CHILDREN'S EMOTION REGULATION DURING A DISAPPOINTMENT: THE MODERATING ROLES OF EMOTION REACTIVITY AND GENDER

by

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A Thesis
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Master of Arts
Psychology

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Date: April 27, 2012 Spring Semester 2012
George Mason University
Fairfax, VA

Children's Emotion Regulation during a Disappointment: the Moderating Roles of Emotion Reactivity and Gender

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts at George Mason University

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Spring Semester 2012
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DEDICATION

This is dedicated to my family. First and foremost, this work is dedicated to my loving husband, Zach, and our absolutely wonderful daughter, Ella. I would also like to dedicate this thesis to my parents for their endless support, love, and advice. I love you all beyond measure.

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ABSTRACT

CHILDREN'S EMOTION REGULATION DURING A DISAPPOINTMENT: THE MODERATING ROLES OF EMOTION REACTIVITY AND GENDER

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Young children differ in the way they experience, modulate and express emotion. Children's ability to modulate their emotions is an important skill for the development of socioemotional competence, as competence is partly judged by the ability to attend and adapt to the demands of specific social situations in appropriate ways. In particular, research has linked difficulty in regulating negative emotions to emotional and behavioral problems. Emotion regulation has been assessed through the use of provocation tasks in social contexts as such tasks allow researchers to contrast displayed emotions to the presumed 'experienced' emotions.

Previous work has linked individual differences in emotion regulation to individual differences in initial emotional reactivity (often marked by broad patterns of temperament and psychophysiology) and gender. The primary objective of this study is to examine the impact of emotion reactivity and gender on children's affective responses

to disappointment. Specifically, we examined levels of positive and negative affect across conditions varying in affective and social demands. The results of this study may elucidate mechanisms that impact a child's ability to adaptively regulate emotions.

INTRODUCTION

The ability to regulate one's emotions is a central component of good mental health and general well-being. Emotion regulation is a capacity that develops in early childhood and has profound effects upon the child's behavioral and social competency into adolescence and adulthood (Halberstadt, Denham, & Dunsmore, 2001). In particular, emotion regulation involves individual differences in the processes associated with modulating initial reactivity and the tendencies to approach or avoid novel people and situations (Rueda, Posner, & Rothbart, 2005). Children who have difficulty regulating negative emotionality are at risk for maladaptive psychosocial outcomes (Calkins, Smith, Gill, & Johnson, 1998).

The mechanisms involved in the regulation of emotion may be exemplified by children's attempts to use socially-defined emotion display rules. Display rules refer to behavior that is intentionally controlled and emotional expression that is altered, displaying an expression that does not reveal what one was really feeling (Saarni, 1984). Young children who have difficulty regulating their initial emotional response and/or who do not regulate their expressive behavior under the pressure of societal norms may have difficulty in their social and emotional development. These individual differences in both reactive and regulatory affective tendencies may reflect individual differences in temperament. There is also a large research base to support that gender plays a role in how young children regulate emotion (Rubin, Stewart, & Coplan, 1995; Saarni, 1984). The present study examines individual differences in young children's regulation of emotional expression in the face of disappointment through the interaction of temperamental characteristics and gender.

The importance of emotion regulation

Emotion regulation is a complex, multidimensional process. The construct of emotion regulation focuses on how and why emotions are recognized, understood, experienced, expressed and subsequently how these integrated pieces facilitate other psychological processes (Cole, Martin, & Dennis, 2004). Young children differ in their threshold to respond to environmental stimuli and the intensity in which they react (Calkins, Fox, & Marshall, 1996). Some children are by nature more highly reactive. As intensity rises, regulation becomes more difficult. Frequent and intense levels of negative emotional reactivity are associated with poor socio-emotional functioning (Blair, Denham, Kochanoff, & Whipple, 2004) and increased risk for anxiety and depression (Belsky, Fearon, & Bell, 2007; Perez-Edgar & Fox, 2005).

When children learn to down-regulate or de-escalate the initial negative arousal, they are better equipped to manage their emotions and better able to navigate across different social contexts. These regulatory skills develop over the first years of life (Fox & Calkins, 2003) and are particularly critical to children's adaptive social behavior, specifically in the modulation of negative affect (Forbes, Fox, Cohn, Galles, & Kovacs, 2006). Effective regulation of negative emotion allows children to balance their own desires and interests with those of other children and caregivers, which in turn results in more harmonious interpersonal interactions and greater social competency (Denham, vonSalisch, Olthof, Kochanoff, & Caverly, 2002). Taken together, these data suggest that individual differences in both reactivity and regulatory tendencies influence a variety of potential psychological and socio-emotional outcomes.

Thompson (1994) characterized emotion regulation as consisting of "internal and external processes involved in initiating, maintaining, and modulating the occurrences, intensity, and expression of emotions." Rothbart and Bates (2006), among other researchers, have worked within this framework to tease apart individual factors that shape emotion regulation. Here, the focus has been on an individuals' emotional reactivity - the threshold, intensity, and length of affective arousal and subsequently how these individual differences influence emotion regulation. Emotion reactivity is present at birth, is relatively stable, and is characterized as initial physiological and behavioral affective responses to sensory stimuli (Fox & Calkins, 2003). The magnitude of reactivity is an essential element in emotion regulation because young children must learn to manage this initial response in adaptive ways.

Processes of emotion regulation encompass numerous factors, both biological and environmental. These are best understood by examining the development and integration of behavioral processes and biological underpinnings (Thompson & Goodvin, 2007; Thompson, Lewis, & Calkins, 2008). For example, Fox and Calkins (2003) examine the development of emotional control through both intrinsic and extrinsic factors. Internal processes reflect "innate" or biological predispositions categorizing individual differences. These internal processes may include emotional cognitions, attention shifting, and the adaptive or maladaptive responses to physiological reactivity (Morris, Silk, Steinberg, Myers, & Robinson, 2007), as well as executive functioning (Thompson, Lewis, & Calkins, 2008). Temperamental dispositions and neurophysiology both play an important role in how children regulate their emotions and behavior in socially appropriate and adaptive ways (Morris et al., 2007; Fox & Calkins, 2003).

External influences of emotion regulation include parents, peers, and the achievement of socially adaptive skills (e.g. developing knowledge of sociocultural display rules; Thompson, Lewis, & Calkins, 2008). Fox and Calkins (2003) refer to these external influences as "extrinsic" factors involved in self-control of emotions that are shaped through parental or caregiver socialization of emotion. In addition to emotion regulation within the family context, children also learn about emotion regulation through social referencing (Morris et al., 2007). Social referencing involves looking to another individual for information about how to feel, think, and respond in reference to a particular environmental event or stimuli (Saarni, Mumme, & Campos, 1998). Research has emphasized the processes by which these internal and external factors interplay throughout childhood within a sociocultural context (Fox & Calkins, 2003).

