Cognitive Reappraisal in Middle Childhood

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ABSTRACT

Cognitive reappraisal (CR) involves changing one's mental states in response to an emotionally eliciting event in order to down regulate the potential emotional impact. In this study, 50 children who were 9-10 years old were instructed to engage in CR during a sad film. Children were then exposed to a disappointing situation and asked to self-report on their CR after the disappointment task. As hypothesized, there was variability in level of CR use during the disappointment task. Contrary to hypothesis, children's CR was not related to parent CR. Nor was the association between parent CR and child CR moderated by child baseline frontal EEG asymmetry, as hypothesized. Post-hoc analyses revealed that parent CR moderated the association between child baseline frontal EEG asymmetry and task-related frontal EEG asymmetry, such that children presenting with left frontal asymmetry at baseline and who had parents with higher CR showed left frontal asymmetry during the disappointment task. This was conceptualized as physiological regulation during an emotion event. Post-hoc analyses also revealed that children's CR after the disappointment task was predicted by task-related frontal EEG asymmetry, as well as self-reports of ER strategies. I conclude that task-specific CR can be assessed in preadolescents but that much research is needed to determine the correlates of child use of CR during emotional situations.

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GENERAL AUDIENCE ABSTRACT

Changing the way one thinks of an emotional event is considered highly adaptive, this strategy is referred to as cognitive reappraisal (CR). 50 children between the ages of 9 and 10 and their parents participated in this study. Children were asked to engage in CR while watching a sad film. Then, they were exposed to a disappointing event. After the disappointment, children were asked to complete a self-report questionnaire which gathered information on their CR during the disappointment task. Parents also completed an adult version of this questionnaire. Children's responses were varied, but their CR was not related to their parent's CR. Children's brain activity was also not related to either parent's nor children's CR. Parent's own CR was linked to children's brain activity during rest and during the disappointment task, making brain activity more extreme for children with greater activation in the frontal left hemisphere of the brain during rest, the area involved with greater regulation. Additionally, children's CR was predicted by their self-reported emotion regulation and their brain activity during the disappointment task. Our results indicate that wen parents are capable of changing the way they think about an emotional event, using CR, their children are benefitting in ways that are not easily observable, such as through brain activity.

DEDICATION

I would like to dedicate this thesis to my wonderful daughter Jade, I would not be doing this if it wasn't for you. Jorge, without all of your support I know I would not be here. I really appreciate everything you have done to help me make it this far, you are an amazing husband, great friend, and awesome support system. Madre, muchas gracias por enseñarme a nunca darme por vencida y siempre hecharle muchas ganas a todo lo que hago. Agradezco todo lo que has echo por mi, te quiero mucho.

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Introduction

Emotion regulation is a skill that begins to develop in infancy and continues well into middle and late childhood and beyond. When children are capable of engaging in emotion regulation (ER), they have the ability to enhance, inhibit, and modulate their emotional experiences and expressions during emotionally eliciting situations (Calkins & Hill, 2007). Children's ER is related to a number of different factors, such as school readiness, academic achievement, and success in the school environment. For example, when children have better ER upon their entrance into formal schooling, they show greater increases in academic achievement than children with poorer ER skills (Howse, et al., 2003). When children do not do well in school, they display maladaptive behaviors in the school environment, have a greater likelihood of dropping out (Horn & Packard, 1985), and develop negative relationships with their peers (Ladd, 1990). Children who have better ER consequently have greater social competence (Hubbard & Coie, 1994) and tend to do better in school than children who have difficulty engaging in ER (Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010). Doing well in school leads children on a more positive trajectory; this eventually leads to more positive behaviors in later childhood, making ER an important component of childhood development to examine.

As children mature, so do their ER strategies. During early childhood, children's ER is focused on the regulation of behaviors, but as children age they become more advanced in their regulation abilities. For example, older children become capable of regulating their emotions through cognitive strategies, such as cognitive reappraisal (CR) and emotion suppression (ES). CR involves changes to thoughts about an emotional event in order to alter the emotional

experience (Lazarus & Alfert, 1964). ES, on the other hand, involves down-regulating the emotional expression in order to hide how one is feeling (Gross, 1998). Engaging in either CR or ES appears to be an individual characteristic, but the tendency to engage in one of these cognitive strategies can also be altered in the lab environment with instruction (Gross & John, 2003).

As noted, CR involves a mental change to an emotionally stimulating event or situation by engaging in positive reframing in order to change the emotional impact (Lazarus & Alfert, 1964). CR is an antecedent-focused strategy, as efforts to change the emotional impact occur before the emotional experience is complete. ES is a response-focused strategy; it happens after the emotional experience occurs and is a behavioral modification strategy rather than a cognitive modification strategy (Gross & John, 2003). CR is more adaptive than ES because the focus is to modify the emotional experience rather than modify the behavior in order to hide the emotional response.

The cognitive costs associated with ES seem to be greater than those of CR. When adults engage in ES they display worse cognitive functioning. For example, when adults engage in ES while watching emotionally eliciting film clips, they display worse memory for contents of the film than participants asked to engage in CR during the clips (Richards & Gross, 2006). The same is true for middle childhood (Davis & Levine, 2013). CR, on the other hand, is associated with better socio-emotional outcomes than ES in adults, such as greater well-being, interpersonal functioning, more positive and less negative emotional experiences (Gross & John, 2003). The majority of research examining CR has focused on adults; only a subset of the research has examined CR in children. For this reason, I will first briefly describe CR in adults and then shift my focus to CR research with children.

Cognitive Reappraisal during Adulthood

Adults who regularly engage in CR during high stress situations display less depressive symptoms than those who engage in lower levels of CR (Troy, Wilhelm, Shallcross, & Mauss, 2010). CR in general is also associated with increased HRV (Denson, Grisham, & Moulds, 2011), lower blood pressure (Memedovic, Grisham, Denson, & Moulds, 2010), greater memory (John & Gross, 2004; McRae, Jacobs, Ray, John, & Gross, 2012), and more positive, less negative emotional experiences (Gross & John, 2003). This evidence suggests that modifying the emotional experience by engaging in CR is much more adaptive than modifying one's behavioral response. Through CR, perception of the emotional event is being modified, which consequently changes the emotional experience and response to the event. When adults report engaging in CR, they also report being more optimistic, having greater self-esteem and life satisfaction than people who report engaging in ES (Gross & John, 2003; McRae, et al., 2012).

CR is also associated with greater interpersonal functioning. When adults report using ES as a means to cope with their emotions, they report sharing their emotions less with others, which then influences their relationships, negatively affecting their relationships with others and not having close relationships. On the other hand, adult using CR and who report sharing their emotions with others report having more close relationships and are also liked better by their peers (Gross & John, 2003). The link between CR and interpersonal functioning suggests the importance of understanding how CR develops during childhood.

Thus, habitual use of CR influences many individual outcomes, but the effects of CR can also be seen when it is induced in a laboratory setting. In the research lab, CR is related to more positive experiences, such as feeling less sad after a sad event and happier after a positive event. On the other hand, when adults are asked to suppress their emotions (i.e., ES), they report feeling

sadder and less happy than the CR group (Gross & John, 2003). In addition to enhancing emotional experiences, CR also increases memory of information during film clips and images. CR has been shown to be correlated with working memory (McRae et al., 2012).

Cognitive Reappraisal during Childhood

Although it has been reported that children as young as 6 years of age can be instructed to engage in CR (Davis & Levine, 2013), the understanding that changing mental states can influence feelings begins to emerge around age 7 (Flavell & Green, 1999). Specifically, 35% of 7-year-old children are able to explain that changing their thoughts about an event could change their emotions. This number increases to 60% by age 9, and 80% by age 11 (Pons, Harris, & de Rosnay, 2004). Children can apply and engage in CR on their own during sad, frustrating, and fear events starting at age 9 (Davis, Levine, Lench, & Quas, 2010; Stansbury & Sigman, 2000).

The method for determining whether children engage in CR varies with child age. For example, in one study children were not asked whether they engaged in CR, but the benefits of implementing CR were examined through memory, as in the adults studies reviewed in the previous section. Davis and Levine (2013) showed 6- to 13-year-old children a sad film. Prior to viewing the film, half of the children were given instructions in CR and half were simply told to view the film. Afterwards, all children were shown a neutral video. Davis and Levine reported that children in the CR group showed greater memory for the information in the neutral film as opposed to children in the control group. They interpreted these group differences as evidence that children in the CR group actually did engage in CR. Specifically, the children in the CR group were able to engage their cognitive processes for processing and remembering the information from the neutral video, rather than continuing to engage their cognitive resources in processing the information from the previous sad film, the way the children in the control group

did. At no time did they ask the children about their strategies for dealing with the sad film, thus relying solely on memory for information in the neutral film as evidence of CR. The rationale for this method of determine CR was based on the youngest ages of children in the study.

On the other hand, when working with older children, more straightforward research strategies are possible. For example, in a study of 8- and 12-year-old children, participants were able to describe strategies to change mental states in order to regulate emotions (Altshuler & Ruble, 1989; McCoy & Masters, 1985). This method of data collection is more like the method done with adult participants and is possible because of work showing that more than half of children are able to apply, engage, and report on CR strategies by age 9 (Davis, Levine, Lench, & Quas, 2010; Pons et al., 2004; Stansbury & Sigman, 2000).

