EPISODIC FUTURE THINKING IN YOUNG CHILDREN:

CONSIDERING BODY MASS AND MEMORY

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EPISODIC FUTURE THINKING IN YOUNG CHILDREN:

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ABSTRACT

With the increase in pediatric obesity, research continues to evaluate new intervention strategies to improve the effectiveness of current obesity treatments. One area of study which may hold promise for pediatric obesity treatments is the use of Episodic Future Thinking (EFT), which is the ability to think of the future based on the present moment or past experiences, and the role of oneself in these episodes or experiences. Additionally, previous literature in EFT has begun to examine the effects that additional variables, such as memory, have on an individual's ability to engage in EFT. The current study aimed to evaluate whether EFT is associated with child's weight status and age, and whether EFT differs with motivational state and memory. Fifty-seven children and their parents were recruited from the Kansas City area. Children completed brief measures of intelligence (Kauffman Brief Intelligence Test – 2), memory (Wide Range Assessment of Memory and Learning – 2), impulsivity (Tasks of Executive Control), and four EFT tasks. Parents also completed the Eysenck Youth Questionnaire for Impulsiveness, and rated their child. Results found that neither intelligence or memory were related to EFT performance. However, many children exhibited poor memory for EFT specific questions, suggesting that specific memories may be related to use of EFT. Additionally, higher impulsivity was associated with poorer EFT in univariate analyses, but not in multivariate regressions, and the relationship between impulsivity and EFT was marginally higher during non-motivated tasks than during motivated tasks. No relationship was found between EFT and child's weight status. Though no significant results were found between EFT and pediatric obesity, relationships were found between impulsivity and EFT. Given the documented relationship between child weight status and impulsivity, this warrants continued research. Also, this study suggests that future studies do not need to account for intelligence and broad memory when designing EFT studies. However, researchers may consider accounting for differences in memory that are specific to EFT.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the College of Arts and Sciences have examined a dissertation titled "Episodic Future Thinking in Young Children: Considering Body Mass and Memory," presented by William R. Black, candidate for the Doctor of Philosophy degree, and certify that in their opinion it is worthy of acceptance.

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TABLE OF CONTENTS

LIST OF TABLES

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CHAPTER 1

INTRODUCTION

Pediatric obesity has become pandemic. In the United States, 32% of children and adolescents between the ages of 2-19 meet classification for obesity (i.e., Body Mass Index ≥ 95th percentile for age and gender) or overweight (i.e., BMI ≥ 85th percentile and less than 95th percentile), with 17% of children in this age range being classified as obese.[1] Globally, the World Health Organization estimates that over 42 million children under the age of 5 are obese or overweight, and over 80% of those children live in developing countries.[2] Though obesity rates have begun to stabilize in the last few years in the United States,[3-5] we have yet to see a decrease in obesity rates. Additionally, pediatric obesity has been linked to numerous well-documented health problems, such as high lipid and insulin levels, and high blood pressure.[6] Pediatric obesity is also associated with a higher risk of insulin resistance, a precursor for the development of Type 2 diabetes.[7] Also, though childhood obesity is associated with adult obesity,[8,9] childhood obesity is linked to numerous long-term health complications regardless of adult weight. Such complications include heart disease, hypertension, sleep apnea, infertility, gall bladder disease, and some forms of cancer.[6,10,11]

Current Pediatric Obesity Treatments

In 1998 and 2007, an expert committee of representatives from health organizations including the American Medical Association, Health Resources and Service Administration, and the Center for Disease Control and Prevention, was formed to evaluate the current literature and better define effective pediatric obesity interventions.[12] Per their recommendations, the most effective pediatric obesity treatments have focused on increasing physical activity and improving dietary habits in children, including reducing consumption of high calorie and low nutrient snack foods and sugary beverages. Cognitive-behavioral strategies are often utilized to help children and families initiate and maintain these lifestyle changes.[13] A meta-analysis of controlled trials utilizing such behavioral interventions in school and health care settings concluded that such treatment programs lead to small to moderate short term improvements in anthropometric outcome measures (e.g. BMI, weight), especially when delivered with greater intensity (i.e., hours of contact). However, there is limited evidence of whether these gains can be maintained for longer periods of time.[14,15] Though a more recent review of pediatric obesity treatments concluded that behavioral interventions are the "cornerstone" of pediatric obesity treatments,[16] other intervention strategies (e.g., pharmacological, bariatric surgery) are increasingly being considered, and treatment guidelines are constantly being re-evaluated, updated, and incorporated into obesity programs. Therefore continued research is needed to improve treatment effectiveness.

Executive Functioning, Self-Control, and Impulsivity

Aspects of executive functioning, such as self-control and impulsivity, are related to eating behaviors and obesity in children. Executive functioning consists of the self-regulatory neurocognitive processes that control both thought and goal-directed behavior.[17] These processes are also associated with more specific functions such as inhibitory control (i.e., the ability to restrain from behaviors that are inappropriate given a context or counter-productive to specific goals), attention (i.e., the ability to maintain a behavior), reward sensitivity (i.e., the degree to which a risky-behavior is motivating), and working memory (i.e., the ability to hold goal-relevant information online).[18-20] Self-control is part of the inhibitory-control aspect of executive functioning, and refers to an individual's engagement in self-regulatory processes. Impulsivity, on the other hand, is the tendency to behave with limited forethought or consideration for long-term goals and consequences.[21,22] Thus, where self-control represents the use of executive functioning capabilities, such as behavioral, cognitive, and emotional control, impulsivity represents the lack of engagement in these capabilities.

Development of Executive Functioning and Self-Control

Previous work has demonstrated that control and decision making brain networks (e.g., prefrontal cortex) continue to develop throughout childhood and into early adulthood.[23] Additionally, brain structures associated with self-control develop at a slower rate than those associated with motivation and value centers (e.g., limbic and striatal structures)[24] and are not fully matured until young-adulthood. Thus, youth may be less able to exhibit behavioral control and regulate their motivation and value centers compared to their older counterparts.[24,25]

Pediatric Obesity and Self-Control

Executive functioning has been evaluated in relation to a range of outcomes (e.g., academic, social functioning, emotional control),[26-28] including eating behaviors and childhood obesity.[29,30] Healthy behavior choices often require individuals to delay or forgo an immediate reward (e.g., food, drugs, money) or inhibit an impulsive response in favor of long term goals (e.g., weight loss, sobriety, saving money). Research demonstrates that obese children tend to be more impulsive than non-obese children.[31-34] This relationship is even more pronounced when impulsivity and disinhibition are evaluated using cognitive tasks that incorporate food-images.[33] Studies have demonstrated a decreased ability to delay rewards (e.g., food, toys) in individuals with higher BMI.[36-38] Early experimental work in the ability to delay gratification evaluated the role that attention and self-control played in preschoolers' ability to wait for a delayed, preferred reward.[35] The researchers found that when the children were physically presented with the choices, which increased the salience of the rewards, they were less able to exhibit self-control. This decrease in self-control was exhibited by shorter wait times before selecting a reward and greater likelihood of choosing an immediate reward. Follow-up studies conducted over a decade later[36,37] found that children who were able to delay gratification were more academically and socially competent, more likely to use reason and logic to solve problems, more attentive, and exhibited better distress tolerance and coping skills. Not only is there variability in children's ability to engage in self-control, greater ability to do so at a young age is predictive of positive long-term outcomes.

There is a strong and well documented relationship between obesity and self-control. Early studies found that obese children exhibited less self-control than non-obese children when presented with a food-reward[38,39] and that younger age was related to poorer self-control.[39] More recent studies have also demonstrated a relationship between self-control and BMI in children. Previous work from our research lab has used an ecologically valid measure of self-control and delay of gratification with children in a pediatric obesity treatment program.[40] In this study, children were awarded points for attending each session, and at each meeting children were given the choice to exchange their points for a prize or save their points for a better prize. It was found that children with lower BMI were able to exhibit self-control and save their points more so than children with higher BMI. Several longitudinal studies have also demonstrated that self-control is related to BMI between four and eight years later.[41-45] Therefore, not only are self-control and impulsivity related to current BMI and weight, they are also predictive of weight status later in life.

