and that this was not reflected in the general measure of accuracy and reaction times that were used for the current analyses.

Exploration of the patterns in the executive function models by breaking down this bilingualism variable into its two fluency components revealed that this is particularly true for children who had less English fluency. These findings are consistent with smaller English fluency in bilinguals being associated with adverse outcomes (Ren, Wyver, Rattanasome, & Demuth, 2015). The finding that greater Spanish fluency was sometimes related to negative outcomes (e.g., greater bias toward threat) supports findings from a study which found that greater Mandarin skills in English-Mandarin bilingual preschoolers were associated with more internalizing symptoms (Ren, Wyver, Rattanasome, & Demuth, 2015). It is important to note, however, that these findings stand in contrast with other studies that have found benefits of higher skills in the non-dominant language on children’s well-being (Bialystok & Martin, 2004; Han & Huang, 2010).

Elaborating on this point, a closer look at the results from the inhibitory control accuracy model, as well as the cognitive flexibility and attentional bias models offers some insight into how vital children’s fluency in their dominant language or at least their language of instruction (i.e., English) was for performance on these tasks. Throughout the analyses, it was clear that rather than their fluency in Spanish, it was their fluency in English what drove many of the findings. For example, in the case of cognitive flexibility, analyses with the level of bilingualism variable suggested that more balanced bilingualism was associated with making more perseverative errors (i.e., less cognitive flexibility), however, a look at the model with the fluency measures revealed that it was children's English fluency what predicted their cognitive flexibility, with smaller English fluency being associated with more perseverative errors. This makes sense, as a smaller English fluency could be signaling other academic and resource-related issues that these children might be experiencing that can potentially affect the development of their executive functions. A look at the attentional bias accuracy model offers some support for this point. Whereas Spanish fluency was not associated with accuracy on this task for children with high English fluency, it was for children with low English fluency. For children who showed low English fluency, high Spanish fluency was associated with poorer accuracy on this task. Rather than thinking of bilingualism (or access to Spanish words) as being harmful for these children, what these findings seem to suggest is that there is a problem with being unequally able to access words in the dominant language (i.e., English) and their heritage language (i.e., Spanish). This makes sense, as children with smaller English fluency scores but larger Spanish fluency scores might be experiencing some adjustment problems and even some anxiety from not being able to perform as expected in their language of schooling.

These issues are further complicated by how the bilingualism variable was computed. The level of bilingualism variable was calculated as an absolute difference between the two languages, thus, children who were both low in Spanish *and* English fluency would have a high bilingualism score, just like the children who said many words in both languages. There is, however, something that might be qualitatively different about these children compared to children who had greater fluency in one language but not the other that was not reflected in the way the bilingualism variable was calculated. For example, it is possible that the benefits of bilingualism are stronger for children who have greater fluency in both languages, or children who have a slightly larger fluency in English but are still able to produce multiple words in Spanish. A theoretical reason for this is that children with greater fluency in both languages access both of their languages more often, which in turn results in more practice shifting between the languages and inhibiting the language that is not being used at the time. In practice, children with greater Spanish fluency compared to their English fluency might show more negative effects from their bilingualism as their discrepant performance between the two languages might be clashing with what is expected from them in academic settings and in society more broadly. This, of course, should be more carefully studied in future work.

An alternative explanation for the current results could be that bilingual children in this study were more deliberate and careful in the way they processed information. Rather than thinking about their bilingualism as being associated with poorer performance on these tasks, these results could also be interpreted as children being more cautious in the way they responded to environmental demands. An example of this would be the results of the reaction time model for inhibitory control. In this model, more balanced bilingualism was associated with longer reaction times, suggesting that bilingual children were more careful in the way they responded to the task. Given that they had a limited amount of time to respond, it is not surprising that in the accuracy model, more balanced bilingualism was marginally associated with poorer accuracy, as these children would have missed the window to give a response if they considered their options too thoroughly. This alternative explanation should be more carefully considered in future studies as it might help understand in which ways bilingualism is beneficial (or not) for children's information processing.

*Emotion regulation development and its links to anxiety symptoms*

Current research on emotion regulation is moving towards understanding more complex emotion regulation processes that could better predict emergence and maintenance of psychopathology (e.g., Dixon-Gordon, Aldao, & De Los Reyes, 2015). For instance, exploration of children's strategy repertoires as an index of children's difficulties accessing their emotion regulation tools in the context of psychopathological symptoms (i.e., strategies children are aware of; Quiñones-Camacho & Davis, 2018). But, much research on this topic in childhood has focused on emotion regulation as a broad concept mainly pertaining to children's apparent calmness during a negative event (e.g., Wirtz, Hofmann, Riper, Berking, 2004), and this does not adequately address the vast growth in emotion regulation that happens throughout childhood. During childhood, children must learn that there are many things one can do to change how one feels about a negative event (e.g., think about something else). They must learn, as well, that some of these things will be more effective in some contexts than others (e.g., when one feels sad about a toy breaking vs. when an unleashed dog is barking at you). As children become more sensitive to contextual demands, they become more effective at choosing strategies that will best aid them in changing how they feel.

But, of course, understanding which strategy might meet the contextual demands at hand is not the same as being able to deploy these strategies effectively. Thus, much more research is necessary to understand how all aspects of emotion regulation are developing through childhood to culminate in effective agentic emotion regulation. To further our understanding on this topic, my dissertation focused on three aspects of children's emotion regulation ability: their context sensitivity, their repertoire of strategies, and their ability to implement emotion regulation strategies. This, on its own, is an advancement over previous studies that have only focused on general measures of emotion regulation, or on implementation at the most. A particularly novel approach taken in this dissertation study is the use of a "context sensitivity" measure. This idea of context sensitivity draws on regulatory flexibility work (i.e., Bonanno & Burton, 2013) that theorizes someone's ability to evaluate contextual demands and opportunities as an essential initial step for effective regulatory flexibility. For this, a set of putatively adaptive strategies for each context (i.e., by considering the emotion being elicited *and* what kind of situation it was) were selected from 10 strategies children could endorse using during a similar event. These strategies were chosen based on previous work on the types of strategies children preferentially use in particular emotional contexts (e.g., Davis et al., 2010; Waters & Thompson, 2014) and broader views of what should work best in some contexts than others (e.g., Webb, Miles, & Sheeran, 2012). By choosing only strategies the children said they were very likely to use, I was able to get a proxy for the kind of regulatory choices children *might* make in a similar situation. Extending research on children's knowledge of emotion regulation strategies (e.g., Dennis & Kelemen, 2009; Waters & Thompson, 2014), children in the current study showed a better ability to select strategies based on contextual demands for anger compared to sadness (e.g., choosing problem-solving for anger rather than for sadness) and for fear rather than for sadness (e.g., choosing to calm themselves down for fear rather than for sadness).