Because my study is focused on children's ability to implement and report on CR after being instructed to do so, I conducted my study with 9- and 10-year-old children. Based on the literature cited above, by focusing on this age I was confident in getting a range of differences in whether children could apply and self-report on their CR use.

Intergenerational Transmission of Cognitive Reappraisal

In addition to children's overall maturation, other factors that influence the development of ER in general, and CR specifically, include parenting behaviors. Beginning in infancy, children learn their initial strategies for ER from their parents or caregivers. Infants will engage their parents, and if parents respond appropriately, then children can transition from having their emotions regulated by the parent to greater personal regulation of emotions (Bell, Broomell, & Patton, 2018). Unfortunately, when mothers are physically and emotionally unavailable, children do not have that critical assistance and they become less capable of regulating their emotions (Field, 1994). When children lack an emotionally well-regulated model, their ability to

learn ER strategies diminishes, making it difficult for children to develop their own ways to cope with distressing situations. On the other hand, when children have an emotionally well-regulated model, their ability to learn ER strategies is greatly enhanced (Calkins & Hill, 2007).

Much of the research that has examined the intergenerational transmission of ER has focused on the impact that parent's own ER has on the parenting environment, which then affects the child's adaptive regulation (e.g., Bridgette, Burt, Edwards, & Deater-Deckard, 2015; Crandall, Deater-Deckard, & Riley, 2015; Cumberland-Li et al., 2003; Lorber, 2012; Lorber & O'Leary, 2005). For example, Morelen and colleagues (2016) examined maternal emotion regulation and supportive parenting as predictors of children's ER behaviors. Results indicated that unsupportive parenting mediated the relationship between maternal emotion dysregulation and the child's emotion dysregulation. Cumberland-Li and colleagues (2003) examined the maternal expressivity as related to maternal emotionality and found that the more negative mother's emotionality, the more negative their expressivity, which in turn was linked to child adjustment and maladjustment.

There has been little research specifically focused on the intergenerational transmission of CR and ES strategies on children's ER. One study that examined maternal CR and ES and children's ER is Rogers and colleagues (2016). This study examined ER and lability, measured through the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997; ER subscale & lability subscale) in third grade children (7-9 years old), and maternal CR/ES strategies, their beliefs about emotions, and the supportive and nonsupportive environment. Rogers and colleagues (2016) defined lability as emotion reactivity and inability to come back to baseline levels after distressing events. Maternal ES was correlated with less ER and more lability in children. Maternal CR, on the other hand, was only correlated with less lability in children. The

hierarchical regression model indicated maternal ES as the only predictor of children's ER. Maternal CR was not predictive of children's ER. In regards to lability, the hierarchical regression indicated multiple predictors affecting children's emotion lability, such as supportive reactions to children's emotions, measured through the Coping with Children's Negative Emotions Scale (CCNES; Fabes, Eisenberg, & Bernzweig, 1990; Stelter & Halberstadt, 2011) and mother's beliefs about emotions, measured through Parent's Belief About Children's Emotions scale (PBACE; Halberstadt, Dunsmore, Parker, et al., 2008). Mother's CR negatively predicted children's lability and mother's ES positively predicted children's lability scores. Both CR and ES strategies in mothers predicted children's emotion lability. This same relationship was not found for children's ER. Although Rogers and colleagues (2016) examined children's ER, they did not examine children's cognitive-based ER strategies of CR and ES.

Another study, Bariola, Hughes, and Gullone (2012) examined correlations between maternal and paternal CR/ES and children's CR/ES. Maternal ES was correlated with children's ES; maternal CR was not correlated with children's CR. Neither paternal CR or ES was correlated with child CR or ES. This study included children with a wider age range, between 9 and 19-years-old and utilized a cross-sectional design. Interestingly, the authors reported a decrease in children's CR with age.

A longitudinal study by the same group (Gullone et al., 2010) examined the trajectory of CR and ES between the ages of 9 and 15 during three different time points. The trajectory of CR development indicated stability in CR use, with older participants indicating less use of CR. ES, however, showed a different developmental pattern by steadily declining with age. These findings are interesting because they suggest that, although most children are capable of

understanding CR (Pons et al, 2004), not all children develop a tendency to engage in CR. Given the value of CR, it is critical to determine predictors of CR use in older children.

A study that examined direct relations between parent's use of CR/ES and children's use of CR/ES was conducted by Gunzenhauser and colleagues (Gunzenhauser, Fasche, Friedlmeier, & Suchodoletz, 2014), who examined parental modeling of CR and ES to predict CR/ES in children age 5 during wave 1 and age 6 during wave 2. Parental socialization was also measured through the Coping with Children's Negative Emotions Scale (CCNES; Fabes et al., 2002). Parent's CR and ES was collected during wave 1 and during wave 2 parent-report of children's CR and ES was collected. Findings indicated that parental CR and parental supportive reactions to children's emotions both predicted children's CR. As expected, children's ES was predicted by parent's own ES and parental nonsupportive reactions to children's emotions. This study also examined parent's sex as a moderator in predicting children's CR and ES. Although parent sex was a significant control variable in predicting children's CR, when it was included as a moderator comparing mother's and father's effect on children's CR/ES, parent sex as a moderator was not significant.

Due to the limited work that has examined direct relations between parental CR/ES and children's CR/ES I was interested in further examining whether parent's use of CR influences the child's ability to implement CR. I hypothesized that the parent's level of CR would be correlated with child's level of CR. Furthermore, because of the link between parent's CR and children's lability, I examined children's physiological regulation, measured through frontal EEG asymmetry, as an important predictor of children's CR along with parental CR.

Frontal Lobe Involvement in Cognitive Reappraisal and General Emotion Regulation

Limited research studies have examined brain activation of children when engaging in CR; much of the work has been conducted with adults using fMRI. During CR, increased activation is seen in the amygdala, which is involved in emotional learning and memory consolidation, as well as in the prefrontal cortex (PFC), which is involved in moderating social behavior, planning complex cognitive behavior, personality expression, and decision-making (Fuster, 2015). Studies that have been conducted with children have found that children between the ages of 6 and 10 who are asked to engage in CR show increased activation in the lateral PFC, orbitofrontal cortex (OFC), medial prefrontal cortex (PFC), right anterior cingulate cortex (ACC), and ventrolateral PFC during CR (Dougherty, et al., 2015; Levesque et al. 2004).

Additionally, activation in the amygdala is positively correlated with activation in the ventromedial PFC (VMPFC) when children engage in CR (Dougherty, et al., 2015). Adults with lesions to the right VMPFC show deficits in emotional processing, personality, social and interpersonal behavior (Tranel, Bechara, & Denburg, 2002). When adults engage in ES habitually, changes in brain volume of the anterior insula are seen as opposed to when adults engage in habitual use of CR (Guiliani, Drabant, Bhatnagar, & Gross, 2011). These differences show how engaging in one ER strategy over another can be related to overall brain structure as well as functioning.

Frontal EEG asymmetry (FA), the increased activation of either the right or left frontal cortices, is associated with the behavioral expression and regulation of emotions (Fox, 1991, 1994; Fox, Schmidt, Calkins, Rubin, & Coplan, 1996). FA can be considered a trait temperamental factor, and can also be induced during different emotion states. Increased activation of the right frontal cortical area is associated with withdrawal-motivated behaviors, whereas increased activation of the left frontal cortical area is associated with more approach-

oriented behaviors (Fox, 1991, 1994). In infants, more right frontal activation during task is associated with increases in fear responses to distressing emotional stimuli, such as stranger approach, the more right frontal infants became during the task the stronger their behavioral responses (Diaz & Bell, 2012).

FA has also been linked to both reactivity and regulation (Kim & Bell, 2006), with left FA being linked to more positive regulation and right FA being associated with regulation difficulties as reported by parents. Task FA can be thought of as physiological regulation during task specific measures. For example, in infants, right FA recorded during baseline is associated with a shorter latency to cry after maternal separation, whereas left FA is associated with longer latency (Bell & Fox, 1994). In general, infant responses to maternal separation are predicted by both baseline and task frontal EEG, with more crying behaviors being related to greater right FA after the separation (Davidson & Fox, 1998). Also in infants, right FA during fear tasks is associated with more fear behavior (Diaz & Bell, 2012). A great deal of research on FA with adults has reported similar findings. More right FA during emotion induction is associated with increasing negative emotions, such as negative affect in response to emotionally provocative films (Coan & Allen, 2003; see Coan & Allen, 2004, for review of adult research).

Individual differences related to FA are associated with a number of behavioral outcomes later in life. Four-year-old children with greater left frontal activation during a resting state display greater social competence than children with greater right frontal activation who display social withdrawal (Fox et al., 1995). Early childhood FA predicts anxiety behaviors during a speech task in middle childhood, with children who exhibited greater right frontal EEG activation during early childhood having increased arousal, such as increases in heart rate and decreases in variability, and decreased parent-reported emotional regulation during middle

childhood (Hannesdóttir et al., 2010). FA is also associated with differences in internalizing and externalizing behaviors. Stability of FA during 10 and 24-months of age predicts both internalizing and externalizing behaviors as reported by their parents. Stability of left frontal EEG asymmetry was predictive of greater internalizing behaviors, whereas right frontal EEG asymmetry stability was predictive of greater externalizing behaviors (Smith & Bell, 2010).