Episodic Future Thinking

In the current literature, it is assumed that obese children have the ability to engage in self-control, but there is a "failure" to control an impulse or behavior.[46] Children prefer smaller immediate rewards over larger long-term rewards and are assumed to suffer from poor self-control. However, this assumption has limited the consideration of other potential causes of poor decision making in childhood. A decision can only be considered impulsive if the child is able to consider both an immediate and delayed reward option. If the child is not capable of considering and evaluating a future reward, then there is no true choice to be made, as the child is only capable of considering the immediate option. Previous literature has demonstrated that older age is associated with better self-control and delay immediate rewards in favor or larger future rewards.[23,24,47-49] Additionally, the ability to engage in future-oriented thinking is key to self-control and delaying gratification. Consequently, there may also be utility in evaluating the extent to which children who make short-sighted decisions are capable of engaging in future-oriented thinking. Perhaps children who engage in more "impulsive" behavior are less able to exhibit self-control for future rewards because they are also generally less able to consider future consequences. One emerging framework that could be used to evaluate this possibility is the evaluation of episodic future thinking (EFT).

Episodic future thinking, also known as episodic foresight, is the ability to think of the future based on the present moment or past experiences, and the role of one's self in these episodes or experiences.[50-53] EFT emerges in early childhood and develops into adolescence.[54-59] It can be differentiated from other constructs of decision making (e.g., delay discounting, delay of gratification) in that it is based on an individual's ability to access their episodic memory, think about a specific episode or moment in time, and their role in that episode.[60] It is the system that allows us to remember personally experienced events, and 'mentally time travel' in order to re-experience the event.[61-65] Once these events are accessed and re-experienced, they can be referenced in order to make future decisions.[62,65] Episodic memories provide a wealth of information that can be evaluated critically to create similar or completely novel future events.[52,66] Through this type of self-awareness, an individual may not only be able to remember previous experiences and their thoughts about that experience, but use these episodic memories to consider potential future experiences (i.e., episodic future thinking).[59,62,67] For example, when planning an upcoming vacation, and adult may consider a variety of factors such as how much spending money is needed. This type of decision would be made by thinking of how much they spent on previous trips, whether that amount was adequate, imagine themselves on their future trip, and then decide how much spending money they will need. In this way, the individual incorporates information about their past spending and planned future travel to make a decision.

Developmental Trajectory of EFT in Children

Previous studies demonstrate that EFT emerges between the ages of three and five[56,68-71] and continues along a developmental trajectory similar to self-control, continuing into middle childhood.[60,72] Older children exhibit a greater ability to make current decisions based on anticipated future needs (e.g., solving a puzzle problem, selecting needed toys), demonstrating the ability to draw on episodic information in order to prepare for future events.[70] For example, Suddendorf, Nielsen, & Von Gehlen (2011)[70] presented three and four-year old children with a locked box, which had a shaped lock that could only be unlocked with a specific corresponding key (e.g., cross, triangle). Some children were immediately presented with several keys and asked which key they wanted. For the other children, the box was then removed and the child was engaged in other activities for 15 minutes. Later the child was presented with the same key choices. All children were able to select the correct key when immediately presented with choices but only the older children were able to select the correct key after a delay, thus demonstrating better episodic future thinking. However, the researchers were concerned as to whether the four-year olds' performance was influenced by the immediacy of the future problem (i.e., unlocking the box). Therefore, these researchers conducted an additional study and re-evaluated four-year-olds. The same methodology was used as the previous study, but after the key was chosen, there was an additional five minute delay. Even with the additional delay, children were able to use their selected key to open a box.[69] This supports the theory that four-year-old children can consider delayed future goals when making immediate choices.

Another study examined EFT a broader age range (3-5 year olds).[71] In this study, children were asked to pick toys that they would need to play a later game. In this experiment, children are shown a game in which two players blow a small plastic ball across a table in an attempt to score a goal. One side of the table has a step that is taller than the other, such that the child is able to easily reach the table (red side). At the beginning of the game, the child was asked to play from the shorter (blue) side of the table, at which point the experimenter commented that the child could not reach the table and then demonstrated the use of a yellow step in order to help the child reach. The child then switched sides and was allowed to play the game from the red side. At the conclusion of the game, the child was told that they were going to play the game tomorrow, but that the child would be playing from the blue side of the table. They were then presented with several objects, one of which was a yellow step, and asked which items they would need. They were also asked to pick items that another child might need if they were to play the game from the blue side of the table. While three-year-old children did poorly five-year-old children did well. Further, four-year-old children performed better when selecting items for another child to use but more poorly when selecting an object for themselves. Thus, while EFT begins to emerge around age four, it appears to be more established by the age of five.

EFT and Memory

A central component to EFT is the access and use of episodic memory. In order to engage in EFT, individuals must first be able to remember past situations. If an individual is not able to reference a past event, then it is impossible for him/her to make future decisions based on those events. However, recent work has proposed that though early studies may reflect age differences in use of EFT, an alternative explanation is that children rely on episodic memory in order to succeed on the tasks. Therefore, where previous studies concluded that the age differences in EFT tasks were due to developmental differences in the ability to engage in EFT, there may be other explanations. One alternative explanation is that younger children may do more poorly on EFT tasks due to difficulties with memory for critical information and not as a result of an inability to use that information.[68] For example, in Suddendorf et al.'s [70] study with three and four-year old children, though four-year old children were the only age group to solve the puzzle-box at a significant level, both age groups performed more poorly when completing the task after a 15-minute delay. In another study including three, four, and five-year-old children,[68] children were presented with several goal-oriented tasks, similar in nature to the aforementioned tasks used by Atance and Metzoff[50,73] and Suddendorf et al.[70] After they made a decision they were asked why they chose their selected object (i.e., assessing for memory of the problem). Results initially showed improved EFT with increased age, but after controlling for the child's performance on a memory task, the age effects were no longer significant.

A similar study was conducted with three and four-year-old children, but focused solely on evaluating episodic memory.[74] In this study, children were presented with a locked box with a prize inside. The children returned 24-hours later and were presented with several items, one of which was a key. After this delay, only the older children chose the key more often than chance, but when the delay was reduced to 15 minutes, the three-year-olds also performed above chance. This shows that while both age groups possessed the semantic knowledge to solve the problem at a short delay, longer delays and thus less ability to recruit episodic memories may explain observed differences in EFT task performance. This is supported by subsequent work demonstrating that in children and adolescents, the ability to generate greater detail about semantic and episodic events is related to their ability to generate past and future events, and engage in EFT.[75] Therefore, while these recent studies do not necessarily challenge EFT as a construct, they do suggest that future studies should account for developmental differences in memory level when evaluating differences in EFT.

EFT and Motivational State

Though EFT has been documented in young children, these aforementioned studies all evaluated EFT using tasks considered to be "non-motivational." This refers to the concept of "cool" tasks of executive functioning, which only require reasoning about future events without a current motivational state.[76] Other studies have shown that when measuring EFT through the use of "hot" tasks (i.e., those with an affective or motivational component), young children are less able to successfully engage in EFT.

In a study conducted by Atance and Meltzoff,[50] three, four, and five-year old children were read several scenarios in which the individual in the story would likely feel some motivational state (e.g., walking down the street on a sunny day, thus feeling thirsty) and what item that individual would want to take with them (e.g., a bottle of water). Children from all three age groups selected the correct item based on a character's motivation state a majority of the time, but four and five-year olds did so significantly more often than three-year-olds. In a follow-up study, these researchers elicited a motivational state within children ages three to five and evaluated the effect on EFT.[73] At baseline, children were asked whether they wanted water or pretzels. Nearly all of the children chose pretzels. In the experimental condition, children were given pretzels to eat while completing an activity. At the end of the activity, some children were asked whether they wanted water or pretzels now, and the other children were asked whether they would want water or pretzels tomorrow (i.e., future orientation). For children in the "tomorrow" condition, this decision requires that the children first recognize their current motivational state and then make a decision based on a future state, while recognizing the brevity of their current state. Children across all ages did equally poorly on the task requiring EFT. Although pretzels were highly preferred during the baseline activity, children were unable to step out of their current motivational state (thirsty), to project they would want pretzels in the future. Thus, in preschool aged children, current desire has a large impact on predicted future desires and choices.

