Direct and Indirect Approaches to Emotion Regulation in Children

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Abstract

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The current study examined the impact of both relatively direct and relatively indirect approaches to emotion regulation in children. In Study 1, 5-year-old children (N = 83) were assigned to 1 of 2 conditions in which they were either trained to reappraise emotional pictures or trained in an irrelevant classification task. The efficacy of reappraisal training was assessed in terms of self-reported arousal, physiological response (skin conductance response), and performance on tasks thought to be influenced by mood (verbal fluency and the Children's Embedded Figures Test, a measure of global and local processing). Children who were trained to reappraise emotional stimuli demonstrated attenuated emotional reactivity to negative stimuli relative to children in the control condition. Furthermore, reappraisal training was related to enhanced performance on the verbal fluency task, thought to be influenced by positive mood, although these effects were only evident when the task was administered immediately after the post-training assessment. However, there was no reduction in self-reported valence and arousal associated with reappraisal training, and there was no relation between physiological responding and executive function (EF), temperament, or parenting. Study 2 used EEG to examine the neural correlates of emotion regulation in the context of relatively indirect task instructions, with a particular focus on the late positive potential (LPP), in children between 6 and 12 years (N = 49) As expected, the amplitude of the LPP was influenced by both valence and response. In particular, the amplitude of the LPP associated with an evaluative response (i.e. decide whether you like or dislike the picture) was larger than the amplitude of the LPP associated with a non-evaluative response (i.e. decide whether

or not there is a person in the picture), but only for the older children. Furthermore, this modulation was related to better performance on the Dimensional Change Card Sort, a measure of EF, controlling for age and IQ. These results add to our knowledge of the development of emotion regulation, suggesting that diverse strategies, including both direct and indirect approaches to emotion regulation, may be an effective means of modulating arousal in children, but at different points in development.

Table of Contents

List of Tables

List of Figures

Chapter 1

Overview

In recent years, there has been a great deal of interest in investigating the development of emotion regulation in children (e.g. Bridges, Denham, & Ganiban, 2004; Cole, Martin, & Dennis, 2004; Thompson, Lewis, & Calkins, 2008; Zelazo, Qu, Kesek, 2010). The ability to engage in adaptive emotion regulation is an important developmental task, critical to successful developmental outcomes such as school performance (Graziano, Reavis, Keane, & Calkins, 2007; Gumora & Arsenio, 2002) and social competence (Rubin, Coplan, Fox, & Calkins, 1995; Shields, Cicchetti, & Ryan, 1994). Many disorders, including both externalizing and internalizing disorders, are associated with difficulties regulating emotion (e.g. Calkins, Graziano, & Keane, 2007; Keenan, 2000; Silk, Steinberg, & Morris, 2003).

Emotion regulation is thought to reflect the modulation of emotion in order to achieve an optimal level of arousal (Thompson, 1994). However, definitions of emotion regulation remain somewhat amorphous and imprecise, and a consensual definition has yet to emerge (Cole et al., 2004). The difficultly evident in defining emotion regulation may reflect the heterogeneity of the construct, which includes multiple potential sources of influence, both relatively direct and relatively indirect (Fox & Calkins, 2003). Direct approaches to emotion regulation are specifically aimed at modulating emotion. Indirect influences, on the other hand, are often the result of context, as when situational demands require one to regulate emotion in order to accomplish a goal. Given the importance of effective emotion regulation, it is critical that we understand the developmental trajectory of these multiple sources of influence. However, there is only limited research examining these different approaches to emotion regulation in children.

The current research used multiple methods to investigate whether children are capable of using both direct and indirect instructions to modulate their emotional experience, including the cognitive and temperamental correlates of that ability. Study 1 examined young children's ability to implement cognitive reappraisal, a direct approach to emotion regulation that involves modifying one's thoughts or evaluations to think about a situation in a different way in order to change its emotional impact (Gross, 1998). In Study 2, children's ability to regulate emotion was examined using a more indirect approach. Specifically, rather than directly instructing children to change their appraisals, children were asked to make more or less evaluative decisions about emotional stimuli to determine whether emotional responding varied as a function of different processing goals.

Chapter 2

Study 1

A. Direct Approaches to Emotion Regulation in Adults

1. *Definitional and Methodological Issues*

Direct approaches to emotion regulation have been studied extensively in adults. Reappraisal, in particular, has received a great deal of attention. In contrast to the construct of emotion regulation, which is inherently broader and less clearly delineated, the definition of reappraisal as a specific strategy to regulate emotion has remained relatively coherent. In an early examination of the effect of cognitive appraisal on emotional arousal, Speisman, Lazarus, Mordkoff, and Davison (1964) proposed that “the same stimulus may be either a stressor or not, depending on the nature of the cognitive appraisal the person makes regarding the significance for him” (p. 367). These authors emphasized the importance of interpretation in influencing how a stimulus is likely to be perceived, and suggested that this interpretation could be experimentally manipulated.

This approach to emotional reappraisal was incorporated into a seminal review by Gross (1998) that provided a clear taxonomy of regulatory strategies. Elaborating on a distinction between antecedent-focused emotion regulation and response-focused emotion regulation, Gross suggests five forms of emotion regulation that occur at different points in the regulatory process. One might attempt to select or modify a situation related to a specific emotion using a problem focused approach that directly remedies the cause of the unwanted emotion before it occurs. Alternatively, attention might be focused away from a current emotional context, by distracting oneself with thoughts and memories incompatible with the unwanted emotion, or concentrating on some other activity (e.g. sports, hobbies). Another strategy involves altering an emotional response after it has occurred, such as through exercise or relaxation techniques. The strategy that has arguably received the most attention is reappraisal, which involves the modification of one’s thoughts or evaluations. According to Gross, reappraisal is a cognitive linguistic strategy that involves the generation of an alternative interpretation of an emotional situation or stimulus. From this definition, which has been widely adopted in the literature, reappraisal can be clearly differentiated from other strategies aimed at emotion regulation.

Reappraisal has frequently been examined in contrast to suppression, which requires the inhibition of emotion (Goldin, McRae, Ramel, & Gross, 2008; Gross, & John, 2003). Although emotion regulation is often thought to be cognitively costly, in that it relies on limited capacity cognitive resources (Muraven, Tice, & Baumeister, 1998), research comparing suppression and reappraisal suggests that reappraisal is not associated with the same cognitive consequences as emotion suppression (Butler et al., 2003; Richards & Gross, 2000). Richards and Gross (2000) found that asking participants to suppress their emotional response to negative pictures was associated with poorer incidental memory for the pictures; however, asking participants to reappraise the pictures did not have the same effect. Suppression requires on-going cognitive resources to successfully dampen the emotional response. Cognitive reappraisal, on the other hand, can be used to reconstrue an emotional situation, after which no further cognitive work is necessary. These results suggest that reappraisal is not as resource demanding as emotion suppression, and may represent a particularly adaptive and flexible form of emotion regulation.

Despite a relatively circumscribed definition, the way in which reappraisal is experimentally manipulated varies. Often, participants are simply instructed to a adopt a detached, neutral, objective, scientific, unemotional, or analytic attitude toward a film, story, or photograph (e.g. Goldin et al., 2008; Gross, 1998; Richards & Gross, 2000). In other cases, participants are given more elaborate instructions to think about how a situation will become better in the future or to generate a more positive alternative interpretation of the stimulus. Often, this training is accompanied by specific examples, practice trials, feedback and coaching, and queries as to the specific reappraisals generated (e.g. Guiliani, McRae, & Gross, 2008; Ochsner, Bunge, Gross, & Gabrieli, 2002; Urry, van Reekum, Johnston, & Davidson, 2009). Prerecorded narratives that vary in emphasis on emotional content have also been used to influence interpretations of a stimulus (e.g. Dennis & Hajcak, 2009; Speisman et al., 1964). Across these wide variations in training and instructions, a number of lines of research suggest that adults can successfully use reappraisal to change their emotional experience.

2. Experimental Investigations of Cognitive Reappraisal

In an early experiment, Speisman and colleagues (1964) found that physiological and self-reported reactions to a film showing an adolescent circumcision ritual could be altered depending on the narrative presented. When the film was accompanied by a soundtrack that described the film in a detached and scientific way, skin conductance response (SCR), a measure of physiological arousal, was reduced relative to conditions in which the narrative emphasized or denied the threatening aspects of the film. In a follow-up study, Lazarus and Alfert (1964) found that the defensive narrative was more effective at reducing physiological arousal when it preceded the film, but that effectiveness was influenced by the dispositional tendency to deny negative emotions. More recent work has found similar reductions in autonomic activity associated with reappraisal (Guilani, McRae, & Gross, 2008; Kalisch et al., 2005; Urry, van Reekum, Johnstone, & Davidson, 2009). For example, Guiliani and colleagues (2008) found that asking participants to use reappraisal to either increase or decrease their emotional response to humorous film clips resulted in corresponding increases and decreases in autonomic activity, including heart rate, blood pressure, respiration, and skin conductance. These results suggest that one's interpretation of a particular stimulus can influence one's physiological response to that stimulus.

Experimental work using neuroimaging has demonstrated that particular patterns of brain activity are associated with reappraisal. For example, Ochsner and colleagues (2002) trained female participants to reappraise negative photos by interpreting negative events in a less negative way. Compared to when they were told to attend to negative photos, participants reported a decrease in the strength of negative affect when they were instructed to reappraise. Furthermore, functional magnetic resonance imaging (fMRI) revealed that reappraisal activated lateral and medial prefrontal regions, areas of the brain associated with cognitive control, while deactivating amygdala and medial orbitofrontal cortex, areas of the brain associated with processing affectively significant stimuli. Other studies looking at the neural correlates of emotion regulation have found similar evidence implicating areas of the prefrontal cortex (PFC) associated with cognitive control in the ability to modulate one's emotions, specifically dorsolateral, dorsomedial, , ventrolateral, and ventromedial areas of PFC (Banks, Eddy, Angstadt, Nathan, & Phan, 2007; Beauregard, Levesque, & Bourgouin, 2001; Goldin et al., 2008; Harenski & Hamann, 2006; Kim & Hamann, 2007; Levesque et al., 2003; Ochsner et al., 2004; Ochsner et al., 2009; Phan et al., 2005; Urry et al., 2009; Wagner et al., 2008). This activation of medial and lateral areas of PFC and associated deactivation of limbic areas suggests that reappraisal represents a more reflective, controlled response in the context of stimuli that tend to elicit immediate, emotional reactions.

3. Individual Differences in the Use and Efficacy of Reappraisal

Although there are general patterns of neural activation associated with reappraisal, there are also individual differences related to the efficacy of reappraisal (Banks et al., 2009; Drambant et al., 2009) For example, in line with previous research, Banks and colleagues (2007) found that the reappraisal of negative affect was associated with activation in dorsolateral and dorsomedial areas of PFC and deactivation of left amygdala. Moreover, an investigation of individual differences found that functional connectivity among PFC and amygdala, the degree to which this neural covariation was coupled, predicted self-reported decreases in negative affect. Variation in the neural pattern typically associated with reappraisal was further illustrated by examining reappraisal in the context of depression. Johnstone and colleagues (2007) found that nondepressed participants demonstrated a typical pattern of neural activation, with reappraisal associated with increased activation in ventrolateral PFC and deactivation in the amygdala. Conversely, in individuals with depression, there was a positive association between PFC and limbic activation, suggesting difficulty implementing effective top-down control of emotion. These results suggest that although reappraisal is generally an effective means of modulating emotion, there are individual differences in the efficacy with which reappraisal is implemented.

Related to the work examining individual differences in the neural bases of reappraisal, research focusing on how individuals regulate emotion in everyday life has demonstrated individual differences in the tendency to engage in various emotion regulation strategies, including reappraisal. The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was designed to quantify these individual differences by asking participants to report on how they tend to regulate their emotions. For example, items designed to assess the tendency to reappraise include “I control my emotions by changing the way I think about the situation I’m in” (p. 350). Despite the challenges associated with self-report measures, the self-reported tendency to engage in reappraisal has positive implications for a number of domains, including affect, well being, interpersonal functioning, memory for emotional events, and physiological response to anger provocation (Gross & John, 2003; Mauss, Cook, Cheng, & Gross, 2007; Richards & Gross, 2000). For example, Gross and John (2003) found that people who reported using reappraisal in their everyday lives had closer relationships and were better liked by their peers. Although reappraisal is a particularly adaptive and flexible form of emotion regulation, there are clear variations in the extent to which individuals are able to implement reappraisal effectively, and the likelihood that they will do so.

In general, a great deal of evidence suggests that emotion regulation is a particularly effective means for adults to modulate their emotions. Although reappraisal tends to be associated with areas of the brain related to cognitive control, which is thought to be a limited capacity resource, it does not appear to have the same depleting effects as emotion suppression. However, there do appear to be individual differences in the extent to which people use emotion regulation in their daily lives. The potential efficacy of reappraisal, as well as the role of individual differences, suggests that an examination of reappraisal in development can further illuminate the individual characteristics that are likely to result in the effective implementation of cognitive reappraisal.

B. Direct Approaches to Emotion Regulation in Children

1. Emotional Development in the Preschool Years

Sroufe (1997) suggests that with development, regulation shifts from the caregiver to the dyad to the child. Only gradually does the child begin to engage in self-regulation, eventually internalizing emotion regulation (Thompson, 1994). The gradual internalization of emotion regulation recognizes that, with development, children are able to modulate their emotion in purposeful, goal directed ways and generate increasingly reflective responses to emotional stimuli (Zelazo & Cunningham, 2007). A great deal of evidence suggests that the ability to regulation emotion improves dramatically over the preschool years as children are increasingly able to appropriately modulate their emotional reactions across a variety of contexts (Blair, Denham, Kochanoff, & Whipple, 2004; Calkins & Dedmon, 2000; Carlson & Wang, 2007; Denham et al., 2003; Eisenberg et al., 1993; Kochanska, Murray, & Harlan, 2000). Children become more adept at recognizing emotional expressions in others, understanding the types of situations that are likely to lead to certain emotions, and identifying strategies for modifying emotion (Camras & Allison, 1985; Cole, Dennis, Smith-Simon, & Cohen, 2009; Harris, 1989; Lagattuta, Wellman, & Flavell, 1997). However, there is some suggestion that preschool children still have difficulty spontaneously connecting internal states with emotion, and are unlikely to report that emotions can be modified by thoughts alone, rather than circumstances (Flavell, Flavell, & Green, 2001).

Despite the substantial emotional development that occurs over the course of the preschool years, the potential adaptive value of reappraisal, and research suggesting that adults can and do reappraise their emotions in the context of laboratory studies (e.g.

Ochsner et al., 2002; Ochsner et al., 2004), as well as in everyday life (e.g. Gross & John, 2003, Richards & Gross, 2000), there is only limited work looking at children's ability to implement similar strategies, and no work examining the physiological implications of reappraisal in preschool age children. Children may have difficulty spontaneously inferring the link between emotion and internal states, but direct instruction may allow this link to be made clear.

2. *Experimental Evidence for Cognitive Reappraisal in Children*

Although there is only minimal research examining children's ability to implement cognitive reappraisal, there is some evidence to suggest they can. Using methods similar to Ochsner and colleagues (2002), Levesque et al. (2004) used fMRI to investigate the neural correlates of emotion regulation in girls between the ages of 8 and 10 years. When the participants were instructed to reappraise a sad film by becoming a detached observer, they reported less intense feelings of sadness. Furthermore, the pattern of neural activation resembled the patterns of activation observed in adults, with reappraisal associated with more lateral and medial areas of PFC. However, children did tend to show more extensive prefrontal activation than adults typically do, which coincides with other research which suggests that the pattern of neural activation associated with cognitive tasks is often relatively more diffuse in children (e.g., Bunge, Dudovic, Thomason, Vaidya, & Gabrieli, 2002; Durston et al., 2006; Luna et al., 2001). This diffuse pattern of activation may also be due, in part, to the relative difficulty of the task for children, requiring the recruitment of additional neural resources.

Carthy, Horesh, Apter, Edge, and Gross (2010) compared children between 10 and 17 years, with and without anxiety disorders, in terms of the extent to which reappraisal reduced self-reported affect and arousal in response to negative pictures. Children with anxiety disorders had more difficulty generating reappraisals, although they were able to effectively reappraise the vast majority of the images. Furthermore, although children with anxiety disorders initially rated the pictures as more negative, both anxious children and non-anxious children rated the pictures as less negative after reappraisal. The main outcome measure was self-reported, which means that children's ratings may have been influenced by demand characteristics, but the results do suggest that, for older children, reappraisal can be an effective means of regulating emotion even in the context of a mood disorder.

There is also some evidence to suggest that even preschoolers can use cognitive strategies to regulate emotion. Using the delay of gratification paradigm, which requires children to choose between a small reward now and larger reward later, Mischel and colleagues demonstrated that preschoolers can employ cognitive strategies to ease the difficult waiting process. Thinking happy, distracting thoughts, as well as thinking about the rewards in non-arousing ways, increases the amount of time children are willing to wait for a larger reward (Mischel & Baker, 1975; Mischel, Ebbesen, & Zeiss, 1972; Moore, Mischel, & Zeiss, 1976). Further evidence to suggest that children can successfully use strategies to modulate their emotions comes from Meerum Terwogt, Schene, and Harris (1986), who had 6-year-old children listen to a story about a child who feels lonely when a friend moves away. Children who were instructed to remain detached during the story, rather than experience emotion, reported feeling less sad, used fewer emotional words when recounting the story, and performed better on a subsequent memory task thought to be influenced by mood. However, when asked to describe what kinds of strategies they used to either increase or decrease their emotion, only 40% of children could articulate a strategy. These results suggest that although children have some ability to implement reappraisal, their understanding of how cognitive strategies modulate emotion is incomplete.

3. *Individual Differences in the Use and Efficacy of Reappraisal in Children*

Although only limited work has directly assessed children's ability to use strategies to reappraise their emotions, a number of studies have indirectly investigated children's tendency to use adaptive coping strategies using self-report and parent-report measures (Blair et al., 2004; Denham et al., 2003; Eisenberg et al., 1993; Gullone, Hughes, King, & Tonge, 2010). However, the results have been somewhat inconsistent. For example, extending work with adults that suggests self-reported tendencies to use various regulatory strategies have important social and cognitive implications, Gullone and colleagues (2010) administered a revised version of Gross and John's (2003) Emotion Regulation Questionnaire to children and adolescents between 9 and 15 years at three time points over 2 years. The results suggest that older children report less use of emotion suppression as a strategy than younger children, although the rate of decrease over time was less marked for females than for males. The results for reappraisal were contrary to prediction, with individual stability over time, and an overall decrease in reported use of reappraisal between ages 9 and 15. These results are difficult to interpret, although the authors suggest that the use of reappraisal may have already stabilized into a trait- like tendency by late childhood.