Furthermore, children's FA moderates the relationship between sociability and shyness to both internalizing and externalizing behaviors. For example, Fox and colleagues (1996) found that when children were highly sociable and also exhibited greater right FA, they consequently displayed greater externalizing behaviors. This relationship was not found for highly sociable children with greater relative left FA. It was also indicated that when shy children exhibited greater relative right FA, they displayed more internalizing behaviors; this was not the case for shy children with greater relative left FA.

Research has not examined FA as a potential factor associated with the use of CR. Because of the general associations between FA and ER, however, I examined FA in my study. I was influenced by the Fox et al. (1996) study showing how FA moderated the link between early sociability/shyness and externalizing/internalizing behaviors. Furthermore, children's temperamental approach, along with parental care, is predictive of greater CR use in 9 to 12-year-old children (Jaffe et al., 2010). In thinking about intergenerational transmission of CR, I considered whether FA might moderate that link. I reasoned that CR is a frontal lobe process and that individual differences in frontal lobe activity (i.e., FA) are linked with general ER and approach motivated behaviors. Because of potential common frontal processes, perhaps there would be associations between CR and FA as well. I hypothesized that children with greater

levels of left FA, approach motivation, and who have a caregiver who with higher levels of CR would will be more capable of implementing CR themselves.

Current Study

The purpose of my thesis study was to examine the effects of parent CR and child FA on the ability to engage in CR at 9-10 years of age. The assessment of child CR in my study was unique in that children were instructed to implement CR prior to watching a sad film and then their CR was assessed later after a disappointment task. I was interested in examining whether children would be capable of using a strategy from the CR instructions for one situation and implement that same strategy later in a different situation. The children received no CR instructions prior to the disappointment task, much like the CR research protocol used by Davis and Levine (2013) with children. Based on my reading of the research literature, my hypotheses were: (1) There would be variability in 9- to 10-year-old children's use of CR. (2) There would be a positive correlation between parent CR and child CR. (3) Children's FA will moderate the relationship between parent CR and child CR. Specifically, the association between parent CR and child CR will be stronger for children with left FA than for children with right FA (Figure 1).

Method

Participants

Participants were 50 children (23 girls) between the ages of 9 and 10 years (M = 9.74; SD = .68) and their parents (45 mothers; 5 fathers). Families self-selected the parent who brought in the child. All questionnaires were completed by the parent who came into the research lab with their child. Participants were recruited from the Virginia Tech Developmental Science database, through flyers, and announcements. Children were primarily non-Hispanic, Caucasian (80%

White, 8% Hispanic or Latino, 6% Multi-Racial, 2% Asian, 2% Native American) with highly educated parents (12% High School Diploma, 4% Technical School, 26% College Degree, and 56% Graduate School).

Procedure

Task order (Figure 2) was highly important for this study; therefore, task order was not counterbalanced. There are tasks on Figure 2 that were administered but are not part of this thesis project (i.e., number Stroop, Wisconsin Card Sort Task, memory film and questions).

Children and their families arrived to our research lab where the experimenter (E1) greeted them and collected parent consent and child assent. The EEG cap was placed while the child completed the PPVT administered by a research assistant. After the EEG was placed and impedance values were checked and accepted, EEG baseline was recorded. Next, children were instructed to sort toys for the Wrong Gift (WG) task. They were provided with CR instructions and then watched a sad film. WG task was used to induce disappointment and then children were asked about their CR strategies during WG task via questionnaire. By using this task order, I sought to examine whether CR instructions during the sad film were used by the child during the disappointment task. Due to the numerous emotion elicitation tasks that were conducted in this thesis, children were asked to rate their emotions throughout the visit.

EEG

Children were capped using an electroencephalogram (EEG) stretch cap (Electro-Cap, Inc.; Eaton, OH; E1-series cap) with electrodes in the 10/20 system pattern. EEG recordings were collected from 26 left, right, and midline scalp sites [frontal pole (Fp1, Fp2), frontal (F3, F4, Fz, F7, F8), central (C3, C4), central frontal (FC1, FC2, FC5, FC6), temporal (T7, T8), parietal (P3, P4, Pz, P7, P8), central parietal (CP1, CP2, CP5, CP6), occipital (O1, O2)]. After

the cap was positioned, abrasive gel was placed and rubbed at each electrode site. Conductive gel was then added and rubbed gently at each electrode site.

Electrode impedances were measured and accepted below 10Ω. EEG electrical activity was amplified from each lead using separate James Long Company Bioamps and bandpassed from .1 to 100 Hz. Activity for each lead was displayed on a monitor of an acquisition computer. EEG signal was digitized on-line at 512 samples per second for each channel so that the data would not be affected by aliasing. The acquisition software Snapshot-Snapstream (HEM Data Corp., Southfield, MI) was used and the raw data was stored for later analyses.

EEG data was examined and analyzed using EEG Analysis software developed by the James Long Company (Caroga Lake, NY). The data were re-referenced via software to an average reference configuration. The average reference EEG data were artifact scored for eye movements and gross motor artifact. These artifacts scored epochs were eliminated from all subsequent analyses. The EEG data was analyzed using a discrete Fourier Transform (DFT) using a Hanning window of 1-second width and 50% overlap. Power was computed from the 8 – 13 Hz alpha frequency bands. Data were log (ln) transformed to normalize EEG values. Frontal asymmetry (FA) values were created by subtracting (ln)F3 from (ln)F4 values. Positive values indicate greater relative left frontal activation compared to the right and negative values indicate greater relative right frontal activation compared to the left.

Baseline EEG was collected during 60-second eyes-open, which is a traditional baseline used in our research lab for children 6 years of age and older. EEG was also recorded throughout the visit.

Verbal Ability

The Peabody Picture Vocabulary Test IV (PPVT) was administered during EEG cap placement. The PPVT is a measure of children's receptive vocabulary and verbal comprehension. Four different images are displayed on a page and children are asked to point to the picture that describes the word spoken by the experimenter. PPVT scores were used as a covariate in the analyses because verbal ability is correlated with ER ability (Carlson & Wang, 2007).

Emotion Ratings

Due to the numerous emotion elicitation tasks that were conducted in this thesis, children were asked to rate their emotions throughout the visit. Children were asked before baseline, after baseline, before the sad film, after the sad film, before WG began, after children received the incorrect prize and were left alone (WG3), after children completed the CERQ-k, which is the CR questionnaire, after Wisconsin Card Sort (task not used in the analysis for this thesis), and after the CEMS questionnaire (final rating). The timing of the ratings are provided in the protocol figure (Figure 2). Children were shown an image with faces eliciting different emotions (happy, sad, neutral, and angry; Appendix 1) and were told the following:

> "Throughout your visit today, I am going to ask you to tell me how you are feeling. I am going to show you some faces and I am going to ask you to tell me how you feel. I will show you this, (Appendix 1) and I want you to tell me if you are feeling happy, sad, okay, or angry. And then I want you to tell me how much of that emotion you are feeling. So for example, if you say you are feeling happy, I am going to ask you to tell me how happy you are feeling, and you will do that with these face here (Appendix 1). So if you feel very happy you would point to this, if you feel somewhat happy you would point to the next one, and if you feel slightly happy you would point to the last one. If you feel an emotion

that isn't on the sheet, just try your best to pick the one that matches most closely. So let's try for real. Go ahead and tell me how you are feeling." Following this explanation, children were then just asked, "Go ahead and tell me how you are feeling" while experimenter 1(E1) showed them the sheet with faces.

Cognitive Reappraisal Task

Children watched a five-minute clip of the film *My Girl.* During the clip a young girl learns of her friend's death who passed away due to an allergic reaction to a bee sting. She attends the funeral, becomes very upset, begins to cry, and runs out of the funeral in tears. This clip has been used to elicit sadness in children between the ages of 6-13 years in previous studies focused on CR (Davis & Levine, 2013; Davis, 2016). Additionally, children were capable of explaining the CR instructions to a researcher as well as their intention to use them (Davis & Levine, 2013).

Prior to the sad film children were instructed to implement CR to help alleviate their sad emotions. E1 stated the following to the child:

> "Watching this makes some children sad. If you feel sad, I want you to try to think about how everything that is sad for the little girl could turn out okay after all. Think about how everything could get better."

Children were then asked what they were going to think about while they watched the movie. If children repeated the CR instructions correctly E1 began the movie clip. If the child did not repeat the CR instructions correctly E1 reminded the child of the CR instructions and asked the child again what they would think about during the film until the child correctly repeated the instructions.

Emotion Regulation Task

Disappointment was elicited in children through the Wrong Gift (WG) procedures from the laboratory temperament assessment battery (Lab-TAB, 2012; Saarni, 1984; Shih et al., 2018). After baseline, children were asked to rank order 5 different toys, toys were both appealing and unappealing, from *least favorite* to *most favorite*, into a box sectioned off into 5 different sections, numbered 1 through 5. Children were asked to place the prize they liked best in the number 1 slot, the prize they liked second best in the number 2 slot, and continue on until the number 5 slot had their lest favorite prize. Once children completed sorting the toys, E1 placed a cloth on top of the box of toys and set the box outside of the room and instructed children on the next task (Figure 2).