Given the discrepancy between EFT under "hot" and "cool" tasks shown by Atance and Metlzoff,[50,73] Mahy et al.[77] proposed that the ability to utilize EFT during actively motivated tasks develops more slowly than during "cool tasks". Therefore, they administered both "hot" and "cool" processing tasks to three and seven-year-old children. In the non-motivational task, children were given an object and then presented with several pictures where they could "use" that item (e.g., using sunglasses on a beach). For the motivational task, researchers administered the pretzel task developed by Atance and Meltzoff.[73] Seven-year-olds out-performed the three-year-olds on the non-motivational task, but not when the active motivational state was elicited. One of the main aspects of EFT pertains to an individual's ability to engage in "mental time travel" and make decisions about future states of mind that may differ from their current state.[73] During the motivational task, when children were asked to reference their current motivational state and then make decisions about future motivational states that differed from their current state (i.e., thirst vs. non-thirst), older children did not outperform the younger children. These results suggest that the ability to use EFT under a motivational state is not developed by age seven. However, this study is limited through its use of age as a categorical variable, and it does not evaluate potential trends in development that may have occurred between the two ages. Examining such trends could provide information about the nature of the development of EFT under motivational state and when it occurs.

Clinical Applications of EFT

Though much of the work in EFT has focused on its developmental trajectory, EFT may also inform our understanding of clinical populations including autism spectrum disorders,[78,79] anxiety, depression, and obesity.[53,80] One recent study has suggested that EFT be incorporated into models of learning, memory, and memory retrieval in understanding future-orientation in anxiety and mood disorders (e.g., depression).[80] Other studies have evaluated EFT as a potential contributor to clinical symptoms of autism spectrum disorders. Lind et al.[78] evaluated episodic memory and EFT in adults with autism spectrum disorder

(ASD) and found that individuals with ASD recalled fewer specific events and were less likely to use first-person perspective during retrieval. Thus, adults with ASD may not re-experience past events from the first-person perspective and are therefore less able to engage in EFT. Hanson and Atance[79] also evaluated EFT in children with ASD as compared to neuro-developmentally normal children, and found that children with ASD showed impairment in EFT. These studies suggest that through better understanding future-oriented thinking in affective disorders and neuro-developmental disorders such as autism spectrum disorders, more effective interventions targeting EFT can be developed.

EFT has also been evaluated in adult obesity.[51,53] In one study obese and normal-weight adults completed an EFT task, in which they were asked to generate positive future events that they were looking forward to over several variant periods of time (e.g., 1 day, 2 days, 1 week). After engaging in the EFT task, they completed a story-recall task and measures of impulsivity (i.e., delay discounting, and the behavioral inhibition and behavioral approach scale). This study found reduced self-reported impulsivity when engaged in EFT as compared to the story-recall task, regardless of obesity status. Additionally, the relationship between EFT and impulsivity was moderated by the drive subscale of the behavioral activation scale. Individuals who exhibited larger differences between the EFT task and story-recall task also had lower drive subscale scores. The authors suggested that for these individuals, EFT may have cued a "temporal re-orientation" in which participants were re-oriented to long-term goals, and their behavior is adjusted according to these goals. It may also be that in "re-orienting" the individuals to long term goals, their motivation was increased by thinking about their goals, making them more salient. Additionally, the authors also found that engaging in EFT was associated with reduced energy intake.[53] Therefore, having individuals purposefully engage in EFT may lead to improvements in obesogenic behavior, such as impulsivity and energy intake, and could therefore be beneficial to individuals in obesity interventions.

The Current Study

Though EFT has been targeted in adult obesity interventions,[51,53] no such work has yet been done in pediatric groups. Though there may be utility in including purposeful EFT as a means of reducing impulsivity in pediatric obesity, several interim questions need to be addressed before EFT is evaluated as an addition to pediatric obesity interventions. First, greater clarity is needed regarding the developmental trajectory of EFT in children. A majority of the current literature has been done on preschool aged children between the ages of three and five.[56,68-71] Though the capacity to engage in EFT seems to be developed by the age of five, it is not yet clear when children develop the ability to engage in EFT when under a motivational state. This is critical to pediatric obesity, as obese children have already been shown to exhibit less self-control than normal weight peers[29-34] and therefore be more prone to impulsive decision making when presented with an active motivational task. If the ability to engage in EFT during a motivational task is not developed until later in childhood, then there may be limited utility in the use of EFT as an intervention component in obese children. However, if EFT is demonstrated to continue to develop throughout childhood and if differences in EFT are related to BMI, then perhaps this would implicate EFT as an area that can be targeted and trained in young children. Second, few studies have evaluated the effect of memory on EFT.[68,70,74] Though this does not necessarily negate previous findings, it does suggest the need for additional study replication while concomitantly measuring and accounting for differences in memory. Third, though BMI in children is related to impulsivity, no studies exist in which EFT has been evaluated in relationship to BMI in children. Daniel et al.[51,53] demonstrated that EFT was effective in reducing impulsivity in both healthy weight and obese adults, but the relationship between EFT and BMI in children is unknown. Evaluating this relationship could have several implications. If EFT is not related to BMI, then it may be that impulsive decision making does not result from an inability to think about the future but rather from greater present based valuation. Conversely, if EFT is related to BMI in children, then this may represent one mechanism though which obesity develops, and may pave the way for interventions targeting EFT in pediatric obesity.

The current study attempts to address these current limitations in the following ways. First, this study evaluated EFT through the use of both non-motivated and motivated tasks and included children from a broader age range. Whereas previous literature has focused on preschool aged children, this study evaluated EFT in early elementary school aged children (ages 5 to 8). Not only does this extend the upper age range of the sample, recruiting children along this continuum allows for the use of age as a continuous variable. Secondly, this study included a standardized measure of memory, in addition to questions assessing episodic memory. This allowed researchers to assess and control for several different aspects of memory (e.g., working memory, delayed recall) when evaluating the relationship between EFT and other study measures. Finally, this study evaluated the relationship between EFT and BMI. Examining this relationship may provide a justification for evaluating the potential use of or targeting EFT as an intervention for pediatric obesity.

The following hypotheses and aims were evaluated through this study:

- Hypothesis 1: Controlling for performance on a memory task, IQ assessment, and impulsivity, older children will perform better on both motivational and non-motivational EFT tasks.
- Hypothesis 2: Controlling for age, IQ, and impulsivity, the better the memory of the child, the better their performance will be on EFT tasks.
- Hypothesis 3: Controlling for memory, age, and IQ, and impulsivity, children will perform better on non-motivated tasks than motivated tasks.
- Hypothesis 4: Controlling for memory, IQ, age, and impulsivity, higher BMI will be associated with poorer performance on EFT.

CHAPTER 2

METHODOLOGY

Participants

English-speaking children between the ages of five and eight and their parents were recruited from the metropolitan Kansas City area with fliers placed in local pediatric clinics. Additional recruitment strategies included university broadcast emails, social media (e.g., Facebook, Craigslist), word of mouth, and from those waiting to begin pediatric obesity treatment programs at both the University of Kansas Medical Center and at Children's Mercy Hospitals and Clinics. Children across the entire weight spectrum were recruited (healthy weight, overweight, obese) and efforts were made to recruit ethnic minorities, such as handing out fliers to families participating in obesity programs, which often included ethnic minorities. Children were excluded if English was not their primary language, if their parent did not speak English, or if the child had a developmental disability or psychiatric diagnosis per parental report (e.g., global developmental delay, intellectual disability, autism spectrum disorders, attention-deficit hyperactivity disorder, anxiety disorders, depression).

Procedures

The study protocol and procedures were approved by the University of Missouri-Kansas City's Social Sciences Institutional Review Board (IRB). Interested parents contacted the research staff member via telephone or email, and screening questions were asked by phone or email to determine study eligibility. Study visits were scheduled at the family's convenience and took place at the University of Missouri–Kansas City. The parent's name, address, and phone number and the child's name and eligibility information were stored in a password protected database in the event of that appointment changes were needed. Upon arrival for the session, the study was explained to both the child and his/her parent(s). Written informed consent was obtained from the parent and assent from the child before any study-related procedures were performed. The child was assigned a subject identification number and all study materials were de-identified. A master code sheet was maintained that included participants' identifying information paired with their ID. This was necessary in the event that a parent requests their child's information be removed from the study at any point in the future. This code was stored in a separate and locked filing cabinet to ensure confidentiality.

Household and demographic information were obtained from the child's parent, and anthropometric data were gathered from both the child and parent (e.g., height, weight). Parents were taken to a room with a one-way mirror, adjacent to one of the study rooms so that they could view the study session. Children completed study measures in one of two rooms: one room with a one-way mirror or a second room adjacent to where the parents were completing measures. The study tasks necessitated the use of both rooms. Children completed several self-report measures, a brief memory and intellectual assessment, and tasks evaluating episodic future thinking. Upon completion of the study (approximately 90-120 minutes), the participants were provided a $20 Target gift card. All information and data were kept in a locked file cabinet, inside a locked office, only accessible to research personnel, and electronic data were stored on a password-protected computer with an identification code.