Halberstadt, Denham, and Dunsmore (2001) posited four progressive abilities for affective social competence: 1) awareness, 2) identification, 3) working within the social context, and 4) management and regulation. Relevant to this study, working within the social environment contributes to the complexity of emotion regulation as children must learn to modulate their own behavior to meet the idiosyncratic demands of specific social contexts. The ability to understand affective meaning in the social environment involves a number of processes (Halberstadt et al., 2001). Young children need to recognize the differences in individual and familial styles of emotional communications and subsequently disentangle their own styles from those around them (Halberstadt et al., 2001). Additionally, young children must learn how to display behavior that is socially advantageous (Kieras, Tobin, Graziano, & Rothbart, 2005). Within each culture exists an acceptable set of socially defined norms for the display of emotion. If and when individuals do not follow this set of rules, they are often ostracized and do not receive the benefits of social acceptance.

Social rules for dealing with the appropriate display of expressive behavior are called display rules (Saarni, 1984). Display rules coupled with the individual variability of children's emotion regulation abilities complicates how researchers measure emotion regulation in varying social contexts. For example, the observed behavior of the child may be the emotion the child is experiencing or the emotion that is deemed socially appropriate to display in a given context. A disappointment experience, such as the receipt of an undesirable toy, is an empirically validated paradigm to examine emotion regulation in varying social environments (Forbes et al., 2005). In this paradigm, children are provided opportunities for affect regulation, as children attempt to reduce negative affect and express gratitude when the researcher is present. During the disappointing event, children encounter further opportunity to display how they may truly be feeling when the researcher is not present and again apply affect regulation when they attempt to recover from the disappointment with the receipt of a desirable toy (Forbes et al., 2005). This disappointment approach provides a window into individual differences in initial reactivity and how it may relate to the modulation of emotion in socially appropriate ways.

Individual differences in ability to meet expectations for emotion regulation

Emotion Reactivity. A large and growing literature suggest that individual differences in initial reactivity can be linked to biological underpinnings reflecting broad indices of motivation and behavior (Rothbart & Ahadi, 1994). Here, the focus is on two such markers – EEG asymmetry and temperament – which, taken together, may provide a stable profile of initial reactivity.

Frontal EEG Asymmetry. Recent research has examined the link between individual differences in emotional responding and asymmetries in frontal EEG activity. Patterns of EEG activation over the left and right hemispheres of the frontal cortex at rest reflect a difference in the degree of activation between the hemispheres. EEG asymmetry is often used to examine how social behaviors are interpreted, encoded, and processed by young children (Schmidt, Fox, Perez-Edgar, & Hamer, 2009). In particular, research has provided compelling evidence for an underlying disposition to approach or withdraw from challenging situations (Davidson, 1993; Fox, 1991) as a function of frontal EEG asymmetry. Right frontal EEG asymmetry at rest has been found in children who tend to withdraw from socially stressful situations, experience higher levels negative affect, and have difficulties regulating affect and behavior (Davidson & Fox, 1989). Moreover, relatively greater right frontal EEG asymmetry is associated with children having "negative reactive" temperaments (Fox, Henderson, Rubin, Schmidt, Hamer, et al., 2001).

In contrast, children with more left frontal cortical activity tend to be more approach-oriented and display more positive emotions (Fox et al., 2001). Individuals with patterns of left frontal EEG asymmetry also have greater ability to attend adaptively and inhibit negative affect in comparison to individuals with patterns of right EEG asymmetry (Henderson, Fox, & Rubin, 2001). Thus, resting frontal EEG asymmetry may reflect the child's broad affective style (Harmon-Jones, Gabel, & Peterson, 2010).

These findings indicate that frontal EEG asymmetry is linked to individual differences in socioemotional characteristics and the ability to meet expectations for emotion regulation. For example, individuals with greater relative right than left resting frontal activity report larger negative affective responses to negative emotion evoking videos (fear) and less positive affective responses to positive emotion (happiness) inducing films (Tomarken, Davidson, & Henriques, 1990). Given these findings, resting frontal EEG asymmetry provides insight into an individual's ability to modulate initial affective responses. In this way, frontal EEG asymmetry may both predict the general affective style of the child and also predict how a child may regulate emotion provided a specific stimuli.

Temperament. Temperament refers to stable, early appearing individual differences in behavioral tendencies that have a constitutional basis (Goldsmith, Buss, Plomin et al., 1987). Temperament-linked differences are characterized by individual differences in emotional reactivity and the emerging regulation of that reactivity beginning late in the first year of life (Rothbart & Bates, 1998). The intensity with which young children react and regulate their emotions in response to stimulation varies widely

(Cole et. al., 2004). Individual differences in temperament may reflect biologically-based thresholds for emotional reactivity to social and affective cues in the environment. Additionally, these differences in biologically-based thresholds work in concert with temperament-based differences in the ability to regulate these initial responses (Rothbart, Ellis, & Posner, 2004). This interaction between reactivity and regulation, in turn, will shape observed behavior, which is often marked by patterns of approach and withdrawal (Fox et al., 2001). These temperamental tendencies to approach and withdraw to new situations and challenges are associated with an underlying physiological response, specifically frontal EEG asymmetry.

Three temperamental traits often considered in the research on emotion regulation are fear (Rothbart & Jones, 1998), shyness (Perez-Edgar & Fox, 2005) and soothability (Schmidt et. al., 2009). Fearful and shy children respond to novel objects and situations with restraint, caution, withdrawal, and are usually timid and fearful with unfamiliar people (Kagan, Reznick, & Snidman, 1987). This withdrawal-oriented state of fear has been associated with relatively greater right frontal EEG asymmetry (Harmon-Jones & Sigelman, 2001). Additionally, children identified as being extremely shy often display greater right frontal EEG asymmetry in comparison to those identified as less shy (Schmidt et al., 2009). Soothability reflects the ease with which a child can be soothed when he or she is upset. Soothability, in turn, has been associated with greater left frontal EEG asymmetry (Schmidt et al., 2009). Individual differences in shyness and sociability are most prominent in social environments that are emotionally evocative and/or require high levels of regulation from the child (Perez-Edgar & Fox, 2005). The present study focuses on fear, shyness, and soothability as markers of temperament that impact initial reactivity and subsequent regulation.