After viewing the sad film and completing the Stroop task (Stroop, 1935), the WG procedure began. The WG procedure was collected in 7 different phases. WG 1 began when E1 explained to the child that because they did so well on the tasks the other experimenter (E2) was going to bring in their prize. Children were left alone for 30-seconds. Then WG 2 began when E2 entered the room and placed the lowest ranked toy on the table, while saying, “Here is your prize”, and sitting in a chair facing the child. The experimenter remained silent unless the child made a remark, to which the experimenter repeated back the child’s remark in question format.

After one minute, WG 3 began when E2 explained to the child that she was going to get E1 and left the room. The child was left alone for an additional 30-seconds. WG 4 began when E1 entered the room and asked, “Did you get the prize you wanted?”. E1 then asked, “How did you feel when you got that prize?” Emotion Rating 5 was collected during this time. E1 then asked the child, “Tell me, what did you say to yourself in your head to deal with getting the (wrong prize)?” WG 5 began when E2 entered the room and explained that the prizes got mixed up in the box and they must have grabbed the wrong one. E2 then took the wrong prize and

children were asked to complete the Cognitive Emotion Regulation Questionnaire – kids (CERQ-k). After completing the questionnaire WG 6 began with E1 placing the box of toys on the table and telling the child to "pick your favorite prize" and leaving the room. WG 7 began when children lifted the cloth and continued for 30-seconds thereafter.

Questionnaires

Cognitive Emotion Regulation – Cognitive Emotion Regulation Questionnaire – kids (CERQ-k; Garnefski & Kraaij, 2007). To assess children's use of CR during the Wrong Gift task (task-specific CR, also referred to as child CR), items were reworded on the CERQ-k to reflect task related questions. Prior to starting the questionnaire E1 explained, "I have some questions that also get at what you were saying to yourself in your head to help you deal with getting the wrong prize." These questions asked the child about the strategies they used to cope with their emotions after they received the wrong prize. This allowed us to gather information regarding the child's use of CR, the strategy they were asked to implement prior to the sad film. The questionnaire measures nine cognitive coping strategies, with each subscale containing 4 items. If one item was left blank, a mean score of the three additional items within the subscale was created and replaced the missing score. This was done for children who had a missing question and who had at least three items completed within the subscale.

The 9 coping strategies/subscales are: self-blame, other blame, acceptance, planning, positive refocusing, rumination or focus on thought, positive reappraisal, putting into perspective, and catastrophizing. Each item is on a 5-point Likert-type scale from (*almost*) never to (*almost*) always (See Appendix 2). For my thesis study, I focused on CR by examining the following 4 subscales: positive reappraisal (Qs: 6, 15, 24, 33), positive refocusing (Qs: 4, 13, 22, 31), refocus on planning (Qs: 5, 14, 23, 32), and putting into perspective (Qs: 7, 16, 25, 34). No

other study has examined CR with these subscales, but due to the nature of the instructions provided prior to the sad film and its link to the definitions of each subscale, examining the four subscales should provide indication of children's CR.

Each subscale has a clear definition based on previous research, which is cited following the subscale definition. Positive reappraisal is defined as inferring positive meanings to events as a means of personal growth (Carver et al., 1989; Spirito, Stark, & Williams, 1988). Positive refocusing refers to thinking of something pleasant rather than the actual event or situation (Endler & Parker, 1990). Refocus on planning is thinking about the necessary steps to take in order to deal with the situation or event (Carver, et al., 1989; Folkman & Lazarus, 1988). Putting into perspective, downplaying the importance of the event in comparison to other situations (Allan & Gilbert, 1995). Cognitive reappraisal scores were created by averaging the previously mentioned 4 subscales. The other questions are ES focused and were not analyzed for this thesis project. The questionnaire that I am using in my thesis has shown good internal consistency for the 9 subscales (ranging from .7 to .8; Garnefski, Rieffe, Jellesma, Terwogt, & Kraaij, 2007).

As noted, children completed the CERQ-k during the wrong gift task, specifically after they were told by E2 that she grabbed the incorrect prize. Although no other study has examined children's CR through these four subscales, the questionnaire itself has been used widely to predict emotional problems, such as depression and anxiety, in children between 12 and 16-years (Garnefski, Kraaij, & Spinhoven, 2001) and fear and worry (Garnefski et al., 2007) in 9 to 11-year olds. Since this questionnaire was phrased in reference to negative life events, I was able to minimally modify the questionnaire (Appendix 2) in order to refer to task specific CR strategies children used during WG.

Children's Emotion Regulation. Children's emotion regulation was obtained through self-report. Children completed the Children's Emotion Management Scale (CEMS; Zeman et. al, 2002; Appendix 3) which asks children to answer questions regarding their inhibition, dysregulation, and coping strategies for sadness, anger, and worry. In my thesis I only used the sadness and anger subscales. Items are rated on a 3-point Likert-type scale (*hardly ever, sometimes, and often*). A composite score was created for dysregulation, inhibition, and coping. Other studies (Thornback & Muller, 2015; Suveg et al., 2009; Morelen et al., 2016) have created composite scores for the different subscales. Parents also reported on their child's ER through the CEMS for parents (CEMS; Zeman et. al, 2002).

Parent Self-Report of Emotion Regulation

Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski & Kraaij, 2006). Parent report of their own ER strategies was collected through the CERQ (Appendix 4). The CERQ is similar to the CERQ-k, but is a shorter adult version. Nine cognitive coping strategies are measured and each subscale contains 2-items: self-blame, acceptance, focus on thought or rumination, positive refocusing, refocus on planning, positive reappraisal, putting into perspective, catastrophizing, and other-blame. Items are on a 5-point Likert-type scale from (*almost*) never to (*almost*) always. Questions are phrased to refer to stressful life events and were used in this study to assess parent self-report of CR. Subscale scores were created by summing the two items in the subscale, with the minimum score being 2 and highest score being 10. Higher scores indicate greater use of the specific strategy. Parent CR was configured based on the same 4 subscales as the children (positive reappraisal, positive refocusing, refocus on planning, and putting into perspective). ES questions were not analyzed for my thesis.

Analysis Plan

I had three hypotheses for my study. Hypothesis 1 was that there would be variability in 9- to 10-year-old children's use of CR, meaning no floor or ceiling effect. I tested this hypothesis by examining mean and standard deviation CR on the CERQ-k.

Hypothesis 2 was that there would be a positive correlation between parent CR and child CR. I tested this hypothesis with Pearson correlation.

Hypothesis 3 was that children of parents who report greater CR use (measured with CERQ-short) will themselves report engaging in greater CR during the disappointment task (measured with modified CERQ-k). Children's FA will moderate this relationship such that children of parents who report using CR and who have greater left FA at baseline recoding will report higher CR more than a child with more right FA at baseline. This hypothesis was tested with regression analysis. Parents' own CR and child FA, as well as the interaction between the two, was used to predict child CR. For a significant interaction, I will test for the direction of my hypothesis.

Results

Correlations and descriptive statistics for the variables of interest are provided in Tables 1, 2, and 3. Variables included in post-hoc analyses are also included in the correlation tables. All 50 children contributed EEG data, 1 child was missing the CEMS, and 1 child was missing EEG data during WG7. Task EEG during WG6 did not contain enough data to examine in our analyses, therefore it was removed from further examination. The CERQ was completed by 45 mothers and 5 fathers.

As seen in Table 1, there was a significant positive correlation between children's CR and task FA during WG2. Parent CR was significantly correlated with children's Inhibition (from CEMS). Task FA during WG3 was significantly correlated with children's Coping (from

CEMS). As seen in Table 2, with partial correlations controlling for parental education, child sex, and child verbal ability (PPVT), the previously mentioned correlations all remained significant. The correlations between child task-specific CR and child Dysregulation (from CEMS) became significant after controlling for the covariates.

Emotion Ratings

Prior to testing my 3 hypotheses, I examined children's emotion ratings between tasks to determine if there was variability in the participants' emotions from one event to another throughout the study. I found that children's emotion ratings were somewhat variable throughout the different tasks (Table 4), but not extremely so. At baseline, children stated being either happy or okay (sub-Table 4.0). Children reported being sad after the sad film (sub-Table 4.3). In contrast, prior to the sad film, children rated their emotions as either happy or okay (sub-Table 4.2). During wrong gift, or after WG5 specifically, children reported being sad and angry (sub-Table 4.6). After WG was complete and children were able to choose their favorite prize, children reported being happy (sub-Table 4.7). Finally, similar to the baseline ratings, children reported either happy or okay as their emotion (sub-Table 4.8) upon completion of my thesis study. I had no hypotheses about these ratings, but these ratings give me confidence that my sad film induced sadness and my emotion regulation task induced emotions of sadness or anger. Importantly, I am confident that at the end of the study, children did not leave feeling sad or angry, according to their self-report of emotion.

Hypothesis Testing

Hypothesis 1 was supported. The mean for child CR was 11.22 (SD 3.07; see Table 1). The range was from 5.25 to 18.25, with the potential range being 4 to 20. Thus, there was variability in the CR measure, with no floor or ceiling effect.