Eisenberg and colleagues (1993) had parents and teachers rate preschool children in terms of their preferred coping behaviors, including cognitive restructuring, defined as the tendency to think about a situation in a more positive way. The results from both informants were combined and submitted to factor analysis, which suggested a two factor solution. One of these factors, termed ‘acting out versus avoidance’, included cognitive restructuring and distraction as well as aggression and venting (negatively loaded). High scores on this factor, indicating high levels of aggression and venting and low levels of distraction and cognitive restructuring, negatively predicted social skills for boys and girls, as well as sociometric status for boys only. These results suggest that, even in preschool age children, there are individual differences in the tendency to engage in various regulatory strategies.

Using similar methods, Blair and colleagues (2004) investigated relations between parent-reported coping strategies and temperament in preschoolers, and found that, in general, the use of passive coping strategies, which involve avoiding or denying the emotion rather than actively attempting to change it (i.e. suppression), moderated the relation between negative affect and internalizing problems in girls and externalizing problems in boys. The results for constructive coping were not as clear, and an unexpected finding suggested for that for girls high in effortful control, but not for girls low in effortful control, difficulty using constructive coping strategies was related to an increase in internalizing behaviors. The reason for this interaction is unclear, although the authors suggest that girls who are high in effortful control may be more aware of their own difficulties in addressing emotional problems, leading to internalizing behaviors. Although the results from this work suggest that the particular emotion regulation strategies children adopt have important consequences, the mixed results make it difficult to draw conclusions about the strategies children use to regulate emotion or the temperamental correlates of effective emotion regulation.

The limited research on children's ability to implement cognitive strategies has left a number of questions unanswered. Research on cognitive approaches to emotion regulation in adults has included relatively extensive investigations of both experimentally manipulated and self-reported cognitive reappraisal, but there is only limited work examining parent and teacher reported coping strategies in children yielding results that are difficult to interpret. Furthermore, although the work by Mischel and colleagues (Mischel & Baker, 1975; Mischel et al., 1972; Moore et al., 1976), and Meerum Terwogt and colleagues (1986) is suggestive, it is unclear whether preschoolers can, with specific instruction, develop a clear understanding of reappraisal strategies that can be applied to a wide range of stimuli.

C. Potential Correlates of Reappraisal Efficacy

1. Executive Function

There is evidence to suggest that even young children may be able to change their interpretations of a stimulus when specifically instructed to do so, but there is also likely to be variation in how effectively those instructions are implemented. Even in adults there are individual differences in the ability to implement reappraisal, but it is currently unclear what specific cognitive and temperamental characteristics are related to the ability to implement reappraisal in the context of emotional stimuli. One factor that may contribute to the efficacy of cognitive reappraisal is executive function (EF), an umbrella term for a number of subfunctions, including working memory, inhibitory control, and attention shifting, that are generally involved in implementing top-down control of thought and behavior (Miyake et al., 2000). Research on the development of EF suggests that it begins to emerge early in development, around the end of infancy, and shows marked changes during the preschool years, in parallel with the development of PFC (Zelazo, Carlson, & Kesek, 2008). Although EF has traditionally been examined using relatively abstract, decontextualized tasks, emerging research suggests that EF is particularly important for generating reflective responses in the context of emotional arousal. Zelazo and Cunningham (2007) suggest that EF and emotion regulation are closely related, reciprocal processes, as emotion regulation relies on one's ability to engage in conscious, goal directed behavior.

There is some evidence for a link between emotion regulation and EF (e.g. Calkins & Dedmon, 2000; Carlson & Wang, 2007; Fox, 1994; Lewis, Lamm, Segalowitz, Stieben, & Zelazo, 2006). Lewis and colleagues (2006) examined the event related potentials (ERPs) related to EF in children between the ages of 5 and 16 years as they performed a GoNogo task. Children were told they had to maintain a high level of points to win a desirable prize. After some initial success, a change in the stimulus duration ensured that the children lost all their points. Two ERP components associated with cognitive control, the N2 and the P3, decreased in amplitude with age, in accordance with evidence suggesting cortical efficiency improves with age. However, amplitudes increased following the emotion induction phase of the task, suggesting a role for EF in the service of emotion regulation. When faced with a suddenly plummeting score, the children had to implement cognitive control to modulate their negative reactions and concentrate on the task at hand.

There is also evidence for a link between EF and emotion regulation in younger children. For example, Carlson and Wang (2007) had preschoolers complete a battery of tasks designed to assess individual differences in inhibitory control (Simon Says, Forbidden Toy, Gift Delay) and emotion regulation (Disappointing Gift, Secret Keeping). The results suggest that inhibitory control and emotion regulation are related; specifically, children who had an optimal, intermediate level of inhibitory control had greater emotion understanding and were better able to control emotional expression in both positive and negative emotional contexts.

The ability to implement cognitive reappraisal requires processes that fall under the umbrella of EF. Specifically, reappraisal requires both the inhibition of one's initial interpretation and the flexibility to generate an alternative. Reappraisal requires top-down, goal directed reflective process in the context of emotional stimuli, and, as outlined above, work with adults suggests that lateral and medial areas of PFC associated with cognitive control are also activated in response to reappraisal (e.g. Ochsner et al., 2002). Given the theoretical and empirical evidence linking EF and emotion regulation, and the requirements of cognitive reappraisal in particular, the ability to successfully implement reappraisal may be related to individual differences in EF.

2. Temperament

In addition to EF, there are a number of other likely correlates of the ability to implement effective reappraisal. The effectiveness of reappraisal training may also be influenced by temperament, which is thought to arise from biologically based individual differences, interacting with experience, and eventually resulting in adult personality (Rothbart, 2007). Rothbart and colleagues (Rothbart, 2007; Rothbart & Ahadi, 1994; Rothbart, Ahadi, & Evans, 2000) suggest that personality in childhood can be characterized by three broad dimensions, including surgency, negative affectivity, and effortful control. In particular, effortful control, which involves attention and inhibition, and is related to the adult trait of conscientiousness, is thought to play an important role in emotion regulation (Rothbart, 2007).

Evidence for the link between effortful control and emotion regulation comes from Kochanska, Murray, and Harlan (2000), who conducted a longitudinal study in which children participated in multiple tasks designed to assess effortful control. At 22 months, children completed a number of delay tasks (i.e. waiting for a bell to ring before retrieving a piece of candy, not peeking at or touching a gift), a motor activity requiring inhibition (i.e. walking a line as slowly as possible), a task looking at willingness to take turns, and a Stroop-like task that required children to attend to non-dominant aspect of a stimulus (i.e. a small fruit embedded within a large fruit). Between 22 and 33 months there were marked improvements in children's ability to exert effortful control. Furthermore, greater effortful control at 22 months was related to emotion regulation at 33 months. Children who were better able to exert effortful control at 22 months demonstrated more regulated emotion in a situation thought to elicit anger (being strapped into a confining car seat), as well as a situation thought to elicit happiness (a humorous puppet show) at 33 months. Although happiness is typically a positive emotion, raucous displays of joy must still be appropriately regulated. In both cases, children who had demonstrated greater effortful control expressed less intense emotional expressions.

Effortful control in preschoolers is often assessed using the Children's Behavior Questionnaire (CBQ), a parent report measure that is related to EF (e.g. Hongwanishkul, Happaney, Lee, & Zelazo, 2005), but focuses on the tendency of children to apply EF in situations that arise in everyday life. Because effortful control provides a measure of children's experience in exerting EF in a variety of contexts, it may be related to how effectively children are able to implement cognitive reappraisal.

3. *Parenting*

In addition to child factors, such as EF and effortful control, how parents tend to cope with their children's negative emotions may influence children's ability to implement cognitive reappraisal. Early in development, parents are primarily responsible for regulation within the parent child dyad, with independent regulation emerging only gradually (Sroufe, 1997). As children proceed through toddlerhood and the preschool years, caregiving is thought to play an essential role in promoting emotion regulation, and there is evidence to suggest that parenting has important influences on children's emotion development (e.g. Belsky, Fish, & Isabella, 1991; Eisenberg et al., 2001; Eisenberg et al., 2005; Kochanska, 2001; Kopp, 1989; Kopp, 2009; Wachslag & Hans, 1999).

There is extensive evidence suggesting that attachment is a critical predictor of emotional development (see Sroufe, 1997), as well as evidence linking specific parenting behaviors to emotion regulation in children (Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997). For example, Cole and colleagues (2009) asked 3- and 4-year-old children to recognize and generate regulation strategies in the context of emotional vignettes. There was an effect of age, such that 4-year-olds demonstrated greater understanding than 3-year-olds. There was also an effect of observed maternal behavior, including both emotional support and scaffolding of self-regulation while children waited for a delayed gift. Children who were offered more maternal support in the context of distress recognized more strategies to deal with anger but generated fewer strategies. Conversely, maternal attempts to scaffold self-regulation were related to increased generation of strategies to cope with anger, but not to recognition. Although the authors predicted that scaffolding would be related to strategy understanding overall, scaffolding, rather than support, may lead children to more actively engage in emotion regulation.

How parents react to their children's negative emotions may influence the strategies children are likely to implement in the context of emotional stimuli, and the effectiveness of those strategies (Valiente, Lemery-Chalfant, & Swanson, 2009). The extent to which parents regularly use strategies aimed at changing their child's response to emotional situations may influence the extent to which children are able to implement these strategies themselves. If children have experience with emotional reappraisal in the context of the parent child dyad, these strategies may become more easily internalized.

D. The Current Study

The current study investigated whether 5-year-old children can successfully use reappraisal to modulate emotion. Children were trained to cognitively reappraise emotional pictures using procedures similar to those developed in previous research with adults (e.g. Ochsner et al., 2002; Ochsner et al., 2004), and the success of the reappraisal training was assessed using multiple measures, including a physiological measure (SCR), self-reported affect, and performance on tasks known to be influenced by emotion. These results were compared to a control condition in which children were trained on an irrelevant classification task (see Figure 1 for an outline of the structure of the study). It was predicted that even 5-year-old children would be able to modulate their emotions when given an appropriate strategy, as demonstrated by the various dependent measures. Furthermore, because of the limited work examining the correlates of successful reappraisal in children, a number of individual difference variables were explored. Children completed a number of measures designed to provide a broad assessment of EF and general intellectual functioning. Parents were asked to complete surveys designed to assess their child's temperament, as well as their typical response to emotional situations involving their child.

Multiple measures of assessment allowed for a comprehensive evaluation of the efficacy of reappraisal training with children. In studies with adults, self-reported affect and arousal is often used as a measure of change in subjective experience as a result of reappraisal. Self-report was also used in the current study, using the Self Assessment Manikin (SAM; Bradley & Lang, 1994; McManis, Bradley, Berg, Cuthbert, & Lang, 2001). This graphic representation was developed as a child-friendly measure of valence and arousal, and has been used with children as young as 5 years as they viewed negative, positive and neutral pictures (Hajcak & Dennis, 2009). Although work with adults has demonstrated that adults tend to report decreased arousal after reappraisal (e.g. Ochsner et al., 2002), children may find it difficult to accurately report on their own affective experience. Furthermore, self-reports may be influenced by demand effects. Therefore, a number of other measures were used to assess the efficacy of reappraisal training.

Electrodermal activity (EDA), and SCR in particular, is a physiological measure that has often been used as an index of arousal in both children and adults (e.g. McManis et al., 2001). Specifically, activation of the sympathetic nervous system increases the sweat response, which changes the ability of the skin to conduct electricity. A greater sweat response is thought to reflect a greater level of arousal. A baseline measure of children's responses to both neutral and neutral pictures was obtained prior to any form of training. Then, SCR was measured again following the training to determine whether reappraisal training is associated with a decreased physiological response to emotional stimuli. Based on previous work with adults demonstrating that the reappraisal of emotional pictures is associated with a diminished physiological response (Guilani et al., 2008; Mauss et al., 2007; Urry et al., 2009), it was predicted that children trained to reappraise would demonstrate decreased physiological responding to negative emotional stimuli relative to children who not trained to reappraise.

After viewing the pictures, children were asked to complete two tasks thought to be influenced by mood. A good deal of previous research suggests that various aspects of cognitive processing are related to mood, such as cognitive flexibility, which increases with positive mood (Ashby, Valentin, & Turken, 2002), and processing mode, with positive mood increasing the tendency to think globally rather than locally (Gasper & Clore, 2002). Although there is some debate as to the precise mechanism by which positive mood influences cognition, Ashby and colleagues (2002) suggest that the release of dopamine associated with positive mood may facilitate creative thinking by increasing the flexibility and scope of one's attention. Most of this research has been done with adults, but there is some work suggesting that mood can also influence cognitive performance in children. Thus, two tasks expected to have opposite effects in the context of negative mood, a measure of global and local processing (the Children's Embedded Figures Test; CEFT) and a measure of verbal fluency, were administered to children following the reappraisal training task. Schnall, Jaswal, and Rowe (2008) found that when children were in a positive mood, their performance on the CEFT (Witkin, Oltman, Raskin, & Karp, 1971), which requires local processing, was impeded. Green and Noice (1988) demonstrated that that positive mood tends to increase verbal fluency in children. Thus, children in a negative mood were expected to show enhanced performance on the CEFT and diminished performance on the verbal fluency task. To the extent that children who have been trained to reappraise are in a less negative mood following presentation of negative stimuli, performance on the verbal fluency task should be enhanced, whereas performance on the CEFT will be impeded.

Given the relation between emotion regulation and EF outlined above, as well as the evidence suggesting reappraisal is closely linked to cognitive control, performance on behavioral measures of EF was expected to predict the efficacy of EF, as measured by the reduction in SCR associated with reappraisal, over and above general intellectual functioning. Furthermore, EF was expected to mediate the relation between the quality of the reappraisals generated and the efficacy of the training. There was also expected to be a relation between EF and temperament, particularly effortful control. However, because EF was measured directly, and is thought to underlie the ability to implement cognitive reappraisal when specifically instructed to do so, EF was expected to be the stronger predictor. Parenting was also expected to be related to reappraisal efficacy. Specifically, the parent reported tendency to react to their children's negative emotions in an emotion focused way aimed to changing negative emotions was expected to predict the effectiveness with which children implemented reappraisal.

Method

Participants

The current study included 85 5-year-old children (45 males; *M* = 66.1 months, range = 61 – 71 months). One boy was not included in the analysis because he did not complete the session, and one boy was not included due to experimenter error.

An additional 15 participants were deleted from the physiological analysis because they had fewer than 3 usable responses per block. The final sample for that portion of the analysis included 36 children in the reappraisal condition (19 males; *M* = 66.1 months) and 32 children in the control condition (14 males; *M* = 66.2 months).

Participants were recruited from the pool maintained by the Institute of Child Development. No ethnic information was reported for 11 participants. Of the children for whom the information was available, 86.4% were Caucasian, 1.4% were Hispanic, and 12.2% were of mixed descent. The majority of children, 94%, were from two parent households. Most parents reported having some post-secondary education.

No developmental disabilities were reported.

Child Measures

EF Battery

Flanker task (Rueda et al., 2004). This task requires participants to focus on a central stimulus while inhibiting attention to stimuli flanking it. The version used in the current study, adapted for use with children, was administered on a computer with a touchscreen. Participants saw a row of five fish and were asked to 'feed' the middle fish by pressing a button that matches the way the middle fish is pointing. In congruent trials, all the fish face the same way. In incongruent trials, the middle fish faces the opposite way from the others. Children first completed practice trials, with feedback. If the practice trials were completed successfully, children completed 25 test trials with the fish stimuli. If children completed 23 trials accurately they then completed 25 trials in which the fish were replaced with arrows. If children did not meet the criterion for accuracy, they completed 25 additional fish trials.

Dimensional Change Card Sort (DCCS; Zelazo et al., 2003). In the DCCS, two target pictures are presented that vary along two dimensions (e.g., shape and color). Participants are asked to match a series of bivalent test pictures (e.g., red crayons and blue trucks) to the target pictures, first according to one dimension (e.g. color, for which they are told, "If it's red, put it here, if it's blue, put it here") and then, after a number of trials, according to the other dimension (e.g., shape, for which they are told, "If it's a crayon, put it here, if it's a truck, put it here"). In the version used in the current study, the stimuli were similar to those described for the standard version, but the switch in dimension was indicated by a cue word (e.g. ‘shape’ or ‘color’) on a computer touchscreen, and participants were instructed to match the test picture to the correct target picture by pressing a button on the screen as quickly as possible. After completing a number of practice trials, children completed the standard version of the DCCS, including 5 preswitch and 5 postswitch trials. If they passed each of these phases of the task (4 out of 5 trials correct), 50 additional trials were administered in which they were asked to switch back and forth between sorting by shape and sorting by color, with one dimension dominant (i.e. a cue to sort by the dominant dimension was given on the majority of trials). The task included 40 dominant and 10 nondominant trials.

Self-Ordered Pointing Task (SOPT; Petrides & Milner, 1982). In the SOPT, participants are presented with a visual array of items over several trials. On each trial, the positions of the items change randomly. Participants were instructed to point to one item on the first trial, and to point to different items on subsequent trials, never pointing to the same item twice. In the current study, a computerized version of the task was administered in which participants indicated their choice on each trial using a touchscreen monitor. In each set different stimuli were used, including drawings of common objects, as in Petrides and Milner (1982). The number of pictures in the array increased by 1 per trial set (up to a maximum of 17). If a child erred on a particular trial set (i.e., points to an item previously pointed to), they received another trial set with the same number of pictures. If the child erred on 4 consecutive sets, testing was terminated.

Intellectual Functioning

The Weschler Preschool and Primary Scale of Intelligence (WPPSI; Weschler, 2002) is an intelligence test for use with children between 2 and 7 years. Two subtests, the vocabulary subtest and the matrix reasoning subtest, were used to generate estimates of IQ.

Emotional Stimuli

A set of 48 developmentally appropriate, negative pictures was selected for use in the current study. Twenty-five of the pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthburt, 2005). To supplement the IAPS pictures, an additional 24 were selected from an in-house set previously used with children. Two subsets of these pictures were randomly selected for the pre-training and post-training assessments. The pictures were selected to be developmentally appropriate (i.e. only mildly negative) and relevant to children (e.g. arguments, car accidents, hospital scenes, and pollution). Eighteen neutral pictures were also selected to establish a baseline level of responding for each participant.

Cognitive Tasks Influenced by Emotion

Children's Embedded Figures Test (Witkin et al., 1971). The CEFT is used to measure global and local processing in children. In this task, children were presented with a complex picture and asked to locate a specific shape within that picture. For example, children were asked to find a particular triangle in a larger, more complex picture of a house composed of many different shapes. Children were asked to complete an abbreviated version of the task that included 12 test items (Hardy, Eliot, & Burlingame, 1986).

Verbal fluency (Green & Noice, 1988). The verbal fluency task measures the spontaneous generation of words, which requires cognitive flexibility. Participants were instructed to name as many words as possible in 1 minute belonging to a specific category. Children were given two trials (animals and fruits).

Parent Measures

Temperament

Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001). The CBQ was designed to measure temperament in children aged 3 to 7 years. It is commonly used in studies examining effortful control in early childhood. Specifically, this questionnaire assesses of how various aspects of effortful control, such as inhibition, are translated into self-regulation in everyday contexts. Parents were given the full version and asked to report on their child's behaviors certain behaviors are of their child in the last six months (1-7 scale).

