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The Relationship Between Emotion Regulation and Executive Functioning After Sleep Restriction in Healthy Preschool Children

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Abstract

Executive functions are a set of higher level cognitive processes that are necessary for the self-regulation of behavior and emotion, which allow individuals to engage in planned, goal-oriented behavior, and guide attention. Emotion Regulation (ER) is the ability to control emotional arousal and adapt to the demands of the daily environment. Sleep has been demonstrated to be important for daily functioning in children, adolescents and adults. However, the impact of emotion regulation on the relationship between sleep and executive functioning (EF) in healthy preschool children has not yet been tested. This study investigated the relationship between ER, EF, and negative emotions after sleep restriction in healthy preschool children. It was hypothesized that ER scores would predict EF scores and negative emotions, and that this relationship would be moderated by the amount of sleep restriction experienced by the participant. Participants were typically developing boys and girls between the ages of 3-5 years (N=55), without sleeping difficulties. A significant relationship between ER and Delay of Gratification was found. No other significant effects were found. Results are discussed in relation to previous literature and specific characteristics of the sample.

The Relationship Between Emotion Regulation, Executive Functioning and Negative Emotions after Sleep Restriction in Healthy Preschool Children

It is important for children to acquire adequate sleep each night in order to deal with the various demands of daily life. Mild sleep loss is common among young children (Molfese et al., 2013). Consequently, it is integral that children adjust to changes in sleep in the most adaptive way in order to avoid temper tantrums and oppositional behavior. Emotion regulation (ER) and executive functions are skills that are used every day in a variety of situations. Executive functions are cognitive abilities that allow individuals to allocate attention towards tasks for engaging in purposeful behavior (Bernier et al., 2010). The ability to regulate emotions is important for the development of social relationships and dealing with life challenges. Negative emotions can have a powerful adverse impact on behavior, thus adequate regulation of these emotions is necessary for optimal functioning. The present study addresses the relationship between ER, EF, and negative emotions, moderated by sleep restriction during early childhood.

Emotion Regulation (ER) and Executive Functioning (EF) both improve over the course of development, beginning at ages 3 – 4 (Rothbart et al., 2013). ER has been defined as the ability to manage emotional arousal in order to achieve individual goals and adapt to the social environment (Thompson, 1994). Poor ER skills have been associated with both internalizing and externalizing problems in children (Calkins, 1994; Hill, Degnan, Calkins & Keane, 2006). For example, a child with poorly developed ER skills may start crying when he cannot find his lucky shirt before going to school. This may lead the child to throw his cereal on the floor, which may result in a temper tantrum. Instead of verbalizing his feelings of frustration and seeking his mother's help, the child cannot regulate his emotions and may consequently act out his anger.

Executive Functions

Executive functions are defined as a set of higher-level cognitive processes that are necessary for the self-regulation of behavior and emotion, which allow individuals to engage in planned, goal-oriented behavior and to guide attention (Bridgett, Oddi, Laake, Murdock & Bachmann, 2013). Executive functions, controlled by the prefrontal cortex, are important in situations marked by distraction, novelty, or stress (Turnbull, Reid & Morton, 2013). Shifting attention, working memory, inhibitory control (i.e., the ability to inhibit inappropriate or irrelevant information or behavior when performing tasks), and delay of gratification tasks are some of the many available measures of executive functions. These measures of executive functions overlap with the general construct of executive attention (Welch, 2001), defined as the ability to monitor and control behaviour, and engage in planning for actions (Rothbart & Reuda, 2005). Executive functions develop rapidly across the preschool years, continue developing into early adulthood (Turnbull et al., 2013), and are extremely important throughout childhood. Disruptions to EF development, caused by negligent or overly permissive parenting, may result in detrimental consequences for children in the domains of social control, cognitive functioning, behavior and emotional control (Anderson, 2002). With regards to behavior, executive dysfunction may be associated with poor impulse control and inappropriate social behavior. Children who display marked social difficulties as a result of weak ER may be vulnerable to increased negative emotions. Thus, executive functions are necessary for children to adapt to the demands of daily life.

Executive Functions have been further divided into two sub-categories; one that is associated with hot (emotion laden) processing, and the other, which is associated with cold (emotionally independent) cognitive processing (Kim et al., 2013). Hot executive functions

include delay of gratification tasks, whereas cold executive functions include measures of inhibitory control, specifically the Go/No-Go task (Kim et al., 2013). Delay of gratification is considered to be a hot executive function because it involves regulating emotions, whereas an inhibitory control task is considered to be a cold EF task because it requires effortful attention and working memory (Kim et al., 2013; Bridgett et al., 2013). All children are faced with both emotional (hot) and cognitive (cold) challenges that require them to utilize EF skills in their daily life. For example, hot EF is required when a peer provokes a child, and the child is able to delay the gratification that comes from hitting the other child, by using self-instruction to walk away from the situation. Alternatively, cold EF is needed during a reading comprehension task where a student is required to sustain their attention and use working memory to answer the questions.

Longitudinal research in preschool-aged children has established a positive relationship between ER and executive functions (Ursache, Blair, Stifter, Voegtline, 2013). Specifically, children who exhibited high emotional reactivity and demonstrated high levels of ER were also found to have high levels of EF ability (Ursache et al., 2013). Therefore, children require both strong ER and EF skills to deal with stressors and changes in their environment.