Hypothesis 2 was not supported. Parent CR and child CR were not correlated (see Table 1 for correlation and Table 2 for partial correlation).

For testing Hypothesis 3, the dependent variable was child self-report of CR they used during the WG task. Step 1 included control variables (parental education, child sex, and child PPVT). Step 2 included parent CR and child baseline FA. Step 3 included the interaction between parent CR and child FA. None of the regression equations indicated a significant model. Step 1 was not significant; $R^2 = .09$, F (3, 46) = 1.59, $p = .20$. Step 2 was also not significant; R^2 change = .04, F (2, 44) = 1.04, $p = .36$. Step 3 was not significant; R^2 change = .03, F (1, 43) = 0.85, $p = .36$ (see Table 5).

Post Hoc Analyses

Predicting task-related FA during WG. I examined potential associations between children's baseline FA, children's report of their CR (via CERQ-k), and their physiological regulation (via task-related FA) during the WG. Partial correlations (controlling for sex, parental education, and PPVT) indicated that children's CR was significantly correlated with children's task FA during WG1, 2, 4, and 5 (Table 3). When children were left alone, their FA during WG3 and WG7 was not correlated with their self-reported CR (Table 3). Due to this inconsistency, I examined factors that may be contributing to children's physiological regulation when they were alone. The WG3 phase of the WG task was chosen because it occurred after children received the incorrect prize and they were left alone by E2. By removing additional people from the context, this allowed the child to engage in coping behaviors that they may have otherwise refrained themselves from doing because someone else was in the room with them. During this age, children expect to receive supportive responses from others (Zeman & Shipman, 1997). I was interested in examining children's physiological regulation when they were alone in order to

remove any expectations they may have had by having someone in the room.

Thus, the dependent variable was child task-related FA during WG3, after they received the incorrect prize and were left alone by E2. Step 1 included the control variables (parental education, child sex, and child PPVT). Step 2 included parent CR and child baseline FA. Step 3 included the interaction between parent CR and child baseline FA. As seen in Table 6, step 1 was not significant; R^2 = .14, F (3, 46) = 2.51, p = .07. Step 2 was not significant; R^2 change = .10, F (2, 44) = 2.92, p = .07. Step 3, which included the interaction term, was significant; R^2 change = .07, F (1, 43) = 4.32, p = .04. Parental education (p = .002), baseline FA (p = .004), and the interaction between baseline FA and parent CR (p = .044) were the significant predictors (Table 6).

I probed the interaction using parent CR as the moderator. As seen in Figure 3, children with left FA during baseline had task-related FA during WG3 that varied with parent CR. If parents self-reported lower CR, then children with Left FA showed frontal symmetry during WG3. If parents self-reported higher CR, then children with left FA showed left FA during WG3 (B = .81, p = .004). Children with right FA during baseline had task-related FA during WG3 that did not vary with respect to parent self-reported CR (B = .29, p = .06.). Using the Fox (1994) model of FA and ER, I interpret this to mean that children with trait left FA, who also had parents high in CR, experienced physiological regulation during the disappointment task.

Exploratory analysis of predictors of child CR. Links have been reported between cognitive behavior therapy and adaptive changes in children's ER measured using CEMS (Suveg et al., 2009; Thornback & Muller, 2015). Thus, I was interested in examining whether children's report regarding their ER would contribute to children's use of CR during WG. Furthermore, because I measured task-specific CR in children during disappointment, I also included

children's psychophysiological regulation (task FA) after children received the incorrect prize and were unaware of the experimenter mistake (task FA WG2, task FA WG3). I was interested in examining WG3 specifically, because of the post-hoc analyses revealing parental CR as a predictor of children's task FA during WG3. Due to the social contexts that are evident in CR outcomes (Gross & John, 2003), with people who engage in CR being liked better by their peers, I wanted to examined children's psychophysiological regulation within a social context. Therefore, I examined task FA during WG2, which was a 1-minute episode of the child having received the wrong prize and having to sit in the room with the experimenter who gave them the wrong prize for an entire minute. By including task FA during this social context, along with task FA when children were alone after having been given the wrong prize (WG3), I was able to examine whether a psychophysiological regulation measure from either episode predicted children's task-specific self-reported CR.

The analyses for this post-hoc test were conducted using stepwise regression, which removes variables that are not significant in the model and provides the final model inclusive of only the variables that are significant in predicting the outcome variable. Thus, these post hoc analyses are highly exploratory. Children's CR (from the CERQ-k after WG) was the criterion. The predictors included the control variables using in all other analyses (parental education, child sex, and PPVT). Predictors were children's ER (CEMS), parent's CR, children's baseline FA, the interaction between parent CR and child baseline FA, task FA (WG2, WG3) and ER (from CEMS; dysregulation, inhibition, and coping).

Step 1 was significant; R2 = .09, F (1,48) = 7.23, p = .01, with children's task FA during WG2 (beta = .36) as the only significant predictor. The covariates were removed from the model for all future steps, as they were not significant predictors. Step 2 was significant; F (2,47) =

5.69, p = .006, with task FA (WG2) (beta = .35) and children's dysregulation (beta = -.25) being significant predictors of child CR. Step 3 was also significant; F (3, 46) = 6.00, p = .002, with children's task FA during WG2 (beta = .39), dysregulation (beta = -.38), and inhibition (beta = -.33) being the significant predictors. Although data driven rather than conceptually driven, by using stepwise regression, I was able to deduce which variables predict children's CR without having to account for additional variance that would remove variance in predicting children's CR.

Discussion

Findings Related to Hypotheses

In reference to hypothesis 1, children varied in their CR ability, with the lowest score being 5.25 and the highest being 18.25 (potential range 4 - 20), in support of my first hypothesis. Thus, there was wide ranging self-reported variability in CR among the child during the WG task.

Based on the correlations between child CR during WG and some of the WG FA variables I believe that I was able to examine the link between children's report of their own CER strategies and their physiological regulation. This link has also been reported elsewhere with cognitive reappraisal being linked to more adaptive physiological regulation, measured through heart rate (Mauss et al., 2007). Since child CR was positively correlated to FA during WG (WG1, WG2, WG4, and WG5), this suggests that greater task-specific CR in children was correlated with greater FA scores, meaning that left FA was correlated with higher CR during the WG task when children were in the room with an experimenter (E1 or E2). By examining children's self-report of task CER strategies and their physiological regulation during the same task, I was able to examine how CR and physiological regulation, measured through FA, are

related. This is the first study that examines FA within the context of children's CR, specifically task CR, which is also another novelty of my thesis study (McRae, 2016). No other study has explicitly asked children to report on their CER strategies used during an emotionally eliciting task.

Hypothesis 2, that parent CR and child CR would be correlated, was not supported. Since no other study has examined task specific child CR, it is possible that children's CR during the WG task is not indicative of what may be the intergenerational transmission of CR. It is also the case that parents were self-reporting on general CR, not task-specific CR. Examining child general CR could provide a more comprehensive picture relating to the intergenerational transmission of CR from parent to child. Alternatively, examining parent task-specific CR could be highly informative.

The main purpose of my thesis was Hypothesis 3, which was to examine the interaction between parent's CR and children's baseline FA in predicting children's CR, measured through children's self-report after disappointment elicitation. I selected baseline FA because I was conceptualizing FA as a trait physiological regulation measure linked to approach motivated behaviors (Jaffe et al., 2010). My hypothesized model was not supported. Parent's CR and children's FA were not individual predictors of children's ability to engage in CR during WG, nor was there an interaction between the predictor variables.

To return to the issue of measurement of CR in my thesis, I believe the reason parental CR was not linked to child CR was because I examined global CR of parents and task-specific CR of children. Examining both global and discipline specific CR in mothers, it was reported that global CR was correlated with over reactive discipline, as well as negative expression and experience during disciple. This was not the same for discipline specific CR (Lorber, 2012). Due

to these findings, I believe there may be differences in specific and global reappraisal ability, in both children and parents, which may be the reason why global parent CR and task-specific child CR were not correlated. Furthermore, due to findings indicating direct relationships between parent and child CR (Bariola et al., 2012; Gunzenhauser et al., 2014), this leads me to further believe that having examined global child CR, would have provided greater insight into the intergenerational transmission of CR between parent and child.

Post Hoc Findings

After my original hypothesis 3 was not supported, I did my first set of post hoc analyses by refocusing on FA and whether baseline FA or task-related FA was most appropriate in my analyses. Because I was interested in examining children's ER during the WG task, I analyzed children's task FA during WG, after children received the incorrect prize and were left alone. Results indicated that resting FA as well as the interaction between parent's CR and children's resting FA predicted children's task FA after controlling for parental education, sex, and verbal ability. For children with right FA during baseline, there was no impact of high and low levels of parent CR on the task-related FA. Thus, there is no benefit of high parent CR to a child's physiological regulation during a disappointment task. However, for children with left FA during baseline, task-related FA did vary with parent CR. Specifically, higher levels of parent CR were associated with greater levels of FA (i.e., greater left FA) during the WG task. For these children, there is a benefit of high parent CR to one's physiological regulation during a disappointment task. Left FA children are already considered to be at an advantage with respect to ER (Fox, 1994). They especially benefit when that trait FA occurs in a home environment with a parent who self-reports high CR.