Coping with Negative Emotions

Coping with Children's Negative Emotions Scale (CCNES; Fabes, Eisenberg, Bernweig, 1990). The CCNES was designed to measure the degree to which parents perceive themselves as reactive to children's negative affect in distressing situations. Parents are presented with different scenarios and a number of different possible responses. For each potential response, parents were asked to indicate how likely they would be to respond in that way (1-7 scale).

Demographics

Parents were asked to complete a short demographics questionnaire.

Procedure

All parents gave informed consent for their children to participate. Children gave verbal assent. Participants were tested in a quiet room in the Zelazo Lab at the Institute of Child Development. Parents were asked to complete the CBQ, the CCNES, and the demographics form as their children participated in the study. The entire session was videotaped.

Intellectual functioning. Participants first completed two subscales, matrix reasoning and then vocabulary, from the WPPSI. The two scales were administered in a standard order to as to best examine individual differences in performance.

Pretraining assessment. Following completion of the WPPSI measures, children were randomly assigned to either reappraisal training or the control condition. Both tasks were administered on a computer. Before the task, children were instructed on how to use the SAM using instructions adapted from the standard instructions for children (Lang, Bradley, & Cuthbert, 2005; See Appendix C). The pleasure scale shows SAM smiling at one extreme and frowning at the other. A sleeping figure at the calm end of the scale and a figure jumping at the other represent arousal. Throughout the instructions, children were asked questions to confirm that they had understood the instructions (e.g. Which

SAM do you point to if the picture is happy?). Children were asked to indicate their responses by pointing to the appropriate figure and given 3 practice trials. Each response was recorded by the experimenter. Children were also asked to indicate their current emotional state using the SAM scale.

Prior to training, children viewed were asked to describe 9 neutral pictures, randomly selected from a pool of 18, to establish a baseline for each participant. After a brief reminder of the instructions, children were then asked to describe 9 negative pictures to establish each child's initial physiological response to negative pictures. Each picture was presented on a computer screen for 8000 ms as EDA was recorded. After each picture, children were asked to rate valence and arousal using the SAM scale.
In both the pre-training assessment and the post-training assessment, EDA was measured using a BIOPAC system. This physiological measure is known to vary with sweat gland activity due to stress, arousal, or emotional excitement. Two Ag/AgCl electrodes filled with isotonic paste were attached to the distal surfaces of the index and middle fingers (i.e. the tips of the fingers) of the left hand. Children were asked to rest their hand on a handprint attached to the table to ensure their hand remained as still as possible. Software accompanying the system recorded stimulus events as well as the ongoing electrodermal response.

Training. After the pre-training assessment, participants were trained (see Appendix D). For participants assigned to the reappraisal condition, the examiner explained that sometimes when something makes us feel upset, we can change our feelings by thinking about it in a different way. The examiner suggested that "we can think of a story about why something in the picture is not that bad at all. Maybe the people are just pretending, like in a movie." The examiner then reappraised five pictures him or herself, to provide a model for the child. For example, for a picture of a child in the hospital, the examiner suggested that she would be better soon. After the experimenter provided examples, the participant was asked to reappraise five pictures him or herself. The child was asked to generate a reappraisal out loud, so the examiner could determine whether or not the reappraisal was appropriate. As in previous work with adults (e.g. Ochsner et al., 2002), the examiner coached and guided the child to ensure he or she could appropriately reappraise.

In the control condition, children were trained to complete an irrelevant classification task in which they were required to determine which object in a group does not belong. After the experimenter completed five examples, children completed five trials on their own. The script for the control condition was closely matched to the reappraisal training script.

Posttraining assessment. After receiving training, children viewed a second set of 9 negative pictures on the computer screen. As in the pre-training assessment, EDA was recorded. Children who received the reappraisal training were instructed to reappraise each picture. Children who received the control training were asked to describe the contents of each picture. In both conditions, children were asked to respond to the picture aloud. Following each picture, valence and arousal were rated using the SAM.

Tasks influenced by mood. Following the reappraisal task, participants completed the CEFT and the verbal fluency task. The CEFT was administered according to the procedures outlined in the manual (Witkin et al., 1971). The task was administered in two phases. In the first phase, children were asked to locate a triangle within a larger picture.

Children had to complete 2 consecutive practice trials correctly, up to a maximum of 4. Following the practice trials, 5 test trials were administered. Participants then completed a second, similar, phase in which they had to locate a house within a larger image. Participants were administered additional practice trials followed by 7 test trials. All trials were untimed.

In the verbal fluency task, children were asked to name as many different category exemplars (animals and fruits) as they could think of in 1 minute. Children's responses were recorded by the experimenter and trials were timed using a stopwatch.

These tasks were administered in counterbalanced order across participants.

EF battery. Finally, children completed the three computer-based measures of EF. The EF tasks were given in standard order (DCCS, SOPT, Flanker) so as to best examine individual differences in these tasks.

Following the study, children and their parents received their compensation and were debriefed. Parents were paid $5 to cover travel expenses, and children received a small toy.

Quantification of Measures

EF Battery

The computerized EF tasks recorded both reaction time and accuracy. However, reaction time in young children is often difficult to interpret due to excessive variability. Therefore, for each of the EF measures accuracy was considered the main outcome variable.

Children's performance on the DCCS task was classified into four categories reflecting their highest level of performance. Children who passed the pre-switch only (4 out of 5 trials correct) were given a score of 1. Children who passed the post-switch (4 out of 5 trials correct), but no other phase of the task, were given a score of 2. Children who passed the dominant trials of the mixed phase (38 out of 40 correct), but not the non-dominant trials, received a score of 3. Children who passed the non-dominant trials (9 out of 10 correct), but not the dominant trials, received a score of 4. Children who passed both the dominant and non-dominant trials received a score of 5.

Performance on the Flanker task was scored in terms of correct congruent and incongruent trials. The difference in median reaction time for congruent and incongruent trials was also calculated.

Performance on SOPT was scored as the number of items in the largest set children completed correctly.

Intellectual Functioning

Raw scores were calculated for both the vocabulary and matrix reason subscales. Scaled scores, which were used in the analysis, were generated based on the WPPSI manual.

Verbal Fluency

Verbal fluency was scored as the total number of items generated that validly represented the two categories (i.e. the sum of the animals and fruits generated). These scores were then corrected for the typicality of the items generated. Posnansky (1978) generated frequency norms for a number of different categories based on how often each exemplar was mentioned by a sample of 375 children between grades 2 and 6. Although the children in this study were slightly older than the children in the current study, they generated similar responses. A low score on these scales indicates that an exemplar was mentioned infrequently when children were asked to name instances of a given category. A score corrected for typicality was obtained for each participant by multiplying each response by the total frequency score calculated by Posansky.

CEFT

Each item was scored as either 1 or 0. A score of 1 was given only when the first choice was correct. Because the version administered had 12 items, the maximum number of points was 12.

Skin Conductance Response

A MATLAB script was used to locate and mark SCRs, including the onset and peak of the waveform, after which each data file was hand edited to ensure proper placement. For each trial, the first response occurring 1000 ms post-stimulus was scored. If a response began before stimulus presentation, a unique response onset was defined by a change of trajectory for > .5 seconds. In defining the peak, the criteria were such that the amplitude had to be greater than .02 microSiemens (µS) above the response start amplitude, although, considering the mild nature of the stimuli, a clearly defined peak smaller than .02 µS was considered acceptable. Trials containing no discernable response, or excessive artifacts, were rejected. Only data from participants who generated at least 3 scoreable responses per block were retained for analysis. The amplitude of the SCR was measured by subtracting amplitude at onset from amplitude at peak.

Quality of Reappraisal

Using the videotapes for each session, each reappraisal was transcribed and the quality of the reappraisal was coded (see Appendix E).

If children did not generate any re-evaluation or reappraisal of the picture, and did not engage with emotional content of the picture, the reappraisal was coded as a 0. This included failures to generate a reappraisal (e.g. “I don’t know”), or descriptions of details in the picture (e.g. “It’s sunny”). If the reappraisal was such that the child did engage with the emotional content of the picture, but the reappraisal was minimal or deemed unlikely to alter emotional impact, it was coded as a 1. This included minimizations (e.g. “It’s just a snake”), very vague reappraisals (e.g. “Goes away”), reappraisals that did not make sense in the context of the picture or were very difficult to interpret (e.g. “Because they are going to get a new ride” in response to a picture of children fighting), or contradictory reappraisals where the child initially gives a more negative interpretation of the picture (e.g. “He’s trying to eat people, he can stop”). Reappraisals that suggested the child engaged with the emotional content of the picture and thought about the picture in a way that constituted a reappraisal and/or re-evaluation likely to alter emotional impact were coded a 2. These included future-oriented reappraisals in which the child suggested a way in which the situation would become better, and/or a positive event that might happen subsequently (a happy ending), and present oriented reappraisals in which the child suggested a reason why the picture was not so bad. Reasons the picture was not so bad included suggestions that the threat was minimal, something had happened before to lessen negative impact, or there was some sort of positive benefit associated with the picture.

For each participant, the mean score across appraisals was calculated. Two coders assessed a subset of reappraisals to assess inter-rater reliability. Each coder was trained using a portion of the sessions and then coded the remaining portion (approximately half). Using this method, 100% of cases were recoded. Inter-rater reliability was assessed using Kappa, ĸ = 0.73. The level of reliability is comparable to previous research using a somewhat similar coding scheme designed to classify emotion regulation strategies generated by preschoolers (Cole et al., 2009).

Self-Reported Affect and Arousal

Median scores for affect and arousal in response to the negative pictures were calculated for each phase of the training task, including the neutral block, the pre-training block, and the post-training block.

Children's Behavior Questionnaire

The CBQ consists of 15 subscales, which can be used to calculate scores for three broad dimensions of temperament. As recommended by the authors of the CBQ, scores for Effortful Control were computed from the scales of Low-Intensity Pleasure, Inhibitory Control, Perceptual Sensitivity, and Attentional Focusing. Surgency scores were calculated from the scales of Impulsivity, Approach, High-Intensity Pleasure, Smiling/Laughter, Shyness (negatively scored), and Activity Level. Negative Affect scores were derived from the scales of Discomfort, Fear, Anger/Frustration, Soothability (negatively scored), and Sadness.

Coping with Children's Negative Emotions Scale

The CCNES was scored according to procedures suggested by the authors. The instrument includes 6 subscales: Distress Reactions (parental distress in response to the child's negative emotion), Punitive Reactions (the degree to which parents use punitive reactions in response to children's negative emotion), Expressive Encouragement (whether parents encourage children to express negative feelings and validate those feelings), Emotion Focused Reactions (the extent to which parents use strategies designed to influence their children's negative emotions in order to help them feel better), Problem Focused Reactions (whether parents tend to help the child solve the problem related to their distress) and Minimization Reactions (the degree to which parents minimize the situation and the child's emotion reaction). The mean for each subscale was calculated.

Results

Assessment of Baseline Responding

In the pretraining assessment, children were expected to generate larger average SCRs in response to negative pictures than in response to neutral pictures. A 2(valence: neutral, negative) x 2(gender) mixed model ANOVA[1] revealed the expected effect of valence, $F(1, 66) = 24.67$, $p < .05$, partial $\eta^2 = .27$. There was no effect of gender. Thus,

[1] Age (based on a median split) was included in initial analyses, but there were no significant effects of age in relation to condition, and age was therefore not included in the final analyses.

as expected, children generated higher amplitude SCRs in response to the negative pictures (*M* = .031 µS, *SD* = .016) than to the neutral pictures (*M* = .024 µS, *SD* = .011).

Efficacy of Reappraisal Training

Skin conductance response. Reappraisal training was expected to be associated with a reduction in SCR amplitude following the training, whereas no change was expected in the control condition. A 2(Condition: reappraisal training, control training) x 2(Block: pre-training, post-training) x 2(gender) mixed model ANOVA revealed a main effect of block, $F(1, 64) = 15.28$, $p < .05$, partial $\eta^2 = .19$. In general, the amplitude of the SCR was higher in the post-training block (*M* = .036, *SD* = .019) than the pre-training block (*M* = .031, *SD* = .016). However, this main effect was qualified by a Block x Condition interaction, $F(1, 64) = 12.86$, $p < .05$, partial $\eta^2 = .17$, as well as a Block x Condition x Gender interaction, $F(1, 64) = 4.44$, $p < .05$, partial $\eta^2 = .07$, see Figure 2. This pattern suggests that for children who received the reappraisal training, there was no difference in SCR amplitude between the pre-training block and the post-training block for either boys, $t(18) = .76$, *ns*, or girls, $t(18) = .64$, *ns*. However, for children in the control condition, there was a significant increase in SCR amplitude between the pre-training block and the post-training block for boys, $t(18) = 3.64$, $p < .05$, and a marginally significant increase for girls, $t(18) = 2.10$, $p = .051$. Thus, reappraisal training did not significantly reduce SCR amplitude, but did attenuate the pattern of increasing amplitude observed in the control condition.

Self-reported valence and arousal. In addition to the expected physiological effects, children who received the reappraisal training were expected to report a decrease in subjective arousal after training. Self-reported affect was not expected to change following reappraisal training, as the valence of the pictures remained constant. A 2(valence: neutral, negative) x 2(gender) mixed model ANOVA[2] examined whether children rated neutral and negative pictures differently. The analysis revealed no significant effects of either block or gender. Thus, children's average ratings of the neutral pictures (M = 3.59, SD = .89) was not different from their average ratings of the negative pictures (M = 3.57, SD = .86). Children's ratings of arousal were submitted to the same analysis, with similar results. Children's ratings of neutral pictures (M = 3.4, SD = 1.04) were not different from their ratings of negative pictures (M = 3.5, SD = 1.13).

Similar analyses examined whether children's ratings of valence and arousal of negative pictures changed between the pre-training and post-training blocks. A 2(Condition: reappraisal training, control training) x 2(Block: pre-training, post-training) x 2(gender) mixed model ANOVA found that ratings of valence decreased (i.e. became less negative) between the pre-training and post-training block, $F(1, 79)$ = 62. 83, $p < .05$, partial $\eta^2 = .44$. However, there were no significant effects of either gender or condition, suggesting that this decrease in rating was evident for children in the reappraisal condition and children in the control condition. Similar effects were found for arousal, with a significant effect of block, $F(1, 79) = 10.19$, $p < .05$, partial $\eta^2 = .11$, and no other significant effects. These results suggest that while subjective reports of valence and arousal decreased over the course of the task, these decreases were not related to training.

[2] The analyses of valence and arousal ratings included all children, whether or not they provided usable physiological data. The results were the same when only those children who provided usable physiological data were included.

However, these results should be interpreted with caution, given that children did not rate the neutral pictures differently from the negative pictures, suggesting they may have had difficulty understanding the scale.

Performance on tasks influenced by mood. Reappraisal training was also expected to influence performance on the CEFT and the verbal fluency task. In line with previous research on the effects of mood on the CEFT and verbal fluency, children who were asked to reappraise negative pictures were expected to perform worse on the CEFT (i.e. fewer embedded figures correctly located) and better on the verbal fluency task (i.e. more items generated, more atypical items) than children in the comparison condition. Because administration of the tasks was counterbalanced, and the duration of mood manipulations is typically short (Brenner, 2000), order was included as a variable, with the expectation that effects may only be evident on the first task administered. No gender effects were expected.

A 2(training: reappraisal, control) x 2 (gender) x 2(order) ANOVA examining total score on the CEFT found no significant effects, suggesting that training did not influence children's performance on the CEFT.

A 2(training condition: reappraisal, control) x 2 (gender) x 2(order) ANOVA examining children's total score on the verbal fluency task found a significant Order x Condition interaction, $F(1, 75) = 7.17$, $p < .05$, partial $\eta^2 = .09$. Thus, when the verbal fluency task was administered first, children in the reappraisal condition ($M = 16.57$, $SD = 4.92$) performed better on the verbal fluency task than children in the control condition ($M = 12.50$, $SD = 4.66$; See Figure 3). Near identical results were found when scores were adjusted for typicality of items, $F(1, 75) = 7.06$, $p < .05$, partial $\eta^2 = .09$. Overall, children trained to reappraise pictures subsequently performed better on the verbal fluency task, but only when the task was administered first, suggesting that they were in a less negative mood following the training task, but that the effect of mood dissipated quickly.

Correlates of Reappraisal Efficacy

As predicted, there was an effect of reappraisal on the amplitude of children's SCRs. However, this effect was not evident as a reduction in mean SCR amplitude, but as an attenuation of increasing mean amplitude. This pattern was reflected in the small, positive mean difference in amplitude between the two blocks (*M* = 0.0004, *SD* = 0.001). However, 16 of the 36 participants in the reappraisal condition did have negative difference scores between the pre-training and post-training block. Thus, despite this absence in an overall significant reduction, correlational analyses explored a possible relation between individual differences in EF and the difference in mean SCR amplitude before and after reappraisal training (see Table 1). However, there was no significant relation between differences in amplitude pre- and post-training and any measure of EF.

There was also no significant relation between differences in SCR amplitude and effortful control. Furthermore, there was no relation between differences in SCR amplitude and parent-reported tendency to use emotion focused reactions in response to their children's negative emotions.

Finally, there was no relation between mean differences in SCR amplitude between blocks and quality of reappraisal, nor was there any relation between quality of reappraisal and EF.

Discussion

Although reappraisal has been studied extensively in adults, there is only limited research on the development of this ability in children. Therefore, the current study used a systematic, multi-method approach to understanding children's ability to reappraise a range of emotional stimuli. Children who were trained to reappraise emotional stimuli demonstrated attenuated emotional reactivity to negative stimuli relative to children in the control condition, as evidenced by an attenuated physiological response. Furthermore, reappraisal training lead to enhanced performance on the verbal fluency task, known to be influenced by positive mood, although this effect was short in duration, and only evident when the task was administered directly after the post-training assessment.

Contrary to hypothesis, there was no reduction in self-reported valence and arousal associated with reappraisal training, and there was no relation between physiological responding and reappraisal quality, EF, temperament, or parenting.

Effects of Reappraisal

There is extensive evidence from multiple sources, including reduced activation in areas of the brain associated with emotional processing and a decrease in physiological responding to emotional stimuli, that reappraisal is associated with effective emotional regulation in adults. However, there has been only minimal work examining the effects of reappraisal in young children. The current study suggests that reappraisal training does influence children's physiological response to emotional stimuli. Children who received the training maintained a steady level of physiological responding, whereas children in the control condition showed a pattern of rising amplitude in response to the negative pictures. It appeared that while children in the control condition were increasingly affected by the negative stimuli, generating larger amplitude SCRs in the post-training block, reappraisal training buffered these effects, and children who reappraised the pictures did not show this same pattern. Thus, the current results suggest that reappraisal was an effective means of influencing children's reaction to negative pictures.