Gender. Another biological factor shown to contribute to individual differences in emotion regulation is gender. As the socially-based reflection of the biological trait sex, gender, is by definition sensitive to social influence and the demand characteristics of the social environment. In both children and adults, females have been consistently found to be more emotionally expressive (Kring & Gordon, 1998; Krohne, 2003). These normative differences are also evident in atypical development; boys and girls often display differential patterns of psychopathology, often within the broad umbrella of externalizing and internalizing difficulties, respectively (Leadbeater, Kuperminc, Blatt, & Hertzog, 1999). Children with internalizing problems are characterized by social withdrawal, anxiety, depression and psychosomatic difficulties, while children with externalizing problems are more prone to anger and impulsivity (Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser, et al., 2003).

Research on emotional development has identified gender-linked differences in the ways children express and regulate their emotions. Saarni's (1984) study of children's emotion regulation during disappointment found that younger boys were less skilled than older girls in regulating their emotion. The researcher proposed that this difference could be due to motivational differences in performing the display rule; specifically boys may be discouraged from showing sadness to a disappointment. Their observed expression of emotion may not necessarily reflect an inability to self-regulate but rather that young boys are socialized to display emotion differently than young girls.

These findings are consistent with the literature in Western cultures which supports that shyness in girls is more likely to be rewarded and accepted by parents, whereas shyness in boys is more likely to be discouraged (Engfer, 1993). Furthermore, shy-withdrawn boys are more likely to be excluded by peers than are shy-withdrawn girls (Coplan, Prakash, O'Neil, & Armer, 2004). These socially influenced pressures imposed on young boys may help explain the differential impact of early temperament on socioemotional functioning (Rubin, Stewart, & Coplan, 1995).

Gender differences are also evident in the relation between early temperament and later behavior. Rubin, Coplan, and Bowker's (2009) review of social withdrawal in childhood notes that shyness-withdrawal tendencies bear a greater cost for boys than girls. Throughout development, shyness appears to be more strongly associated with socio-emotional difficulties for boy than girls. For example, Dettling, Gunnar, and Donzella (1999) found that shyness in preschool-aged boys, but not girls, was associated with increased cortisol levels over the day at childcare. These data suggest that shy boys find the demands of a social setting as stressful, such that the longer they are in a social setting, the greater the experience of stress (Dettling et al., 1999). This finding may reflect the greater burden on boys to regulate their emotions to meet socially mediated display rules that discourage the expression of negative affect, particularly in the form of shyness or sadness.

One study examined the strong interconnections between early reactivity, as marked by temperament and EEG asymmetry, gender, and socioemotional outcomes. The researchers found that maternal report of negative reactivity during infancy was positively related to social wariness for boys at 4 years of age, but not for girls (Henderson, Fox, and Rubin, 2001). This finding held most strongly for reactive boys who also showed right frontal EEG asymmetry. This interaction between a biological substrate, gender, and temperament seems to be a stable pattern of development in children because similar relations have been found with related mechanisms (e.g., cortisol; Perez-Edgar, Schmidt, Henderson, Schulkin, & Fox, 2008). Similar to Saarni (1984), Henderson and colleagues (2001) suggest that their findings may be due to differences in the socialization of emotion for boys and girls, such that caregivers interact in qualitatively different ways with highly reactive sons versus daughters. Frontal EEG asymmetry reflects a biological factor that may make a child more resistant to internal and environmental forces that typically dissipate early extremes in reactivity (Fox, 1994). Therefore, frontal EEG asymmetry may in turn act as a developmental tether that sustains the effects of temperament over the course of early childhood (Perez-Edgar et al., 2011).

Disappointment and socially defined emotion display rules

The disappointing toy task is a structured paradigm used to investigate children's attempts to regulate their expressive behavior in the face of a mildly stressful situation (Saarni, 1984). Saarni (1984) gave children a baby toy or a "disappointing gift" after they had chosen a more desirable toy and coded the children's expressive behavior based on three dimensions: positive, negative and transitional (See Table 1). These dimensions of behavior included verbal and nonverbal expression of emotion. Saying "Thank you", a mumbling a "thank you" or omitting an expression of thanks are examples of positive, transitional, and negative verbal behaviors, respectively.

Many items of the coding scheme focus on nonverbal facial behaviors as well as motor actions and engagement with the toy. An example of nonverbal behavior would be a broad smile, whereas a puckered or pursed mouth would be coded as negative. These nonverbal facial expressions of emotion were used for several reasons. First, the underlying principle is that children who have not yet mastered the ability to employ display rules to regulate behavior would have greater difficulty verbalizing that they are happy when they are not. In contrast, nonverbal behavior would allow researchers to detect emotion regulation abilities that are not as overt. Furthermore, it is unlikely that young children explicitly say, "this makes me happy" or conversely, "I don't like this." Motor activity and the manipulation of the toy are noted because these behaviors may also illustrate the attempts of children to regulate their emotion in the absence of verbal expression. For example, a shoulder shrug when a child receives a disappointing toy may be a subtle indicator of negative emotion.

In her initial study, Saarni (1984) found a significant age by gender interaction. Younger boys tended to display more negative emotion when they received the disappointing gift and older girls were more likely to maintain their positive expressive behavior. These findings suggest that emotion regulation abilities increase with age and that younger boys seem to have greater difficulties meeting display rules.

The design of the current study allowed us to observe how children's affective responses differed in various social and emotional situations. The first situation was used as a baseline and consisted of a short period of time (15 seconds) in which the researcher thanked the child for their participation in the study, while the child sat quietly in a chair.

The second part involved the receipt of the disappointing toy. In this phase, the researcher gives the child a nicely wrapped gift and asks the child to open it. The researcher remains in the room with the child as he opens the gift to find a less-than-desirable toy (broken slinky, broken doll, empty box of crayons, etc.). This situation allowed us to examine the child's attempt to use socially-defined emotion display rules in their initial response to receiving an unwanted toy in the presence of another individual. In the third phase, the researcher left the child alone in the room, which provided the child with an additional opportunity to regulate emotion in the absence of someone else and/or also allowed us to observe the child's true emotional experience. The last phase allowed us to examine the child's recovery from the disappointment when the researcher returns with a sincere apology for giving the "incorrect" gift and provides the child with the desired toy.

The disappointing toy paradigm provides opportunities to examine affect regulation in the face of social demands. In its design, the disappointing toy task allows researchers to observe events that should presumably elicit both negative (the receipt of a disappointing toy) and positive (the eventual receipt of the desired toy) affect. One central difficulty in studying observed emotion in this situation lies in the fact that outward behavior may reflect either a child's initial affective response to a stimulus or event or the child's outward behavior may be a result of the child's regulation (and thus masking) his or her initial response. When deemed necessary, a child will display an expression that does not correspond with what he or she is was really feeling (Saarni, 1984). For example, a child may express gratitude for a gift, even though they are unhappy with what they have just received. In documenting the child's actual expressed emotion, researchers have the opportunity to observe both reactivity and regulation.