These findings suggest that the environment parents provide for their children should be explored in a greater context, looking beyond parenting behaviors and examining CR of the parent. Buckholdt et al. (2014) findings support this notion, with parental emotion dysregulation affecting the parent's behaviors when responding to their adolescent's emotional expressions, which then subsequently affected the adolescents' emotion dysregulation. I examined the effects of positive parental ER, such as CR, which was linked to the psychophysiological regulation of children (i.e., FA during WG) but not the child's self-reported CR use. By examining both self-reported and psychophysiological regulation, I was able to gather a more comprehensive story of children's regulation ability that may have otherwise been overlooked.

For my second set of post hoc analyses, I attempted a different strategy. In my hypothesized model examining child task-specific CR during disappointment, I did not find links between children's CR and parent's CR. For my post-hoc analyses, I wanted to examine additional factors that could be affecting children's ability to implement CR during a disappointment task. Because CBT uses similar techniques and strategies to assist children in their ER as CR, with a focus on cognitive restructuring and relaxation (Suveg et al., 2006), I wanted to examine outcomes of CBT. The outcomes associated with CBT affect children's ER, measured through CEMS (Suveg et al., 2009; Thornback & Muller, 2015), I examined whether children's ER (measured using the CEMS child-report) as predictors of task-specific CR during the WG task. Additionally, because of children's temperamental approach predicting their CR (Jaffe et al., 2012), I wanted to examine a psychophysiological regulation measure of approach-motivated behaviors as a predictor of task-specific CR in children. Because the control variables were not significant in predicting CR in my hypothesized model, I examined this model through

stepwise regression, which removes variables in the model that are not significant. In this model, multiple variables were significant predictors of task-specific child CR.

Although parental CR was in my post hoc model, it was not a significant predictor of children's CR during disappointment. The interaction between baseline FA and parental CR was also not significant. Similar to my hypothesized model, where parent's CR was not significant predictor, it may not have been significant within this model because I examined children's CR within the context of a disappointing event (task-specific CR) and parent's CR was based on negative life events, a more general form of CR. However, children's task-related FA and their ER was related to CR during WG. Thus, all significant predictors were child centric.

Limitations and Strengths

In hindsight, I should have had children explain their CR more broadly and in relation to negative life events. I also could have had parents explain their CR more specifically and in relation to a very specific event in the research lab. In these ways, I may have been able to better examine the intergenerational transmission of CR. Future research should examine general CR in addition to task-specific CR strategies in both children and parents. This would allow for broader examination of any potential intergenerational transmission of CR across different contexts.

Despite these shortcomings, my thesis study had several strengths. First, no other study has explicitly asked children to explain the strategies that they implemented to cope with disappointment. By gathering children's self-reported CR, I was able to examine various factors associated with the self-reported regulation of children during an emotion-eliciting task.

Furthermore, studies that have examined CR with children have asked children to implement the strategy while neurological data were being collected. In my study I asked

children after we collected EEG data about the strategies they used during the disappointment task. This allowed me to examine different factors that were contributing to CR use during the disappointment task instead of examining the effects of CR implementation. Finally, because CR is linked to both cognitions and emotions (Ochsner & Gross, 2008), examining FA, which is also psychophysiological cognitive and emotion measure (Bell & Wolfe, 2004), as a predictor of CR can greatly inform our understanding of the role that early brain development and ER is playing in the development of CR.

Unlike other studies, my thesis attempts to understand whether children are employing CR strategy after an emotionally eliciting task. No other study has asked children to rate their CR strategies after having been exposed to a disappointment task, such as the wrong gift task. Other studies have provided children with instructions to implement CR strategy and then examined either brain differences or memory to neutral information and compared differences between the control group and the CER groups (Davis & Levine, 2013; Davis et al., 2010; McRae et al., 2012). My study is unique because I explicitly asked children to report on their CR strategies during an emotionally eliciting task without instructing them to use a CR strategy prior to the task.

Conclusions

In sum, I have shown that task-specific CR can be assessed in 9 – 10-year-old children. The hypothesized correlates of CR, which were parent ER and child baseline FA, were not related to level of CR reported by children, however. Post-hoc analyses were potentially fruitful. They suggested that parent CR was related to children's physiological ER during a disappointment task. This may mean that the parenting environment is important for child ER in ways other than children observing and then modeling parents' adaptive behaviors. Given the

value of CR for well-being, understanding the correlates and predictors of CR is a worthy research endeavor.

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Table 1. *Correlations and Descriptive Statistics*

	1	2	3	4	5	6	7	8	9	10	11
Means (SD)	.015 (.19)	6.7 (1.24)	11.22 (3.07)	.04 (.22)	.05 (.21)	5.14 (1.09)	7.26 (1.59)	9.36 (1.83)	–	83.74 (17.40)	–
1. Baseline FA	–										
2. Parent CR	.17	–									
3. Child CR	.22	.19	–								
4. WG2 FA	.56***	.16	.36**	–							
5. WG3 FA	.29*	.08	.01	.33*	–						
6. Dysregulation	-.02	-.25	-.28	-.07	-.16	–					
7. Inhibition	.10	.40**	-.11	.17	.33*	-.40**	–				
8. Coping	.05	.17	.08	-.04	.38**	-.59**	.48***	–			
9. Parental Education	.27	.10	.23	.09	-.28	.05	-.07	-.04	–		
10. PPVT	.26	.02	.23	.16	.14	-.03	-.10	-.10	.16	–	
11. Child Sex	-.30*	.00	-.05	-.32*	-.15	-.07	-.11	-.04	-.23	-.29*	–

***$p \leq .001$ **$p \leq .01$ *$p < .05$.

Baseline FA = Baseline frontal EEG asymmetry; CR = cognitive reappraisal (CERQ-k for children, CERQ for parents); WGj FA = Wrong Gift episode j frontal asymmetry; dysregulation, inhibition, coping = subscales from CEMS

Table 2. *Partial Correlations Controlling for Sex, Parental Education, and Vocabulary*

	1	2	3	4	5	6	7	8
Means (SD)	.01 (.19)	6.7 (1.24)	11.25 (3.10)	.04 (.22)	.04 (.21)	5.14 (1.09)	7.27 (1.59)	9.37 (1.83)
1. Baseline FA	–							
2. Parent CR	.15	–						
3. Child CR	.15	.19	–					
4. WG2 FA	.53***	.19	.36*	–				
5. WG3 FA	.33*	.10	.08	.36*	–			
6. Dysregulation	-.05	-.25	-.30*	-.09	-.16	–		
7. Inhibition	.13	.42**	-.07	.16	.33*	-.42**	–	
8. Coping	.07	.18	.12	-.04	.41**	-.61***	.47***	–

*p<.05.

Baseline FA = Baseline frontal EEG asymmetry; CR = cognitive reappraisal (CERQ-k for children, CERQ for parents); WGj FA = Wrong Gift episode j frontal asymmetry; dysregulation, inhibition, coping = subscales from CEMS

Table 3. *Partial Correlations and Descriptive Statistics Between Task FA, Baseline FA, and Child CR*

	1	2	3	4	5	6	7	8
Means (SD)	.02 (.20)	11.26 (3.09)	.02 (.22)	.04 (.22)	.05 (.21)	-.02 (.30)	.00 (.25)	.06 (.22)
1. Baseline FA	–							
2. Child CR	.14	–						
3. WG1 FA	.42**	.42**	–					
4. WG2 FA	.52***	.36*	.57***	–				
5. WG3 FA	.35*	.08	-.00	.33*	–			
6. WG4 FA	.42**	.44**	.54***	.65***	.30*	–		
7. WG5 FA	.46***	.51***	.42**	.58***	.43**	.55***	–	
8. WG7 FA	.28	.16	.30*	.57***	.31*	.46***	.43**	–

***p≤.001 **p<.01 *p<.05.

Baseline FA = Baseline frontal EEG asymmetry; CR = cognitive reappraisal; WGj FA = Wrong Gift episode j frontal asymmetry

Table 4. *Emotion Ratings after Specific Tasks*

Table 4.0. *Baseline Emotion Rating* (*ER0*) *after consent, PPVT, and EEG cap Placement*

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	27	1.70	.61	10	15	2
Okay	23	---	---	---	---	---
Total	50	1.46	.50	---	---	---

Table 4.1. *Emotion Rating after EEG Baseline* (*ER1*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	27	1.6	.64	13	12	2
Okay	22	---	---	---	---	---
Angry	1	---	---	---	1	---
Total	50	1.5	.61	---	---	---

Table 4.2. *Emotion Rating after Wrong gift ranking/ Before Sad Film* (*ER2*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	40	1.80	.82	18	12	10
Okay	9	---	---	---	---	---
Total	49	1.18	.39	---	---	---

Table 4.3. *Emotion Rating after Sad Film* (*ER3*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	4	1.25	.50	3	1	---
Okay	25	---	---	---	---	---
Sad	19	2.53	.61	1	7	11
Angry	2	1.50	.71	1	1	---
Total	50	2.38	.70	---	---	---