The order of the tasks was not randomized, as one of the primary goals of this study was to account for memory when conducting EFT tasks. Therefore, a memory task was given first to reduce the potential effect of testing fatigue on these items, and an intelligence assessment and computerized impulsivity task were given second and third. Additionally, the four EFT tasks were randomized in blocks of three instead of four. This was done as one of the tasks described below (i.e., Snack Task) elicits a motivational state necessary for the next task (i.e., Juice Task). By the end of the Snack Task (in which children ate a salty snack of their choice) the children would be thirsty, and thus more motivated by the Juice Task. Therefore, these two tasks were presented in this order, though their relative placement to the other two tasks (i.e., first, second, third) was determined using a random number generator.

Measures

Demographic and Anthropometric Information

Demographic information was obtained from the child's parent, including birth date, sex, and ethnicity of the child, as well as household and parental information (e.g., sex, age, household income, education level, number of individuals in the home). While wearing light clothing and no shoes, child and parent height and weight were measured using a Befour MX805 Measurement Station and Column Scale. The child's standardized body mass index (BMI-z) was calculated based on the Center for Disease Control's (CDC) growth charts and by an available online calculator (http://stokes.chop.edu/web/zscore/). This BMI-z score accounts for both age and gender differences in weight-for-height that occur throughout child development. Parent BMI was calculated using CDC's BMI calculator available online at http://www.cdc.gov/healthyweight/assessing/bmi.

Child Self-Report Measures

Visual Analog Scale. Visual analog scales[81] use a 100 mm scale with the words "Not at all" anchored to the left-hand side and "Extremely" anchored to the right-hand side. Each scale includes one of the following questions, "How hungry do you feel right now?", "How thirsty do you feel right now?", "How full do you feel right now?", "How nauseated do you feel right now?", "How much stomach discomfort do you feel right now?", "How sick do you feel right now?" and "What is your energy level right now?". Each of these questions were read aloud and the child placed a vertical line along the scale continuum that best described their perceived feelings. The 100 mm VAS is similar to a Likert-type scale in that each 10 mm is equivalent to an index of 1. The first two items of the scale assessed for current hunger and thirst. This scale was given between the two motivational tasks described below as a manipulation check of motivational state. The two items that assessed for hunger and thirst are included in the analyses.

Smile Scale. A 7-choice (1 = liking the most, 7 = liking the least) smile scale developed to measure the consumer preferences of children was administered to children before consuming a snack or juice.[82] This was done to evaluate the child's desire for, and acceptability of the chosen snack food.

Parent Report Measures

The Eysenck I6 Junior (Youth) Questionnaire - Impulsiveness Subscale (EYIS). The impulsivity subscale of the EIJ is a widely used self-report questionnaire, developed in children between the ages of 7 and 15.[83] It consists of 23 yes-no questions about acting or speaking impulsively (e.g. "Do you mostly speak before thinking things out?"). Responses are recoded (0 = No, 1 = Yes), and the responses are summed to yield a total impulsivity score ranging from 0 to 23. A more recent study utilizing this measure has demonstrated good internal reliability in an 8 to 15 year-old, American population (α = .97).[84] Pilot testing with the age group in this study found that even with verbal administration, children had difficulty with the task. Therefore it was administered to parents and asked that they fill it out as they believed applicable to their child. As this measure was developed for a slightly older age group, and is meant for self-report, internal consistency was evaluated using Cronbach's alpha and demonstrated high reliability (α = .98).

Standardized Assessments

Kauffman Brief Intelligence Test-II (KBIT-2). The KBIT-2[85] is an individually administered test of intelligence for children as young as age 4 through adulthood (age 90). It was designed for brief assessment purposes such as screening, conducting periodic cognitive evaluations, and assessing cognitive functioning as a secondary consideration. It is used in research, clinical, educational, and vocational settings, takes approximately 15 minutes to administer, and provides estimates of crystallized (verbal) intelligence, fluid (non-verbal) intelligence, and a composite score (M = 100, SD = 15). The verbal scale is composed of two combined subtests measuring receptive vocabulary and general information (i.e., verbal knowledge), as well as comprehension, reasoning and vocabulary (i.e., riddles). The nonverbal scale uses a matrices subtest that evaluates the individual's ability to complete visual analogies and understand relationships. This assessment was developed in conjunction with the Kaufman Assessment Battery for Children Second Edition, and utilizes similar subtests as used on the full assessment. It has demonstrated good internal reliability (α = .93), and correlated well (r = .77) with Wechsler Intelligence Scale for Children-IV, thus showing concurrent validity.

Wide Range Assessment of Memory and Learning (WRAML)-2. The WRAML-2[86] is an individually administered, standardized, norm-referenced instrument for assessing memory ability. It was developed and validated for use in children from age 5 through adulthood (age 90). The WRAML-2 consists of measures of verbal memory, visual memory, and attention/concentration. These factors are combined to constitute a general memory index (*M* = 100, *SD* = 15). It also includes subtests for verbal working memory, symbolic working memory, delayed working memory, story memory recognition and delayed recall, verbal learning recognition and delayed recall, and design memory recognition. Additionally, the four core subtests (story memory, verbal learning, design memory, and picture memory) can be administered as a screening measure which takes approximately 20 minutes to administer. For this study, the four core subtests were administered as a screening measure. Overall, the measure has demonstrated good internal reliability (α = .93), exhibits good correlations with other memory scales such as Wechsler Memory Scale-III (*r* = 0.6) and the Tests of Memory and Learning Second Edition (*r* = 0.69), demonstrating good concurrent validity. The screening form also correlates highly with the overall general memory index (*r* = .91), indicating that it is a valid short measure of memory. Given the lower age range of the children participating in this study, raw scores were calculated for these subscales and are evaluated in relationship to EFT and other independent variables by including age as covariate.

Task of Executive Control (TEC). The TEC is a computerized test of executive control processes such as working memory and inhibitory control.[87] It has been used with children between 5 and 18 years of age, and consists for four sequential tasks for children between ages 5 and 7, and six tasks for children eight and above, with each task consisting of 100 timed-interval stimuli. Each task level increases in difficulty, requiring either increased working memory through the use of an n-back paradigm, and/or completion of a go-no go task (inhibition). For example, during the first task children are presented with toys and asked to sort them based on a given rule (i.e., zebras in a red box, all other toys in a blue box). In the second level, children complete the same task but an additional rule requiring an inhibitory response is added. For the third and fourth levels, the same tasks as level one and two are completed, but utilizing an n-back paradigm. Children were administered up through the first four levels. Additionally, if a child was unable to successfully complete the practice items for a given level, as determined by an error message and prompt from the computer program, the test was discontinued. In 5-7 year olds, the TEC has demonstrated good reliability for its factor scores (.75-.97), measurement of response accuracy (.68-.95), and response time (.71-96). Convergent validity is based on correlations between the TEC and the inhibitory subscale of the Behavior Rating Inventory of Executive Functioning.[88] The TEC was administered as a measure of impulse control; thus, analyses in this study evaluate both the number of incorrect items and commission errors (i.e., button pressed in the presence of an inhibitory cue). Higher errors due to incorrect responses and instances of disinhibited responses are indicative of greater impulsivity during the task; thus incorrect items and errors of commission were included as independent measures of impulsivity from the TEC. Additionally, given the broader age range of the study sample, and the desire to evaluate performance differences across the age range as opposed to comparing individuals against norms, raw scores are evaluated.

Episodic Future Thinking

Non-motivational Tasks of EFT

Picture Book Task. In this task (as described in Atance & Meltzoff,[50] and Mahy et al.[77]), children were presented with a series of 6 photographs (Picture Task 1) with the following scenes: (1) desert-sandy landscape with a sunny blue sky, (2) stream-forest image with a rocky brook, (3) road-trees/shrubs next to a dirt road with a sunny blue sky, (4) snowmountains and valley surrounded by trees, (5) mountain-two grassy mountains with a valley, and (6) waterfall-bordered by grass. Children were asked to describe what they saw in the photograph and then to imagine themselves in that particular scene. For example, after showing the road picture the experimenter said, “What do you see in this picture?” After recording the responses, the experimenter then asked, “Okay, let’s pretend that you are going to walk down this dirt road. It’s time to get ready to go! Which one of these items do you want to take with you?” The experimenter then presented a photo of three items, in this example sunglasses, soap, and a mirror, with the correct item being sunglasses. Children selected their desired item. Children were then asked to explain why they chose a particular item, and their responses were recorded. Choice responses were coded as a 0 or 1 for correct or incorrect (with a potential total of 6). The children’s verbal responses were then coded on a 0 to 2 scale, based on how future-oriented their answers were, with a 0 for no answer or an irrelevant answer, 1 for an answer based on a simple association without reference to the future (e.g., there is a sun), and 2 for an answer that made reference to the future by the use a self-referent (e.g., I) or corresponding state term (e.g., hurt, bright, shine). Responses were coded independently by two researchers, and discrepancies were discussed and resolved on an item by item basis. This scale results in a total item-choice score (0 to 6 points) and total explanation score (0 to 12 points). Children that chose the incorrect item but provided an explanation qualifying for two points were given credit for the item-choice question.