Executive functions also overlap with the similar construct of effortful control (Bridgett et al., 2013), which has been defined as the ability to "inhibit a dominant response, to perform a subdominant, less salient response and to detect errors and engage in planning" (Rothbart & Bates, 2006). Effortful control is similar to executive functions because it involves the executive function of updating and monitoring information in working memory, and it utilizes focused attention. However, it is distinct from executive functions because it does not include inhibitory control (Bridgett et al., 2013). There is significant development of effortful control during the preschool years (Rothbart et al., 2011). It is important to understand effortful control because

studies have demonstrated that a relationship exists between high effortful control and low rates of negative emotions in young children (Rothbart et al., 2011).

Negative Emotions

Negative emotions are displays of negative affect (e.g., anger and sadness). In the preschool age range, children who experience increased levels of negative emotions may appear to be any of the following: somber, tearful, irritable, whiny, cranky, fear separation from their caregiver, and display withdrawn behavior. Insensitive caregiving has been associated with increased rates of negative emotions in young children (Bradley, 2003). Negative emotions in infants have been shown to be relatively stable across time (Ursache et al., 2013). Infants with a disposition to display high levels of negative emotions in reaction to novelty tend to consistently display negative emotions for the first five years of life (Kagan, Snidman, & Arcus, 1998), and this is related to reduced amounts of attention and inhibitory control (Rothbart, Ellis, Rueda, & Posner, 2003). Despite this continuity, changes have been reported with negative emotions during this time period (Ursache et al., 2013). Specifically, 13% of four month old infants labeled as highly reactive displayed an inhibited temperament at later assessments (Kagan, Snidman, & Arcus, 1998). This change in negative emotionality may be partially attributed to the development of ER behaviors (Ursache et al., 2013). During infancy, the automatic regulation of emotions, when coupled with arousal, is presumed to lead to the development of effortful control of attention, an integral component of executive functions (Ursache et al., 2013).

Sleep in Young Children

Sleep problems, defined here as difficulties initiating sleep and staying asleep, have been reported in 15% to 20% of toddlers and preschoolers within large normative samples (Jenkins et al., 1980; Richman, 1981; Scott & Richards, 1990). Specifically, between 10 and 30% of

children between 6 and 48 months of age exhibit sleep problems (Lozoff et al, 1996; Anders & Dahl, 2007). These sleep problems continue in 30% of children into adulthood (Anders & Dahl, 2007).

Sleep is the main activity of the brain during the child's early development (Dahl, 1996). The relationship between attention, sleep, arousal and emotions is an important area of investigation because they are intimately connected in an active neurobehavioral regulatory system (Dahl, 1996). Children who have disrupted or insufficient sleep tend to have problems managing their emotions and controlling attention (Dahl, 1996). Conversely, children with emotional disturbance often have difficulties with regulating sleep (Dahl 1996). A meta-analysis by Pilcher and Huffcutt (1996) concluded that sleep deprivation leads to a significant impairment to human performance. Even moderate changes in sleep duration, specifically 1-hour of sleep extension, has been shown to create significant improvements on neurobehavioral functioning in children 9 – 12 years old (Sadeh, Gruber & Raviv, 2003). Neurobehavioral functioning was evaluated by tasks that measure working memory, a domain under the umbrella of executive functions (Sadeh et al., 2003).

The volume of children's sleep literature demonstrates that sleep is necessary for many cognitive aspects of daily functioning. Specifically, sleep is important for the optimal functioning of learning, memory and academic performance. A longitudinal cohort study in 3-7 year old children found a correlation between inconsistent bedtimes at age 3 years and lower levels of cognitive performance (i.e., poorer reading, spatial and math scores) in girls, but not boys at age 7 years (Kelly, Kelly, & Sacker, 2013). Furthermore, self-reported sleep quality and duration of sleep, measured by time in bed, have been correlated with school functioning, achievement motivation and academic performance in elementary school children (Meijer, Habekothe & Van

Den Wittenboer, 2000; Curcio, Ferrara & De Gennaro, 2006). Sleep restriction has been correlated with decrements in procedural learning, defined as knowledge of how to complete a task, as well as declarative learning, which refers to factual knowledge about the world (Curcio et al., 2006). It can be concluded that sleep duration is related to memory, learning, and academic performance. Thus it is important that research examines the effects of sleep restriction during early childhood.

Sleep, Negative Emotions and Emotion Regulation

Previous literature has established a relationship between sleep restriction and emotional problems during childhood (Berger et al., 2012). For example, Berger et al. (2012) reported that acute sleep restriction (nap deprivation), in 3-year-old children resulted in a reduction in positive emotion responses and an increase in negative emotion responses exhibited by facial expressions. Therefore, children who are sleep restricted display more negative emotions than children who are not sleep restricted (Berger et al., 2012). Children exhibiting increased negative emotions, as a result of sleep restriction, may be more vulnerable to externalizing their emotions by acting aggressively. This would indicate greater emotion dysregulation. Alternatively, a child with high ER ability may be better able to buffer the negative effects of sleep restriction than a child with low ER ability. Thus, negative emotions and ER may be other important areas that are notably disrupted by sleep restriction in young children. Experimental sleep restriction studies (Sadeh et al., 2003) have established that acute sleep deficits cause marked deficits in cognitive functioning and behavior control in school-aged children (i.e., age 6 to 12). In a recent review article, Turnbull et al., (2013) noted that parent reported sleep difficulties have been correlated with child psychosocial problems, which refer to attention difficulties, anxiety, hyperactivity, mood, and aggressive behavior. The evidence reviewed thus far suggests that adequate sleep is

vital to optimize children's emotions, behavior, and cognitive functioning (Turnbull et al., 2013).