Findings from this study also extend previous work by highlighting the importance of children's biases in emotional selective attention as an important predictor of their context sensitivity. Better accuracy on an emotional selective attention task was associated with better context sensitivity broadly, as well as with better context sensitivity for sadness specifically. This is a stimulating finding as children's ability to manage their attention during an emotional attention task efficiently might indicate a child's ability to more readily understand emotional contextual demands and respond accordingly while effectively inhibiting unnecessary emotional information in the environment. Furthermore, this link between emotional attention and context sensitivity was moderated by children's level of bilingualism, such that the pattern described above was stronger for less balanced bilinguals. For children who were more balanced bilinguals, on the other hand, their ability to correctly respond to a task aimed at assessing biases in attention to emotional stimuli was a less important predictor of their context sensitivity. This is a highly novel finding, and although it needs further confirmation with other studies, it offers provoking evidence of the role of children's bilingualism on their emotional development. It is possible that more balanced bilinguals are better able to identify contextual demands and choose responses according to these contextual demands and are, thus, less affected by irrelevant emotional information. Findings for the anger context sensitivity measure somewhat confirm this, as more balanced bilingualism was associated with better context sensitivity for anger.

Regarding children's emergence of psychopathological symptoms, there are many aspects of emotion regulation development that could relate to anxiety and related psychopathologies. Findings suggest that when it comes to Hispanic children's anxiety symptoms, children's understanding of what strategies are most appropriate for a given emotion is a particularly significant predictor of anxiety symptoms, at least for this group of children. Studies looking at the association between symptoms of anxiety and emotion regulation have often found that children with high anxiety symptoms tend to describe less adaptive strategies they believe they can use to change how they feel about a negative event (Carthy, Horesh, Apter, & Gross, 2010). Although this dissertation did not focus on the specific strategies being described, but on children's understanding that the effectiveness of emotion regulation strategies is constrained by contextual demands, the current findings are consistent with the idea that more symptoms of anxiety are associated with a decreased ability to know which strategies will be most effective in different contexts.

It is important to note, however, that contrary to the study hypotheses, only context sensitivity was related to anxiety symptoms, whereas strategy repertoires and strategy implementation were not, at least in the regression models. In bivariate correlations, greater difficulty implementing an emotion regulation strategy *was* associated with more anxiety symptoms, but when all other variables were included in analyses, this pattern was no longer significant. Thus, rather than no relation at all between strategy implementation and anxiety symptoms, it seems that this association was obscured by other aspects of children's experience that were more important for their anxiety symptoms (as their symptoms of other psychopathologies were).

It is thought-provoking that I did not find that strategy repertoires were associated with anxiety symptoms in this sample, as I have found similar associations in other samples (Quiñones-Camacho & Davis, 2018). However, there are some critical differences between these two studies that might explain why the effect was there for one sample but not the other. In the previous study (Quiñones-Camacho & Davis, 2018), I focused on the adaptive fear repertoire only (not the general repertoire measure used in this study), moreover, the main effect of strategy repertoire in that study was also not significant. Instead, an interaction of age, resting RSA (i.e., a trait measure of regulatory capacity), and strategy repertoire interacted to predict anxiety symptoms. In that study, a larger repertoire was associated with fewer symptoms only for older children with high resting RSA, thus, it is possible that if similar measures were available in the current study, that a similar pattern would have emerged. But, given that these data are not available, it is not possible to conclude whether the same effect would be present or not in this study.

It is particularly interesting that the effects of context sensitivity on anxiety were moderated by children's cognitive flexibility, such that more cognitive flexibility was associated with fewer anxiety symptoms only for children with high cognitive flexibility. The idea that cognitive biases are associated with anxiety symptoms is not new, and previous studies have shown that cognitive difficulties in the form of underestimation of the ability to cope with ambiguous situations and maladaptive cognitions centered on the overestimation of danger are common in childhood anxiety (Bogels & Zigterman, 2000). Thus, more research is necessary to understand the constraints on this cognitive-emotional inflexibility that might be a particularly important predictor of anxiety in childhood. It is possible that advanced cognitive flexibility abilities are a necessary precursor for proficient context sensitivity, but this has not been explicitly tested in past studies. If this is true, it would explain why children who were low in cognitive flexibility showed no benefit from showing better context sensitivity. Moreover, it is possible that greater cognitive flexibility might influence implementation partially through greater context sensitivity, but this idea should also be tested in future studies. In the current study, children were constrained to implement a strategy (i.e., distraction or reappraisal) independent of their actual ability to implement that strategy or their view of how appropriate that strategy would be for the given contexts. This constrains the interpretation of the current findings, as differences between what children choose to do (i.e., selected strategy) and what children are told to do (i.e., instructed strategy) should be important for our understanding of strategy use as it relates to the emergence and maintenance of symptomatology.

The findings from this study extend previous research by showing how cognitive flexibility interacts with an understudied aspect of emotion regulation (i.e., context sensitivity) to better explain anxiety symptomatology in Hispanic children. These findings are promising as context sensitivity is an aspect of emotion regulation that can be easily integrated into intervention efforts that already target emotion regulation like the use reframing (DeWitte, Sutterlin, Braet, & Mueller, 2017; Renna, Seeley, Heimberg, Etkin, Fresco. & Mennin, 2017). These findings also offer support to these intervention efforts by highlighting other aspects of emotion regulation strategy knowledge and use that are also linked to symptomatology in childhood.

*Anxiety symptoms in Hispanic children: A problem often overlooked?*

It is now recognized that minority children have life experiences that are meaningfully different to non-minority children and that this often results in heightened symptoms of psychopathology (Anderson & Mayes, 2010; Ginsburg & Silverman, 1996; McLaughlin, Hilt, & Nolen-Hoeksema, 2007; Pina & Silverman, 2004). But, few studies have genuinely focused on exploring symptomatology in minority children, specifically Hispanic children, and most of what we know about symptomatology in this population is a product of secondary analyses of data from studies that were not aimed at studying these specific populations (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). This is a problem, as these types of studies are inherently limited in what they can say about precursors and protective factors for these groups. Thus, much more research is necessary to understand how Hispanic children's life experiences might influence the development of psychopathology in late childhood. The current study is an improvement over previous studies by focusing exclusively on Hispanic children and exploring multiple internal (e.g., EF) and external factors (e.g., parental psychopathology) that might predict anxiety symptoms in this population.

Previous research on psychopathological symptoms in Hispanic children has shown that Hispanic children often report more anxiety symptoms than non-Hispanic children (Ginsburg & Silverman, 1996; Pina & Silverman, 2004; Varela et al., 2004). These effects are particularly marked for females, who tend to report the highest levels of symptoms across all ethnic groups, especially for global anxiety symptoms and physical symptoms of anxiety (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). The findings from this dissertation study are consistent with previous research. An impressive 50% of the children who participated in this study self-reported levels of anxiety high enough to be diagnosed with an anxiety disorder. Even when combining child report with parental report (parents reported their children, on average, as having less anxiety compared to how the children rated themselves) over 30% of the sample still showed heightened levels of anxiety. This number is well above epidemiological and cohort studies in the US, which often report a prevalence of 5-15% for disorder level symptoms of anxiety in children and adolescents (e.g., Heimberg, Stein, Hiripi, & Kessler, 2000).