Current study

In the present study, our aim was to explore individual differences in positive and negative affect expression across the phases of a disappointing toy task as a function of emotion reactivity and gender (boys vs. girls). In doing so, the study will examine factors that have been previously shown to impact emotion regulation across varying social contexts. Given that these differences in reactivity and gender influence trajectories of social and emotional development, it is crucial to study them in young children in order to identify potential relations in how these factors shape emotion regulation. We will test three hypotheses. We hypothesize that individual difference in the degree of initial reactivity is a predictor of emotion regulation, such that children with high reactive tendencies will display more emotion (negative) behavior relative to the low-reactive children across the four conditions, particularly when they have the disappointing toy. We also hypothesize that gender is a predictor of emotion regulation, such that boys will display more negative emotion behavior, particularly when they have the disappointing toy. Finally, we hypothesize that an interaction exists between reactivity and gender, such that, boys with high reactivity are more likely to display negative affect expression throughout the four conditions of the disappointment task.

METHOD

Participants

Participants included 57 typically developing children (23 female) ages 4 to 7 years (M=5.58, SD=0.625) recruited from a major metropolitan area. The children were selected from a larger participant group for a broader study of socioemotional development. The participants were pre-screened with the Colorado Child Temperament Inventory (CCTI; Rowe & Plomin, 1977) and the Behavioral Inhibition Questionnaire (BIQ; Bishop, Spence, & McDonald, 2003) in order to obtain a wide range of temperamental characteristics. These maternal report questionnaires have been widely used to index a range of childhood temperament traits (Zentner & Bates, 2008). From the initial sample of 57 children: 53 children had video of the disappointing toy task and 36 children had complete task and EEG data. One participant was removed from the analyses because their frontal EEG asymmetry score was extreme (>3 standard deviations from the mean) and another participant was removed because no gender was reported. This produced a final sample of 51 participants and 35 children had complete data on all task parameters.

Of the 51 participants in the study, 22 were female and 29 were male. The participants were between the ages of 4 and 7 years (M=5.57, SD = 0.64) and education ranged from pre-school to second grade. The self-reported ethnicity distribution was

79% white, non-Hispanic, 9% Asian/pacific islander, 8% Hispanic, and 4% African American, non-Hispanic. The Human Subjects Review Board (HSRB) approved all procedures and families consented to participate.

Measures

Electroencephalogram (EEG) Procedures. Resting frontal EEG measures were recorded using the Lycra NeuroScan Quick-cap system (NeuroScan, Texas, USA) from 64 EEG and EOG channels, while participants sat with eyes open for two minutes and eyes closed for two minutes. This procedure yields minimal eye movements and gross motor movements. EEG channels were references to an electrode 2cm posterior to Cz. Vertical eye movements (VEOG) were recorded through electrodes placed above and below the left eye, while horizontal eye movements (HEOG) were collected by electrodes on the external canthi of each eye. Researchers attempted to keep all electrode impedances below 10 K ohms. The data from each channel were digitized at a 500 Hz sampling rate (High pass 0.10 Hz; Low pass 40 Hz). Researchers manually inspected the digitized EEG data and removed any channels with unreliable signals. Furthermore, portions of EEG data with eye movement or motor artifact were automatically removed from all channels using predetermined parameters (e.g., signal ±100μV). The artifact free EEG data were analyzed using a discrete Fourier transform (DFT), with a Hanning window of 1-s width and 50% overlap.

EEG Asymmetry Calculation. Resting EEG was recorded for four minutes while the participants sat comfortably alternating between eyes closed and eyes open for two minutes. Following a widely used approach, data analysis for frontal EEG asymmetry examined the left and right midfrontal electrodes (F3 and F4; Silva, Pizzagalli, Larson, Jackson, & Davidson, 2002). For each electrode site, alpha power was computed by summing power in single Hz bins in the 8 – 13 Hz frequency band. Frontal EEG asymmetry values were computed by subtracting the natural log (ln) of alpha power at the left electrode (F3) from the ln of alpha power at the corresponding right electrode (F4). Alpha asymmetry is inversely related to cortical activation. Thus, a positive asymmetry value reflects greater relative left-sided activity, whereas a negative score reflects greater relative right-sided activity (Davidson, 2004). Frontal EEG asymmetry was maintained as a continuous variable as opposed to dichotomizing left versus right frontal EEG asymmetry. Employing resting frontal EEG asymmetry as a continuous variable better reflects the magnitude of relative activation between the left and right hemisphere. Additionally, frontal EEG asymmetry as a continuous variable increases statistical power by reducing the number of contrasts in the specified model (Coan & Allen, 2004).

Child Behavior Questionnaire (CBQ). The child's parents were asked to complete the Child Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001). The CBQ contains 196 items designed to measure general patterns of behavior in children, specifically patterns of reactivity and regulation in children aged 3 to 7 years old. Individual differences are assessed on 15 primary temperament characteristics: Positive Anticipation, Smiling/ Laughter, High Intensity Pleasure, Activity Level, Impulsivity; Shyness, Discomfort, Fear, Anger/ Frustration, Sadness, Soothability, Inhibitory Control, Attentional Focusing, Low Intensity Pleasure, and Perceptual

Sensitivity. Parents are asked to indicate how well statements describe their children using a 7-point Likert scale from 1 extremely untrue, to 7 extremely true. Three scales of the CBQ questionnaire were used to assess individual differences in the temperamental contribution to reactivity: CBQ Shyness, Fear, and Soothing.

In the current sample of children, the internal consistency reliability for the parent-report CBQ was examined. The shyness subscale had very high internal consistency reliability, Cronbach's alpha $\alpha = .92$. The fear and soothability subscale had lower internal consistency reliability, with Cronbach's alpha $\alpha = .79$ for each subscale. However, both are still considered to have adequate reliability by the widely accepted social science cutoff (.70, Kline, 1999). These findings provide support for the reliability of the subscales of shyness, fear and soothability, in the CBQ for the current sample and permit the further exploration of these subscales in the model of reactivity.

Disappointing Toy Task (Saarni, 1984). Upon arrival to the lab, children were asked to rank-order attractive and broken toys. After completing several tasks, including the EEG baseline, the children were told that they would receive a prize for participation. The disappointing toy paradigm was video recorded and coded by several researchers. Interrater reliability was considered good across all coders (Kappa = .70).