The results from children's self-reported valence and arousal were not as clear. Although the SAM scale has been used with children as young as 5 years (Hajcak & Dennis, 2009), other research has found that children this young have difficulty subjectively rating valence and arousal (Dennis & Hajcak, 2009). In the current study, there was no difference between children's ratings of the neutral pictures and their ratings of the negative pictures, a finding which suggests that children may not have fully understood the SAM scale, despite efforts to ensure that they did. Given that the ratings of neutral pictures were included to ensure that children understood the scale, it is difficult to interpret their subsequent ratings. Further contributing to the difficulty in interpreting these results is the contrast between the findings from the SAM scale and the physiological data. The decline in mean rating between the pre- and post-training blocks did not interact with condition, and differed from the pattern evident in the physiological data, which suggested an overall pattern of steady or increasing SCR amplitude, depending on condition. This pattern of less negative ratings may have been due to problems understanding the SAM scale or children's difficulty reporting their own emotional responses. Even in work with adults, physiological changes are generally considered the more valid measure of the effects of reappraisal, because they do not depend on participant's understanding of a rating scale, and are relatively immune to demand characteristics.

In addition to examining the effects of reappraisal on physiological responding and subjective valence and arousal, the current study also included two tasks known to be influenced by mood administered after the training task. To the extent that children in the reappraisal condition were in a less negative mood than children in the control condition, they were expected to show better performance on the verbal fluency task and worse performance on the CEFT. As predicted, children who received the reappraisal training subsequently generated more items during the verbal fluency task than children in the control condition. However, the CEFT and verbal fluency tasks were administered in counterbalanced order, and this effect was only evident when the verbal fluency task was administered first. Thus, as has been found in previous research, the effects of mood were fleeting (Brenner, 2000). This relatively brief effect of mood may explain the lack of a significant difference in performance on the CEFT. The instructions for the verbal fluency task were very short, and could be administered quickly. The instructions for the CEFT, on the other hand, required more explanation and several practice trials. By the time the test trials were administered, the effect of mood may have already been diminished. Another possibility is that while children in the control condition may have been in a relatively less positive mood than children in the reappraisal condition, they may not have been in a strongly negative mood, which may have attenuated any effect on performance on the CEFT.

Correlates of Reappraisal Efficacy

Reappraisal training was expected to be generally effective, but it was also expected that there would be individual differences in children's ability to implement the training. Specifically, it was predicted that reappraisal efficacy would be influenced by both child factors, such as EF and temperament, and parent factors, such as the extent to which parents encourage emotion focused responses to negative affect. However, contrary to prediction, there were no significant individual differences in the ability to implement reappraisal. Furthermore, there were no significant effects of reappraisal quality. These null results must be considered in light of the relatively small sample size, and may be the result of a lack of power. However, work with adults and older children has examined the tendency to use reappraisal as a trait-like characteristic, which is related to emotion regulation both in the lab and in everyday life (Gross & John, 2003), but there has been less work examining how individual differences more generally are related to reappraisal efficacy.

Reappraisal has often been associated with areas of PFC typically associated with cognitive control, but there has been only limited work examining individual differences in adults in the ability to implement reappraisal effectively. There is some evidence that subject changes in arousal are linked to changes in neural activation (Banks et al., 2007), but there is no work examining the relation between the physiological and neural changes associated with reappraisal and other, related, abilities. Specifically, no study has linked performance on behavioral EF tasks to reappraisal efficacy, either in terms of neural activation or self-reported changes in valence and arousal. The current research found that although 5-year-old children were able to generate reappraisals in response to negative stimuli, there was no link between reappraisal efficacy, as measured by changes in physiological responding, and performance on behavioral measures of EF. Five-year-old children had the cognitive ability to generate reappraisals, which were related to physiological responding, but differences in the ability to do so were not related to EF. Although there may not have been adequate power to detect differences, it is also possible that given that there was only minimal training, children tended to have a similar, baseline level of ability that allowed them to implement reappraisal, but with minimal individual differences in effectiveness. With development, or further training, individual differences may have been more evident.

From work with adults, it is clear that there are individual differences in the self-reported tendency to reappraise. Indeed, these differences have been studied as a trait-like characteristic, and there is some relation between the tendency to report the use of reappraisal in everyday life and other aspects of personality. Specifically, the tendency to use reappraisal is negatively related to neuroticism, and modestly, positively related to extraversion, agreeableness, conscientiousness, and openness (Gross & John, 2003). There has also been some work examining personality differences in relation to reappraisal efficacy. Ray and colleagues (2005) found that trait rumination was associated with specific patterns of neural activation; specifically, individuals high in trait rumination tended to show greater amygdala activation when purposefully increasingly negative emotion, and greater decreases in areas of PFC associated with self-focused processing when purposefully decreasing negative emotion. These lines of research suggest that there may be some relation between personality and the ability to implement reappraisal, but in the current study there were no significant relations between temperament and reappraisal efficacy. Given the modest correlations between the tendency to reappraise and other aspects of personality in adults, a larger sample may have revealed similar results. Another possibility is that reappraisal may be best considered independent from other aspects of temperament. Further work is needed to examine how personality and self-reported reappraisal tendencies relate to physiological and neural measures of reappraisal efficacy in both children and adults.

In addition to child-factors, the current study also examined the role of parenting in reappraisal efficacy. Because parents play an important role in the socialization of emotion (Cassidy, 1994; Morris, Silk, Steinberg, Myers, & Robinson, 2007), the efficacy with which children were able to implement reappraisal was expected to be influenced by the extent to which parents reported using emotion focused responses to their child's negative affect. However, no significant relation was found. There may be methodological reasons for this null result, such as the relatively small sample, or the possibility that parents did not accurately report their use of various parenting strategies. It also may be the case that parenting had little effect in this particular situation. Specifically, the current sample was composed of typically developing children with relatively high functioning families. Not only does this suggest limited variance in socialization, it also suggests that with the benefit of direct training, these children may have had the ability to implement new strategy for regulation emotion with little effect of differences in parenting. The effect of parenting on reappraisal efficacy may have been more evident earlier in development, when children's regulatory abilities may have been more variable and parents play more of a role in emotion regulation, or later in development, when the ability to implement reappraisal becomes more trait-like, and socialization may have more of an effect on reappraisal efficacy.

Implications, Limitations, and Future Directions

The ability to effectively regulate emotion is a critical developmental task, related to significant outcomes, that young children often have difficulty mastering. The current results suggest that reappraisal may be an effective means of encouraging even young children to modulate their emotion. Building on the extensive research demonstrating the efficacy of reappraisal for adults, the results suggest that children, with direct instruction, can also implement reappraisal. Given that extensive work with adults has demonstrated reappraisal is a particularly adaptive and flexibly means of emotion regulation, it is critical that research explore the developmental time course of this ability, including various avenues of encouraging constructive emotion regulation.

This study represents a first step in understanding the developmental time course of reappraisal. However, the current study included only one age group, and no measure of children's existing tendencies to use various emotional strategies. Although it is clear that even young children can implement reappraisal in the context of specific training, it remains unclear whether young children spontaneously use reappraisal to modulate their emotions. In general, the evidence on whether children understand the link between cognition and emotion is mixed. There is some evidence that children have difficulty recognizing emotions can be modified internally (Flavell et al., 2001), there is also some suggestion even preschool children will spontaneously suggest strategies to regulate emotion that involve cognitive processes (e.g. thinking about something else), although Cole and colleagues (2009) found that strategy generation was not a particularly good predictor of actual emotion regulation. Future work should continue to examine the time course of the development of reappraisal, including the age at which children spontaneously engage in reappraisal, and the age at which the tendency to do so becomes trait-like. Work such as this may also serve to further elucidate the role of individual differences, such as personality and temperament, in reappraisal efficacy.

The current study, as with most research involving adults, involved only a relatively minimal intervention. In the interest of encouraging emotion regulation in children, future research should examine the potential of more extensive training on the extent to which children use reappraisal in an effective way. It remains unclear whether even this short intervention could have long term effects on how children approach emotional situations, or whether a more extensive training program could result in long term effects. This sort of intervention might be particularly important in the context of mood disorders and behavioral problems, where ineffective emotion regulation is often thought to be an underlying cause of difficulties.

It is clear that reappraisal can function as a direct, effective way of regulating emotion. However, reappraisal represents an approach to emotion regulation that is implemented in a relatively top-down way. In the current study, children were able to reappraise pictures when directly instructed to do so. Often, in emotionally salient contexts, individuals may not have the resources to engage in top-down emotion regulation. Although it is clear that early in life there are important indirect influences on emotion regulation, such as caregivers (Sroufe, 1997), as children develop and emotion regulation becomes increasingly internalized, there has been little acknowledgement of the important role that more indirect influences may continue to play. Children may be able to implement emotion regulation in a top-down way, but this capacity may not operate efficiently in all circumstances.

Emerging work with adults suggests that indirect forms of emotion regulation play an important role across the lifespan. In fact, Gross (2008) suggested that the study of automatic influences on emotion regulation represents an exciting new direction for research. Mauss, Bunge, and Gross (2007) suggest that relatively automatic emotion regulation is a part of everyday life, although research has largely neglected this potentially important influence on affective experience. To address this lack, a second study examined the development of emotion regulation across childhood through an investigation of a relatively indirect approach to emotion regulation. Unlike reappraisal, which has been demonstrated in older children, there is almost no work examining relatively indirect influences on emotion regulation in children. Thus, Study 2 used EEG to investigate the time course and processes underlying indirect emotion regulation across middle childhood. Not only does this allow for an investigation of the development of indirect emotion regulation across development, the variance associated with examining a range of ages may offer a more powerful means to examine relations between individual differences in EF and temperament and successful emotion regulation.

Chapter 3

Study 2

A. Indirect Approaches to Emotion Regulation in Adults

1. *Experimental Investigations of Indirect Approaches to Emotion Regulation*

It is evident from several lines of research that direct approaches to emotion regulation, such as specific training or instructions to reappraise emotional stimuli, can lead to effective regulation in adults. However, regulation does not always occur in the context of direct attempts to modulation emotion, but often as the result of relatively indirect influences. As outlined by Zelazo and Cunningham (2007), emotion regulation may be a goal in itself, as is the case in research examining how emotional responses are modulated in response to direct instructions to reappraise; at other times, emotion regulation may not be a primary goal, but may occur in the service of a specific task that must be accomplished, or as the result of changing processing demands. In an effort to gain a broader understanding of emotion regulation in development, the current study examined the impact of relatively indirect approach to emotion regulation across middle childhood.

There are a number of ways that emotion regulation may be influenced relatively indirectly. The approach to influencing behavior indirectly that has arguably received the most attention is priming. For example, Mauss, Cook, and Gross (2007) primed participants with words related to either emotion expression or emotion control as they completed a scrambled sentence task. Anger was then provoked by having participants work on a difficult, tedious task as the experimenter made increasingly irritated remarks. Participants who were primed with emotion control words subsequently reported less anger than participants primed with emotion expression words, suggesting that priming emotion regulation was effective at reducing affective responses. A second study found that the indirect priming of emotional control was not associated with maladaptive physiological responding. While priming represents perhaps the prototypical example of an indirect influence, the growing interest in indirect approaches to emotion regulation (Mauss, Bunge, & Gross, 2007) suggests that in addition to priming, there are a number of other relatively indirect ways to influence thought and behavior in the context of emotion.

Work with adults using a number of different methods suggests that task instructions that vary in the extent to which they require one to attend to the valence of a particular stimulus can influence emotional responding. Using fMRI, Hariri, Bookheimer, and Mazziotta (2000) asked participants to either label emotional faces with an appropriate emotional label, or to match faces based on emotional expression. Perceptually matching expressions, versus labeling expressions, was associated with increased signal in the amygdala. Labeling emotional expressions, versus matching expressions, was associated with decreased signal in the amygdala and increased signal in right PFC. A follow-up study (Hariri, Mattay, Tessitoire, Fera, & Weinberger, 2003) found similar results when a range of emotional stimuli were presented, and participants were asked to match identical emotional pictures or to judge whether the content of the pictures was natural or artificial. Whereas perceptual matching was associated with increased amygdala activity, non-emotional judgments were associated with decreased activity in the amygdala and increased activity in right PFC. These results suggest that, similar to more direct approaches, processing emotional information in a relatively unemotional way can lead to modulation of emotional responding.

Northoff and colleagues (2004) also used fMRI to examine the neural activation associated with making more or less affective judgments in response to emotional stimuli. Specifically, participants were shown negative, neutral, and positive photographs and asked to judge whether the content was positive or negative, whether feeling was present or absent during picture viewing, or whether the photograph was in portrait or landscape format. The non-emotional judgment task was associated with relative signal increases in lateral areas of ventral and dorsal PFC, whereas the emotion judgment tasks were associated with a relative increase in activation of medial areas of ventral and dorsal medial PFC. These differences were primarily due to greater absolute signal changes in the context of the non-emotional judgment, with larger increases in lateral PFC and larger decreases in medial PFC compared to baseline (the intertrial interval). Emotional judgments, on the other hand, were associated with neural activation more similar to that observed at baseline, suggesting the stimuli were processed relatively automatically, with limited reflective processing. In general, the results from neuroimaging work suggest that indirect approaches to emotion regulation, in the form of varying task instructions, are associated with patterns of neural modulation similar to those observed in response to more direct instructions (e.g. Ochsner et al., 2002).

In addition to work using fMRI, a number of studies have used EEG to examine the effects of emotional arousal and regulation on neural activity. In particular, the late positive potential (LPP) is a waveform typically seen in response to both positive and negative arousing stimuli. A positive deflection is evident at approximately 250 ms after the presentation of emotionally arousing stimuli at midline parietal sites, with the LPP relatively sustained compared to the more transient P3 component and maximal at approximately 500 ms post-stimulus (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000). Although the LPP is associated with emotional arousal, emerging research suggests that the LPP can be modulated by relatively direct, top-down control processes.

For example, Hajcak and Nieuwenhuis (2006) recorded EEG as participants were cued to either attend to or reappraise emotional pictures. Reappraisal was associated with a reliable reduction in the amplitude of the LPP, and the magnitude of this reduction was correlated to self-reported decreases in emotional intensity following reappraisal. In addition to evidence suggesting that the LPP can be modulated by direct instructions to regulate emotion, there is also evidence to suggest that similar emotional modulation can be achieved through more indirect approaches.

Cunningham, Espinet, DeYoung, and Zelazo (2005) found that when participants were asked to judge whether various affectively salient concepts were abstract or concrete, the amplitude of the LPP was attenuated relative to when participants were asked to decide whether each concept was good or bad. Hajcak, Moser, and Simons (2006) found that the amplitude of the LPP was greater when participants were asked to judge whether or not emotional pictures were pleasant or unpleasant, relative to when participants were asked to judge whether or not there was a person in the picture. Both of these studies suggest that asking adults to attend to non-emotional aspects of the stimuli leads to a reduction in emotional responding. Even though participants are never directly instructed to regulate their emotions, adults are able to shift attention away from the emotional content of a stimulus in the context of a non-affective processing goal.

Although the focus of the current study was the LPP, the P3 is a related, earlier component, which may reflect similar processes to the later, slower wave component (Kok, 1997). The P3, typically maximal at approximately 300 ms post-stimulus at parietal sites, is modulated by emotional stimuli, both in the context of passive viewing (Keil et al., 2002) or when emotional stimuli are presented as distracters in an oddball task (Delplanque, Silvert, Hot, & Sequeira, 2005). The majority of this work has been done with adults, although there is evidence for an effect of valence on the amplitude of the P3 in children, particularly in response to emotional faces (Kestenbaum & Nelson, 1992; Pollak, Cicchetti, Klorman, & Brumaghim, 1997; Pollak & Tolley-Schell, 2003). However, there is some debate regarding whether the P3 can be functionally differentiated from the LPP (Foti, Hajcak, & Dien, 2009). Outside of the work on face processing, there is relatively little research examining this component in relation to how children process emotional stimuli, particularly in the context of changing processing goals.

2. *Individual Differences in the Efficacy of Indirect Approaches to Emotion Regulation*

Although adults are generally capable of implementing both direct and indirect forms of emotion regulation, the relative efficacy of direct and indirect processes may vary depending on the particular context. Zelazo (2004) suggests that although adults are capable of high level reflective thought, contextual factors such as fatigue or time constraints may result in lower order, less reflective processing. In these situations, the relative influence of explicit and implicit processes on behavior may shift, with explicit influences becoming less effective and indirect influences proving more effective. For example, reliance on stereotypes, which are thought to be the result of relatively shallow processing based on sometimes subtle environmental cues, increases when time is limited (e.g. Kruglanski & Freund, 1983) or in the context of cognitive load (e.g., Macrae, Hewstone, & Griffiths, 1993).

There may also be critical individual differences that have a more enduring influence on the extent to which adults are capable of implementing direct emotion regulation. Williams, Bargh, Nocera, and Gray (in press) used the Emotion Regulation Questionnaire to examine how individual differences in the tendency to use reappraisal influenced the efficacy of different instruction types. The results demonstrated that for people who reported using reappraisal frequently in their daily lives, providing explicit instructions to reappraise and priming reappraisal using a scrambled sentence task containing words such as 'reassessed' and 'perspective' were equally effective at reducing physiological reactivity. However, for participants who reported infrequent use of reappraisal strategies, priming emotion regulation resulted in more successful emotion regulation than did explicit instructions, suggesting that indirectly activated goals may be particularly effective for individuals who have relatively less experience with intentional implementation of emotion regulation.

B. Indirect Approaches to Emotion Regulation in Children

Although there has not been a great deal of work examining individual differences in the efficacy of various approaches to emotion regulation, there is some evidence to suggest that the efficacy of different approaches to emotion regulation interacts with experience applying different strategies. In addition to trait-like individual differences in adults, neural and cognitive functionality in the context of developmental change may also influence the relative efficacy of direct and indirect approaches to emotion regulation. Given extensive research suggesting children have difficulty engaging in goal-directed behavior (Zelazo et al., 2008), indirect approaches may be an important influence on emotion regulation over the course of development.

Currently, there is very little work examining relatively indirect influences on behavior in children, although there is some suggestion that even young children respond to the effects of priming (Over & Carpenter, 2009). The investigation of indirect approaches offers the opportunity to investigate a wider range of influences on emotion regulation in children. Clearly, the ability to internally regulate one's own emotions is a critical developmental task. However, it may be unrealistic to expect this capacity to operate efficiently in all circumstances. As children develop, and gain more experience regulating emotion, well-practiced forms of regulation may be implemented in less effortful ways and in the absence of direct instructions. For both children and adults, there is likely to be an optimal balance of direct and indirect forms of emotion regulation, which may change over the course of development. Although there are clear individual differences in the extent to which children are able to regulate their emotion, there has been no work examining systematic changes in the ability to implement emotion regulation in the context of changing processing goals.

C. Potential Correlates of the Efficacy of Indirect Approaches to Emotion Regulation in Children

1. *Executive Function*

Given the limited research examining indirect influences on emotion regulation, particularly in children, it is currently unclear whether specific cognitive and temperamental characteristics are related to the ability to modulate emotional reactions given different processing goals. In general, the ability to regulate emotion improves with age. Thus, over the course of development, the influence of different types of task instructions on emotional arousal is likely to increase with age. As children proceed through elementary school, they encounter increasingly complex academic and social settings that require greater levels of self-control (Best, Miller, & Jones, 2009). However, any effect of age is likely to be the result of underlying neural and cognitive development, particularly in terms of EF. A reduction in emotional arousal as the result of making a non-affective decision about emotional stimuli requires a shift in attention away from the emotional content of the picture, a process that is likely to rely on EF. Variation in the ability to implement emotion regulation in response to changing task instructions may be particularly evident across middle childhood. Research has demonstrated marked increases in working memory, inhibition, and set shifting in children over the course of the school age years (Best et al., 2009; Luciana & Nelson, 1998).