A comparison between the means for boys' and girls' anxiety symptoms in the current sample confirmed that the girls in the sample were particularly affected, as they showed significantly more symptoms than the boys. Again, these findings are consistent with previous studies suggesting that Hispanic females are at a particularly high risk of experiencing anxiety symptoms. When paired with findings on how boys showed better context sensitivity to fear, the results from this dissertation suggest that Hispanic girls are at a heightened risk of experiencing debilitating mental health issues in adolescence and adulthood. Although not directly explored in this dissertation, it is possible that these maladaptive trajectories might be increased by difficulties in understanding contextual demands and modifying regulatory responses to fit these demands. These results further support views of Hispanic girls being a group that needs to be more carefully targeted in prevention and intervention efforts and the current study offers one possible way through which this can be done, namely, by increasing children's emotion regulation context sensitivity.

**Limitations and Future directions**

While the findings from this dissertation extend research on Hispanic children's anxiety development and bilingualism's role in shaping executive functions and emotion regulation, some limitations should be noted. First, as often happens with research focused on children from specific ethnic groups, the current sample is small, limiting the power to test more complex interactions that might better predict children's anxiety, such as an interaction between children's bilingualism, children's SES, and their context sensitivity. This is particularly salient when looking at analyses that include the LPP measures, as there was some significant loss of electrophysiological data. Although loss of this type of data is very common in studies with children, it still reduced the ability to test more complex models. Despite this limitation, some interesting patterns emerged, such as cognitive flexibility emerging as an important moderator for the effect of context sensitivity on child anxiety symptoms.

Another limitation pertains to the cross-sectional nature of the study. This is important to consider as the cross-sectional nature of the data limits what can be said about the directionality of these effects. For example, although in the current study context sensitivity was hypothesized as a predictor of anxiety, it is possible that some children show poorer context sensitivity because of their symptoms, and not the other way around. Nevertheless, given the unique nature of the sample recruited for this study, these findings still represent a meaningful progress in our knowledge of how bilingualism, executive functions, and emotion regulation relate to anxiety symptoms in Hispanic children.

Lastly, although, to my knowledge, the implementation task used here is the first late positive potential (LPP) task used to assess Hispanic children's emotion regulation and the first to use distraction in children, several aspects of this task constrain what can be said about children's strategy implementation. First, given the short stimuli presentation time, it might have been too difficult for children to implement the given strategies in the time given. This is not surprising, however, as other studies have failed to find effects of emotion regulation strategies on the LPP using similar tasks with a similar age range (e.g., DeCicco, O'Toole, & Dennis, 2014). Longer presentation times or different psychophysiological measures (e.g., RSA) might be better suited to test implementation in childhood. Secondly, studies on strategy implementation have greatly focused on instructed emotion regulation, but by age 8 (the youngest children in this sample) children can independently deploy strategies without external instructions. Although harder to assess, it is likely that greater focus on this aspect of implementation will offer important knowledge on the development of agentic emotion regulation and its link to anxiety and related disorders.

There are many ways in which these findings could be extended or clarified. For example, for the analyses described in this dissertation, only one type of fluency was considered. It is possible that when it comes to emotional outcomes, a measure of bilingualism that better reflects children's knowledge of emotional words would be more informative. Thus, future work could explore different conceptualizations of bilingualism and how they differentially relate to emotional outcomes. Additional to bilingualism being able to be conceptualized in many ways, it is also true that there are different types of bilinguals (e.g., highly fluent in both languages, more fluent in heritage language, not fluent in both languages) and that these groups probably differ in ways that might help explain why bilingualism relates (or does not relate) to cognitive and emotional outcomes for each group. Thus, an extension of the current work would be to test differences across these groups of bilinguals as this might help clarify for whom bilingualism is most protective.

Furthermore, there is some evidence that the benefits of bilingualism are specific to more cognitively demanding tasks, thus, future studies should explore the role of bilingualism in these more advanced forms of executive functions. For example, there is evidence that bilingual children outperform monolingual children on hard or more complex trials, but not necessarily on easier trials. Future studies should better explore the nuances in these relations to identify the boundaries of the link between bilingualism and cognition.

Although Hispanic children are at a particularly high risk of experiencing symptoms of anxiety, they also tend to show higher symptoms of other internalizing and externalizing disorders, such as depressive symptoms. In the current study, for example, 37% of children self-reported having meaningfully significant depressive symptoms (scale cutoff is 15, 29 children had a score of 15 or higher). Thus, a better understanding of the emergence of depressive symptoms and related disorders is necessary, as well as a better understanding of comorbidity of symptoms in this population. This is especially true for Hispanic females entering puberty, as adolescent Hispanic girls show markedly higher suicidal ideation and attempts than any other group (McLaughlin, Hilt, & Nolen-Hoeksema, 2007). Therefore, future studies should aim to explore the role of these factors on children's symptoms of depression and other internalizing psychopathologies, especially for girls.

**Conclusion**

Findings from the current study represent an important step towards deepening our understanding of emerging anxiety in Hispanic children. They extend our knowledge on this topic by highlighting the importance of cognitive flexibility and emotion regulation context sensitivity on anxiety symptoms. Studies on emotion regulation and anxiety in childhood have often ignored the growing population of Hispanic children who are at an increased risk of experiencing anxiety and related disorders. This dissertation is an essential step towards understanding how Hispanic children's development of emotion regulation abilities influence anxiety symptoms in this population by pointing at context sensitivity as a particularly important aspect of emotion regulation for understanding symptoms in this group.

Although the small sample and other methodological limitations constrain the interpretation of the findings, this study is still valuable to developmental research in multiples ways. For example, studies often limit their assessment of emotion regulation to parent-report or one type of self-report at the most. This study used behavioral, physiological, self-report, and parent report of emotion regulation, making the study a truly comprehensive look into children's developing emotion regulation. Additionally, studies looking at anxiety often use white/Caucasian samples even when there is research to show that other ethnic groups, like Hispanics, are at a higher risk of experiencing these disorders. The current study focused exclusively on Hispanic children to better identify factors that might influence the development of symptoms in these children.

As the population of Hispanic children and adolescents continues to grow, it is imperative that research moves to focus on how their life experiences impacts their developmental trajectories, and what aspects of their context might explain why these children are at an increased risk of experiencing clinically significant symptoms of anxiety and other internalizing disorders. Moreover, as the number of bilingual children continues to increase in the US, it will also be necessary to more thoughtfully consider how the experience of managing two languages and the cultural aspects associated with these languages might be shaping children's development beyond the usually studied aspects of cognition. This study is a step in that direction.

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## Appendix A

**Appendix A1:** Modified version of the Bilingual Switching Questionnaire (BSWQ; English version can be found after Spanish version). The original questionnaire was used to assess code-switching in Catalan-Spanish speakers (Rodriguez-Fornells et al., 2012).