The Effects of Sleep on Executive Functions

The effects of sleep restriction on EF of young children, and how ER ability is involved in this process, is a research area that requires investigation. In terms of the adult literature on this topic, sleep deprivation has been correlated with a lowered performance on EF tasks in adults (e.g., Harrison & Horne 1997, Harrison, Horne & Rothwell, 2000; Heuer et al. 2004; Jones and Harrison 2001; Killgore, Balkin & Wesensten, 2006; Lingenfelser et al. 1994; McCarthy and Waters 1997; Tsai et al. 2005). Similarly, shorter sleep duration in typically developing infants and toddlers is longitudinally associated with decrements in later EF, particularly in tasks that rely on impulse control (Bernier, Carlson, Bordeleau, & Carrier, 2010). Specifically, shorter duration of sleep at 12 months was correlated with both poorer EF and impulse control at 26 months of age, while shorter duration at 18 months was correlated with poorer concurrent working memory and later impulse control (Bernier et al., 2010). Molfese et al., (2013) found that sleep restriction in 6 to 8 year old children negatively impacted children's EF, specifically inhibitory control as measured by the Directional Stroop Task.

EF, due to its long course of development, may be very sensitive to the effects of typical childhood sleep problems (Turnbull et al., 2013). Sleeping problems may lead to decrements in EF skills in childhood and play an important role in self-regulation (Turnbull et al., 2013). Thus, healthy sleep hygiene is needed to promote the optimal development of executive functions during childhood.

Research Rationale and Hypotheses

Cognitive and emotion based self-regulation improve rapidly throughout childhood (Ursache et al., 2013). It is important to conduct research on young children in order to gain a

better understanding of these systems because the preschool age period is a time of rapid development of both ER and executive functions. No studies have examined the relationships between ER, executive functions and negative emotions during the preschool years within the context of sleep. Thus, the preschool age range is particularly relevant for the present study. As a secondary data analysis, the present study aimed to extend research by examining the relationship between ER, executive functions and negative emotions in healthy preschool children within the context of sleep. It is important that these mechanisms be investigated at a young age in order to understand the role that they play in development.

The overall goal of the present thesis was to examine the relationship between ER as a predictor of both EF and negative emotions after sleep restriction in children without sleeping difficulties between the ages of 3-5 years. The Delay of Gratification Test and the Go/No-Go Task, which measures inhibitory control, were selected as measures of EF based on the volume of literature that supports a relationship between the underlying EF skills measured by these tasks and ER (Giesbrecht, 2008; Feng et al., 2008).

Two hypotheses were proposed:

(1) Higher ER was expected to be related to better EF ability (i.e., higher EF scores) and lower levels of negative emotions.

(2) The relationship between ER, EF and negative emotions were expected to be moderated by the degree of sleep restriction. Specifically, individuals with lower ER ability (or poorer ER skills) were expected to be more affected by sleep restriction than individuals with high ER. Under conditions of no/low sleep restriction, individuals with higher ER scores were expected to have better EF and lower levels of negative emotions than individuals with lower ER scores. Furthermore, individuals with higher ER scores were expected to be less affected in the domains

of EF and negative emotions, by higher levels of sleep restriction, than individuals with lower ER scores.

Method

The present study was a secondary data analysis based on the data collected from a study conducted by Kathryn Turnbull under the supervision of Dr. Graham Reid. This was an experimental study with four groups (3 experimental, 1 control), but experimental group assignment was not taken into consideration in the analyses for the present study. The participants, measures and procedure for collecting the data relevant to the current study are outlined below.

Participants

A total of 75 children between the ages of 3-5 years old ($M = 4.3$, $SD = .88$, 37 boys) were recruited to participate in the current study (see Table 1). One child per family was allowed to participate in the study. In order to participate, one parent or guardian agreed to complete the questionnaires and the Sleep and Negative Emotion Diary. Children with sleeping difficulties, non-typically developing children (e.g., Autism Spectrum Disorder), and parents who did not speak English, were excluded. The clinical cutoff for emotional disorders, according to the Strengths and Difficulties Questionnaire (SDQ), is a score of 4/5 on the emotionality scale (Goodman, 2001). With respect to the general population 2.2% of children in the normative sample are above the clinical cutoff for emotionality (Goodman, 2001). However, no children scored above a 3/5 in the present study. Thus, no children in the present study had a clinical level of emotional symptoms as measured by the SDQ. Furthermore, 94.5% of the participants in the present study scored below a 2/5. Thus, the children in the present study displayed a low range of emotional symptoms. Additionally, no children from the present sample scored above the clinical

Table 1

Parent Participant Demographic Characteristics

	N
Martial Status	
Married	50
Common law	4
Single	1
Highest Level Education of Parent	
Did not graduate high school	2
High school diploma	2
Community/business college	8
Diploma/certificate from community college, CEGEP, nursing school, university	13
Bachelor/undergraduate degree	23
Masters degree	4
Professional degree	3
Language	
English	52
Arabic	2
Unknown	1
Household Income	
Prefer not to answer	1
> $39, 999	11
$40, 000 – $99, 999	27
≤ $100, 000	15
Unknown	1
Number of children under the age of 18 living at home	
1	9
2	23
3	16
4	6
Missing	1

cutoff for total difficulties as measured by the SDQ.

Measures

The Emotion Questionnaire. The Emotion Questionnaire (Rydell, Thorell & Bohlin, 2003) was completed by parents (typically the child's mother). The questionnaire consisted of 40 items that describe the child's emotional reactions of anger, fear, positive emotions, and sadness with regards to 12 statements describing daily situations. Parents rated their child's emotional reactions using a 5-point Likert Scale ranging from 1 (doesn't apply at all) to 5 (applies very well). A sample item reads as follows: "My child's toy is lost or broken. My child reacts strongly and intensely" (Rydell, Thorell & Bohlin, 2003). The Emotion Regulation subscale of the Emotion Questionnaire was used for the purposes of this study and consisted of 18 items. The scores from all the questions were averaged for a total ER score; higher scores reflect greater dysregulation of negative emotions.