The children were first given the lowest ranked toy and their behavior was coded at four different time points. Positive, negative, and transitional behaviors (See Table 1) were coded (1) at baseline, (2) when receiving the disappointing toy in the presence of the researcher, (3) when alone with the disappointing toy, and (4) when the researchers returned with the top-ranked toy. Behaviors were coded in 15 second intervals for each of the four phases. Each of the 15 second coding areas (4 parts of the task) was broken into three, five-second periods. Behavior within these five-second periods was coded as one/zero events (i.e. a 1 is given if the behavior occurs at any time within the window and a 0 is given if the behavior does not occur.) The scores were summed across the three, five-second time periods for each part of the disappointing toy task and averaged.

RESULTS

Preliminary Analysis

Model testing using structural equation modeling (SEM). In the first step, analyses were performed in a Structural Equation Modeling (SEM) framework using AMOS software (Arbuckle, 2009). SEM was selected as a statistical methodology because of its several advantages. In particular, it was used because SEM allows for multiple indicators per latent variable and can output factor scores for the two proposed factors: biological initial reactivity and behavioral reactivity. Furthermore, SEM can handle missing data well. SEM was used to create a two-factor model for initial emotional reactivity. This model included a factor consisting of the biological marker of reactivity including EEG eyes open and EEG eyes closed. As expected, frontal EEG eyes open and eyes closed are strongly correlated (See Table 2). The second factor was a behavioral marker of reactivity including CBQ shyness, fear, and soothability. The three CBQ items were also strongly interrelated in the expected direction (See Table 2). These variables all fit the assumptions of normality and the hypothesized two-factor model of reactivity was tested.

Model specification. As can be seen in Figure 1, the EEG and CBQ factors were allowed to correlate to help determine the extent to which these two factors were measuring different constructs. In fact, they were not correlated, suggesting that the two factors can be used as independent predictors. The EEG factor had two manifest indicators: eyes open and eyes closed. Constraints were set on the pathways for these indicators such that they had to have equal loadings. The constraints were placed to reflect effects whose parameter has been established in the literature. As commonly reported, the EEG predictor includes a resting period of counter-balanced two minute-long epochs of eyes open and eyes-closed, averaged (Coan, Allen, McKnight, 2006). Furthermore, error variances for both terms were constrained to be equal to reflect that the amount of measurement error associated with both EEG eyes open and closed should be relatively the same. The CBQ factor had three manifest indicators: fear, shyness, and soothability.

Missing Data. Approximately 31% of the data was missing for frontal EEG asymmetry. All other data were complete. Multiple imputation was used to account for missing data. Ten imputed data sets were imputed, and this is considered sufficient for small to moderate amounts of missing data in terms of getting more stable parameter estimates and better estimates of standard errors and test statistics (Allison, 2003). Therefore, a total of ten imputed data sets with factor scores for the EEG factor and CBQ factor were produced with Bayesian estimation. The Bayesian estimator was used to handle missing data because it does a better job of accommodating small sample sizes and any non-normality in the indicators in producing the factor scores. The Bayesian analyses used uninformed priors, restricted error variances to be positive, and converged properly (Alfaro, Zoller, & Lutzoni, 2003). Reported results are aggregated across the ten datasets.

Fit indices. Fit statistics were examined to determine the difference between the observed covariance matrix and the one hypothesized by the specific model. The goodness-of-fit indices calculated were (1) the X^2 goodness-of-fit statistic; (2) the comparative fix index (CFI); (3) the Root Mean Square Error of Approximation (RMSEA). These indices were chosen with the intent to use multiple fit measures to accept or reject the model. The non-significant, $X^2 = 7.85$, df = 6, $p > 0.05$, value indicates that the hypothesized two factor model fits the data well. The X^2 index is sensitive to sample size such that the probability of rejecting a hypothesized model increases as sample size increase (Schaufeli, Salanova, Gonzalez-Roma, and Bakker, 2001). Importantly, we were able to accept the model with a relatively small sample size. The CFI value indicates good model fit as it approaches close to 1. In particular, the widely accepted rule of thumb argues that values greater than 0.9 indicate good fit (Hoyle, 1995). The CFI for the two-factor model was .94. The RMSEA refers to the lack of fit of the model to the population covariance matrix. Values smaller than 0.08 are indicative of an acceptable fit while values greater than 0.1 should lead to model rejection (Cudeck & Browne, 1993). The RMSEA value of 0.08 suggests acceptable fit. Given that RMSEA is sensitive to model size, such that the value increases as model complexity decreases, and the hypothesized model is fairly small, this value suggests that the two-factor model of reactivity fits the data well.

Path Coefficients. To examine how well the factor held together, the standardized regression weights are reported (See Figure 1). Each observed variable had a loading at or above .5, which indicates strong contribution to the factor. For the frontal EEG asymmetry factor, the pathways and error variances were constrained to be the same and therefore both eyes open and eyes closed had equal factor loading contributions, B = .766. In terms of the CBQ factor, fear and shyness had positive loading values, while soothability had a negative loading, as one would expect that low soothability reflect greater initial emotional reactivity. The biggest loading for the CBQ factor was fear, B = .878. Soothability and Shyness contributed about the same with regard to the pathway loadings, B = -.50 and B = .515 respectively.

Analysis

Data analyses examined the participants' positive and negative affect expression during each of the four phases of the disappointing toy task. More specifically, our aim was to explore whether children characterized as highly reactive by either the biological marker of EEG or the behavioral marker of the CBQ factor would be more likely to display negative behaviors during the disappointing toy task. Furthermore, the analyses aimed to elucidate whether boys were more likely to display negative behavior during the task in comparison to girls. Lastly, the analyses were run to test the hypothesized gender by reactivity interaction such that boys who are highly reactive were more likely to display negative affect during the disappointing toy task.

The first step was to explore the outcome variable of positive and negative affect expression during the four phases of the disappointing toy task. In doing so, we noted that the positive emotion behavior values during each phase were not normal. During the baseline, positive emotion behaviors were positively skewed with a skewness value of

2.34 and a kurtosis value of 5.01. In the bad-toy phase, positive behaviors had a kurtosis value of 2.34. During the alone with toy phase, positive emotion had a skewness of 3.49 and kurtosis of 14.25. Finally, in the desired toy phase, positive behavior had a skewness value of 2.16 and kurtosis of 6.04. This finding necessitated the recoding of all the outcome variables (positive and negative) to four dichotomous outcome variables. Instead of an average of positive or negative affect behaviors during the four time points of the disappointing toy task, I computed a yes/no (0 = no, 1 = yes) dichotomous variable that was analyzed using logistic regression. See Table 3 for a frequency distribution of observed emotion behaviors across phases and the gender groups.