### BSWQ SPANISH VERSION

Trate de contestar en qué medida las siguientes preguntas representan o se ajustan a su forma de hablar y expresarte en los idiomas que conoce (p. ej., Inglés-Español), en términos generales. Muchas de estas preguntas hacen referencia a si usted cambia o mezcla frecuentemente el inglés y el español en sus conversaciones. Cambiar o mezclar leguajes es una característica muy particular de algunos entornos bilingües, como es el caso en el sur de California. El siguiente cuestionario pretende investigar sobre dichos hábitos de cambio y mezcla de lenguas. Si tiene dudas sobre algunas respuestas, intente comparar su forma de hablar y expresarte con el de la mayoría, o de las personas que conoce bien.

1. Me faltan o no recuerdo algunas palabras en INGLES cuando estoy hablando en dicho idioma.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

2. Me faltan o no recuerdo algunas palabras en ESPANOL cuando estoy hablando en dicho idioma.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

3. Tiendo a mezclar idiomas durante una conversación (por ejemplo, cambio de español a inglés o a la inversa).

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

4. Cuando no me sale una palabra en INGLES, tiendo a producirla inmediatamente en ESPANOL.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

5. Cuando no me sale una palabra en ESPANOL, tiendo a producirla inmediatamente en INGLES.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

6. Cuando cambio de idioma (p. ej., de inglés a español) o los mezclo, no me doy cuenta de que lo estoy haciendo y suelen ser los otros los que me lo dicen.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

7. Cuando mezclo un idioma lo hago conscientemente.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

8. Me resulta difícil controlar los cambios de idioma que introduzco ([, ej., de inglés a español) a lo largo de una conversación.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

9. Sin quererlo, a veces me sale primero la palabra en ESPANOL cuando estoy hablando en INGLES.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

10. Sin quererlo, a veces me sale primero la palabra en INGLES cuando estoy hablando en ESPANOL.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

11. Hay situaciones en las cuales siempre mezclo dos idiomas.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

12. Hay asuntos o temas sobre los cuales suelo hablar mezclando ambos idiomas.

☐ Nunca ☐ muy raramente ☐ ocasionalmente ☐ frecuentemente ☐ siempre

POR FAVOR, COMPRUEBE SI HA RESPONDIDO A TODAS LAS PREGUNTAS

**BSWQ ENGLISH TRANSLATION**

Please, try to answer to what degree the following questions are representative of the manner you use to talk or speak in the languages you know (e.g. English-Spanish). Many of these questions ask you to report your tendency to switch or mix languages during a conversation. Switching and mixing languages is a characteristic of some bilingual contexts of environments, as in Southern California. The present questionnaire aims to identify the language switching patterns that exist in these languages. If you have doubts about how to rate yourself on the following questions, please try to compare your manner of speaking and talking with that of most people, or those whom you know very well.

1. I do not remember or I cannot recall some English words when I am speaking in this language.

☐never ☐very infrequently ☐occasionally ☐frequently ☐always

2. I do not remember of I cannot recall some Spanish words when I am speaking in this language.

☐never ☐very infrequently ☐occasionally ☐frequently ☐always

3. I tend to switch languages during a conversation (for example, I switch from Spanish to English or vice versa).

☐never ☐very infrequently ☐occasionally ☐frequently ☐always

4. When I cannot recall a word in English, I tend to immediately produce it in Spanish.

☐never ☐very infrequently ☐occasionally ☐frequently ☐always

5. When I cannot recall a word in Spanish, I tend to immediately produce it in English.

☐never ☐very infrequently ☐occasionally ☐frequently ☐always

6. I do not realize when I switch the language during a conversation (e.g., from English to Spanish) or when I mix the two languages; I often realize it only if I am informed of the switch by another person.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

7. When I switch languages, I do it consciously.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

8. It is difficult for me to control the language switches I introduce during a conversation (e.g., from English to Spanish).

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

9. Without intending to, I sometimes produce the Spanish word faster when I am speaking in English.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

10. Without intending to, I sometimes produce the English word faster when I am speaking in Spanish.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

11. There are situations in which I always switch between the two languages.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

12. There are certain topics or issues for which I normally switch between the two languages.

☐ never ☐ very infrequently ☐ occasionally ☐ frequently ☐ always

PLEASE, CHECK IF YOU HAVE ANSWERED ALL THE QUESTIONS

**Apendix A2.** Modified version of the Language and Social Background Questionnaire (LSBQ). The questionnaire was further modified to include a parent version (of themselves) and a child version that were both completed by the parent. The original questionnaire was used to assess bilingualism in a Canadian sample (Luk & Bilystok, 2013).

**Language, Social and Background Questionnaire (LSBQ)**

1. Subject ID: ___________________________
2. Today's date:___________________________

3. Sex: M F 4. Hand: L R

5. Dates of Birth: ________________________

6. On average, how many hours do you spend on a computer every day? ________

7a. Do you play video games? Yes No

b. If yes, how many hours do you play in a week?
___________________________________________

8. Do you speak any languages in addition to English? If yes, please specify the language(s)

_______________________________________________________________________

9. Do you need to speak/read/write in the non-English language everyday? Yes No

10. Have you ever lived in a place where the non-English language is the dominant communicating language? Yes No

11. If yes, where and for how long?
_________________________________________________

12. Were you born in California? Yes No (If yes, skip Q. 13)

13a. If No, where were you born?
_____________________________________________________________

b. When did you first move to California?
____________________________________________________

14. What is the first language that you have acquired?
_____________________________________

15. What is the second language that you have acquired?

___________________________________

16. What is your dominant language for the last 5 years?

___________________________________

17a. Do you speak any other language(s)? Yes No

b. If yes, what are the language(s)?

_________________________________________________________

18. Where di you learn your second language? Home School Community

19a. At what age did you first start **learning** your second language **informally at home**? ___________

19b. At what age did you first start **learning** your second language **formally at school**?

_______________

19c. At what age did you first start **using** your second language actively?

________________________________

In each of the scales below, indicate the proportion of use for English and your other language in **daily life**. These scales are set up for different activities at home or at school. On one end of the scale, you have 100, which indicates that the activity in that environment is carried out in ALL ENGLISH. On the other end, you have 0, which indicates that you do not use English at all to carry out the activity.

**At Home**

20.a Speaking 0 100

__________l___________l__________l_________

No English All English

20b. Listening 0 100

__________l___________l__________l_________

No English All English

20c. Reading

0 100

___________l___________l__________l_________

No English All English

20d. Writing

0 100

__________l___________l____________l________

No English All English

20e. Watching TV

N/A 0 100

__________l___________l__________l_________

No English All English

20f. Listening to radio

N/A 0 100

__________l___________l__________l_________

No English All English

**At School**

21a. Speaking

0 100

__________l___________l__________l_________

No English All English

21b. Listening

0 100

__________l___________l__________l_________

No English All English

21c. Reading

0 100

__________l___________l__________l_________

No English All English

21d. Writing

0 100

__________l___________l__________l_________

No English All English

Relative to a native speaker's performance, rate your proficiency level in a scale of 0 – 100 for the following activities conducted in your first and second language.