The Emotion Questionnaire has been established as a reliable measure. The Chronbach's alpha for the overall scale was $\alpha = .89$ for children 5-8 years old (Rydell, Thorell, Bohlin, 2007). Test-retest reliability coefficients for the Emotion Regulation scale ranged from .62 to .79 in 8-year-old children (Rydell, Berlin & Bohlin, 2003). The Emotion Questionnaire has been compared with the Child Behaviour Questionnaire (CBQ) (Rothbart et al., 2001) for the purpose of determining construct validity. As a measure of construct validity, Rydell and colleagues (2003) used the Anger, Fear, Smiling and Laughter subscales of the Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001) to validate the Emotionality subscales of the Emotion Questionnaire. The Soothability, Inhibitory Control, and Attentional Focusing scales were used to validate the Emotion Regulation subscale of the Emotion Questionnaire. The correlation between the Anger subscale in the CBQ, and the Anger subscale within the Regulation scale of

the Emotion Questionnaire (r = -.45), demonstrates convergent validity for the Emotion Questionnaire. This correlation demonstrates that children who exhibit a large amount of anger display weak anger regulation skills as measured by the Emotion Questionnaire. The correlation between the Anger subscale on the CBQ, and the Positive Emotions subscale (part of the Regulation scale) of the Emotion Questionnaire (r = -.22), demonstrates adequate discriminant validity.

The Sleep and Negative Emotion Diary. The Sleep and Negative Emotion Diary was developed specifically for the project by Turnbull (2011) based on sleep questions from Corkum et al. (2008), Izard et al. (2000), and Buss and Plomin (1984).

Parents recorded information about the time that their child went to bed and awoke each day, as well as the duration of any naps. Sleep duration was calculated based on the bedtimes, nap time durations, duration of night waking, and morning waking times. Sleep restriction was then calculated as the difference in mean duration of sleep in the experimental period (three days), subtracted from mean sleep duration during the baseline period (seven days) measured in hours. Higher scores reflect greater sleep restriction and consequently less sleep than lower scores.

The emotion measures within the Sleep and Negative Emotion Diary consisted of two subscales. The first was the Emotion Expression Rating Scale (Izard et al., 2000). Parents rated how often his or her child exhibited each of seven emotions (interest, happiness, sadness, anger, fear, shame, guilt) that day using a 6-point Likert scale from 1 (very seldom) to 6 (very often). Only the ratings of negative emotions (sadness, anger, fear, shame, and guilt) were used for the present study. Internal consistency for negative emotions was reported to be α = .69 in a study of teacher ratings of preschool children (Izard et al., 2000).

A second negative emotion measure was adapted from the Negative Emotionality subscale, part of the EAS Temperament Scale (Buss & Plomin, 1984). Parents were asked to rate how true each of the 5 statements was regarding their child that day using a 5-point Likert scale ranging from 1 (not true) to 5 (very true). A sample item from this subscale reads as follows: "Child cried easily; child tended to be somewhat emotional". The EAS Temperament Scale (Buss & Plomin, 1984) is a widely used, reliable, and valid measure of temperament. However, no studies have as yet assessed the reliability and validity for the Emotionality subscale as a daily report measure in a diary context. This is because the EAS Temperament Scale measures emotionality as a stable temperament construct. However, conceptually it would make sense that emotionality could be reported on a daily basis. The researchers of the current study assessed convergent validity of the EAS Temperament Scale by comparing it with the Emotionality subscale within the SDQ, $r = .26$ (Goodman, 1997). Scores obtained from the Sleep and Negative Emotion Diary during the seven day baseline period were compared with the scores obtained during the three days of sleep restriction or control condition. Negative emotion was calculated by subtracting the mean negative emotion scores from the experimental period from mean negative emotion scores from the baseline period. Finally, Z-scores of both Negative Emotion and Negative Emotionality were computed in order to combine both subscales into one measure.

Go/No-Go Task. The Go/No-Go Task is a behavioral inhibition computer task (Simpson & Riggs, 2006), which requires a participant to press a button (Go) in response to one type of stimulus that occurs with greater frequency, and not press a button (No-Go) in response to a different type of stimulus. For the current project, a Go/No-Go task was created in Eprime (Psychology Software Tools, 2012) with a picture of a mouse as the Go stimulus and a picture of

a cat as the No-Go stimulus. This format was shown to have moderate test-retest reliability (α = .43) and strong convergent validity with the day-night task (α = .58) in previous research with preschool aged children (Simpson & Riggs, 2006). The duration of the task was approximately 5 minutes. The number of errors made (e.g., by clicking the cat No-Go stimulus which indicates a failure to inhibit a dominant response) during the task is computed; higher scores reflect greater difficulties with behavioural inhibition, and therefore poorer EF performance.

Delay of Gratification Task. The Delay of Gratification Task (Mischel & Gilligan, 1964) requires a child to forgo the immediate gratification in order to receive a larger reward at a later point in time. During this task the researcher asked the child to choose two preferred toys from a selection of five options. Once chosen, the researcher placed one of the toys on a square embedded in a board in front of the seated child. The child was told that if he/she waited without touching the toy or playing with it before the researcher returned, then he/she could have both toys to keep. However, the child was told that if he/she wished to play with the toy before the researcher returned, then he/she could only keep one toy. Children were videotaped during this task and a video coder, blind to the degree of sleep restriction experienced by each child, coded the videos to establish when and whether children finished waiting by picking up the toy or moving it before the researcher returned. Children were also judged to have finished waiting if they went to the researcher and/or their parent and verbally indicated that they were finished waiting. The total number of seconds the child waited before picking up the toy, or moving it from within the square section of the board (up to a maximum of 10 minutes) was computed; higher scores (i.e., longer time the child waited without touching the toy) reflect stronger delay of gratification abilities, and thus better EF performance.