Logistic Regression. One logistic regression was run for each type of emotion expression (positive and negative) during the specific phase of the disappointing toy task (pre-toy, bad-toy, alone with toy, and desired toy). This resulted in 8 logistic regressions, each run 10 times for the imputed datasets. The method for combing results from the data analysis performed 10 times was produced to obtain a single set of results following Rubin's (1987) recommendation. The statistical significance of individual regression coefficients was tested using the Wald chi-square statistic (See Table 4). Surprisingly, no significance ($p<0.05$) was found for any of the predictors in the eight logistic regressions.

The results did identify two Wald chi-square statistics that reached the critical value for significance at the $p<.10$ level. CBQ reactivity predicts negative emotion in the pre-toy phase $B = 3.569$, $p<.10$. Gender also predicts positive emotion during the bad-toy phase, $B = 3.346$, $p<.10$.

Additional Analyses

Given the small variability of the recoded yes/no positive and negative behavior outcome variable, two additional variables were recoded and tested. The first variable was to examine those children whose average positive and negative emotion score was above or below the median. Frequencies confirmed that this variable had even less variance then the yes/no outcome variable. The second attempt was to create a variable of difference scores between adjacent phases separately for positive and negative behaviors. Again, the variability was not large enough to yield any significant results.

DISCUSSION

This study examined individual differences in positive and negative affect expression across the phases of a disappointing toy task as a function of emotion reactivity (biological and behavioral) and gender. It was predicted that young children with greater levels of emotional reactivity would exhibit greater negative emotion behavior during a disappointment compared with relatively less reactive children. Additionally, it was hypothesized that boys would display greater negative affect behavior than girls when they received the disappointing toy. Finally, it was predicted that an interaction exists between reactivity and gender, such that, boys with high initial emotional reactivity are more likely to display negative affect expression throughout the four phases of the disappointment task.

The results suggest that the hypothesized associations between reactivity, gender, and affect expression during a disappointing toy task were not supported. The first aim was to examine if greater reactivity as marked by biological and behavioral indices were associated with greater negative emotion behavior during the disappointing toy task. Results from the logistic regression analyses did not support an association between reactivity and displayed negative affect during the phases of the disappointing toy task at standard levels of significance. However, it is notable that the CBQ factor did show a trend ($p<0.10$) for greater negative affect expression during the baseline phase of the disappointing toy task. Therefore, maternal report of fear, shyness, and soothability may be indicator of negative expression at baseline. In other words, the CBQ factor may be a suitable indicator of affective style. Additional research is needed to examine these associations.

The second goal of the study was to explore the effects of gender on affect expression. In this study, gender did not significantly predict emotional expression during the phases of the task. However, gender did approach significance ($p<0.10$) for positive behavior during the undesirable toy phase. There was a general trend for boys to be more emotionally expressive in each phase of the disappointing toy task. In particular, boys displayed more negative emotion behavior than girls in every phase. During the undesirable gift phase, boys were more likely to display negative emotion, while girls displayed more positive emotion. These patterns of emotional expressiveness were not statistically significant. However the data are consistent with a recent study on children's responses to undesirable gifts (Kieras et al., 2005). Kieras and colleagues examined individual differences in children's (ages 3 to 5) regulation of emotional expression after receiving an undesirable gift and found a similar trend (not statistically significant) of affect expression, such that girls were more positive and less negative than were boys.

The last aim of the study was to examine an interaction between reactivity, both biological and behavioral, and gender on affect expression. The results were not statistically significant between the EEG factor and gender nor between the CBQ factor and gender. One reason for the non-significant findings may be that there was little to no variability between children on their positive and negative emotion behavior during the specific parts of the disappointing toy task. The small degree of variability is more clearly evident when looking at the results for negative emotion behavior during the part of the disappointment task where the children receive the undesirable toy. There is no variability in negative emotion, such that every girl displayed negative emotion and a vast majority of boys did as well. These results indicate that the task elicited the expected response - negative emotion in response to receiving an undesirable gift. Thus, the coefficients and standard error values are much greater in comparison to the other logistic regression analyses across the phases of the task.

Another reason for non-significant results is the limitation of the outcome variable. Due to the non-normality of emotion driven behavior across phases, the outcome variable had to be dichotomized. This significantly reduced statistical power. Other studies using a disappointment paradigm have used potentially more meaningful coding methodologies to observe affect expression. For example, Kieras et al., (2005) coded children's display of emotion using a 5-point Likert-type scale that ranged from 1 (no evidence of the emotion) to 5 (intense or continual evidence of the emotion). In this study, the outcome variable was limited to a frequency count. The addition of an intensity measure for affect expression would provide greater variability and an outcome variable that may be more likely to meet the assumptions for normality. An intensity scale of emotion would also lend to further exploration of the extent to which initial emotion reactivity relates to greater or less affect expression during a disappointment.

This thesis examined the structure of reactivity both from a biological and behavioral perspective. The study proposed a neurophysiological and behavioral two-factor model to represent the construct of initial reactivity. These measures of initial reactivity where then used to investigate the relation between reactivity, gender, and affect expression in varying social contexts. Results of the two-factor model confirmed the hypothesized structure of reactivity such that frontal EEG asymmetry (both eyes open and closed) represents a factor of reactivity for the current sample. These results are consistent with a large literature that has provided compelling evidence to support frontal EEG asymmetry (left vs. right) and differences in threshold for behavioral reactions to stimuli. In particular, greater relative right frontal activation is linked to a lowered threshold for negative affective reactions, whereas left frontal EEG activation has been linked to positive emotional reactivity (Kim & Bell, 2006; Fox, 1991). Additionally, the CBQ items of fear, shyness, and soothability contributed to the underlying construct of behavioral reactivity. In line with previous research in young children, reactivity in our sample can and should be measured using both an underlying biological marker such as frontal EEG asymmetry as well as by behavioral tendencies included in the maternal report Child Behavior Questionnaire (CBQ; Kim & Bell, 2006). The results of the two-factor model support that frontal EEG asymmetry and maternal report of temperamental traits are not interrelated and therefore appear to be two legitimate factors in a model of reactivity. This study suggests that multifaceted approaches enhance research design because it allows for various indicators of emotional reactivity through both neurobiological patterns and associated emotion behaviors.

There are a few limitations of note when considering the results of our study. Most importantly, due to the difficulty of obtaining viable EEG data from young children, a large percentage of our sample had missing data. These subjects were not excluded from the study. Rather, their EEG and CBQ factor scores were estimated based on missing information using Bayesian estimation. Although the children with missing EEG data did not differ from those with complete data on our other demographic variables, it is possible that there was an underlying selection bias. In particular, it could be that those participants who refused to wear the EEG cap represent a class of young children that is more reactive. If this theory holds then the analysis sample had an underrepresented number of children with high levels of reactivity.