Language #1:_____________________________ (please indicate)

22a. Speaking

0 100

__________l___________l__________l_________

Non-native-like Native-like

22b. Understanding (Comprehension)

0 100

__________l___________l__________l_________

Non-native-like Native-like

22c. Reading

0 100

__________l___________l__________l_________

Non-native-like Native-like

22d. Writing

0 100

__________l___________l__________l_________

Non-native-like Native-like

Language #2: ______________________________ (please indicate)

23a. Speaking

0 100

__________l___________l__________l_________

Non-native-like Native-like

23b. Understanding (Comprehension)

0 100

__________l___________l__________l_________

Non-native-like Native-like

23c. Reading

0 100

__________l___________l__________l_________

Non-native-like Native-like

23d. Writing

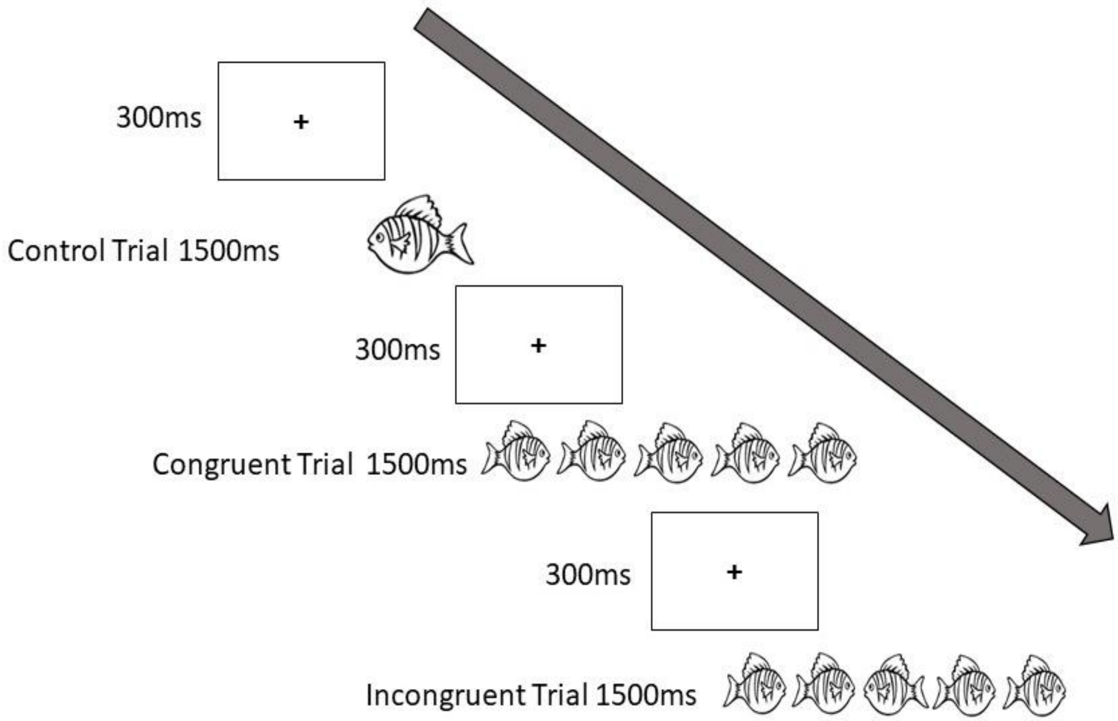
0 100

__________l___________l__________l_________

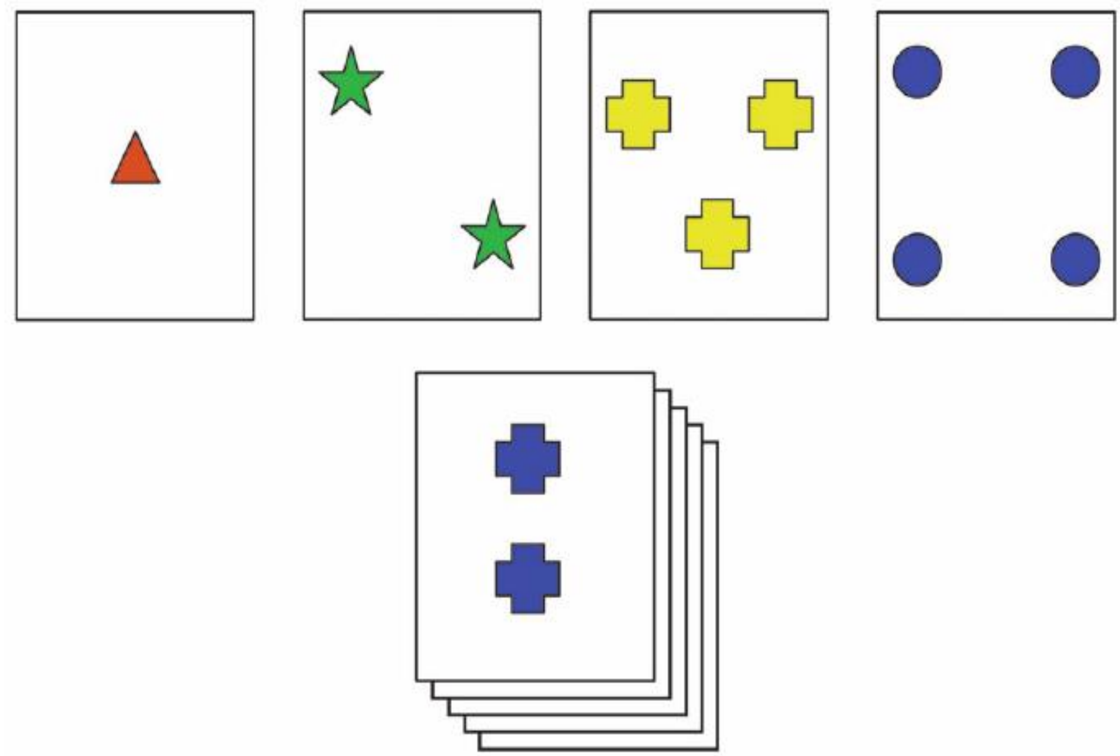
Non-native-like Native-like

**Appendix B**

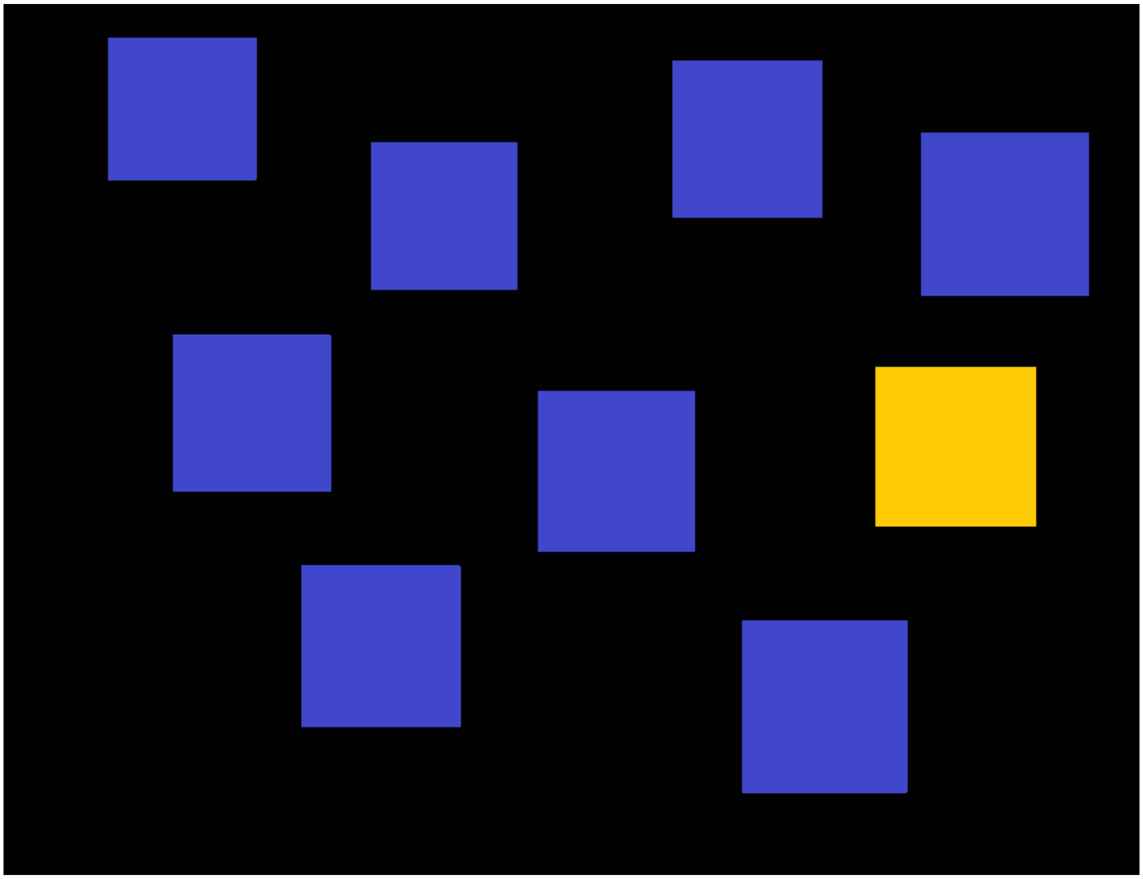
**Appendix B1**. Examples of all three different trial types on the EF Flanker task.



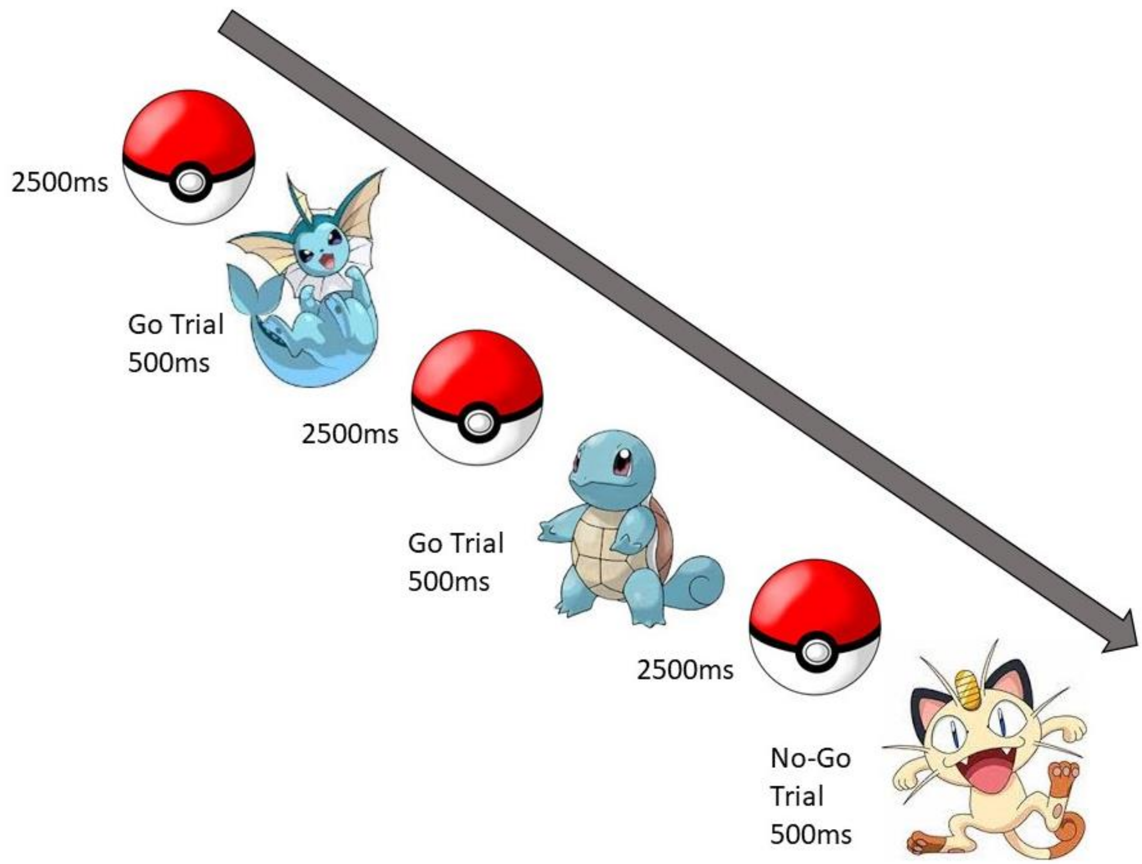
**Appendix B2.** Wisconsin Card Sorting Task (image taken from Jonides & Nee, 2005). Participants are given a rule before they start sorting cards (e.g., sort by color) and are then asked to sort 10 cards, after which the rule changes (e.g., sort by shape).