Test-retest reliability data regarding the Delay of Gratification Task has not typically

been collected, as performance on this task is often seen as a developmental milestone. Schwartz and Schrager (1983) have validated the use of a Delay of Gratification Task in preschool aged children. Specifically, the finding that choice of the delayed reward was not correlated with age or verbal IQ, can be seen as evidence of discriminant validity (Schwartz & Schrager, 1983). This shows that the delay of gratification test effectively measures EF ability, which differs amongst children of the same age, rather than a skill that improves equally among all children as they grow older.

The Strengths and Difficulties Questionnaire. The SDQ (Goodman, 1997) consists of 25-items. This questionnaire uses a 3-point Likert scale for parent responses, which range from 1 (not true) to 3 (certainly true). The questionnaire is divided into five scales consisting of five items each (emotional symptoms, conduct problems, hyperactivity – inattention, peer relationship problems, and prosocial behavior). One of the sample items reads as follows: "Often loses temper." Normative data have been collected from 2779 children between the ages of 4 -7 years in the USA. Test-retest reliability after 4 – 6 months (r = .62), inter-rater reliability (r = .34) and internal consistency (α = .73) scores demonstrate that the SDQ has strong reliability as a measure for children 5 -15 years old (Goodman, 2001). Convergent validity was supported by associations between the SDQ and the occurrence or nonoccurrence of psychiatric disorders with an odds ratio of approximately 15 (Goodman, 2001). This finding explains that the SDQ is correlated with diagnoses of related psychological disorders. For example, the Hyperactivity subscale of the SDQ is correlated with the diagnosis of Attention Deficit Hyperactivity Disorder.

Procedure

The participants were recruited using flyers, which were distributed to various day care and community centers in London, Ontario. Parents were approached by a research assistant who

provided them with information about the study. Additionally, advertisements with contact information for the researchers were posted on an on-line classified website (Kijiji) to recruit potential parent participants.

Once parents expressed interest in participating, they were telephoned to be screened for suitability for participating in the study. Parents who agreed to participate and who were eligible were mailed a letter of information and an introductory home visit was scheduled. Written consent was obtained at the home visit. During this visit, the researcher reviewed the study protocol with the parent and showed him/her how to complete the Sleep and Negative Emotion Diary. The parent was asked to complete the diary each day for the duration of the 11-day study. Parents also completed a series of questionnaires including the Emotion Questionnaire.

Following the introductory home visit the child participants completed seven days of normal sleep in order to obtain baseline measures of the child's daily emotions and duration of sleep. Participants were then randomly assigned to one of four sleep conditions. Condition 1 was a control group, with no change in sleep for the participants for the last three consecutive nights of the study. Condition 2 was a sleep delay of 20 minutes for the last 3 consecutive nights of the study. Condition 3 was a sleep delay of 40 minutes for the last 3 consecutive nights of the study. Condition 4 was sleep fragmentation, where the participants went to bed at their usual bedtime and were awoken after 1.5 hours of sleep, and kept awake for 20 minutes for the last 3 nights of the study.

After three nights in the experimental or control sleep conditions, a researcher or trained research assistant visited the home of the child participant to test his/her EF. EF tasks included: Go/No-Go Task, Delay of Gratification Task, Visual-Spatial Memory Test, Digit Span Test. Of the four EF tasks administered in the original study (Go/No-Go Task, Delay of Gratification

Task, Visual-Spatial Memory Test, Digit Span Test) the Go/No-Go Task and the Delay of Gratification Task were included as outcome measures in the present study. The tasks were administered in the same order for each participant. Parents were provided with a total of $80 in gift cards for completing the entire 11-day study.

Results

Preliminary Analyses

From the original 75 participants, 16 were excluded from the present analyses. Nine participants were excluded because they did not complete the ER questionnaire. Five participants were excluded because they withdrew before completing all 11 days of the study. Finally, two participants were excluded for medical reasons (1 child contracted an illness that required a visit to the hospital during the study, and 1 child was excluded because of a history of a head injury in which there was a loss of consciousness).

Four participants with scores that were outliers were excluded from the present analyses. Two participants had extreme negative emotion scores, and two participants had sleep restriction scores that were more than three standard deviations below the mean. The final data analysis consisted of a sample of 55 participants (28 males; $M_{age} = 4.27$, $SD = .817$).

The distribution of negative emotion scores was significantly skewed. A square root transformation normalized the distribution. Furthermore, Delay of Gratification Test scores were significantly skewed. Consequently, a logarithm transformation was performed.

ER and sleep restriction variables were each split into terciles based on the shape of the normal distribution of scores. ER tercile cutoff scores ranged from: Low Ability ≥ 3.33, Medium Ability $\leq 3.32 - \geq 2.99$, to High Ability ≤ 2.98. Larger scores in ER indicate greater ER dysregulation. Sleep restriction tercile cutoff scores, measured in hours, ranged from: Low $\leq$ -

0.12, Medium > -0.11– < 0.46, to High ≥ 0.47. A negative score indicates that the participant obtained more sleep on average during the experimental sleep period than the baseline period. A positive score indicates that the participant obtained less sleep in the experimental sleep period than during the baseline period. A median split was used to group Delay of Gratification Test scores. Delay of Gratification Test cutoff scores, measured in seconds, ranged from: Low ≤ 399, to High > 399. The Go/No-Go Task was divided into two groups, those who made no errors, and those who made one or more errors.