Children were also administered two additional original picture-book tasks, developed specifically for this study. In the second task (Picture Task 2) children were presented with 6 pictures featuring social situations (i.e., hospital room, birthday party, cafeteria, movie theater, swimming pull, and a soccer game). Again, children described what they saw in the photo, selected an item they would bring, and some children provided verbal explanations of their choices. In a third task (Picture Task 3) 6 more pictures were presented (i.e., beach, campground, school, garden, gym, and church) and children were asked to provide a free response of what they would take with them and why. These items were scored on a 0 to 2 scale, just as was done in the first task. Items in which children did not answer or were unable to provide a response were scored as a zero.

Thus, across these tasks two types of scores were obtained: the number of correct items (Task 1 and 2) and EFT score (Task 1, 2, and 3). Whereas the number of correct items is intended to be used as a measure of how difficult the items are, the verbal explanations are meant to measure the degree of EFT exhibited by the child. Therefore, two children may choose the same and correct item (e.g., sunglasses for the desert scene) and both be given credit, but one child may explain their choice as “because it looks bright,” whereas the other child states “to keep the sun out of my eyes.” Coding the EFT responses in this manner provides information as to the degree that the child used EFT to make their decision that cannot be ascertained from only whether a correct choice was made.

Smiley Face Task. Children were brought to one room and the experimenter told them that they would receive a smiley face drawing. [68] The experimenter retrieved the drawing and expressed dismay at the fact that one of the eyes has fallen off, “Oh no! I have this smiley face to give you, but one of the eyes has fallen off, so I can’t give it to you! Oh well.” Children were then led to another room but were told that the smiley face drawing and the eye would remain in the first room. After looking at different pictures for 10-12 minutes, the children were told that it was time to return to the first room. They were presented with several objects (e.g., scissors, an eraser, a shovel, and glue, [with glue being the correct option]) and asked the choice question ("Which one of these do you want?"). Children received a score of 1 if they chose the correct item. The children were also asked why they chose that item (e.g., "Why did you choose the X?") and their responses were recorded. If the child referenced the smiley face in the other room or a specific action to be carried out (e.g., "to glue the eye") then 1 point was recorded. Children that chose an incorrect item but provided an explanation that is judged to be future-oriented were given credit for the item-choice question and explanation question. For children that answered incorrectly or provided no response, a memory question was asked (e.g., "What's on the table in the other room?"). Children that referenced the smiley face or some part of the smiley face received 1 point. Children were then taken to the first room and re-presented with the smiley face. Those that chose the correct item were given that item and a smiley face. Those that chose the incorrect item were re-presented with the options in person, while being asked "Which one of these can you use to fix this picture?" This question was asked to determine whether children were able to select the correct item in the present, determining whether their failure to select the correct item was due to a lack of problem-solving ability. For this task, the explanation question (e.g., "Why did you choose the X?") was used as an indicator of engagement in EFT.

Motivational Tasks of EFT

Snack Task. The snack task was based on the pretzel task developed by Atance and Meltzoff,[73] but was modified to include multiple snack options that are gluten-free/nut-free/dairy-free, in case of dietary allergies. After asking parents about potential food allergies, children were given their choice of gluten-free pretzels, cheese crackers, or potato chips for "snack time." Children were provided with 30g of the snack and told to eat as many as they would like. A story lasting approximately 10-12 minutes was then read to the child. Children were presented with several story book options, all of approximately the same number and detail of illustrations, and written for the developmental level appropriate to the child's age (see Appendix A). For younger children, two stories were selected and read to meet the 10-12 minute time interval. During initial task development, children were required to consume at least a third (10g) of the snack, to ensure the development of a motivated condition (i.e., thirst). For the purposes of this study, the relationship between the amount of snack and other motivation checks were evaluated, and all children were included in the analyses. After the story, the snack was removed from the table and the children were asked questions about what they would prefer to consume the next day. For example, the experimenter said, "Let's pretend that you're going to come back here tomorrow, and we're going to play a game with these bouncy balls. We're not going to play with the bouncy balls now, we are going to play with them tomorrow. What would you like to have for the bouncy ball game tomorrow: some (snack), or some water to drink?" The order of presentation of the two options was randomized. The amount of their snack eaten and whether they chose water or their snack in response to the tomorrow question were recorded. Children who chose the snack were given one point.

Juice Task. In the juice task,[68] children were told that the experimenter wanted to give them some juice (8 fluid ounces). The children chose what kind of juice they wanted (e.g., apple, grape, or orange) and it was poured into a cup that was glued to the center of a tray. The children were told that the glass is stuck (e.g., "Oh no! The glass is stuck to the board, so you can't drink it!"). Children were then led to another room but were told that the cup with the juice would remain in the first room. After engaging in a variety of distracting tasks for 10-12 minutes (i.e., playing with toys, looking at pictures, drawing), the children were told that it was time to return to the first room. They were presented with several objects (straw, ruler, paint brush, pencil) that they could select to take to the previous room (with the straw as the correct answer) and asked the choice-item question ("Which one of these do you want?"). Children were awarded 1point if they chose the correct item. The children were then asked why they chose that item (e.g., "Why did you choose X?") and their responses were recorded. If the child made a future-oriented response (e.g., choosing the ruler "because it might make the cup unstuck") credit was assigned for both the choice-item question and explanation question. Also, children that answered incorrectly or provided no response were asked a memory-question (e.g., "What's on the table in the other room?"). Children that referenced the juice, cup, or tray were given 1 point. Children were then taken to the first room and re-presented the cup full of juice. Those that chose the correct item (straw) were given that item access to the juice. Those that chose the incorrect item were re-presented with the options in person, while being asked "Which one of these can you get the juice?" This question was asked to determine whether children are able to select the correct item in the present, determining whether their failure to select the correct item was due to a lack of problem-solving ability. For this task, the explanation question (e.g., "Why did you choose the X?") was used as an indicator of engagement in EFT.

Statistical Analyses

Preliminary analyses were conducted to evaluate demographic variables and independent variables. Normality was assessed using the Z-score of the skewness statistic (Z_{skew}), where values greater than 1.96 were noted to be potentially problematic for parametric analyses.[89] Potential collinearity between the demographic variables and independent variables (i.e., IQ, memory, impulsivity) was investigated using Pearson's and point-biserial correlations.

Preliminary analyses on the EFT tasks also were conducted by evaluating average scores, standard deviations, and skewness. Independent sample t-tests and a repeated-measures ANOVA were used to evaluate potential confounds of missing data for the Picture Task. Chi-square analyses, ANOVA, and Pearson's correlations were used to evaluate potential confounds (i.e., snack/juice choice, snack consumption, hunger and thirst ratings). Additionally, as an intermediate analysis, Pearson's correlations and point-biserial correlations were used to evaluate relationships between independent variables and the EFT scores without controlling for other variables.

Hypotheses were evaluated using multiple linear regressions, multiple logistic regressions, and Pearson chi-square analyses. Multiple linear regression was used to determine whether independent variables (i.e., age, memory, BMIz) were related to the Picture Task 3 total score. Additionally, multiple logistic regression was used to predict the child's response on the Snack task, Juice task, and Smiley task. For the analysis of differences between motivational states, in addition to chi-square analyses, repeated-measures ANOVA were conducted on the dichotomous paired dependent variables. As dichotomous variables, the average of each variable represents the percentage of children who responded correctly to an item. Therefore, in comparing two average scores, a repeated-measures provided a comparison of the percentage of children who demonstrated the use of EFT on each question, while controlling for other variables.

To account for error due to multiple comparisons, a step-up false discovery rate procedure was selected to control the expected proportion of incorrectly rejected null hypotheses. Methods of false discovery rate are less stringent than corrections of family wise error (e.g., Bonferroni).[90] Given the sample size of this study, the Benjamini-Hochberg method was selected.