2. *Temperament*

In addition to EF, trait-like tendencies to engage in emotional control may influence the efficacy with which changing processing goals can be implemented. In particular, effortful control, an aspect of temperament that reflects how well children control their thought and behavior in response to everyday situations, may influence how easily children respond to instructions that vary in the extent to which they require the processing of emotional content.

Temperament in middle childhood can be measured through the parent-report Temperament in Middle Childhood Questionnaire (TMCQ; Simonds, 2006). Although similar in design to the CBQ, there has been less research examining the TMCQ. Simonds, Kieras, Rueda, and Rothbart (2007) found that executive attention, as measured by a Flanker task, was related to both parent reported effortful control on the TMCQ and positive reactions to a disappointing gift. There was no significant relation between effortful control and emotion regulation, as measured by reaction to a disappointing gift. However, because emotion regulation was assessed using only one task, it remains unclear whether parent reported effortful control is related to emotion regulation in other contexts.

3. *Parenting*

One way children develop effective strategies is through external support that allows them to achieve goals that might be otherwise beyond their range of capabilities (Vygotsky, 1978). Often, this external support comes from parents. A number of studies suggest that children can be scaffolded to perform better on various kinds of tasks than their age and baseline level of performance would suggest (e.g. Bibok, Carpendale, & Muller, 2009; Landry, Miller-Loncar, Smith, & Swank, 2002). For example, Bibok and colleagues (2009) found that parents who guided their children's efforts to solve a complicated puzzle by using elaborative utterances were more successful at influencing children's ability to shift attention than parents who used more direct instructions. These results suggest that parents may influence how flexibly children respond to changes in task demands.

The extent to which parents are able to support the development of emotion regulation in the context of negative emotions may influence how effectively children are able to shift their attention away from the emotional content of stimuli when required to do so. In particular, the tendency of parents to encourage children to respond to emotional situations by modifying their emotions or addressing the problems may be related to how flexibly children respond to changing processing demands in the context of emotional stimuli.

D. The Current Study

To determine whether children are able to modulate their emotional reactions in the context of different processing goals, EEG was used to determine whether responses to emotional pictures change as a result of differing task demands (See Figure 4 for an outline of the study structure).Specifically, children viewed negative, positive, and neutral pictures in 3 blocks. In one block, children made affective judgments about the pictures, in a second block children made non-affective decisions about the pictures, and in a control block children responded to each picture by pressing a button.

It was expected that the evaluative response would be associated with the greatest amplitude LPP, and the control response, which did not require engagement with the content of the picture, was expected to be associated with a reduction in the amplitude of the LPP. Importantly, the modulation of emotion in response to tasks instructions was expected to develop across middle childhood. It was expected that older children, but not younger children, would show a diminished emotional response when asked to make non-affective judgments. Furthermore, because this attenuation of emotional arousal relies on the ability to shift one's attention away from the emotional content of pictures when that content is irrelevant, this ability was expected to be related to EF, controlling for age and general intellectual functioning. The reduction in emotional arousal associated with non-affective decisions was also expected to be related to parent-reported effortful control, which assesses the extent to which children tend to regulate their behavior in everyday day life, although EF, which was measured directly, was expected to be the stronger predictor. Adaptive parenting in the context of children's negative emotions was also expected to influence the extent to which children modulate their emotional responses as task instructions change.

Study 2a

In a preliminary study, participants were asked to provide ratings of valence and arousal for each picture. Often, emotional pictures are selected from the IAPS, which has been well validated in work with adults. However, many of the pictures included in the IAPS are not appropriate for use with children because they are either irrelevant or too graphic. The current study validated a set of 120 negative, positive, and neutral pictures appropriate for use with children.

Method

Participants

The study included 34 children (17 males; M = 9.92 years, range = 6.58 – 12.92 years). The ratings from an additional boy (12 years) were deleted due to a parent-reported developmental disability.

The final sample of 33 children was divided into 4 age groups: 6-year-olds (*n* = 5; 2 males; *M* = 6.65 years, range 6.58 - 6.75 years), 8-year-olds (*n* = 9, 5 males; *M* = 8.44 years, range 8.17 – 8.92 years), 10-year-olds (*n* = 9; 4 males; *M* = 10.22 years, range 9.92 – 10.92 years), and 12-year-olds (*n* = 10; 5 males; *M* = 12.60 years, range 12.50 to 12.92 years). Of the 6-year-old children, only 1 completed the rating task. The other 6-year-olds completed between 9 and 71 trials. These incomplete ratings were retained in the analysis.

Participants were recruited from the pool maintained by the Institute of Child Development. No ethnic information was reported for 4 participants. Of the children for whom the information was available, 87.9% were Caucasian and 12.1% were of mixed descent. The majority of children, 89%, were from two parent households. Most parents reported having some post-secondary education.

Materials

Children viewed a set of 120 negative, neutral, and positive pictures. Half of the pictures featured at least one person and half did not. The pictures featured both children and adults, and were selected to be relevant to children between 6 and 12 years. Examples of positive pictures include enjoyable activities (e.g. swimming, camping, sports), appealing animals (e.g. kittens, dolphins), and food (e.g. pizza, cake). As in Study 1, negative pictures included arguments, car accidents, hospital scenes, and pollution, as well as pictures relevant to school age children (e.g. homework, failing grades). Neutral pictures included household objects (e.g. basket, table) and everyday activities (e.g. walking, brushing teeth).

Procedure

After obtaining informed consent from the parent, and written assent from the child, parents were asked to complete a demographics form as their child participated in the study.

Each picture was presented on a computer screen, followed by two separate rating screens. Participants rated each picture in terms of valence and arousal using the 9-point SAM scale (1 = most positive, 9 = most negative; 1 = least arousing, 9 = most arousing). Children listened to a recording of the standard instructions for the SAM (Lang et al. 2005), and the experimenter clarified the task and answered any questions.

Following the study, children received $10, and both parents and children were debriefed.

Results and Discussion

To validate the selected stimuli, mixed model ANOVAs examined how children rated positive, neutral, and negative pictures in terms of valence and arousal. A 3(valence: negative, neutral, positive) x 4(age group: 6, 8, 10, 12) X 2(gender), revealed, as expected, a highly significantly effect of valence, Wilks' Lambda = .051, $F(2, 27) = 253.46$, $p < .05$, partial $\eta^2 = .95$. See Table 2 for means and standard deviations. Positive pictures were given lower (i.e. more positive) ratings than either neutral, $t(30) = 15.96$, $p < .05$, or negative pictures, $t(30) = 21.65$, $p < .05$. Negative pictures were given higher (i.e. more negative) ratings than the neutral pictures, $t(30) = 15.76$, $p < .05$. However, this main effect was qualified by a significant Valence x Age x Gender interaction, Wilks' Lambda = .636, $F(6, 54) = 2.29$, $p < .05$, partial $\eta^2 = .20$. The interaction was driven by the 6-year-old boys, for whom the only significant comparison was between negative and neutral pictures, $t(1) = 7.74$, $p < .05$. However, given the small cell size, and the difficulty associated with having children this young rate emotional stimuli (e.g. Dennis & Hajcak, 2009), the observed pattern suggests that even the youngest children rated the pictures similarly to the oldest children. Across all ages and genders, as expected, the positive pictures were given the highest ratings, the negative pictures were given the lowest ratings, and the neutral pictures were given ratings in the middle of the scale.

A 3(valence: negative, neutral, positive) x 4(age group: 6, 8, 10, 12) X 2(gender) ANOVA examining ratings of arousal found only a main effect of arousal, Wilks' Lambda = .175, $F(2, 27) = 63.56$, $p < .05$, partial $\eta^2 = .83$. See Table 3 for means and standard deviations As expected, neutral pictures were rated as less arousing than negative pictures, $t(35) = 4.06$, $p < .05$, or positive pictures, $t(35) = 12.43$, $p < .05$. Positive pictures were also rated as more arousing than negative pictures, $t(35) = 3.88$, $p < .05$. There results suggest that, as expected, negative and positive pictures were rated more arousing than neutral pictures. Although the higher ratings of arousal associated with positive pictures was unexpected, a similar effect has been found in previous research with children (Hajcak & Dennis, 2009), and may be related to the fact that standard instructions for the SAM use the word 'exciting', which may have a positive connotation for children, to refer to arousing pictures.

Study 2b

Using the stimuli validated in Study 2a, Study 2b used EEG to examine children's ability to modulate arousal in the context of different varying processing goals. Finegrained age related changes in the ability to modulate emotional responding in the context of varying task instructions across middle childhood were examined by including children of all ages between 6 and 12 years. The current study also used correlation analyses to examine whether emotional modulation in response to changing task demands is related to age, EF, temperament, and general intellectual functioning. In particular, the extent to which children are able to inhibit their response to emotional stimuli in response to changing task demands was expected to be related to EF, over and above the effects of age and IQ. This ability was also expected to be related to effortful control, although EF was expected to be the stronger predictor. Finally, parenting practices that encourage flexible responding in the context of emotional stimuli was expected to predict how well children implement emotion regulation in the context of indirect approaches.

Method

Participants

Participants included 49 children between the ages of 6 and 12 years (25 males; *M* = 9.44, years, range 6.08 to 12.83 years).

One 6-year-old girl refused to complete the EEG session. Two boys (6 and 10 years) were deleted from the EEG analysis because their data did not contain 15 usable trials per condition.

The final sample included 46 children between the ages of 6 and 12 years: 6-year-olds (*n* = 6; 3 males; *M* = 6.6 years, range 6.08 – 6.92 years), 7-year-olds (*n* = 7; 4 males; *M* = 7.20 years, range 7.00 – 7.50 years), 8-year-olds (*n* = 6; 3 males; *M* = 8.57 years, range 8.08 – 8.94 years), 9-year-olds (*n* = 7; 4 males; *M* = 9.58 years, range 9.25 –

9.92 years), 10-year-olds (*n* = 8; 3 males; *M* = 10.64 years, range 10.25 – 10.92 years), 11-year-olds (*n* = 6; 3 males; *M* = 11.51 years, range 11.08 – 11.67 years), and 12-year-olds (*n* = 6; 3 males; *M* = 12.71 years, range 12.50 – 12.83 years).

For the purposes of investigating potential age differences, children were divided into 3 age groups: youngest (*n* = 15, 8 males, *M* = 7.09 years, range 6.08 to 8.25 years), middle (*n* = 15, 7 males, *M* = 9.59, range 8.58 to 10.50 years), and oldest (*n* = 15, 8 males, *M* = 11.80, range 10.83 to 12.83 years).

Participants were recruited from the pool maintained by the Institute of Child Development. No ethnic information was reported for 3 participants. Of the children for whom the information was available, 87.0% were Caucasian, and 13.0% were of mixed descent. The majority of children, 92%, were from two parent households. Most parents reported having some post-secondary education.

No developmental disabilities were reported.

Materials

During the EEG task, children viewed the set of 120 negative, neutral, and positive pictures validated in Study 2a.

Following the EEG recording, children completed a number of additional tasks. As a measure of general intellectual functioning, children completed the verbal and matrix reasoning subscales from the Wechsler Abbreviated Scale of Intelligence (WASI), which is designed to assess individuals between the ages of 6 and 89.

As a measure of EF, participants completed the computer administered EF battery (DCCS, SOPT, Flanker) outlined in Study 1.

Parents completed the CCNES, and the demographics forms as described in Study 1. Parents also completed the Temperament in Middle Childhood Questionnaire, which is similar to the CBQ but designed for use in middle childhood (Simonds, 2006).

Procedure

After obtaining informed consent from the parent, and written assent from the child, parents were asked to complete the demographics form, the TMCQ, and the CCNES as their child participated in the study.

*EEG task.*EEG data was collected using a 128 channel Hydrocel net, sampled at 1000 Hz and recorded using NetStation software and EGI amplifiers. Participants completed 3 blocks presented in random order. In each block, participants viewed each of the 120 pictures and responded using a response box. Prior to each block, the experimenter placed the correct labels on the response box using Velcro, read the instructions to the participant (see Appendix F), and reminded the participant to remain as still as possible. In the control block, children were asked to press a button when each picture appeared on the screen. In the non-evaluative block, children were asked to decide whether or not there was at least one person in the picture. In the evaluative block, children were asked to indicate whether or not they liked the picture. Across the 3 blocks, children completed a total of 360 trials.

Each trial began with a fixation point. To maintain attention, and ensure that participants could not predict exactly when the next stimulus would appear, the fixation point was jittered so that it remained on the screen for between 1000 and 1200 ms. Following the fixation point, the picture appeared for 2000 ms. After 2000 ms, a cue to respond appeared below the picture. In the control block, two small stars centered below the picture appeared. In the non-evaluative block, the words ‘person’ and ‘no person’ appeared. In the evaluative block, the words ‘like’ and ‘dislike’ appeared. The cue words on the screen were congruent with the labels on the response box, and the position of the cue words was counterbalanced across participants. After a response was made, the picture remained on the screen for an additional 500 ms.

EF and intellectual functioning. Following the EEG task, participants completed the as the verbal and matrix subscales of the WASI followed by the computerized EF battery. The tasks were administered in a standard order.

Quantification of Measures

The analyses of the DCCS and Flanker focused on reaction time. For both the DCCS and Flanker, the median reaction time for each trial type for each participant was calculated, and responses that were more than 3 standard deviations above the median were removed. Responses less than 300 ms were also removed.

For the DCCS, the difference in median reaction time between switch trials (i.e. non-dominant trials and the immediately following dominant trial) and non –switch trials was calculated.

For the Flanker, median reaction time on congruent trials was subtracted from median reaction time on incongruent trials.

As in Study 1, Performance on SOPT was scored as the number of items in the largest set children completed correctly.

Scaled scores on the vocabulary and matrix reasoning measures of the WASI were calculated using the WASI manual.

CCNES was scored as described in Study 1. The TMCQ was scored as recommended by Rothbart and colleagues, which involves deriving 4 factor scores: Negative Affectivity, Surgency/Extraversion, Effortful Control, and Sociability.

EEG Data Processing

The NetStation mark-up tool was used to identify specific trial types in each data file. Continuous data files were then exported into EEGLAB (Delorme & Makeig, 2004), and downsampled to 250 Hz. The data were referenced to Cz, and filtered using a 0.01 Hz high pass filter and a 30 Hz low pass filter. Then, a combination of EEGLAB's Channel Statistics function and visual inspection was used to identify bad channels. Bad channels were then interpolated and the data files were segmented into epochs that began 1000 ms before stimulus onset and continued for the 2000 ms the picture remained on the screen. For each participant, the analysis focused on this window during which participants viewed the picture before making a response.

Following segmentation, the data were again inspected and obvious artifacts were removed. Artifacts typically had high amplitudes, in the range of 500 to 1000 μV. For each participant, a minimum of 15 trials of each type were retained. The data were then submitted to Independent Components Analysis (ICA), and the resulting component maps were used to remove additional artifacts (e.g. eye blinks, vertical and horizontal ocular movements). For all participants, up to 12 components were removed.

The files were then averaged and baseline corrected, and the data were exported for further analysis. The data were submitted to Principal Components Analysis (PCA), which was used to derive component waveforms occurring throughout the viewing window. PCA uses a factor analysis framework to extract latent components occurring across time and space that might not be apparent when ERPs are averaged (Foti et al., 2009).

For the analysis, a multivariate approach was used examine the main effects and interactions of the within subjects factors (the Wilks Lambda procedure corrects against violations of sphericity and is recommended when there are more than 2 levels of a within subjects factor; Hill & Lewicki, 2007).

Results

Behavioral Data

Accuracy in the non-evaluative decision block was near ceiling, 97.8%. Children's decisions in the evaluative block were more likely to be influenced by idiosyncratic responses to the pictures, but the responses were generally as expected, with children indicating they liked the positive pictures and disliked the negative pictures on 89.3% of trials.

A 3(Block: Evaluative, Non-Evaluative, Control) x 3(age group: youngest, middle, oldest) x 2(gender) mixed model ANOVA revealed that median reaction time varied across blocks, Wilks' Lambda = .631, $F(2, 39) = 11.42$, $p < .05$, partial $\eta^2 = .37$ (see Figure 5). There were no significant effects of either age group or gender. Follow-up Bonferonni corrected *t*-tests revealed that median reaction time was faster when children made the control response versus the evaluative response, $t(45) = 5.04$, $p < .05$, or the non-evaluative response, $t(45) = 3.28$, $p < .05$. There was no significant difference in reaction time between the evaluative and the non-evaluative block, $t(45) = .38$, *ns.* Thus, the evaluative and non-evaluative tasks, across the age groups, were comparable in terms of the amount of time required to respond.

EEG Data

The grand average waveform derived from the PCA analysis of electrode sites across the scalp, as well as the separate latent components, is presented in Figure 6. Based on an analysis of the Scree plot, 5 components were derived for further analysis. Of those components, 3 were selected as relevant to the current investigation of the late positive potential: Principal components 1, 4, and 5.

Principal Component 1

The first component was a large, slow positive potential, beginning approximately 250 ms after stimulus onset and maximal at approximately 600 ms. These characteristics suggested that the first component was the LPP typically seen in response to arousing stimuli. Given that the LPP is maximal at midline parietal sites, analyses of this component focused on mean amplitude at electrode Pz (Channel 62; Cuthbert et al., 2000; Keil et al., 2002; see also recommendation by Luck, 2005). A 3(response: control, non-evaluative, evaluative) x 3(valence: negative, neutral, positive) x 3(age group: youngest, middle, oldest) x 2(gender) mixed model ANOVA examined variations in the mean amplitude of the LPP. The analysis revealed a main effect of valence, Wilks'

Lambda = .814, $F(2, 39) = 4.46$, $p < .05$, partial $\eta^2 = .19$, as well as a main effect of response, Wilks' Lambda = .423, $F(2, 39) = 26.60$, $p < .05$ partial $\eta^2 = .58$. However, these main effects must be interpreted in light of a significant Response x Valence interaction, Wilks' Lambda = .719, $F(4, 37) = 3.62$, $p < .05$, partial $\eta^2 = .28$ (See Figure 7).