A 3 (ER) x 3 (Sleep Restriction) Between Subjects ANOVA was conducted for the outcome variable negative emotions. Levene's Test of Equality of Error Variances was found to be significant, $F(8, 46) = 2.699$, $p = .016$. Thus, the differences found in sample variances are unlikely to have been found from a randomly sampled population with equal variances. Consequently, findings with regards to negative emotion should be interpreted with caution.

Analyses

Research question A) Do ER scores predict EF (Delay of Gratification) after sleep restriction?

A Multiway Frequency Analysis (Hierarchical Loglinear Analysis) was conducted to determine if there was a significant interaction effect between ER, sleep restriction and EF (Delay of Gratification Test). This analysis was not statistically significant: χ^2 (4, N = 55) = 1.902, p = .745, G^2 (4, N = 55) = 1.928, p = .749. Thus, there was no significant interaction between ER, and sleep restriction on EF (Delay of Gratification).

Two Chi-Square Analyses were conducted to examine main effects of ER and sleep restriction on EF (Delay of Gratification). Contrary to the original hypothesis, a significant main effect was not found for sleep restriction on the Delay of Gratification Test, $\chi^2(2, N = 55) =$

2.786, p = .248 (see Table 2). However, results did support the original hypothesis with a significant main effect for ER on the Delay of Gratification Test, $\chi^2(2, N = 55) = 6.728$, p = .035 (see Table 3).

Research question B) Do ER scores predict EF (Inhibitory Control: Go/No-Go Task) after sleep restriction?

A Multiway Frequency Analysis (Hierarchical Loglinear Analysis) was conducted to determine if there was a significant interaction effect between ER, sleep restriction and EF (Go/No-Go Task). This analysis was not statistically significant: $\chi^2(4, N = 55) = 1.574$, p = .813, G^2 (4, N = 55) = 1.559, p .816. Thus, there was no significant interaction between ER and sleep restriction on EF (Inhibitory Control: Go/No-Go Task).

Two Chi Square Analyses were conducted to examine main effects of ER and sleep restriction on EF (Inhibitory Control: Go/No-Go Task). A significant main effect was not found for sleep restriction on the Go/No-Go Task, $\chi^2(2, N = 55) = .236$, p = .889 (see Table 4), which does not support the original hypothesis. Additionally, a significant main effect was not found for ER on the Go/No-Go Task, $\chi^2(2, N = 55) = 3.307$, p = .191 (see Table 5), which does not support the original hypothesis.

Research question C) Do ER scores predict negative emotions after sleep restriction?

A 3(ER) x 3(sleep restriction) Between Subjects ANOVA was conducted. Contrary to the initial hypothesis, a significant main effect for sleep restriction was not found, $F(2, 55) = 1.213$, p = .307, η^2 = .050. Furthermore, a significant main effect for ER was not found, $F(2, 55) = .392$, p = .678, η^2 = .017. This finding does not support the original hypothesis. There was also no

Table 2

Percentage of Children in Each Sleep Restriction and Delay of Gratification Test Group tested by Chi Square Analysis

	Delay of Gratification Group	
Sleep Restriction Group	Low	High
Low	20.0%	12.0%
Medium	16.4%	18.2%
High	10.9%	21.8%

Table 3

Percentage of Children in each Emotion Regulation and Delay of Gratification Test Group tested by Chi Square Analysis

	Delay of Gratification Group	
Emotion Regulation Group	Low	High
Low	12.0%	21.0%
Moderate	23.6%	9.0%
High	10.0%	21.8%

Table 4

Percentage of Children in Each Sleep Restriction and Go/No-Go Task Group tested by Chi Square Analysis

	Go/No-Go Group	
Sleep Restriction Group	0 Errors	1+ Errors
Low	12.7%	20.0%
Medium	12.7%	21.8%
High	14.5%	18.2%

Table 5

Percentage of Children in each Emotion Regulation and Go/No-Go Task Group tested by Chi Square Analysis

	Go/No-Go Group	
Emotion Regulation Group	0 Errors	1+ Errors
Low	9.1%	25.5%
Moderate	12.7%	20.0%
High	18.2%	14.5%

significant interaction effect between sleep restriction and ER $F(4, 55) = 1.049$, $p = .392$, $\eta^2 = .084$ (see Table 6).

Discussion

In support of the original hypothesis, ER significantly predicted Delay of Gratification Test scores. Children with higher ER ability waited longer in the Delay of Gratification Task in order to obtain a toy, compared to children who had lower ER ability. ER did not predict EF and negative emotions after sleep restriction. Specifically, ER did not predict inhibitory control, as measured by the Go/No-Go Task. The lack of a statistically significant main effect found for ER on the Go/No-Go task, but not the Delay of Gratification Test, may suggest that ER is more related to the delay of gratification component of EF, than inhibitory control. This explanation supports research by Kim et al. (2013) who suggested that Delay of Gratification requires ER ability as it is a hot EF task, whereas inhibitory control (Go/No-Go task) doesn't require as much ER ability, because it is a cold EF task that uses sustained attention.