Power Analysis

An a-priori power analysis indicated that with the significance criterion set at $\alpha = 0.05$ for a two-tailed point biserial correlation, large effects,[68,73,77] and desired power of $\beta = 0.8$, a sample size of 26 children is sufficient, with planned sample sizes of 29 for Pearson's correlations, and 34 for a multivariate linear regression with four predictors.[91] With an obtained sample size of 57 children, this study was adequately powered to detect large effect sizes. With an obtained sample size of 57 children, this study was adequately powered to detect large effect sizes for these planned analyses. Given the total number of children included in the multiple regression analyses ($n = 44$), significance criterion, and effect size (as determined by the correlation matrices of the predictors and the predictors and dependent variables), achieved power for the multiple regression analyses ranged from .35 to .54. Thus, while adequate sample size was obtained for univariate analyses, this study may be underpowered to detect effects using multivariate methods.

CHAPTER 3

RESULTS

Preliminary Analyses

Demographics

Fifty-seven children, each with a parent, participated in the study. Ages ranged 4.03 to 8.92 years of age (M_{age} = 6.55, *SD* = 1.57, Z_{skew} = -.316), with marginally more males (*n* = 35, 61%) than females, $X^2(1) = 2.965$, *p* = .085. Children presented with an average BMI z-score (BMIz) of 0.822 (*SD* = 1.03, *Zskew* = .043) and an average BMI percentile (BMI%) of 71.43 (*SD* = 24.03, *Zskew* = -3.101). Most children were accompanied by their mother (*n* = 51, 89.5%) and participated in the study along with a sibling (*n* = 30, 52.6%); all parent-child dyads are included in the study. Additional demographic information is presented in Table 1 and Table 2. Child demographics were analyzed for covariability in order to determine if planned analyses needed to account for additional covariates (i.e., gender, BMIz). A Pearson's correlation showed child age was not related to BMIz (*r* = -.108, *p* = .524) and a point-biserial correlation found no relationship between gender and either age (r_{pb} = .061, p = .653) or BMIz (r_{pb} = -.172, *p* = .201). Thus, age effects are evaluated independently of gender and BMIz.

Other Independent Variables

In order to determine the suitability of the planned analyses and the uses of parametric vs. non-parametric statistical methods, other independent variables were evaluated and are reported, including skewness statistics. Initial distributions for the KBIT Non-Verbal subscale, WRAML Story subscale, TEC 1-back inhibited incorrect items were

Table 1 – Child Demographics

		Mean	SD	N	%
Age		6.55	1.57	57	
Gender					
	Male			35	61.4
	Female			22	38.6
Race					
	White			48	84.2
	Black			1	1.8
	Hispanic			2	3.5
	Multiracial			2	3.5
	Native American			1	1.2
BMIz		.82	1.04	57	
BMI%		71.44	24.04	57	
Weight Category					
	Normal Weight			36	63.2
	Overweight			13	22.8
	Obese			8	14.0
Grade					
	Pre-kindergarten			15	26.32
	Kindergarten			10	17.54
	1st Grade			3	5.26
	2nd Grade			15	26.32
	3rd Grade			14	24.56

Table 2 – Parent and Household Demographics

	Mean	SD	N	%
Parent Age	38.08	5.02	42	
Parent Gender – Female			38	90.5
Parent Race				
White			39	92.9
Black			1	2.4
Native American			1	2.4
Parent BMI	25.58	4.70	39	
Parent Weight Category				
Normal			23	54.8
Overweight			8	19.0
Obese			8	19.0
Household Income				
< $50,000			2	6.25
50,000 – 99,000			7	21.88
100,000 – 149,000			8	25.00
150,000 – 199,000			10	31.25
>199,000			5	15.63
Highest Education				
Associate’s			1	2.4
Bachelor’s			15	35.7
Master’s			10	23.8
Doctorate/Professional			14	33.3

significantly skewed ($Z_{\text{skew}} > 1.96$) (see Table 3 for additional descriptive information). Visual inspection of the data distribution (via histograms and scatter plots) identified single outliers for both the KBIT Non-verbal and WRAML Story subscales. Subsequent removal of these outliers resulted in skew statistics within acceptable limits. Thus because the Total scale scores for both the WRAML and KBIT scores were within normal limits, and the removal of outliers yielded approximately normal distributions, no corrections were applied. Additionally, one-sample *t*-tests were conducted to evaluate the cognitive functioning of the sample as a whole. The Total KBIT score ($M_{Total} = 107.84$) was significantly greater than the average score of 100 [$t_{Total}(56) = 3.509$, $p = .001$], demonstrating that the children in this study may have higher cognitive functioning than the average child.

To determine whether to consider additional covariates when isolating the effect of independent variables of interests, the relationships between child age, gender, and BMIz were evaluated concerning other independent variables (i.e., KBIT, WRAML Total Score and subscales, TEC Incorrect and Commission scores, and EYIS). Neither child gender nor BMIz were related to any of the total or subscale scores for these measures ($p > .05$), suggesting that it is generally not necessary to model interaction effects between these demographic variables and other covariates. However, age was significantly correlated with the Total score for the WRAML ($r = .630$, $p < .001$), as well as the Story ($r = .534$, $p < .001$), Design ($r = .678$, $p < .001$), Verbal ($r = .326$, $p = .014$), and Picture subscales ($r = .430$, $p < .001$). Given that raw scores were utilized for the WRAML in order to allow for a broader age range outside the provided norms, this was expected. Subsequently, age is included as a covariate in analyses in which the WRAML Total score is included. A trend toward significance was found between age and incorrect responses on the no inhibit 0-back task of

Table 3 – Scale Scores

	Mean	SD	N	Z_{skew}
KBIT				
Verbal	110.39	15.10	57	<.051
Non-Verbal	102.77	19.55	57	-.313*
Total	107.84	16.87	57	.639
WRAML				
Story	19.70	14.76	56	2.78
Design	16.18	10.23	56	1.93
Verbal	21.30	7.61	56	-0.95
Picture	20.91	7.72	56	-0.12
Total	78.09	32.90	56	1.00
TEC				
0-Back No Inhibit Incorrect	17.61	9.62	49	1.92
1-Back No Inhibit Incorrect	17.26	8.04	31	1.50
0-Back Inhibit Incorrect	15.17	8.27	47	0.63
1-Back Inhibit Incorrect*	14.12	5.02	24	.286
1-Back Inhibit Commission	7.43	4.20	47	-0.69
1-Back Inhibit Commission	5.12	3.79	25	1.44
EYIS	10.77	5.37	54	.412

*Outlying data point removed.

the TEC (r = -.261, p = .070), which may warrant future consideration, but was not accounted for in these analyses.

EFT Task Descriptive Information

As one of the goals of this study was to evaluate EFT across a broader age range, and extend beyond preschool age (i.e., 3-5 years) which has been reported in the literature to date, descriptive information was first evaluated within each task independently.

Non-Motivational Tasks: Picture Book and Smiley Face

Picture Book Task. The picture book tasks consisted of three separate presentations of pictures. This included six items (Picture Task 1) that were developed by Atance and Meltzoff,[50] and two additional six-item sets (Picture Task 2 and 3) that were developed by the research team. For Picture Task 1 and 2, children were presented pictures and asked to choose which item they would take with them. On Picture Task 1, children selected the correct future-based item an average of 5.56 times (SD = .88, n = 57) and 5.39 times for Picture Task 2 (SD = 1.05, n = 57), with no difference between the two groupings, $t(56)$ = 1.603, p = .115. After selecting the item, children were asked to provide an explanation for the choice, and responses were coded for their degree of EFT.

Data Collection Errors and Evaluations. Due to protocol deviation and therefore error in data collection, fewer children were appropriately administered the follow-up questions for the first two tasks (n = 17). Of those that were administered the items, 5.59 points out of 12 potential were awarded on Picture Task 1 (range = 0 to 11; SD = 2.85; Z_{skew} = .060) and 5.65 on Picture Task 2 (range = 1 to 11; SD = 2.74; Z_{skew} = .162). Again, no difference was found between the number of points scored for the first and second task, $t(16)$ = -.164, p = .872.