Follow-up one-way ANOVAs revealed a significant effect of response for each picture type: negative, neutral, and positive, all *F'*s > 3.5, all *p*'s < .05. Bonferroni corrected *t*-tests revealed that for negative pictures, the evaluative response was associated with a greater amplitude LPP than either the non-evaluative response, $t(45) = 2.58$, $p < .05$, or the control response, $t(45) = 4.60$, $p < .05$. The non-evaluative response was also associated with a greater amplitude LPP than the control response, $t(45) = 2.74$, $p < .05$. For the positive pictures, the contrast between the evaluative and the control response was significant, $t(45) = 6.44$, $p < .05$, as well as the contrast between the control response and the non-evaluative response, $t(45) = 5.68$, $p < .05$. The difference between the evaluative and the non-evaluative response was not significant, $t(45) = 1.29$, *ns*. For the neutral pictures, the evaluative response was associated with significantly higher amplitude LPPs than the control response $t(45) = 2.71$, $p < .05$, but the contrast between the control response and the non-evaluative response did not survive the Bonferroni correction $t(45) = 2.35$, *ns*, and the contrast between the evaluative and the non-evaluative response was not significant $t(45) = .95$, *ns*. In summary, these results suggest that there was an effect of response for all picture types, with evaluative responses associated with larger amplitude LPPs than the control response. The amplitude of the LPP associated with the non-evaluative response was also greater than the control response for both the negative and positive pictures. The contrast between the different response types was most pronounced for the negative pictures, with the 3 response types, control, non-evaluative, and evaluative, associated with systematic increases in the amplitude of the LPP.

This general pattern of results was further qualified by a significant Age Group x Response interaction, Wilks' Lambda = .720, $F(4, 78) = 3.48$, $p < .05$, partial $\eta^2 = .15$, see Figure 8. As in previous research, younger children had higher amplitude ERPs than older children. To test for the predicted age differences in LPP amplitude across different response types, a series of one-factor (response type: control, non-evaluative, evaluative) repeated measures ANOVAs were conducted for each age group, all *F*'s > 4.10, all *p*'s < .05. A series of Bonferonni corrected *t*-tests then further explored differences in LPP amplitude associated response type for children in each age group. For the oldest group, the amplitude of the evaluative response was greater than the control response, $t(15) = 3.48$, $p < .05$, or the non-evaluative response, $t(15) = 2.75$, $p < .05$. There was no difference between the control and non-evaluative response, $t(15) = 1.55$, *ns*. For the middle age group, the evaluative response was greater in amplitude than either the control response, $t(14) = 6.55$, $p < .05$, or the non-evaluative response, $t(14) = 2.77$, $p < .05$. The non-evaluative response was also greater in amplitude than the control response, $t(14) = 4.19$, $p < .05$. However, for the youngest age group, the only significant contrast was between the control response and the non-evaluative response, $t(14) = 2.77$, $p < .05$. The difference between the control response and the evaluative response did not survive the Bonferroni correction, $t(14) = 2.18$, ns, and the difference between the non-evaluative and the evaluative response was not significant even before correction, $t(14) = 0.89$, *ns*. As predicted, the difference in amplitude between the evaluative response and the non-evaluative response varied across the age groups, with significant differences between the two responses types for the two older age groups, but not for the youngest children.

There was also a marginally significant interaction between response and gender, Wilks' Lambda = .864, $F(2, 39) = 3.07$, $p = .058$. Because previous research has found differences in how males and females respond to emotional stimuli, this trend was explored further. Two follow-up repeated measures ANOVAs examining the effects of response type for each gender revealed a significant effect for both genders. Follow-up Bonferonni corrected *t*-tests demonstrated that for boys, the contrast between the control response and the non-evaluative response was significant, $t(22) = 4.85$, $p < .05$, as was the contrast between the control response and the evaluative response, $t(22) = 4.37$, $p < .05$. However, the contrast between the non-evaluative response and the evaluative response was not significant, $t(22) = .069$, *ns*. For girls, the contrast between the non-evaluative response and the evaluative response was significant, $t(22) = 3.68$, $p < .05$, as was the contrast between the control response and the evaluative response, $t(22) = 4.51$, $p < .05$. However, unlike the boys, the difference between the control response and the non-evaluative response was not significant after Bonferonni correction, $t(22) = 2.21$, ns. These results suggest they may be some gender differences in the way in which boys and girls modulate their responses in light of different task instructions, with boys showing more modulation between the control response and the non-evaluative response, and girls showing more modulation between the non-evaluative and the evaluative response. However, because the interaction was only at the level of a trend, these results should be interpreted with caution.

Principal Component 4

The fourth component was a slow, large positive component that had similar characteristics to the first component. Given the similarities between this component and the earlier LPP, analyses focused on electrode Pz (channel 62). Indeed, the results of this component were very similar to the results of the first component, suggesting a sustained LPP. As with the first component, the analysis revealed a main effect of valence, $F(2, 39) = 8.61$, $p < .05$, partial $\eta^2 = .31$, as well as a main effect of response, $F(2, 39) = 20.07$, $p < .05$ partial $\eta^2 = .51$. However, these main effects must be interpreted in light of a significant response x valence interaction, Wilks' Lambda = .748, $F(4, 37) = 3.11$, $p < .05$, partial $\eta^2 = .25$ (See Figure 9).

As observed for the first component, follow-up one-way ANOVAs revealed a significant effect of response for each picture type: negative, neutral, and positive, all *F*'s > 6.0, all *p*'s < .05. Bonferroni corrected *t*-tests revealed that for negative pictures, the evaluative response was associated with a greater amplitude LPP than the control response, $t(45) = 4.60$, $p < .05$. However, the contrast between the control response and the non-evaluative response did not survive Bonferonni correction, $t(45) = 2.41$, *ns,* and the contrast between the evaluative response and the non-evaluative response was not significant, $t(45) = 1.70$, *ns*. For neutral pictures, only the contrast between the control response and the non-evaluative response was significant, $t(45) = 3.63$, $p < .05$. For positive pictures, the contrast between the evaluative and the control response was significant, $t(45) = 5.20$, $p < .05$, as well as the contrast between the control response and the non-evaluative response, $t(45) = 4.93$, $p < .05$. The difference between the evaluative and the non-evaluative response was not significant, $t(45) = 0.48$, *ns*. In summary, these results suggest that the effects of valence and response on this component are similar to the first component, although the effects are not as strong or as consistent. Given that this component occurred relatively late after stimulus onset, the initial strong effects of valence and response, although still present to some extent, may have been somewhat diminished.

As with the first component, the general pattern of results was qualified by a significant Age Group x Response interaction, Wilks' Lambda = .764, $F(4, 78) = 2.81$, $p < .05$, see Figure 10. A series of one-factor (response type: control, non-evaluative, evaluative) repeated measures ANOVAs were conducted for each age group, all *F*'s > 8.00, all *p*'s < .05. A series of Bonferonni corrected *t*-tests then further explored differences in late LPP amplitude associated response type for children in each age group. For the oldest group, the amplitude of the evaluative response was greater than the control response, $t(15) = 4.63$, $p < .05$, but the contrast between the evaluative and the non-evaluative response did not survive correction, $t(15) = 2.23$, *ns*. There was no significant difference between the control and non-evaluative response, $t(15) = 2.01$, *ns*. For the middle age group, the evaluative response was greater in amplitude than the control response, $t(14) = 3.89$, $p < .05$, and the non-evaluative response was also larger than the control response, $t(14) = 4.57$, $p < .05$. The evaluative response was not greater in amplitude than the non-evaluative response, $t(14) = .96$, ns. However, for the youngest age group, the only significant contrast was between the control response and the non-evaluative response, $t(14) = 4.25$, $p < .05$. Neither the difference between the control response and the evaluative response, $t(14) = 1.07$, *ns*, or the difference between the non-evaluative and the evaluative response was significant, $t(14) = 1.13$, *ns*. Although these results are not as straightforward as the results for the first component, it appears that there are some sustained differences in responding across the age groups, with only the middle and older age groups remaining systematic in their responding, showing a consistent difference between the evaluative and the control response.

Principal Component 5

The time course of the fifth component, with a peak at approximately 300, is typical of a P3, which is often thought to be a precursor to the slower, more sustained LPP. The P3, like the LPP, is typically maximal at parietal sites, and so analyses focused on electrode Pz (Channel 62). Although some previous studies have found effects of valence on the P3, in the current study a 3(response: control, non-evaluative, evaluative) x 3(valence: negative, neutral, positive) x 3(youngest, middle, oldest) x 2(gender) mixed model ANOVA revealed only a main effect of response, Wilks' Lambda (2, 39) = .658, $F(3, 39) = 10.14$, $p < .05$, partial $\eta^2 = .34$ (see Figure 11). Follow-up Bonferonni corrected *t*-tests found that the evaluative response was greater in amplitude than either the non-evaluative response, $t(45) = 4.11$, $p < .05$, or the non-evaluative response, $t(45) = 2.83$, $p < .05$.The control response and the non-evaluative response were not significantly different, $t(45) = 1.80$, *ns.* These results suggest that this early component, while sensitive to response type, is not sensitive to valence, unlike the later LPP.

Correlations with Executive Function

Reaction time on the DCCS, calculated as the difference between switch and non-switch trials, was correlated with reaction time on the Flanker task, calculated as the difference between incongruent and congruent trials, $r = .32$, $p < .05$. This correlation was not high enough to suggest that these two variables could be usefully combined into a composite EF variable, and so scores for each of these tasks were treated separately. Furthermore, because mean accuracy on both the DCCS (94% on the mixed trials) and Flanker (99% on test trials) was high, the analysis focused on reaction time.

The analysis of the relation between EF and the modulation of arousal in response to changing processing demands focused on the first principal component (See Table 4). Specifically, the mean amplitude of the LPP during the non-evaluative block was subtracted from the mean amplitude of the LPP during the evaluative block to create a difference score. Correlational analyses revealed a significant relation between performance on the DCCS and modulation of arousal, $r = -.39$, $p < .05$. Thus, as modulation of arousal in response to task demands increased, the slowing of reaction time associated with switch trials decreased. This relation remained significant when controlling for both age and IQ, $r = -.33$, $p < .05$.

The modulation of responding was not significantly related to any other variable, including IQ. Contrary to hypothesis, this difference was not related to performance on the Flanker or SOPT, nor was it related to parent-reported effortful control, or parenting strategies.

Discussion

The current study sought to examine the efficacy of a relatively indirect approach to emotion regulation across middle childhood. Often, emotion regulation occurs not as the result of attempts to directly modify one's emotional response, but as the result of changing task demands. The current study focused on a particular waveform, the LPP, which is seen in response to arousing stimuli but can be modulated by changing task demands (Cunningham et al., 2005; Hajcak et al., 2006). As expected, the amplitude of the LPP was influenced by both valence and response, with the strongest effects of response evident for negative pictures. In particular, as expected, the amplitude of the LPP associated with the evaluative response was larger than the amplitude of the LPP associated with the non-evaluative response, but only for the older two age groups. Furthermore, this modulation was related to performance on the DCCS, controlling for age and IQ.

Modulation of the LPP

It was expected that the amplitude of the LPP would be greatest for the evaluative response, which required active processing of emotional information, and relatively diminished for the control response, which did not require children to process the stimuli in a meaningful way. In contrast to the evaluative and control conditions, the non-evaluative decision required children to actively process each picture, but in the service of making a non-affective judgment. Because the non-evaluative response does not require participants to process the emotional content of each picture, it was expected that, as in previous work with adults (Cunningham et al., 2005; Hajcak et al., 2006), the amplitude of the LPP would be attenuated when children were asked to make a non-affective decision about emotional stimuli. However, given the neural and cognitive development that continues throughout middle childhood, older children were expected to be more able to direct attention away from salient emotional content than younger children. Furthermore, across middle childhood, modulation of arousal in response to changing task demands was expected to be related to performance on behavioral tasks of EF, providing further support for the theoretical and empirical evidence to suggest a link between emotion regulation and EF. These predictions were supported by the current data. PCA confirmed that the LPP accounted for the majority of the variance, and as expected, the amplitude of this component was influenced by both valence and response type. Furthermore, the modulation of emotion in response to changing processing goals was more evident in older children than younger children.

Across picture types, as expected, the amplitude of the LPP associated with the evaluative response was larger than the LPP associated with the control response. However, the effect of response type was most evident for emotionally arousing pictures, particularly negative pictures. When participants were presented with negative pictures, the amplitude of the LPP was characterized by monotonic increases associated with the control, non-evaluative, and evaluative responses. This pattern of results is in line with previous work suggesting that emotional processing is characterized by a negativity bias, such that more attention is allocated to negative stimuli (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Ito, Larsen, Smith, & Cacioppo, 1998). To the extent that negative stimuli capture attention, these additional resources may have resulted in more pronounced modulation of arousal in the context of changing task demands.

The effect of response on amplitude of the LPP was influenced not only by valence, but also by age and gender, although the effect of gender was only at the level of a trend. While the older children showed evidence of reduced arousal when making the non-evaluative response relative to the evaluative response, the youngest children did not show this pattern. For the youngest children, the LPP amplitude associated with the evaluative and non-evaluative response was almost identical, with no significant reduction in responding associated with making a non-evaluative response. The suggestion that emotion regulation in response to changing task demands, a relatively indirect approach, is influenced by the cognitive and neural development that occurs over the course of middle childhood is further supported by the relation between performance on the DCCS and the attenuation of emotional responding. Controlling for age and IQ, larger differences between the evaluative and non-evaluative response, suggesting greater emotional modulation, were associated with smaller differences in response time between switch and non-switch trials on the DCCS. The DCCS, which requires participants to switch rapidly between rules, may tap into the same processes that allow participants to modulate arousal as task instructions change. These similar requirements may also explain why there were no relations between emotion modulation and performance on the Flanker and SOPT, which require somewhat different abilities. In general, the results provide support for the suggestion that EF underlies emotion regulation, with the processes typically associated with EF, such as attention shifting, supporting successful emotion regulation (Zelazo & Cunningham, 2007).

Although there was some suggestion that EF was related to the ability to modulate arousal in response to changing task instructions, there was no evidence that either parenting or temperament was related to this ability. These null results may be attributed to the relatively small sample, and reflect a lack of power. However, given that the current study examined middle childhood, a period where regulation becomes increasingly internalized, it is possible that parent-reported temperament and parenting techniques may be less important than EF. The majority of research examining both temperament and parenting in relation to regulation has been done with younger children, and the validity of these measures are not well established with older children, which suggests further research is needed to establish how parenting, and parent-reported temperament, influence regulation across childhood.

Overall, these results suggest that indirect task instructions are effective at encouraging emotion regulation in children, although the efficacy of this modulation is influenced by both age and EF. Although the task instructions were simple, and children of all ages were able to implement them on a behavioral level, the younger children showed no evidence of attenuated arousal in response to implementing a non-evaluative processing goal. Although there is some suggestion that indirect approaches may be more effective at encouraging emotion regulation in individuals who have little experience implementing regulation in a top-down way (e.g. Williams et al., in press), the current results suggest that even relatively indirect approaches to emotion regulation are influenced by individual differences such as age and EF. Indirect approaches may avoid some top-down processing demands, depending on the particular manipulation, but some baseline level of cognitive ability may still be required. Future research might usefully investigate the constraints and limiting factors associated with the effective implementation of emotion regulation in the context of relatively indirect manipulations.

In addition to examining the typical LPP, a principal components approach allowed for an examination of the broader time course of the LPP, including a later, sustained LPP that was similarly influenced by age, valence and response type (i.e. the fourth component), and the earlier P3 (i.e. the fifth component). Although the LPP can be differentiated from the P3, there is some suggestion that these components are part of a positive, slow wave in response to affective stimuli (Olofsson, Nordin, Sequeira, & Polich, 2008). Indeed, there is evidence that the amplitude of the P3 is influenced by affective stimuli (Delplanque et al., 2005; Keil et al. 2002; Schupp et al. 2000). However, in the current study, there was only an effect of response, and no effect of valence, evident in this early component. There is some evidence from work with children that suggests facial expressions of emotion influence P3 amplitudes (Kestenbaum & Nelson, 1992; Pollak et al., 1997), but there is less work examining how the P3 is influenced by other kinds of emotional stimuli, such as the relatively complex emotional scenes used in the present study. Facial expressions may be more motivationally relevant, and easily processed, leading to earlier effects of valence than emotional scenes.

Implications, Limitations, and Future Directions

In general, the results of the current study provide support for the notion outlined by Gross (1998) that effective regulatory strategies may take various different forms. Although regulatory strategies may be complex, even relatively simple strategies, such as shifting attention, may be an effective means of modulating emotional responding. These data suggest that an indirect approach to emotion regulation, specifically changing task demands, can be an effective means of influencing emotional arousal in middle childhood, although both age and EF influence this ability.

Although the current study provides some insight into how relatively indirect influences may affect emotion regulation, only one manipulation, task instructions, was examined. Future research should continue to investigate the extent to which children of different ages influenced by various forms of indirect emotion regulation, such as the context, culture, and close others, including how these influences interact with temperament and EF over the course of childhood.

Future research may also usefully compare relatively direct and relatively direct forms of regulation directly to examine the relative efficacy of different approaches across early and middle childhood. The current study found evidence that the particular indirect approach examined here, changing task instructions, was effective at encouraging emotion regulation only in the older children. However, it is currently unknown whether more direct instructions to regulate emotion would follow a similar developmental course. Given the finding that direct instructions to reappraise influence how 5-year-olds respond to negative pictures, younger children may be able to more effectively modulate emotion when the instructions are relatively direct.

Finally, the current study was designed to examine one particular waveform, the LPP. Future research should continue the examination of how various early ERPs are influenced by affective stimuli. The data from with adults are mixed (Olofsson et al., 2008), and the work with children is limited (Hajcak & Dennis, 2009). However, an understanding of how children regulate emotion may be incomplete without knowledge of how children first process emotional stimuli. How and whether children rapidly process emotional stimuli, including possible gender differences in that processing, may have important implications for how children respond to emotional contexts, including how regulation is likely to unfold and may best be supported.

Chapter 4

General Discussion

The ability to control one's emotions is critical for the successful navigation of a socially complex world. Difficulties regulating emotion are linked to emotional and behavioral problems, as well as problems maintaining positive social relationships. Emotion regulation is influenced by both relatively direct processes, which are implemented in a top-down way in response to a specific goal, and relatively indirect processes, which may occur as the result of context or changing task demands. The implications of emotion regulation are such that it is critical we understand the developmental trajectory of both these influences. The current study aimed to investigate the development of emotion regulation by examining both relatively direct and relatively indirect approaches to emotion regulation. The findings suggest that reappraisal, which influences emotion in a relatively direct, top-down way, can influence emotional responding even in 5-year-old children. Indirect emotion regulation, in the form of task instructions, can also effectively influence how older children respond to emotional stimuli.

The current research has a number of implications for our knowledge of the development of emotion regulation. First, it helps to elucidate our understanding of children's ability to regulate emotion in both relatively direct and relatively indirect ways, including how both these processes influence responses to emotional stimuli at several different levels. Reappraisal is thought to be a particularly flexible and adaptive form of emotion regulation, which suggests that it is critical that we understand how children develop this capacity. The current results suggest that with direct training, even

5-year-old children can implement reappraisal in a way that influences emotional responding. This study is the first to demonstrate that children this young can implement reappraisal in a top-down way, and that reappraisal serves to attenuate physiological responses to emotional pictures.