Table 4.4. *Emotion Rating after Stroop Task* (*ER4*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	34	1.76	.74	14	14	6
Okay	15	---	---	---	---	---
Sad	1	---	---	---	---	1
Total	50	1.34	.52	---	---	---

Table 4.5. *Emotion Rating during Wrong Gift* (*WG5*) (*ER5*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	13	1.62	.65	6	6	1
Okay	24	---	---	---	---	---
Sad	10	2.50	.53	---	5	5
Angry	3	2.67	.58	---	1	2
Total	50	2.06	.84	---	---	---

Table 4.6. *Emotion Rating after Wrong Gift Resolution* (*ER6*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	38	1.55	.65	20	15	3
Okay	9	---	---	---	---	---
Sad	3	2.33	1.16	1	---	2
Total	50	1.30	.58	---	---	---

Table 4.7. *Emotion Rating after Wisconsin Card Sort* (*ER7*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	31	1.74	.86	16	7	8
Okay	11	---	---	---	---	---
Sad	1	---	---	1	---	---
Angry	7	2.29	.76	1	3	3
Total	50	1.68	1.06	---	---	---

Table 4.8. *Final Emotion Rating after completing CEMS* (*ER8*)

	Frequency	Mean	SD	Very (1)	Somewhat (2)	Slightly (3)
Happy	23	1.57	.73	13	7	3
Okay	27	---	---	---	---	---
Total	50	1.54	.50	---	---	---

Table 5. *Hypothesized Interaction Model Predicting Child CR* (*hypothesis 3*).

Predictors	B (SE)	β	R^2
Step 1			.09
Sex	.35 (.91)	.06	
Parental Education	.77 (.52)	.21	
PPVT	.04 (.03)	.21	
Step 2			.14
			$\Delta R^2 = .04$
Sex	.48 (.93)	.08	
Parental Education	.62 (.53)	.17	
PPVT	.03 (.03)	.19	
Parent Cognitive Reappraisal	.37 (.35)	.15	
Baseline Frontal EEG Asymmetry	1.96 (2.45)	.12	
Step 3			.15
			$\Delta R^2 = .02$
Sex	.34 (.94)	.05	
Parental Education	.58 (.54)	.16	
PPVT	.03 (.03)	.19	
Parent Cognitive Reappraisal	.32 (.36)	.13	
Baseline Frontal EEG Asymmetry	3.38 (2.89)	.21	
EEG Asymmetry x Parent CR	1.48 (1.61)	.16	

Table 6. *Post Hoc Analyses – Hierarchical Regression Predicting task FA during Wrong Gift 3.*

Predictors	B (SE)	β	R^2
Step 1			.14
Sex	-.07 (.06)	-.18	
Parental Education	-.08 (.04)	-.34*	
PPVT	.00 (.00)	.15	
Step 2			.24
			$\Delta R^2 = .10$
Sex	-.05 (.06)	-.11	
Parental Education	-.10 (.03)	-.41**	
PPVT	.00 (.00)	.09	
Parent Cognitive Reappraisal	.01 (.02)	.06	
Baseline EEG Asymmetry	.35 (.16)	.33*	
Step 3			.31
			$\Delta R^2 = .07$*
Sex	-.07 (.06)	-.16	
Parental Education	-.11 (.03)	-.44**	
PPVT	.00 (.00)	.10	
Parent Cognitive Reappraisal	.00 (.02)	.03	
Baseline EEG Asymmetry	.55 (.18)	.51**	
EEG Asymmetry x Parent CR	.21 (.10)	.33*	

**$p<.01$ *$p<.05$.

Table 7. *Post Hoc Analyses – Stepwise Regression Predicting Child CR from Task Frontal EEG Asymmetry and Child Emotion Regulation*

Predictors	B (SE)	β	R^2
Step 1			.09
Task FA (2)	5.08 (1.89)	.36**	
Step 2			.20
			$\Delta R^2 = .06$
Task FA (2)	4.84 (1.84)	.35*	
Dysregulation	-.72 (.37)	-.25	
Step 3			.28
			$\Delta R^2 = .09$*
Task FA (2)	5.51 (1.78)	.39**	
Dysregulation	-1.08 (.39)	-.38**	
Inhibition	-.63 (.27)	-.33*	

**p<.01 *p<.05.

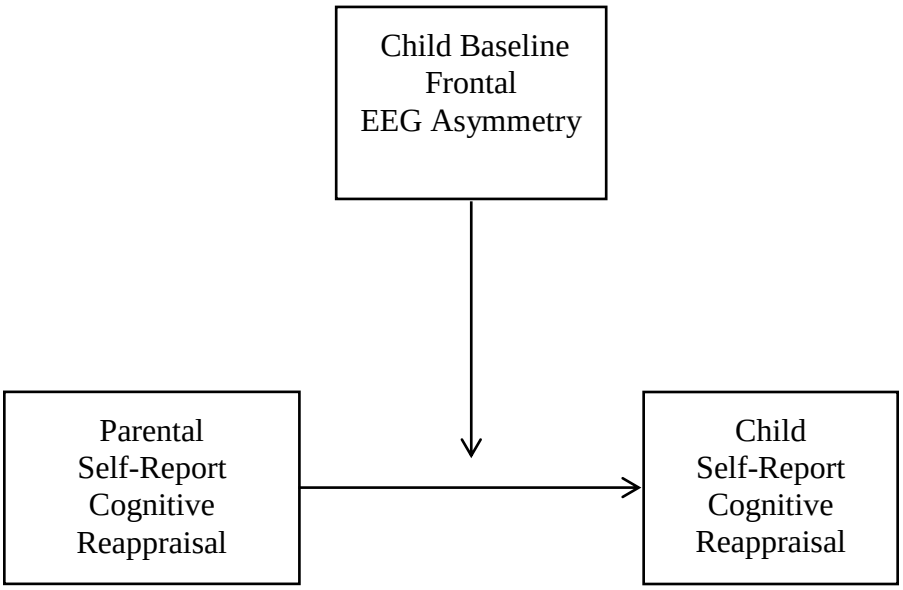


Figure 1. *Hypothesized links between constructs.*

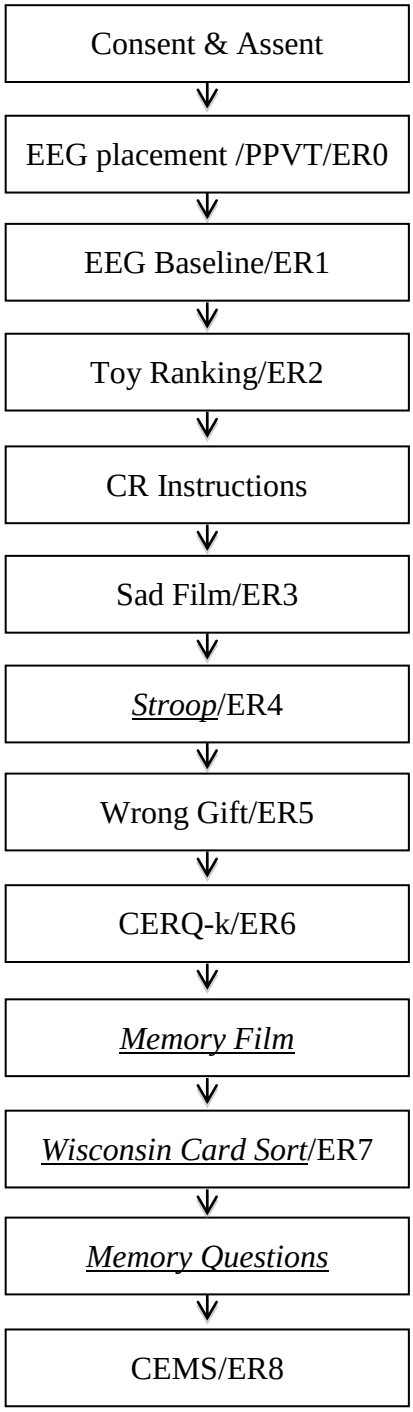


Figure 2. *Task Order*. *Underlined* and *italicized* tasks were not included in the analyses for this thesis. ER – Emotion Rating. ER0 indicates rating prior to starting the EEG recording.