All children were appropriately administered Picture Task 3 and averaged 5.67/12 points (range = 0 to 12; *SD* = 2.66; Z_{skew} = -.348). Repeated-measures ANOVA with a Greenhouse-Geisser correction for violations of Mauchly's test of sphericity (Mauchly's W = .661, *p* = .045) was conducted. Results found that for children who were correctly administered all three tasks (n = 17), marginal differences were found in the number of points scored between the three sets of items (M_1 = 5.59, M_2 = 5.63, M_3 = 6.82), $F(1.49, 23.89)$ = 3.51, *p* = .064. Evaluating post-hoc comparisons was inconclusive, as pairwise comparisons between the three groups found no significant differences ($p > .1$). Thus, we were unable to determine whether the new items were any more or less difficult than the original items.

<u>*Determination of Data to be Included.*</u> Due to these limitations, additional analyses were conducted to determine whether the data obtained in EFT Tasks 1 and 2 could be analyzed. First, independent samples *t*-tests determined that age did not differ between those that were administered all follow-up questions and those who were not, $t(55)$ = -.481, *p* = .632. Second, this was done by comparing EFT Task 3 scores from children who were correctly administered follow-up queries on all of the items to those who were only administered queries on Task 3 items. If the scores did not differ, then it could be assumed that the EFT scores on Task 1 and 2 of the 17 children included in the analyses may be representative of those with missing data. However, differences between the two groups would suggest that Tasks 1 and 2 scores for children who were administered all 18 items may also differ from those children who were only queried with follow-up questions for Task 3. Independent samples *t*-tests found that children who were only asked follow-up questions on the last task scored lower (*M* = 5.17, *SD* = 2.77, *n* = 40) than children who were administered all of the follow-up questions (*M* = 6.82, *SD* = 2.00, *n* = 17), $t(55)$ = -2.213, *p* = .031).

Subsequently, it cannot be assumed that the data obtained on Tasks 1 and 2 from the 17 children in the subsample generalizes to all of the children in the sample; therefore, EFT data from Tasks 1 and 2 were omitted from the analyses. EFT data from Picture Task 3 remained in the study and are included in the analyses.

Smiley Face Task. For the smiley face task, children were provided a smiley face which required problem solving (i.e., a missing eye), and then they were distracted for 10-12 minutes in a room separate from the smiley face. When they were provided a set of items and allowed to select one to take to the first room, 44.6% (n = 25) children correctly chose the glue as the item. In order to determine whether children utilized EFT when choosing their item, they were asked to explain their item selection. When asked to explain why children chose their item, only 28.6% of the entire sample (n = 16) provided a response that related to the smiley face. Therefore, only 28.6% of the children can be said to have made a decision based on episodic future thought.

Children who chose an incorrect item were asked follow-up questions about 1) whether they remembered what was on the table in the previous room, and 2) after being shown what was on the table, what they would use to solve the problem. These two questions assessed potential confounds of memory and knowledge of the problem on the children's ability to engage in EFT for this task. Children who initially reported choosing their item in order repair the smiley face were automatically awarded credit on the memory and problem solving items of the task and were not asked follow-up questions. Of the children (n = 40) who did not provide a future based explanation, 60% (n = 24) were not able to correctly answer the memory question (i.e., "What is on the table in the other room?"). However, when presented with the smiley face and associated items, 97.5% (n = 39) correctly chose the glue.

This demonstrates that children were able to solve the problem presented. Thus, difficulties answering either of the first two questions (i.e., "What item do you want to take with you" and "Why?") can be attributed more to a poor memory for the smiley face and problem than to an inability or lack of knowledge on how to solve the problem.

Motivational EFT Tasks

Snack Task. All children (n = 57) successfully completed the snack task. At the beginning of the task, each child chose their preferred snack.

Snack Choice Evaluation. A Pearson's chi-square test was conducted to determine whether children were more likely to choose one type of snack over another, which would indicate the need for additional evaluation of motivational differences associated with snack choice. For instance, if a vast majority of the children chose potato chips, then additional analyses would be necessary to rule out any differential effects of task motivation between the three snack choices. Children were equally likely to choose potato chips (n = 22, 38.6%), pretzels (n = 21, 36.8%), or cheese crackers (n = 14, 24.6%), $X^2(2) = 2.000$, $p = .368$. In order to determine whether it may be necessary to account for snack preference or liking, the average snack rating was evaluated over all and between the three snack choices. Children reported a high degree of liking for their chosen snack (M = 2.00; Md = 2; SD = 1.11, Z_{skew} = 2.52), and food ratings did not differ by snack choice [$F(2,54) = 1.025$, $p = .366$], demonstrating that it was not necessary to account for snack differences throughout the EFT analyses.

Manipulation Evaluations. In addition to snack preference, other manipulation checks for thirst motivation were evaluated. First, the amount of snack consumed was evaluated. Children consumed and average of 18.98 grams (out of 30 grams) of their snack (SD = 9.83;

Z_{skew} = .984), and reported being somewhat hungry after consuming their snack (M = 48.80; SD = 35.93; Z_{skew} = .185) and a mild degree of thirst (*M* = 67.82; *SD* = 32.48; Z_{skew} = -2.01). Second, thirst and hunger ratings were evaluated in relation to their snack consumption to determine if these motivational states were related to the amount of snack consumed. Neither hunger ratings (r = .161, p = .236) nor thirst ratings (r = .036, p = .793) were associated with the amount of snack consumed. Thus children that consumed a greater amount of snack did not appear to be more satiated or thirsty than those that consumed less of the offered snack. Third, as the primary aim of providing a snack was to motivate the children toward thirst, thirst and hunger ratings were compared using an independent samples *t*-test. Children generally reported greater thirst (*M* = 67.82; *SD* = 32.48) than hunger (*M* = 48.80; *SD* = 35.93) [$t(55)$ = -2.993, p = .004], suggesting that children were more motivated toward thirst than hunger at the end of snack consumption, regardless of the amount of snack consumed. Thus, it could not be determined whether child motivation for thirst was a result of the snack task or whether another unaccounted variable (e.g., previously consumed food or liquids) explained the child's motivational state. However, because children expressed greater thirst than hunger, all children were included in the analyses, regardless of the amount of snack consumed.

EFT and Motivational State. To evaluate EFT in the event of a motivational state (i.e., thirst), children were asked whether they would choose to have (1) more of their snack or (2) water if they were to return to the study the following day. When choosing between water and a snack, 68.4% (n = 39) chose water, suggesting that a majority of children were not engaging in episodic future thinking when motivated by thirst. Point-biserial correlations were conducted to determine whether this choice was related to snack consumption and reported motivational state. These analyses found that the likelihood of choosing water versus a snack was not associated with snack consumption (r_{pb} = -.156, *p* = .248) or reported hunger (r_{pb} = -.107, p = .435), but was moderately associated with reported thirst (*rpb* = -.247, *p* = .067). This suggests that the ability to engage in EFT may be impaired by an internal motivational state.

Juice Task. All children (*n* = 57) also completed the juice task. Similar to the beginning of the snack task, each child chose their preferred juice.

Juice Choice Evaluation. Pearson's chi-square test was conducted to determine whether children were more likely to choose one type of juice over another, which would indicate the need for additional evaluation of motivation differences associated with juice choice. Children were equally likely to choose apple juice (*n* = 22, 39.3%), grape juice (*n* = 22, 39.3%), and orange juice (*n* = 12, 24.6%), $X^2(2) = 3.571$, *p* = .168. One child reported no thirst and declined juice. Though motivation could not be evaluated for this child, the child did complete the EFT task and was included in subsequent analyses. Additionally, in order to determine whether it may be necessary to account for juice preference or liking, the average juice rating was evaluated overall and between the juice choices. Children reported a high degree of liking for their chosen juice (*M* = 1.890; *Md* = 2; SD = 1.021, Z_{skew} = 3.03), and drink ratings did not differ by juice choice, [$F(2,54) = .067$, *p* = .935], demonstrating that it was not necessary to account for differences in juice selection throughout the EFT analyses.

Initial EFT Assessment. For the juice task, children were provided their selected juice in a cup that was "stuck" to a plate, and they were then distracted for 10-12 minutes in a room separate from the juice. When they were provided a set of items and allowed to select one to take to the first room, approximately half of children (49.1%, *n* = 28) correctly chose the straw as an item they would take with them. In order to determine whether children utilized EFT when choosing their item, they were asked to explain their item selection. When asked to explain why they chose their item, 45.6% (n = 26) provided a response that related to the juice, indicating that nearly half of the children demonstrated the use of EFT in the selection of their chosen item.