When interpreting these results it is important to address the limitations associated with the sample used for the present study. The participant sample of typically developing children without any sleeping problems allowed the present study to control for prior sleeping problems, developmental delays, and psychological disorders (e.g., ADHD). However, this homogenous sample of participants may have limited the range of ER in the sample by eliminating children that were more likely to display extremely weak ER abilities. This speculation is supported by a relatively small standard deviation regarding the distribution of ER scores in the present study, which indicates a more narrow distribution ($M = 3.13$, $SD = .39$). This can be compared to the normative sample reported in the Regulation of Negative Emotions subscale of the Emotion Questionnaire at age 5, which had a greater mean and standard deviation ($M = 3.53$, $SD = .75$)

Table 6

Means and Standard Errors of Emotion Regulation and Sleep Restriction Groups Tested as Independent Variables in the ANOVA of Negative Emotions

	Mean	Standard Error
Emotion Regulation Group		
High	.051	.201
Low	- .078	.206
Medium	.182	.211
Sleep Restriction Group		
Low	- .280	.206
Medium	.168	.201
High	.043	.211

(Rydell, Thorell & Bohlin, 2004). In general, because there is less variation in ER in the current study it is likely that the results are underestimating the impact of ER. Even though the results were significant with regards to ER and the Delay of Gratification Test, the homogenous sample may be underestimating the strength of the relationship. This homogenous sample may also explain why there was no significant finding with regards to ER and inhibitory control (Go/No-Go task) and negative emotions.

Another explanation for the insignificant findings regards to ER and inhibitory control, as measured by the Go/No-Go task, may be related to the measure chosen for inhibitory control. A ceiling effect was found on the Go/No-Go task among the preschool aged participants. Overall, 40% of children made no errors on the task. This ceiling effect may have contributed to the lack of significance found between ER and the Go/No-Go task by limiting the range of inhibitory control scores obtained from the sample. Additionally, some children failed to hit the target Go stimuli, but also failed to hit the No-Go stimuli, which would not truly reflect a good inhibitory control score. Thus, children who are extremely poor and children who are extremely successful at the Go/No-Go task may have obtained the same score, zero errors. This characteristic of the task may explain why main effects for the Go/No-Go task were not found. This is because children who received the same score actually hold very different EF abilities. Thus, analyzing scores would not yield significant differences between the two groups (zero errors, and one or more errors). Future research would benefit from using a more sensitive measure of inhibitory control, for example the Stroop task (Stroop, 1935), or using a more challenging version of the Go/No-Go task.

Sleep restriction was not found to predict EF performance (both Delay of Gratification and Go/No-Go Task scores), nor negative emotions. Furthermore, sleep restriction was not found

to moderate the relationship between ER, EF and negative emotions, which does not support the original hypothesis. Thus, children with high ER ability were not able to buffer the negative effects of sleep restriction better than children with low ER ability, as measured by EF performance and the display of negative emotions. The narrow range in ER scores and the lack of significance found for sleep restriction may lead one to conclude that for children without any sleeping problems or psychological disorders, acute sleep restriction may not impair EF or influence the display of negative emotions. In other words, changes in sleep schedules may not hinder EF performance, nor increase displays of negative emotions in children with adequate ER ability, as they may be able to adapt to new situations without difficulty.

A lack of significance found for sleep restriction as a predictor for both negative emotions and EF, and the lack of interaction effect between sleep restriction with ER, may also be attributed to the degree of sleep restriction. The minimum duration of sleep restriction in the high sleep restriction group, which was 28.2 minutes per night over three nights, may not have been long enough to create a significant effect on EF and negative emotions. Furthermore, the limited period of sleep restriction of only three days may not have been a long enough period of time to see a significant effect on EF and negative emotions. Thus, the findings regarding sleep restriction may indicate that children without pre-existing sleep problems are resistant to small changes in sleep of up to three consecutive days.

ER and sleep restriction were not found to predict increased negative emotions during the experimental period of the study. Therefore, children with high ER ability, and children who obtained more sleep were not more likely to exhibit fewer negative emotions than children who had weak ER ability or children who had obtained less sleep. The lack of significance for ER and

sleep restriction as a predictor of negative emotions does not support findings from previous literature involving young children.

The results of previous literature may have differed from the present study due to the use of direct observation and facial coding of negative emotions, rather than use of parent report measures (Berger et al., 2012). Direct observation by trained researchers may provide a more objective measure of negative emotions than parent reports, and thus reduce social desirability bias associated with parental reporting. Trained researchers may more easily observe negative emotions and consequently report wider ranges of ER ability in preschool children. Furthermore, previous literature differed from the present study with regards to the age of participants, and the dependent measures used. For example, Sadeh et al., (2003) may have found significant effects of sleep restriction because of their older sample of participants, and measures of neurobehavioral functioning as their dependent measure. The significant effects of sleep restriction may be observed more easily in older children, compared to preschool children, because as children age they develop stronger ER abilities. Subsequently, in an older sample children with weak ER abilities would be more noticeable to a trained researcher, which would result in a broader range of ER abilities to be identified. Furthermore, the significant relationship between ER and EF found by Ursache et al., (2013) may have been a result of the longitudinal design of their study. Considering that childhood ER and EF skills are continuously developing throughout childhood, a longitudinal design might have better captured individual differences with respect to these skills.

Limitations

Several limitations may have contributed to the lack of support found for the original hypotheses. Ideally, the sample of participants in the present study should have been randomly

selected. However, due to natural constraints, the researchers had to rely on a sample of individuals that volunteered to participate. Consequently, self-selection may have influenced the results by attracting participants interested in the financial incentive rather than for the purpose of contributing to scientific research. Thus, it is possible that participants did not care about the integrity of the study and may have completed the daily Sleep and Negative Emotion Diary inaccurately. This would have jeopardized the reliability and validity of the present findings. However, it is likely that the magnitude of this bias is small, given the relatively minor financial compensation amount provided to participants for the 11day study.

Social desirability bias may also have impacted the current findings because ER, sleep restriction, and negative emotions were all based on parent reports. Specifically, parents may have evaluated their child more favorably by reporting better ER ability and fewer negative emotions exhibited by their child compared to objective measures (e.g., observational methods). As a result, the range in ER scores reported by the parents could be narrowed substantially, which would reduce the possibility of finding significant effects regarding ER. However, parent report measures were chosen because observational methods were not feasible for an 11 day study. In addition, the substantial time commitment required for observational methods would be too taxing for busy parents of young children.