The current study also represents one of the first attempts to examine how an indirect approach to emotion regulation, changing task instructions, influences emotional arousal in children. To a large extent, research has focused on top-down, internally driven strategies. However, depending on the context, children may be more or less able to implement effective emotion regulation strategies. Indirect approaches allow for the regulation of emotion in a less effortful way, in the absence of direct, top-down control. Research has already suggested that emotion regulation only gradually becomes internally driven, and that in early life it is primarily regulated in the context of a dyad. Recently, there has been increasing recognition that external influences on emotion regulation are likely to remain important across the lifespan. The current research found that a more indirect approach, changing processing goals, was an also effective means of influencing emotion, although only for older children. These results support the notion of gradual internalization. Indirect approaches may be most effective in cases where some baseline regulatory ability exists, and can be implemented in the absence of specific, direct instructions. In the absence of this baseline ability, however, direct approaches may be more effective. Together, these results add to our knowledge of the development of emotion regulation, suggesting that as children develop, a broader range of strategies, including both direct and indirect approaches to emotion regulation, can be used to effectively modulate arousal.

Second, this research helps to elucidate the theoretical link between EF and emotion regulation. The proposal that EF and emotion regulation are critically linked (Zelazo & Cunningham, 2007) suggests that EF should predict the ability to successfully implement emotion regulation. However, when 5-year-old children were directly trained to reappraise emotional stimuli, no evidence was found to suggest EF influenced their ability to attenuate their emotional response to negative pictures. In contrast, performance on the DCCS was related to the ability to modulate emotional responses in the context of a relatively indirect influence, in the form of changing task instructions. These results suggest possible differences in the forms of regulation expected to be related to behavioral measures of EF. Specifically, 5-year-old children may have had the requisite ability to implement reappraisal when trained to do so, and individual differences may have accounted for little additional variance. In the context of an indirect influence, however, where there is no explicit instruction to regulate, EF may have played a larger role. Future research should continue to investigate the factors that influence whether or not EF is expected to influence the implementation of various forms of emotion regulation.

Finally, this research has potentially important implications for the everyday lives of children. For example, children might be encouraged to think about a situation in a different way when they are required to cope with emotional situations. Children as young as 5 years might be encouraged, if upset by the actions of a playmate, to think about the situation in a different way. This ability might be particularly important in clinical settings, where reappraisal might be used as a tool in helping children cope with stressful life events. Given the adaptive nature of reappraisal, cognitive approaches to emotion may be usefully incorporated into interventions aimed at addressing difficulties regulating emotion. This work also has implications for the point at which less direct approaches become effective. For older children, who have more experience regulating emotion, various indirect strategies, such as shifts in attention through changing processing demands, may also be an effective means of encouraging emotion regulation and may be usefully included in interventions.

The importance of emotion regulation across the lifespan suggests that our understanding of this ability is critical to promoting healthy development. Although the current research suggests both direct and indirect approaches can effectively modulate emotion, the optimal balance between relatively direct and relatively indirect emotion regulation may shift over the course of development. Future research should continue to endeavor to understand the multitude influences on emotion regulation across the lifespan, including the particular individual differences and contextual factors that determine the most effective approach.

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APPENDIX A

Tables

Table 1.

Zero-order correlations between the difference in SCR amplitude before and after reappraisal training and EF, IQ, temperament, and emotion-focused parenting. All correlations are non-significant.

	Difference in SCR Amplitude (μS)
DCCS Performance	.14
Flanker Accuracy	.06
Flanker Reaction Time	.05
SOPT Total Score	.10
Vocabulary	.04
Matrix Reasoning	.18
Effortful Control	-.11
Surgency	-.15
Negative Affect	.01
Emotion Focused Parenting	-.20

Table 2.

Mean ratings (plus standard deviation) of valence for negative, neutral, and positive pictures by gender and age

	Boys			
	Age in Years			
Picture Valence	6	8	10	12
Negative	4.41 (2.77)	6.62 (.97)	7.81 (.59)	7.35 (.56)
Neutral	3.40 (1.46)	4.99 (.59)	4.04 (.38)	4.69 (.34)
Positive	2.50 (.56)	3.03 (84)	1.74 (.31)	2.85 (.57)
	Girls			
	Age in Years			
	6	8	10	12
Negative	7.28 (.53)	7.32 (.98)	7.75 (.23)	7.58 (.57)
Neutral	4.22 (.65)	5.27 (1.09)	4.86 (.31)	4.95 (.32)
Positive	2.02 (.49)	2.95 (.59)	2.81 (.94)	2.63 (.69)

Table 3.

Mean ratings (plus standard deviation) of arousal for negative, neutral and positive pictures by gender and age

	Boys			
	Age in Years			
Picture Valence	6	8	10	12
Negative	6.09 (2.96)	3.86 (2.02)	5.25 (1.11)	4.66 (1.58)
Neutral	5.49 (3.93)	2.71 (1.56)	2.98 (1.15)	3.06 (1.32)
Positive	7.20 (.92)	4.97 (1.93)	6.66 (1.76)	5.68 (1.00)
	Girls			
	Age in Years			
	6	8	10	12
Negative	4.53 (1.10)	2.83 (1.32)	5.11 (2.06)	4.34 (2.38)
Neutral	3.92 (2.45)	3.40 (1.72)	3.00 (1.17)	2.36 (1.14)
Positive	7.32 (.92)	6.09 (1.55)	5.76 (1.63)	4.54 (1.10)

Table 4.

Zero-order correlations between the change in LPP amplitude (the first component) between evaluative and non-evaluative responses and EF, IQ, temperament, and emotion focused parenting.

	Difference in LPP Amplitude (μV)
DCCS Reaction Time	-.39*
Flanker Reaction Time	.05
SOPT Total Score	.08
Vocabulary	.08
Matrix Reasoning	-.17
Effortful Control	-.16
Surgency	.11
Negative Affect	.04
Emotion Focused Parenting	-.15

*$p < .05$

APPENDIX B

Figures

*Figure 1.*An outline of Study 1, including all tasks and conditions.

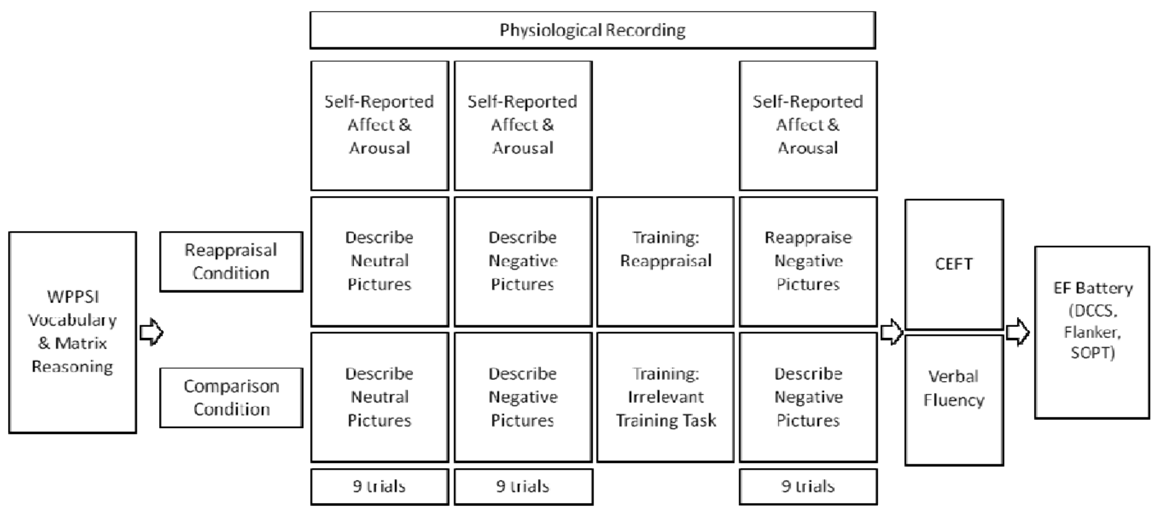


Figure 2. Mean SCR amplitude generated in response to negative pictures in the pre-training block and post-training block, by gender, for the (a) control and (b) reappraisal conditions.

(a)

(b)

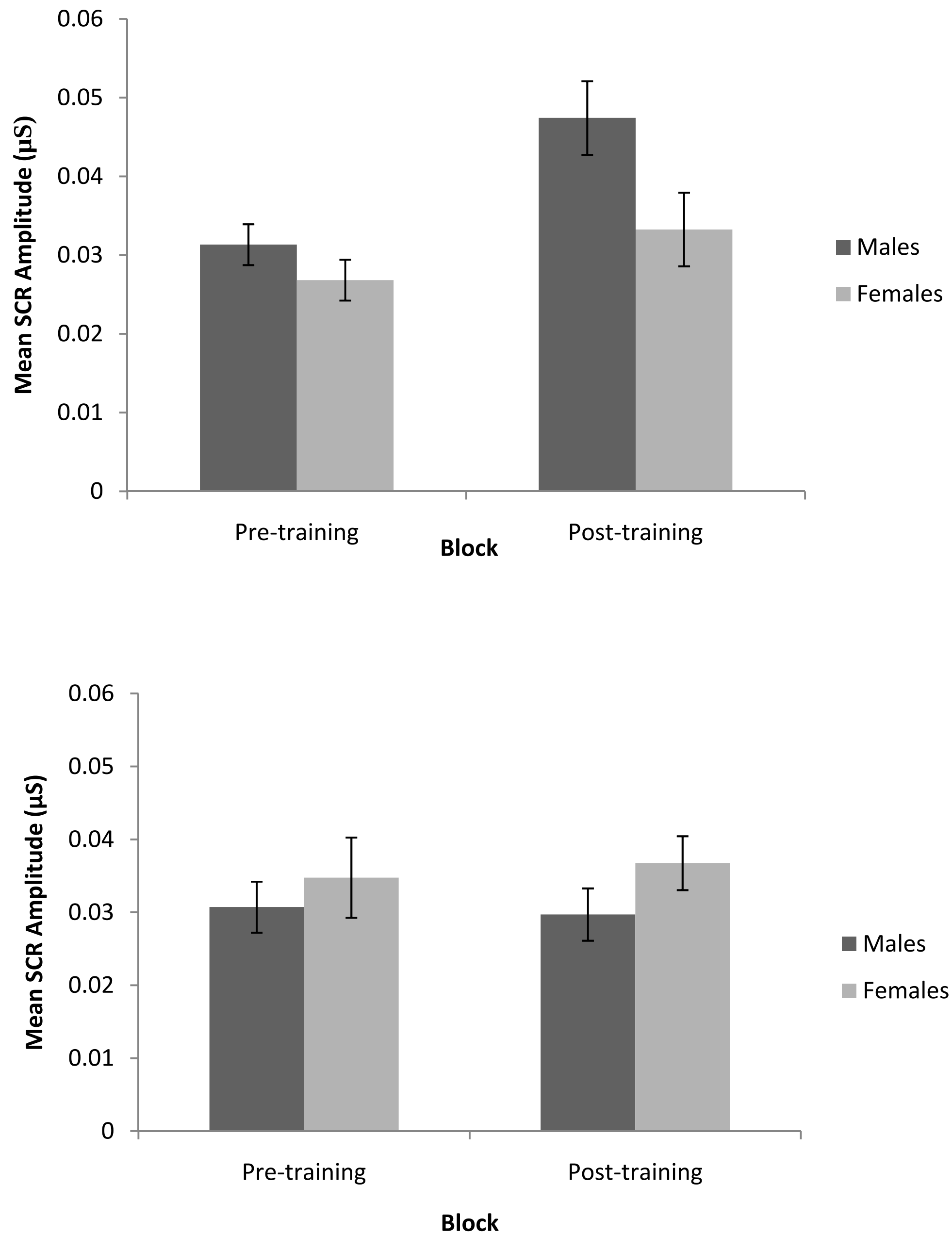


Figure 3. Mean number of animals and fruits generated during the verbal fluency task following reappraisal and control training, by the order the task was administered.

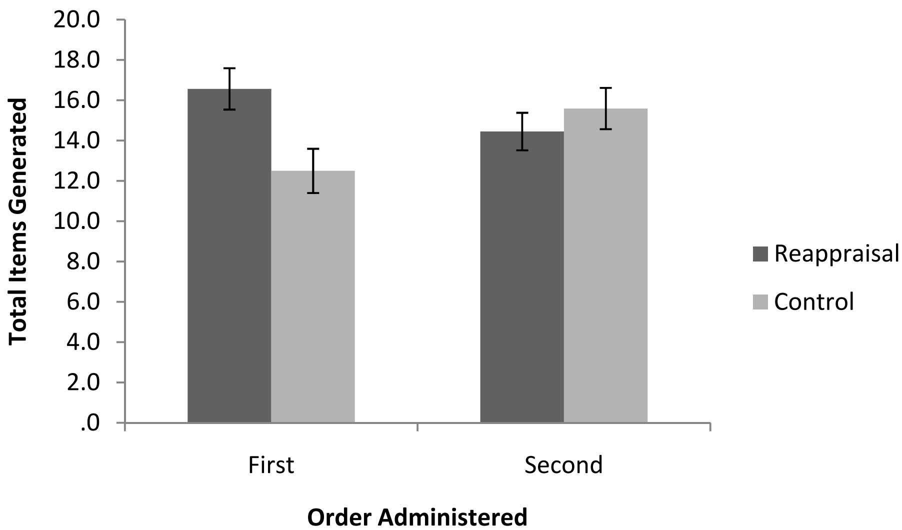


Figure 4. An outline of Study 2, including all tasks and conditions.

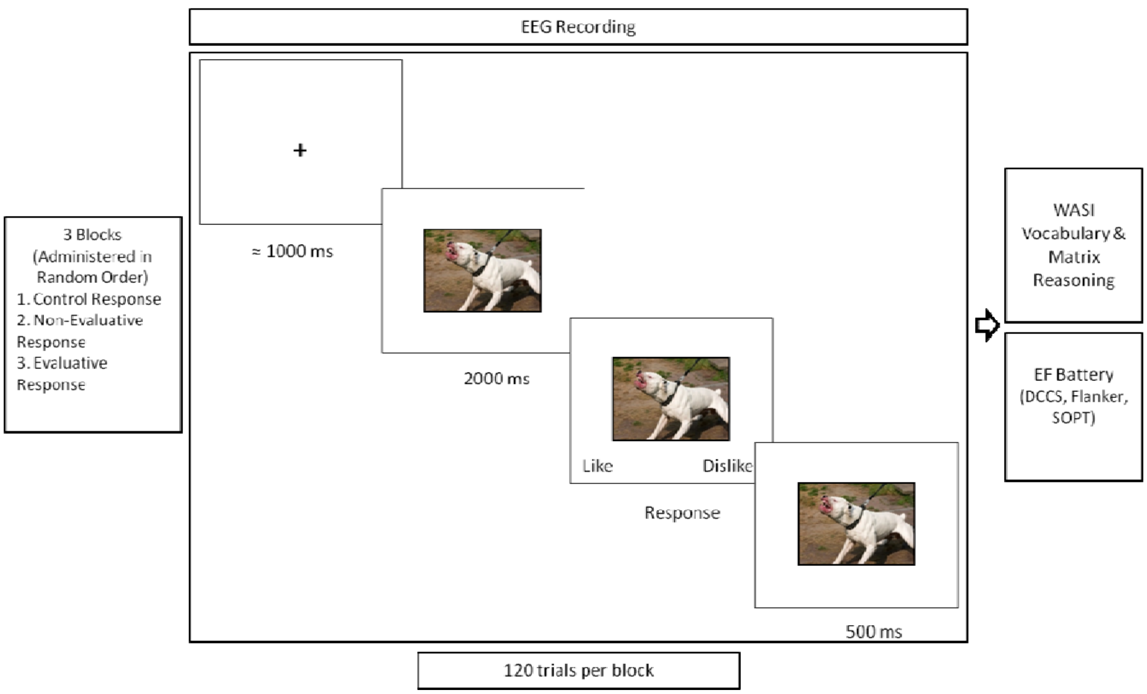


Figure 5. Median reaction time (plus standard error) of behavioral responses during the EEG task for each response type.

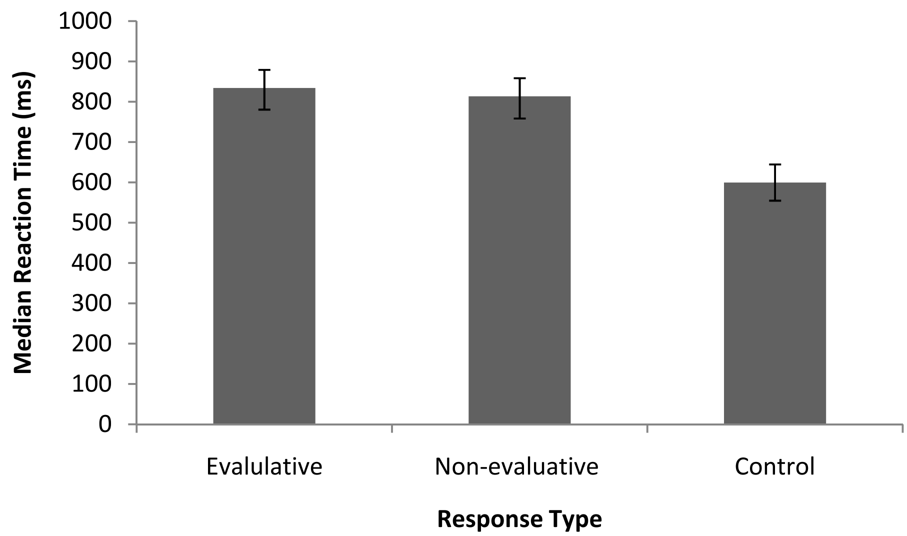


Figure 6. The grand average waveform (µV), derived from electrode sites across the scalp, as well as the principal components derived from across the viewing window.