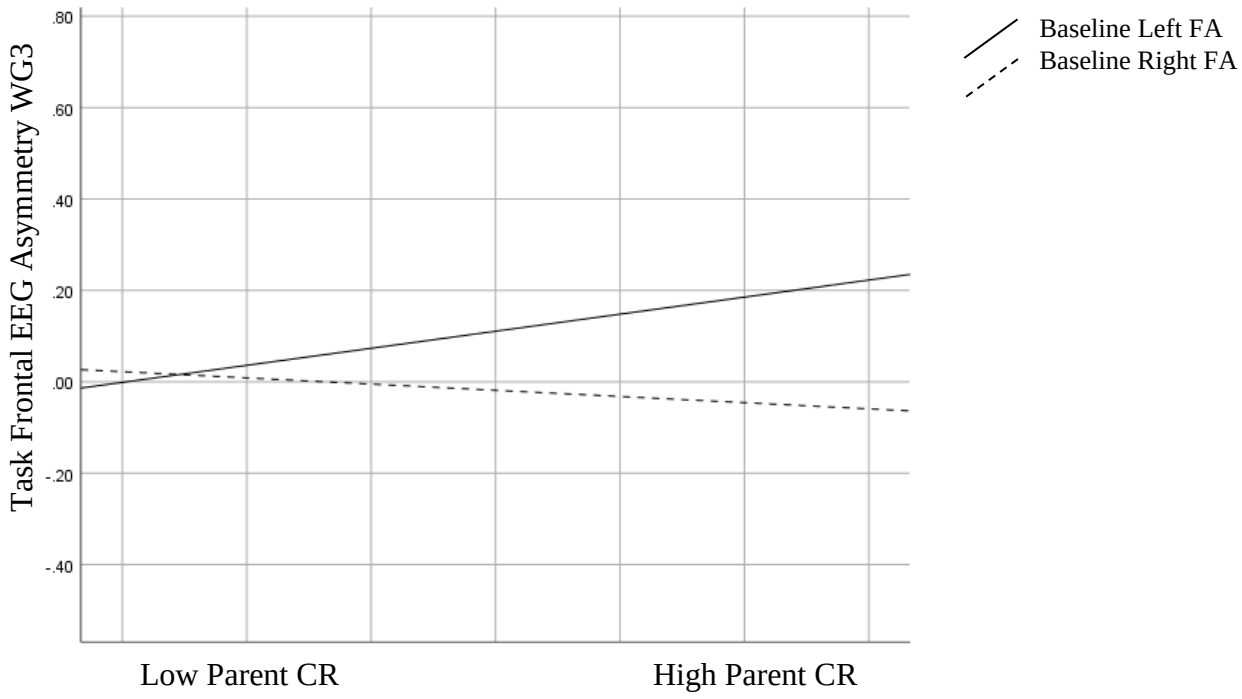
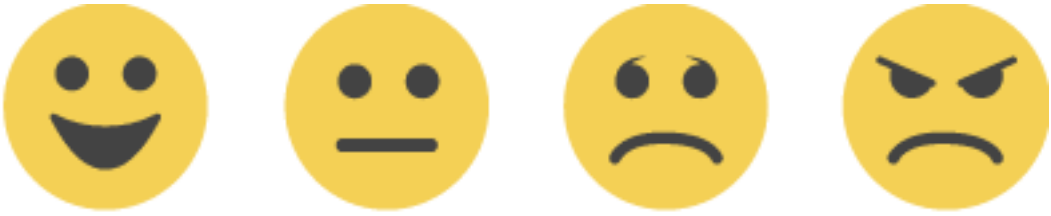


Figure 3. *Interaction of parent CR and baseline FA predicting task FA during WG3 when children were left alone*.

Appendix 1

Emotion Rating Scale



Happy Ok Sad Angry

Very Happy Somewhat Happy Slightly Happy

Very Angry Somewhat Angry Slightly Angry

Very Sad Somewhat Sad Slightly Sad

Appendix 2

CERQ-kids Modified Version

	(almost) never	some-times	regu-larly	often	(almost) always
1. I thought that I was to blame	1	2	3	4	5
2. I thought that I had to accept it	1	2	3	4	5
3. Again and again, I thought of how I felt about it	1	2	3	4	5
4. I thought of nicer things	1	2	3	4	5
5. I thought about what would be the best for me to do	1	2	3	4	5
6. I thought that I can learn from it	1	2	3	4	5
7. I thought that worse things could happen	1	2	3	4	5
8. I often thought that it's much worse than what happens to others	1	2	3	4	5
9. I thought that others are to blame	1	2	3	4	5
10. I thought that I have been stupid	1	2	3	4	5
11. It just happened; there is nothing I can do about it	1	2	3	4	5
12. I often thought of what I was thinking and feeling about it	1	2	3	4	5
13. I thought of nicer things that had nothing to do with receiving the wrong prize	1	2	3	4	5
14. I thought of how I could cope with it	1	2	3	4	5
15. I thought that it made me feel 'older and wiser'	1	2	3	4	5
16. I thought that worse things happen to others	1	2	3	4	5
17. Again and again, I thought about how terrible it all was	1	2	3	4	5
18. I thought that others had been stupid	1	2	3	4	5
19. I thought that it was my own fault	1	2	3	4	5
20. I thought that I can't change it	1	2	3	4	5
21. All the time, I thought that I wanted to understand why I felt that way	1	2	3	4	5
22. I thought of something nice and not about what happened	1	2	3	4	5
23. I thought of how I can change it	1	2	3	4	5
24. I thought that there are good sides to it as well	1	2	3	4	5
25. I thought that it was not as bad as other things that could happen	1	2	3	4	5
26. All the time, I thought that this was the worst thing that could happen to me	1	2	3	4	5
27. I thought that it was the fault of others	1	2	3	4	5
28. I thought that it was all caused by me	1	2	3	4	5
29. I thought that I couldn't do anything about receiving the wrong prize	1	2	3	4	5
30. I often thought of how I felt about receiving the wrong prize	1	2	3	4	5
31. I thought of nice things that have happened to me	1	2	3	4	5
32. I thought of what I could do best	1	2	3	4	5
33. I thought that it wasn't all bad	1	2	3	4	5
34. I thought that there were worse things in the world	1	2	3	4	5
35. I often thought about how horrible the situation was	1	2	3	4	5
36. I thought that it's all caused by others	1	2	3	4	5

Appendix 3A

Children's Emotion Management Scale – Sadness

Instructions: Please circle the response that best describes your behavior when you are feeling **sad**.

		Hardly Ever	Sometimes	Often
1.	When I'm feeling sad, I can control my crying and carrying on.	1	2	3
2.	I hold my sad feelings in.	1	2	3
3.	I stay calm and don't let sad things get to me.	1	2	3
4.	I whine/fuss about what's making me sad.	1	2	3
5.	I hide my sadness.	1	2	3
6.	When I'm sad, I do something totally different until I calm down.	1	2	3
7.	I get sad inside but don't show it.	1	2	3
8.	I can stop myself from losing control of my sad feelings.	1	2	3
9.	I cry and carry on when I'm sad.	1	2	3
10.	I try to calmly deal with what is making me sad.	1	2	3
11.	I do things like mope around when I'm sad.	1	2	3
12.	I'm afraid to show my sadness.	1	2	3

Appendix 3B

Children's Emotion Management Scale: Anger

Instructions: Please circle the response that best describes your behavior when you are feeling **Angry**.

		Hardly-Ever	Sometimes	Often
1.	When I am feeling mad, I control my temper.	1	2	3
2.	I hold my anger in.	1	2	3
3.	I stay calm and keep my cool when I am feeling mad.	1	2	3
4.	I do things like slam doors when I am mad.	1	2	3
5.	I hide my anger.	1	2	3
6.	I attack whatever it is that makes me mad.	1	2	3
7.	I get mad inside but I don't show it.	1	2	3
8.	I can stop myself from losing my temper.	1	2	3
9.	I say mean things to others when I am mad.	1	2	3
10.	I try to calmly deal with what is making me feel mad.	1	2	3
11.	I'm afraid to show my anger.	1	2	3

Appendix 4

CERQ

How do you cope with events?

Everyone gets confronted with negative or unpleasant events now and then and everyone responds to them in his or her own way. By the following questions you are asked to indicate what you generally think, when you experience negative or unpleasant events.

	(almost) never	**some-times**	**regu-larly**	**often**	**(almost) always**
1. I think that I have to accept that this has happened	1	2	3	4	5
2. I often think about how I feel about what I have experienced	1	2	3	4	5
3. I think I can learn something from the situation	1	2	3	4	5
4. I feel that I am the one who is responsible for what has happened	1	2	3	4	5
5. I think that I have to accept the situation	1	2	3	4	5
6. I am preoccupied with what I think and feel about what I have experienced	1	2	3	4	5
7. I think of pleasant things that have nothing to do with it	1	2	3	4	5
8. I think that I can become a stronger person as a result of what has happened	1	2	3	4	5
9. I keep thinking about how terrible it is what I have experienced	1	2	3	4	5
10. I feel that others are responsible for what has happened	1	2	3	4	5
11. I think of something nice instead of what has happened	1	2	3	4	5
12. I think about how to change the situation	1	2	3	4	5
13. I think that it hasn't been too bad compared to other things	1	2	3	4	5
14. I think that basically the cause must lie within myself	1	2	3	4	5
15. I think about a plan of what I can do best	1	2	3	4	5
16. I tell myself that there are worse things in life	1	2	3	4	5
17. I continually think how horrible the situation has been	1	2	3	4	5
18. I feel that basically the cause lies with others	1	2	3	4	5

Thank you for filling out the questionnaire!

Appendix 5

VIRGINIA TECH

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Institutional Review Board
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MEMORANDUM

DATE: August 6, 2018

TO: Martha Ann Bell, Tatiana Garcia-Meza, Ran Liu, Leslie Ann Patton, Madeline Slough, Kara Vlahcevic, Kayla Keith, Alex Tucker

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: Cognitive Reappraisal in Middle Childhood

IRB NUMBER: **17-699**

Effective August 6, 2018, the Virginia Tech Institution Review Board (IRB) approved the Continuing Review request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 4,5,6,7**
Protocol Approval Date:	**August 9, 2018**
Protocol Expiration Date:	**August 8, 2019**
Continuing Review Due Date*:	**July 25, 2019**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.