Future Directions

Future research would benefit from using additional and/or alternative measures of EF, specifically for young children. A ceiling effect was found in the Go/No-Go Task where 40% of participants made no errors. Thus, another measure of inhibitory control suitable for children between the ages of 3-5 may eliminate this ceiling effect. Future research may benefit from using a longer period of experimental sleep restriction, rather than only three days and longer

increments of sleep restriction per night. It may also be beneficial for future research to use additional ER measures suitable for preschool age children. Furthermore, future researchers may want to consider using alternative methods of data collection. This might involve observation of emotions rather than parent reports or tasks that challenge the child to use emotion regulation skills that are scored by a researcher.

Conclusion

The present study examined the relationship between ER, EF, and negative emotions after sleep restriction. The hypothesis that ER would predict EF performance in preschool children, as measured by the Delay of Gratification Test, was supported. This finding supports the need for programs that foster ER skill development in young children. However, all other components of the original hypothesis were not supported. This surprising finding does not support current literature regarding the relationship between ER, EF, and sleep in young children. The current research extends previous literature by examining the direct relationships between ER, sleep restriction, EF, and negative emotions, in preschool aged children. This research has implications for understanding the role of ER and sleep restriction in early childhood and its effects on daily functioning. The present study also has implications for understanding children's behavioral and emotional problems, as well as the treatment of sleep problems in early childhood. Further research in this field is needed to explore these relationships and to replicate the present findings.

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Appendix A

SLEEP DIARY

Family Research Number: _____

Start Date: _____ End Date: _____

GENERAL INSTRUCTIONS

- Please leave diary in a convenient location
- It is important to fill out this diary as things happen throughout the day (evening and morning)
- Make sure your child wears the actigraph at all times possible but ESPECIALLY make sure that he or she puts it on and is wearing it before bedtime.
- If you have any questions please call **Kathryn Turnbull** at **519-661-2111 ext 89331**

THANK YOU VERY MUCH FOR YOUR PARTICIPATION!

Day 1 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.
Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 2)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 1 that was unusual for your child:

Day 2 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.
Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
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Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 3)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 2 that was unusual for your child:

Day 3 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.
Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 4)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 3 that was unusual for your child:

Day 4 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.

Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 5)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 4 that was unusual for your child:

Day 5 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.

Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 6)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 5 that was unusual for your child:

Day 6 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.

Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 7)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 6 that was unusual for your child:

Day 7 Date: _____

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.
Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO
If YES, how many times did he/she get out of bed? _____
If YES, what time did your child go back to bed? _____
If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 8)? _____
Did you have any problems waking your child up? YES NO
If YES, describe: _____

Please describe anything on Day 7 that was unusual for your child:

Day 8 Date: _____

YOUR GROUP IS:

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.

Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5

Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO

If YES, how many times did he/she get out of bed? _____

If YES, what time did your child go back to bed? _____

If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 9)? _____

Did you have any problems waking your child up? YES NO

If YES, describe: _____

Please describe anything on Day 8 that was unusual for your child:

Day 9 Date: _____

YOUR GROUP IS:

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.

Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5

Child got upset easily	1	2	3	4	5
Child reacted intensely when upset	1	2	3	4	5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO

If YES, how many times did he/she get out of bed? _____

If YES, what time did your child go back to bed? _____

If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 10)? _____

Did you have any problems waking your child up? YES NO

If YES, describe: _____

Please describe anything on Day 9 that was unusual for your child:

Day 10 Date: _____

YOUR GROUP IS:

Day:

Did your child take the "watch" off today? Please write down the time of day, the amount of time the watch was off, and why it was taken off:

example: *7:10 pm, 15 minutes, bath time.*

_____

_____

Did your child take a nap today? YES NO (Circle one)

If YES, how long did your child nap: from _____ to _____

Emotion Ratings:

Please rate how often your child expressed each of the emotions listed below today. Consider all forms of expression – facial expression, vocal expression, as well as gestures, postures, and movements.
Circle a number to tell us how often your child showed each emotion **TODAY**. The numbers start with **1**, which means **very seldom**, and go up to **6**, which means **very often**.

	Very Seldom					**Very Often**
Interest	1	2	3	4	5	6
Happiness	1	2	3	4	5	6
Sadness	1	2	3	4	5	6
Anger	1	2	3	4	5	6
Fear	1	2	3	4	5	6
Shame	1	2	3	4	5	6
Guilt	1	2	3	4	5	6

Please rate how true each of these statements was about your child TODAY:

	Not True		True		Very True
Child cried easily	1	2	3	4	5
Child tended to be somewhat emotional	1	2	3	4	5
Child often fussed and cried	1	2	3	4	5
Child got upset easily	1	2	3	4	5

Child reacted intensely when upset 1 2 3 4 5

Night:

What time did you put your child to bed? _____

What time did you turn the lights out? _____

At what time did your child fall asleep? _____

Did your child get out of bed or wake up after lights out? YES NO

If YES, how many times did he/she get out of bed? _____

If YES, what time did your child go back to bed? _____

If YES, how long was your child out of bed/awake? _____

At what time did your child wake up (on Day 11)? _____

Did you have any problems waking your child up? YES NO

If YES, describe: _____

Please describe anything on Day 10 that was unusual for your child:

Thanks again for helping out with our research. You have completed the sleep diary!

Please feel free to add any additional comments about your thoughts on this research and your experience with participating, as well as anything you would like to add about your family and your child. We welcome parent feedback.

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