The second limitation of the current study is the small sample size. The smaller the sample size, the more difficult it is to find significant relationships in the data. Statistical tests normally require a larger sample size to justify that the effect did not occur by chance alone. Additionally, a minimum sample of one hundred participants is typically recommended for analyses using a structural equation modeling framework (Hoyle, 1995). With a small sample size, caution must be applied, as the findings may not be transferable to a larger sample. Although the model held together and fit the data well, the small sample size produced unstable parameter estimates and tests that lack statistical power.

The present study was additionally limited by the non-normal outcome variable for affect expression. The data collection procedures for affect expression behavior during the disappointing toy task were not specifically designed to create dichotomized outcome variables. This significantly reduced statistical power. In the present study, frequency of specific emotions, both positive and negative were collected at three time points during each of the four phases during the disappointing toy task. This did not provide enough variability in affect expression among the participants of the study. In future data collection, an intensity scale should be applied to measure the degree to which emotion driven behavior is expressed throughout the phases, in line with Kieras and colleagues (2012) and Cole, Zahn-Waxler, and Smith (1994). This would provide more meaningful outcomes in comparison to a yes/no variable.

A final limitation of the study was that all measures and data were collected on the same day. The assessments of behavior and psychophysiological functioning could have fluctuated if the data were collected and averaged over several visits (Harmon-Jones et al., 2010). Frontal EEG activation may fluctuate during different times of day and the year. The potential for these data to fluctuate could have principally impacted the Bayesian estimation of missing data and the imputation of ten datasets. Bayesian estimation uses priors to estimate values and given that only one measure of frontal EEG asymmetry was observed, there may have not been sufficient priors to predict scores for those participants missing EEG data. In addition, the disappointing toy task was implemented at the end of the child's lab visit. It may be that the battery of other assessments collected fatigued the participants and this resulted in less affect expression.

In summary, this study argues that initial emotional reactivity is a critical precursor for affect expression and emotion regulation – two processes essential for social and emotional competency in the early childhood periods of development. This relation was hypothesized to be more salient in young boys then in girls. The results did not support the hypothesized relations: however, this research plays a role in implications for future research in the area of socioemotional development in young children. The first implication suggests the importance of a multifaceted approach to studying initial emotional reactivity. Furthermore, this study suggests that affect expression should not only be measured in terms of frequency but also intensity. In addition to the aforementioned measures, it may also be of critical importance to ask the child after the task how they perceived their emotional state during the four phases. Individual differences in initial reactivity as well as the subjective nature of children's emotion regulation abilities make the study of emotion regulation complicated. Therefore, it may behoove future research to obtain measures of not only neurophysiological data, maternal report, and observation of age-appropriate tasks, but also to collect qualitative data on how the child felt during testing. Did they feel they had to exhibit social display rules in front of the researcher? Did the absence of the researcher make them feel more expressing the emotions they were experiencing? The individual differences in child perception of a disappointment may be applied as a moderator in future research to examine the degree to which young children regulate emotion within the varied social environments. For example, the link between reactivity and affect expression may be moderated by the child's perception of the emotionally arousing task with and without a researcher present.

Another implication for future research stems from the observed trends for emotion expression for in boys and girls. The findings suggested that there are subtle differences in how boys and girls express emotion during a disappointment paradigm. Additional research is needed in this area to explore how and why these patterns differ.

Finally, future research would benefit from a similar investigation with an adequate sample size and multiple time point measures of initial emotional reactivity. In sum, this study suggests that research on individual differences of initial reactivity, emotion regulation, and gender would profit from more in depth exploration. Further research is need that emphasizes the importance of developing an understanding of the factors that contribute to the development of emotion regulation.

Table 1.

Emotionally Expressive Behaviors

Positive	Negative	Transitional
Broad smile with teeth showing	Physical show of dislike	Manipulation of toy
Broad, closed lip smile	Nose wrinkling	Private Speech
Enthusiastic “Thank you”	Lowered brows as in frown or annoyance	Slight smile with open or closed lips
Arched brows as in positive surprise	Omitted “Thank you”	Faint or mumbled “Thank you”
Smiling eye contact with experimenter	Puckered or pursed mouth	Knit brows while smiling slightly, or as in distress
Eye crinkle with smile	Tight, straight line mouth	Tongue movements visible outside mouth
	Avoids eye contact with experimenter	Two or more gaze shifts between gift and experimenter
	Negative noise emitted (e.g. snort, “ugh”)	Biting or teeth visible on lips
	Makes a negative comment (e.g. this is just an X)	Hands to face, had
	Shoulder shrug	Head tilt, turn
	Manipulation of surroundings (i.e. desk/chair)	Questioning vocalization
		Laughing, giggling
		Mouthing (opening, shutting)
		Abrupt loss of smile
		Fidgets

Table 2.

Correlation matrix for CBQ Fear, Soothing, Shyness, and Frontal EEG Asymmetry: Eyes Open and Eyes Closed

	CBQ Fear	CBQ Soothing	CBQ Shyness	EEG eyes open	EEG eyes closed
CBQ Fear	1				
CBQ Soothing	-.421**	1			
CBQ Shyness	.452**	-.280	1		
EEG eyes open	-.050	.236	-.335	1	
EEG eyes closed	.057	.361*	-.079	.733**	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 3.

Frequency distribution of yes-no outcome variable

Emotion during Phases of Disappointing Toy Task	**Gender**	
	Male (n = 29)	**Female (n = 22)**
Pre-toy: Positive Emotion	7	5
Pre-toy: Negative Emotion	18	15
Disappointing toy: Positive Emotion	6	10
Disappointing toy: Negative Emotion	28	22
Alone with toy: Positive Emotion	3	5
Alone with toy: Negative Emotion	21	17
Desired toy: Positive Emotion	15	13
Desired toy: Negative Emotion	22	15

Table 4.