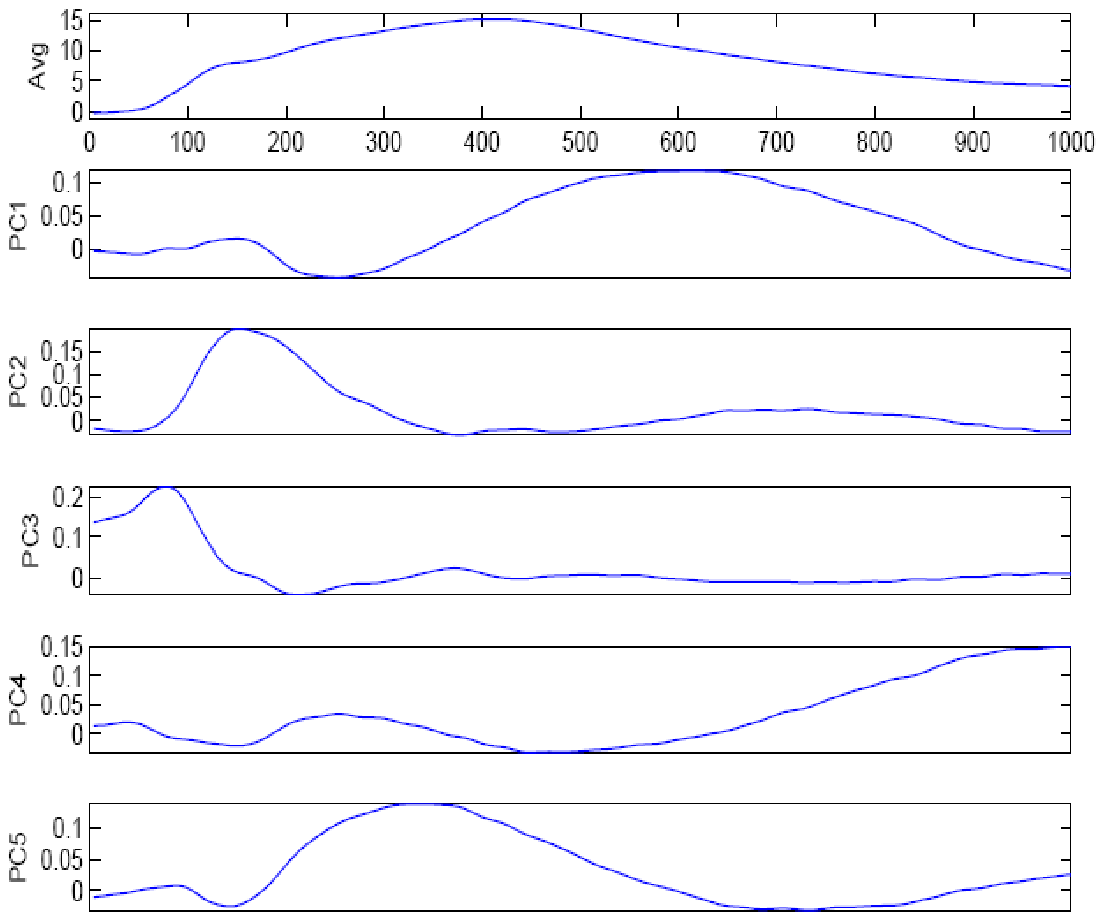


Figure 7. Mean amplitude (plus standard error) of the first component at electrode Pz for each valence and response type.

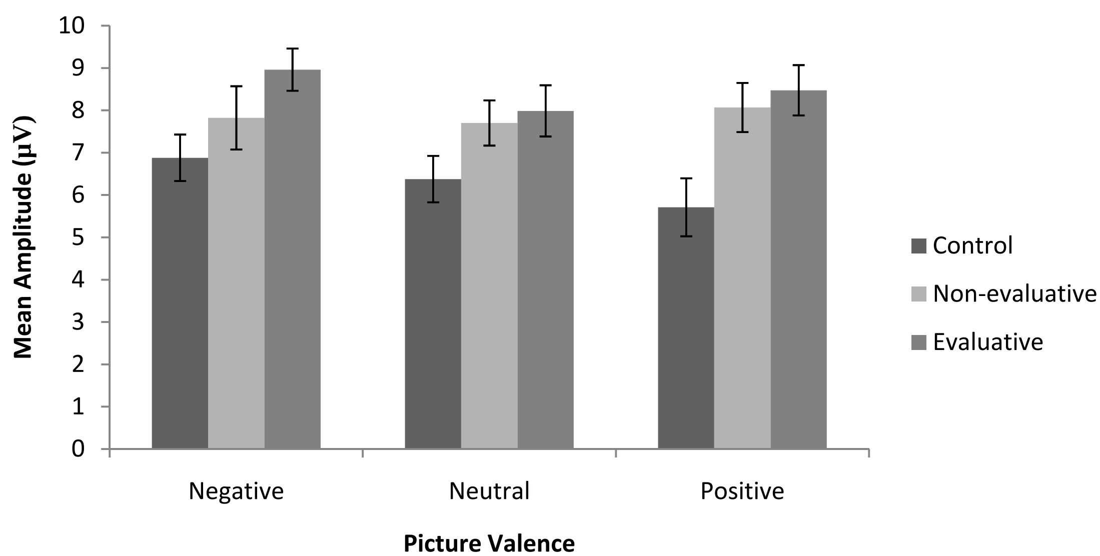


Figure 8. Mean amplitude (plus standard error) of the first component at electrode Pz for each age group and response type.

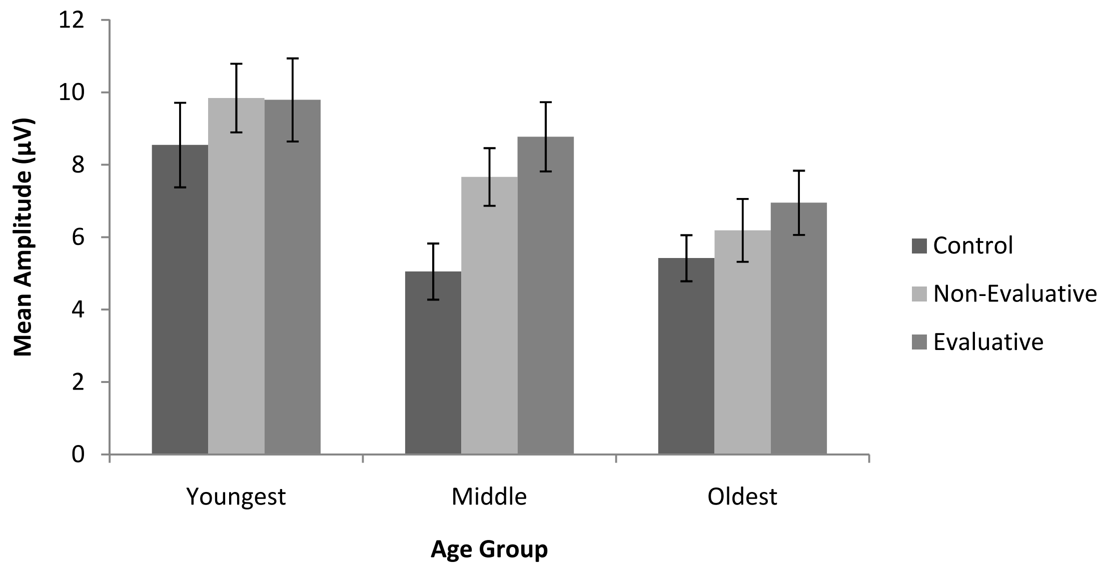


Figure 9. Mean amplitude (plus standard error) of the fourth component at electrode Pz for each valence and response type.

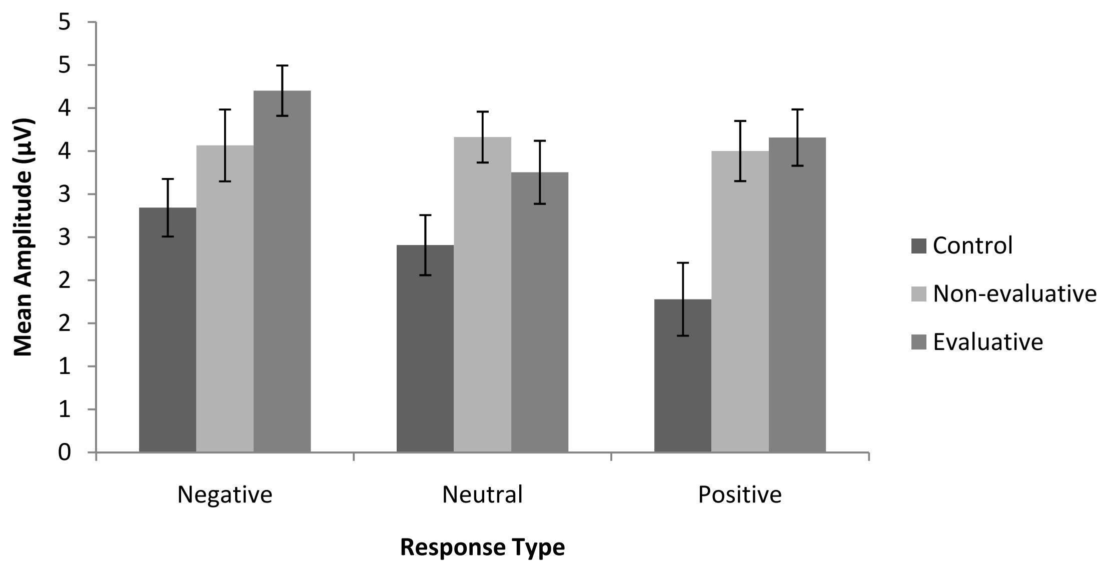


Figure 10. Mean amplitude (plus standard error) of the fourth component at electrode Pz for each response type for each age group.

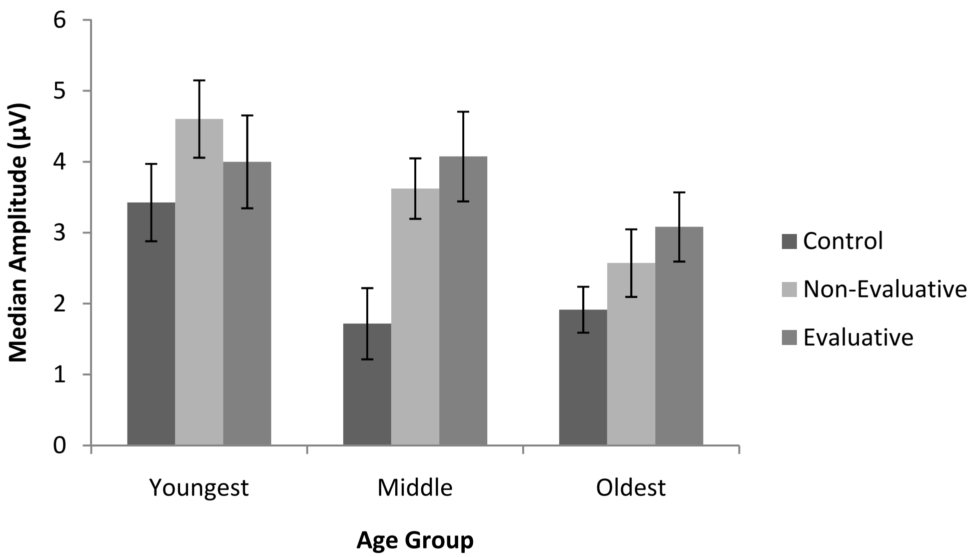
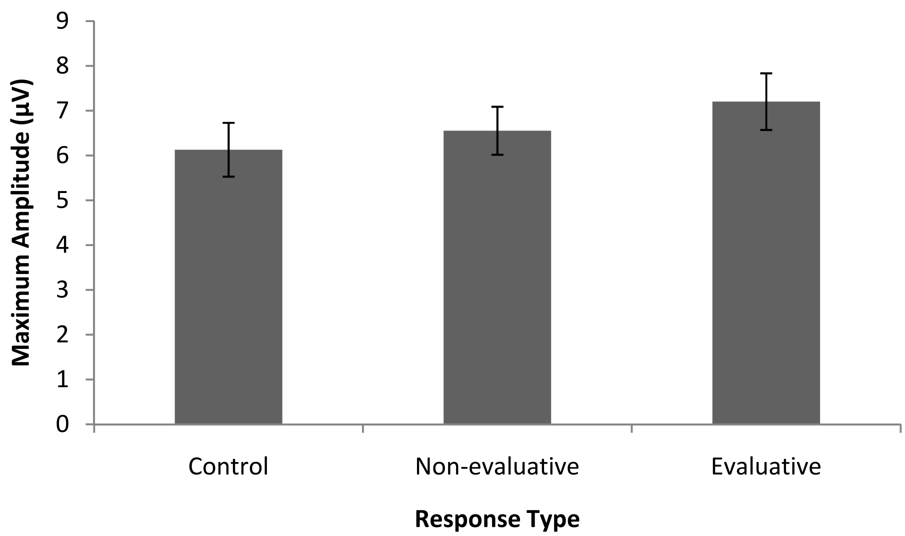


Figure 11. Mean amplitude (plus standard error) of the fifth component at electrode Pz for each response type.



APPENDIX C

Instructions for the SAM scale
(Adapted from Lang, Bradley, & Cuthbert, 2005)

Now, you are going to see some pictures.
We need to know how you feel when you see these pictures so that we can learn more about children's feelings.

You will see lots of pictures showing different things that may make you feel happy or unhappy, excited or relaxed, or maybe even angry, scared, or thrilled.

Everybody feels differently about each picture. There are no wrong answers. Whatever you feel is the right answer.

To help you tell us how you feel when you see the pictures, we are going to use SAM.

When you see each picture, you will be able to tell us how you feel when you look at the picture by pointing to the picture of SAM that best shows how you feel. There are no right or wrong answers. Just tell us how you feel when you see the picture.

Here are five pictures of SAM. On one side, SAM is frowning, on the other side, SAM is smiling, and in the middle, SAM is not smiling or frowning. These pictures are in order from a very unhappy SAM to a very happy SAM.

This is where you point if the picture makes you feel happy, glad, cheerful, pleased, good, or hopeful.

If you feel in between being very happy and a little bit happy, you point to this SAM.

This is where you point if the picture makes you feel unhappy, scared, angry, or bad.
If you feel in between being very sad and a little bit sad, you point to this SAM.

If you feel neutral, that is, you don't feel either happy or unhappy, then you can point to the picture of SAM that is not smiling or frowning.

Which SAM do you point to if the picture is happy?

Which SAM do you point to if the picture is sad or scary?

Which SAM do you point to if the picture isn't sad or happy - just normal?

Now let's look at the second feeling. This one shows SAM when he is very still and his eyes are closed. You would point to this SAM if you feel very calm, relaxed, bored or sleepy.

You would point to this SAM if you feel very excited, nervous, jittery, active or wide awake.

Notice how it looks like SAM is jumping up and down and his stomach is excited. This is like when you get excited and can't sit still or like when you have butterflies in your stomach when you are very nervous.

Use SAM to tell how excited or calm you feel when you see the picture. If you are very excited, enthusiastic, nervous, scared, or wide awake you would point to this SAM. If you feel calm, relaxed, sleepy, or bored point to this SAM.
If you feel in between calm and sleepy and very excited, you can point to one of these pictures of SAM.

Which SAM do you point to if the picture is boring, and not that interesting?
Which SAM do you point to if the picture gets you all worked up?

Let's practice!

APPENDIX D

Scripts for reappraisal and control training

Reappraisal Script

When we look at a picture that makes us feel upset, we can change our feelings by thinking about it in a different way!

We can think of a story about why something in the picture is not that bad at all.
Maybe it is just pretend, like in a movie.
We can think of a happy ending!

Let's think about the picture in a different way!

1. Trash	Look at this litter. I bet someone is coming to clean it all up. Soon it will be nice and clean.
2. Dog	Look at this dog. I bet he is protecting his owner from danger. What a good guard dog.
3. Plane Crash	Look at this airplane crash. It looks like it is from a movie. They probably used special effects and did it very carefully so no one was hurt.
4. Child in Hospital	Look at this girl in the hospital. Even though this girl is in the hospital, I bet she will be better really soon. The doctors and nurses will help her get well.
5. Bully	Look at these boys fighting. Maybe they are just pretending to fight, as part of a game. They are actually friends.

Now it's your turn to try!
Tell me how to think about the pictures in a different way!

What is this a picture of?
Is it a happy picture or a sad/scary picture?
Can you think of a reason why it might not be so bad?
    Can you think of a different story about this picture?
    Can you think of things might get better?

Think about the picture in a different way!
Now, we will see some more pictures. Remember to think about the pictures in a different way!

Control Script

When we see a group of things, sometimes we can try to figure out if all of the things belong together!

We can think of why one object in a group doesn't belong.
Maybe it is a different color.
Maybe it is a different shape.

Let's think about which object doesn't belong!

1. 3 blue circles & 1 green circles	Look at these circles. Three are blue and one is green. The green one isn't the same color as the other circles, so it doesn't belong.
2. 3 squares & 1 circle	Look at these shapes. Three are squares and one is a circle. The circle isn't the same as the other shapes, so it doesn't belong.
3. 3 red ones & 1 purple one	Look at these shapes. Three are red and one is purple. The purple one isn't the same color as the other shapes, so it doesn't belong.
4. Test Tubes	Look at these test tubes. Three are full of green stuff and one is empty. The empty is different, so it doesn't belong.
5. Arrows	Look at shapes. All of these are arrows and this one is a hand. The hand doesn't belong isn't like the arrows, so it doesn't belong.

Now it's your turn to try!
Tell me which object doesn't belong!

What are these pictures of?
Which one doesn't belong?
Tell me which object doesn't belong!

Now, we will see some more pictures. Name each one as it appears!

APPENDIX E

Reappraisal Coding Scheme

Highly Unlikely to Change Emotional Impact

0

Failure to generate any re-evaluation or reappraisal of the picture – does not engage with emotional content of the picture

Guidelines

❑ **Failure to generate any re-evaluation or reappraisal of the picture**

Examples:
I don't know, shrugs, no response, didn't generate

❑ **Points out some detail of the picture or describes the picture without reappraising, or comments on some action in the photo without reappraisal**

Examples:
'It's sunny'

'A person without a shirt'

Unlikely to Change Emotional Impact

1

Does engage with the emotional content of the picture, but minimal or ineffective attempt at reappraisal that is unlikely to alter emotional impact

Guidelines

❑ **Minimization with no attempt at reappraisal or justification why it's not so bad, or just repeats 'it's not so bad'**

Examples:

'It's just a snake'

'It's not really litter'

❑ **Very vague, with no mention of a specific subject and/or action and/or object and meaning is not obvious from the picture**

Examples:

'Goes away '

(no mention of what goes away)

' Not in the hospital'

(no mention of who is involved or a specific event)

'she is going to stop'

(no mention of what will be stopped)

- [ ] Some attempt at reappraisal, but reappraisal clearly does not make sense in the context of the picture, or very difficult to interpret the meaning

Examples:

'well because um because um because um because these are ones are like in a camp or something '

'because they are going to get a new ride'

- [ ] Contradictory response where child initially gives a more negative interpretation of the picture

Examples:

'he's trying to eat people, he can stop'

Likely to Change Emotional Impact

2

Engages with the emotional content of the picture and thinks about the picture in a way that constitutes a reappraisal and/or re-evaluation that is likely to alter emotional impact

Guidelines

- [ ] **Future oriented reappraisal: Suggest a way in which the situation will become better, and/or a positive event that might happen subsequently (a happy ending)**

Examples:

'the dog will feel better'

'because they are going to fix it'

'somebody is going to clean it up'

'the snake dies'

❑ Present Oriented Reappraisal: Suggest a reason why the picture is not so bad, such as how the threat is minimal, something that happened before to lessen negative impact , or a positive benefit

Examples:

'I think that bear is trying to protect something, like the babies'

'because people probably got out'

'because that bug was his pet'

'because you are getting your teeth cleaned'

APPENDIX F

The instructions presented before each block of the EEG task.

In this part of the study, you will see different pictures on the screen.

Control Block

In this block, hit a button when you see the picture.

First, you will see the picture.

Then, 2 little stars will pop up on the bottom of the screen.

When the stars pop up, hit the button on the response box.

Non-Evaluative Block

In this block, decide whether or not there is at least one person in the picture.

First, you will see the picture.

Then, the words 'person' and 'no person' will pop up on the bottom of the screen.

When the words pop up, hit a button on the response box.

Evaluative Block

In this block, decide whether or not you like the picture.

First, you will see the picture.

Then, the words 'like' and 'dislike' will pop up on the bottom of the screen.

When the words pop up, hit a button on the response box.