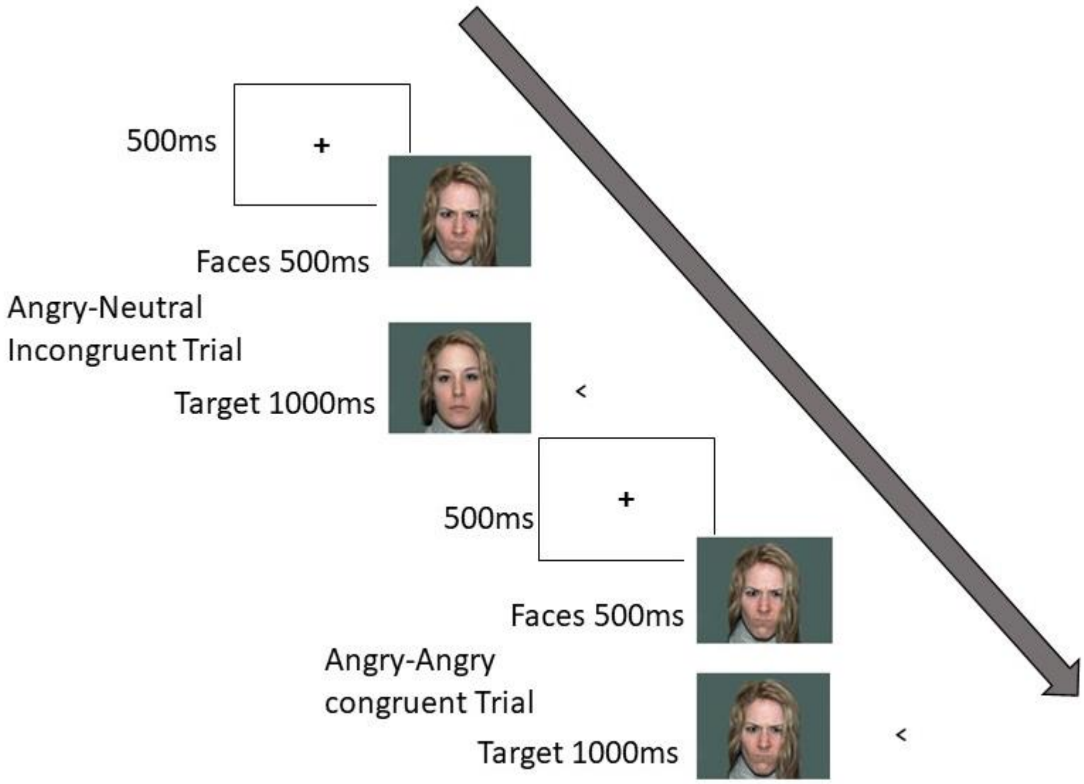
**Appendix B3.** Corsi working memory task. Participants are asked to repeate an increasingly complex sequence of lighting blocks.



**Appendix B4.** Example of a sequence of trials during the Go/No-go EF task. Children saw a total of 75 trials and pokéballs precede each trial.



**Appendix B5.** Example of a sequence of trials during the Dot Probe task. Children will see a total of 120 trials, 40 angry-angry, 40 angry-neutral, and 40 neutral-neutral.



## Appendix C

**Appendix C1.** Emotion Regulation Strategy Coding for the Autobiographical Emotion Interview. A similar version of this coding scheme has been previously used in our lab for the same task.

| **Strategy** | **Definition** | **Example** |
|---|---|---|
| **1. Problem-solving** | • Child takes action to solve the initial problem (the negative situation or event that the child has described). | • I thought about different ways to get my grades up in language arts.<br>• I turned on the light. |
| **2. Changing Thoughts** | • Child changes thoughts to try to feel better after emotional event. | |
| **a. Cognitive Reframing** | • Thinking about the event in a different way that will make it less negative/more positive. Could be thinking about the event in a more positive light or thinking about how the event is not that important. | • Think about the good things.<br>• Knew it was going to be over soon, like a week.<br>• I thought about how no one was going to scare me.<br>• I tried to think it was morning already. |
| **b. Cognitive Distraction** | • Thinking about something else. | • I thought about ice cream (when event did not involve ice cream). |
| **c. Thought Suppression** | • Trying not to think about the situation, not thinking about it. | • I just didn't think about it.<br>• I tried not to think about how my mom would be mad if I didn't clean my room. |
| **d. Sleep/Change Mental State** | • When a change in mental state is described (e.g., going to sleep). | • I took a nap<br>• I closed my eyes<br>• Tried to sleep |
| **e. Imagined/Wished For Social Support** | • Imagining there is social support or wishing for it to make oneself feel better. | • I thought someone was sleeping right next to me.<br>• I thought that he was here with me. |

| | | |
|---|---|---|
| **f. Calm down** | • Describing self-talk meant to calm down | • Told myself to calm down<br>• Told myself to breath |
| **g. Rumination** | • Describing continuously thinking about the negative event | • I kept thinking about them, that's why I couldn't sleep. |
| **3. Changing Goals** | • Instead of reinstating the goal (as under problem solving) this is indicated by a change in goal. | |
| **a. Goal Substitution** | • Deciding, achieving, or doing something that replaces the first goal with another goals that was presumably interfered with by the negative event/emotion. | • I just try and play all by myself and don't play with nobody else because everyone else was too scary.<br>• I played with my friends that go to my school. |
| **b. Goal Forfeit** | • Giving up on a goal. | • I sucked at soccer tryouts. I decided not to play anymore. |
| **c. Behavioral Distraction** | • Getting involved with/playing with/doing something else unrelated to the emotional event described. | • I played soccer.<br>• I made funny faces.<br>• I went home. I took my toys and did puzzles.<br>• I went to the restroom. I played with my toys. |
| **d. Avoidance/Withdrawal** | • Child describes leaving the situation to feel better | • I just walked away |
| **4. Social Support** | • Child describes seeking, getting, or receiving social support (e.g., from a friend, parent, pet, animal). | |
| **a. Sought** | • Child seeks out, asks for, or takes action to get social support. | • I told my friends about it.<br>• I told my mom and my mom told me she would get me something. |
| **b. Received** | • Social support is received but has not been described as being sought. | • My grandma brought me a Bandaid. |
| **c. Gave** | • Child describes giving support to someone else | • I welcomed him to my school |
| **5. Did Nothing** | • Child describes having done nothing to feel better). | |

| | | | |
|---|---|---|---|
| a. | **Felt emotion but did nothing** | • Child describes having felt a certain way but not doing anything to feel better. | • I didn't do anything.<br>• Nothing. |
| b. | **Felt nothing/Did nothing** | • Child describes never having felt a certain way and not having had to do anything to feel better. | • I didn't feel that ever, I didn't do anything to feel better. |
| c. | **Just feeling it, experiencing emotions without trying to change them** | • Child describes having emotions without trying to change them or without describing catharsis. | • I just cried.<br>• I just felt mad.<br>• I was upset still. |
| 6. | **Don't Know** | • Child answers that they don't know. | • I don't know. |
| 7. | **Other/Uncodable** | • Child describes a strategy that does not fit into this scheme.<br>• Child says something that cannot be categorized that doesn't seem to make sense in context. | • The hungry caterpillar likes leaves.<br>• Dorothy is my best friend (unrelated to anything else said).<br>• Clouds have eyeballs sometimes. |

**Appendix C2.** Example of Emotion Regulation Strategy Effectiveness Interview Vignette. Three vignettes were developed for the study, a fear vignette, a sad vignette, and an anger vignette. Only the description of the strategies was read to the child (e.g., find a way to fix it).

**Experimenter:** Now, we will go over some situations that children your age experience sometimes, imagine this situation is happening to you and respond as honestly as possible what you would do in that situation

**<u>Scary Vignette:</u>** *"You are alone in your room at night, in the middle of the night, and it is VERY dark. You hear some weird noises coming from under your bed; you are VERY scared."*

**Experimenter:** Sometimes, when we experience this kind of situation, we do things to change how we feel. If you were in that situation and felt very scared, what would you do to make yourself feel better?