Average of the logistic regression analysis across the ten imputed datasets

	Positive Emotion Pre-Toy						Negative Emotion Pre-Toy					
Predictor	**B**	**S.E.**	**Wald**	**df**	**Sig. @ p<.05**	**Sig. @ p<.10**	**B**	**S.E.**	**Wald**	**df**	**Sig. @ p<.05**	**Sig. @ p<.10**
Gender	-0.0194	0.7651	0.0001	1	n/s	n/s	1.1431	0.938	1.4851	1	n/s	n/s
EEG	-0.1486	0.5792	0.0658	1	n/s	n/s	-0.3898	1.0338	0.1421	1	n/s	n/s
CBQ	-0.5729	0.6525	0.7709	1	n/s	n/s	-1.7036	0.9017	3.569	1	n/s	†
GenderXEEG	0.3595	0.8415	0.1825	1	n/s	n/s	0.2093	1.1877	0.0311	1	n/s	n/s
GenderXCBQ	0.882	0.8671	1.0345	1	n/s	n/s	1.5132	1.0139	2.227	1	n/s	n/s
CBQXEEG	-0.1681	0.5305	0.1004	1	n/s	n/s	-0.2733	0.551	0.246	1	n/s	n/s
	Positive Emotion Bad-Toy						**Negative Emotion Bad-Toy**					
Gender	1.3834	0.7563	3.3459	1	n/s	†	-46.1506	54733.1234	~ 0	1	n/s	n/s
EEG	-0.2882	0.5157	0.3123	1	n/s	n/s	19.7533	108122.652	~ 0	1	n/s	n/s
CBQ	0.063	0.5297	0.0141	1	n/s	n/s	20.449	117102.165	~ 0	1	n/s	n/s
GenderXEEG	0.3425	0.9403	0.1327	1	n/s	n/s	19.9832	108872.293	~ 0	1	n/s	n/s
GenderXCBQ	-0.1464	0.8094	0.0327	1	n/s	n/s	-85.5184	119282.3878	~ 0	1	n/s	n/s
CBQXEEG	-0.1613	0.5601	0.0829	1	n/s	n/s	-18.9413	3277.3718	~ 0	1	n/s	n/s
	Postive Emotion Alone with Toy						**Negative Emotion Alone with Toy**					
Gender	0.8886	1.2443	0.5099	1	n/s	n/s	0.4857	0.7806	0.3871	1	n/s	n/s
EEG	-0.0201	0.7829	0.0007	1	n/s	n/s	0.1955	0.6177	0.1002	1	n/s	n/s
CBQ	0.8913	0.8764	1.0343	1	n/s	n/s	-0.492	0.6386	0.5936	1	n/s	n/s
GenderXEEG	0.2934	1.1949	0.06	1	n/s	n/s	-0.453	0.8654	0.274	1	n/s	n/s
GenderXCBQ	-0.3119	1.3368	0.0544	1	n/s	n/s	0.3528	0.8227	0.1839	1	n/s	n/s
CBQXEEG	-0.3721	0.7188	0.268	1	n/s	n/s	-0.1381	0.5021	0.076	1	n/s	n/s
	Positive Emotion Desired Toy						**Negative Emotion Desired Toy**					
Gender	0.5781	0.688	0.706	1	n/s	n/s	-0.4446	0.751	0.3505	1	n/s	n/s
EEG	-0.0677	0.5424	0.0156	1	n/s	n/s	-0.2359	0.5695	0.1716	1	n/s	n/s
CBQ	-0.7663	0.6352	1.4554	1	n/s	n/s	0.1173	0.5811	0.0407	1	n/s	n/s
GenderXEEG	0.2089	0.7318	0.0815	1	n/s	n/s	0.1197	0.8279	0.0209	1	n/s	n/s
GenderXCBQ	0.4362	0.7993	0.2978	1	n/s	n/s	-0.6011	0.8274	0.5278	1	n/s	n/s
CBQXEEG	-0.2346	0.476	0.2429	1	n/s	n/s	0.0017	0.4981	~ 0	1	n/s	n/s

† Logistic regression is significant at the p<.10 level
Note. Significance was determined by the critical cut-off of 3.94 for p<.05 and 2.706 for p<.10 using the Wald chi-square statistic.

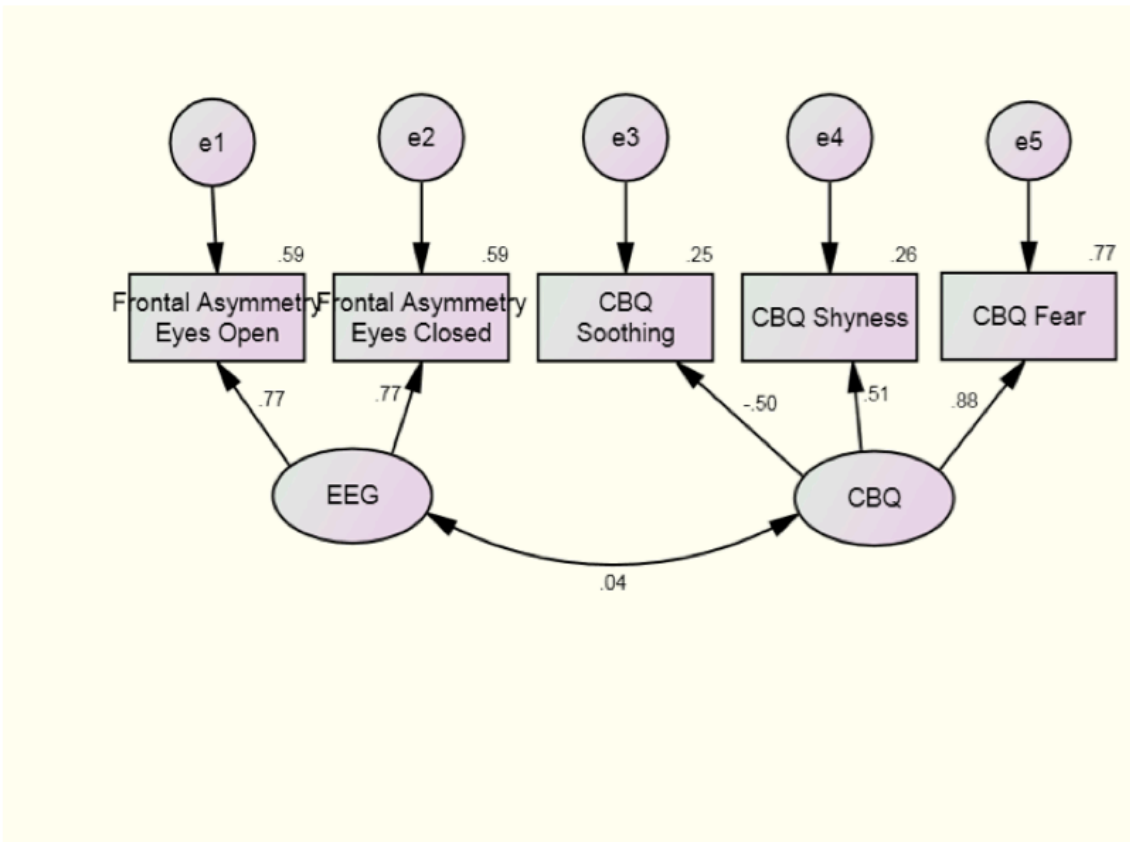

Figure 1. Two-Factor Model of Reactivity

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