**Experimenter:** Is there anything else you would do? What else would you do to make yourself feel better?

**Experimenter:** Thank you! We will now go over different ways of changing how you feel. I want you to tell me if you think you would do that if you were in that situation. I also want you to tell me how well you think doing that would make you feel.

**Experimenter:** How likely do you think you are to ________ if you were in that situation; on a scale from 1-5 *(1 being definitely would not do it; 2 being probably would not do it; 3 being maybe I would not do it, maybe I would do it; 4 being probably would do it; and 5 being definitely would do it)* how likely are you to________.

1. **Problem Solving:** Find a way to fix it *(e.g., checking under the bed)*
2. **Cognitive Reappraisal:** Think about how it is not a big deal *(e.g., probably just the wind)*

3. **Cognitive Distraction:** Think about something else *(e.g., ice cream)*
4. **Rumination:** Continue to frequently think about the situation
5. **Thought Suppression:** Stopping yourself from thinking about it
6. **Behavioral distraction:** Do something else *(e.g., play a game)*
7. **Social support:** Find someone to talk to and help you *(e.g., go talk to your mom)*
8. **Avoidance:** Leave or stop engaging with the situation so you don't have to deal with it *(e.g., go to the kitchen)*
9. **Acceptance:** Let yourself feel that way *(e.g., just keep being scared)*
10. **Changing Physiological arousal/Breathing:** Try to breath and calm down

**** Give the examples if Child looks confused****

**Experimenter:** Now, on a scale from 1-5 *(1 being definitely would not make me feel better; 2 being probably would not make me feel better; 4 being probably would make me feel better; and 5 being definitely would make me feel better)* how good do you think _________ would make you feel:

**Experimenter:** Thank you! Now, you said that you would definitely ________ *(say all the strategies C said 5 to)* to make yourself feel better if you were in that situation and felt VERY scared

**If C said more than 1*: Which one would you do first? Which one would you do next?

**If C said only one 5*: Is that what you think you are *most* likely to do?

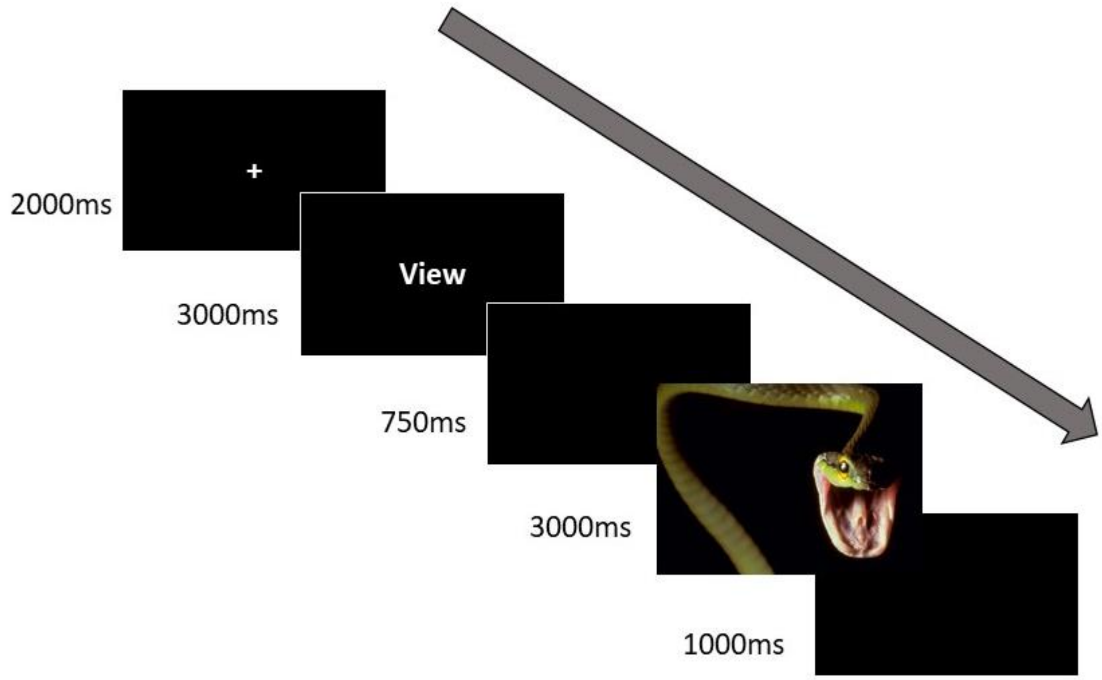
**Experimenter:** You also mentioned that you would _________ *(say all the strategies C said 4 to)* to make yourself feel better if you were in that situation and felt VERY scared.

**If C said more than 1*: Which one of those would you do next? And which one would you do after that?

**If C said only one 4*: Is that what you would try next?

**Experimenter:** Great! We will now go over a different scenario.

**Appendix C3.** Trial structure for the viewing task (all pictures within a block belong to the same emotion). The regulation task followed the same format, but children saw the word "change" (for both distraction and reappraisal conditions) instead of the word "view".

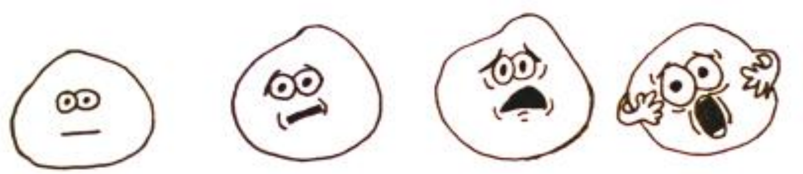


**Appendix C4.** Self-report of emotion scales for the LPP picture viewing tasks.

**Sad:**

Not at all A little Pretty much Very

**Scared:**



Not at all A little Pretty much Very

**Angry:**

Not at all A little Pretty much Very

**Happy:**

Not at all A little Pretty much Very

**Appendix C5.** Emotion Regulation Strategy Training Instructions for children during the emotion regulation EEG task. After the general instructions, children are guided through six practice trials to ensure their understanding of the instructions.

Distract. Now we are going to play a game like the one we just did. Pictures are going to come up on the screen and I want you to pay close attention to them. While you are looking at the pictures, if you start to feel upset or bad in any way, I want you to try to think about something **BORING** instead. For example, you can think about a circle, the color white, or the number three. Anything that you can think of that doesn't make you feel **ANY** kind of way is ok to think about instead of the pictures, ok? Can you try to do that? Ok, so if this picture shows up on the screen (*experimenter shows the child a practice picture*) what are you going to try to do? Are you ready?

Reappraise. Now we are going to play a game like the one we just did. Pictures are going to come up on the screen and I want you to pay close attention to them. While you are looking at the pictures, if you start to feel upset or bad in any way, I want you to try to think about how the picture is **NOT** real, how it is **NOT A BIG DEAL** because it is just a picture. For example, if you feel upset when a picture shows up, you can think about how it is from a movie, how it is posed so it is not a big deal, or how it is just a picture and nothing will happen to you. Can you try to do that? Ok, so if this picture shows up on the screen (*experimenter shows the child a practice picture*) what are you going to try to do? Are you ready?