EFT Follow-up Queries – Memory and Problem Solving. Children who chose an incorrect item were asked follow-up questions about 1) whether they remembered what was on the table in the previous room, and 2) after being shown what was on the table, what they would use to solve the problem. These two questions assessed potential confounds of memory and knowledge of the problem on the children's ability to engage in EFT for this task. Children who initially reported choosing their item in order to access the juice were automatically awarded credit on the memory and problem solving items of the task and were not asked follow-up questions. Of the children (n = 29) who did not provide a future based explanation, 38.7% (n = 12) were not able to correctly answer the memory question (i.e., "What is on the table in the other room?"). However, when taken to the room and shown the cup of juice on the table, and 77.4% (n = 24) chose the straw when the items were re-presented. This demonstrates that the children were able to solve the problem presented. Thus, difficulties answering either of the first two questions (i.e., "What item do you want to take with you" and "Why?") are attributed more to a poor memory for the cup of juice to an inability or lack of knowledge on how to solve the problem.

Memory and EFT. Because one study purpose was to elicit a motivational sate of thirst for the juice task by administering the snack task beforehand, point-biserial correlations were conducted to determine whether memory for the juice glass or providing an EFT response were related to any of the manipulation checks previously discussed. However, neither memory for the juice glass nor use of EFT were associated with snack consumption, reported hunger, or reported thirst ($p < .1$), suggesting that memory for the problem and EFT use were not related to hunger or thirst.

Overall, these results demonstrate that children were able to solve the problem and that difficulties answering either of the first two questions were not due to uncertainty or difficulty in selecting which item would allow them to access the juice. This supports the idea that memory difficulties rather than ability to use EFT may influence the results. Additionally, though children were more motivated by thirst than hunger, independent measures of motivation were not related to the child's performance. This would suggest that internal motivational state did not affect EFT.

Hypothesis Testing

Covariates and Independent Variables

Before evaluating each hypothesis, a series of Pearson's and Point-biserial correlations were conducted to evaluate the relationship between each independent variable and EFT, without controlling for covariates (see Table 4). This was done to evaluate univariate relationships before conducting multivariate analyses and inform on whether each independent variable should be included in multivariate analyses. These preliminary analyses found that several of the independent variables were related to EFT tasks, without controlling for other variables. First, age was significantly related to poorer EFT on the snack task (r_{pb} = -.302, p = .023) such that older children were more likely to select water than a snack. Also, there was a trend toward a relationship between better EFT on the Picture Task 3 (r = .226, p = .092), suggesting that older children demonstrated the use of EFT when providing

Table 4 – Correlation Coefficients of Independent Variables with EFT

	Picture Task 3 Total		Smiley Explanation		Snack Response		Juice Explanation	
	r (n)	P	r_{pb} (n)	p	r_{pb} (n)	p	r_{pb} (n)	p
Age	0.226 (57)	0.092	-0.097 (56)	0.479	-0.302 (57)	0.023	0.148 (57)	0.271
KBIT Total	0.217 (57)	0.105	.301 (56)	0.024	0.112 (57)	0.405	0.158 (57)	0.240
WRAML Total	0.214 (56)	0.113	-1.65 (55)	0.827	-0.097 (56)	0.477	0.12 (56)	0.377
EYIS Total	**-.387 (56)**	**0.004**	0.096 (55)	0.494	-0.153 (56)	0.269	.314 (56)	0.021
TEC 0-Back No Inhibit Incorrect	-.303 (49)	0.035	-0.229 (48)	0.117	-0.053 (49)	0.717	-0.19 (49)	0.191
TEC 1-Back No Inhibit Incorrect	-0.067 (31)	0.722	-0.197 (31)	0.288	-0.135 (31)	0.470	-0.292 (31)	0.111
TEC 0-Back Inhibit Incorrect	-0.254 (47)	0.085	**-.414 (47)**	**0.004**	-0.036 (47)	0.810	-0.15 (47)	0.313
TEC 1-Back Inhibit Incorrect	-0.262 (25)	0.206	-.453 (25)	0.023	-0.078 (25)	0.710	-.451 (25)	0.024
TEC 0-Back Inhibit Commission	-0.131 (47)	0.381	**-.418 (47)**	**0.003**	-0.048 (47)	0.748	-.295 (47)	0.044
TEC 1-Back Inhibit Commission	-0.242 (25)	0.244	-0.284 (25)	0.169	-0.094 (25)	0.655	-.496 (25)	0.012
BMIz Score	-.008 (57)	.950	.023 (56)	0.865	-.042 (57)	0.754	-.154 (57)	0.252

*Bolded values are significant after Benjamini-Hochberg correction free-response explanations. Second, a brief measure of IQ was also related EFT on the Smiley Face task (r_{pb} = .301, p = .025) such that children with higher cognitive functioning were more likely to demonstrate EFT when describing why they chose their item. Third, several measures of impulsivity were significantly correlated with EFT. Greater parent reported impulsivity based on the EYIS was related to poorer performance on the Picture Book Task 3 (r = -.387, p = .004, n = 54), but better EFT on the Juice Task (r = .314, p = .021, n = 54), though the latter did not remain once multiple test correction was applied. Several of the TEC measures were also significantly related to EFT. The number of incorrect items on the inhibitory 0-back tasks (0-back InhibInc) was associated poorer EFT on the Smiley Task (r_{pb} = -.414, p = .004, n = 47), and inhibitory 0-back commissions (0-back InhibCom) also was related to EFT on the Smiley Task (r_{pb} = -.418, p = .003, n = 47). Additional correlations indicating that children with more impulsivity performed worse on these tasks are presented in Table 4, with original significance values, and indication of which correlations survived false discovery rate.

Due to the significant and marginally significant relationships between the independent variables and measures of EFT, when attempting to evaluate the effect of a single variable on EFT, it was necessary to control for the other independent variables, including the EYIS Total, TEC 0-back inhibit incorrect responses, and TEC 0-back inhibit commission errors. Though the WRAML and KBIT were not significantly correlated with the EFT variables in bivariate analyses, they were included as covariates to further test and evaluate the hypotheses of this study, as this was part of the planned analyses.

Hypothesis 1: Controlling for performance on a memory task, IQ assessment, and impulsivity, older children will perform better on both motivational and non-motivational EFT tasks.

To evaluate the relationship between age and EFT, linear and logistic regressions were conducted to isolate the unique contribution of age. Because age is significantly related to the WRAML total score, and age is the primary independent variable of interest for this hypothesis, covariates including KBIT, EYIS, WRAML Total, TEC 0-back inhibit incorrect responses and commission errors, and the interaction term between the WRAML and age were included in the analysis. The interaction term was created as the product of mean-centered WRAML and age.

When predicting the total score for Picture Task 3, the model marginally significantly predicted the total number of points scored for Task 3 [$F(7,36) = 2.110$, $p = .067$, $R^2 = .291$, Adjusted $R^2 = .153$] and the EYIS score was significantly associated with the total score ($\beta = -.423$, $p = .008$), suggesting that parent-reported impulsivity was independently related to the degree or quality of EFT responses made by the children. For the remaining tasks with bivariate outcomes (i.e., Smiley task, Snack task, and Juice task), logistic regressions were conducted to evaluate the unique relationship between age and EFT. When predicting responses on the Smiley task, the overall model was not significant with whether children chose water or a snack [$X^2(7) = 7.035$, $p = .425$, Nagelkerke $R^2 = .225$], and age was not significantly predictive ($p = .681$). Similar results were found when predicting whether children demonstrated EFT based reasoning on the Smiley task [$X^2(7) = 11.705$, $p = .111$, Nagelkerke $R^2 = .338$] and the Juice task, $X^2(7) = 12.193$, $p = .094$, Nagelkerke $R^2 = .323$]. However, EYIS score ($p = .053$) and 0-back inhibited commission errors ($p = .036$) were marginally and significantly predictive of whether or not children provided an EFT-based response (Table 5).

Though univariate analyses found a marginal relationship between age and use of EFT when explaining an item choice (Picture Task 3), and a significant relationship with whether children chose water or a snack (Snack Task), once other variables were accounted for these relationships did not hold.

Post-hoc Analyses. It is possible that these null results are due to a lack of variability in the EFT task due to ceiling effects. Because 77% (n =44) of the sample was older than 5.0 years of age, it is possible that older children performed better than younger children, but that ability level for these tasks max out at young age. To evaluate potential ceiling effects associated with age, additional analyses were conducted to determine whether the oldest children (i.e., greater than or equal to 8.0 years of age; n = 14) differed from the youngest children (i.e., less than 5.0 years of age; n = 13) in the study. An independent samples t-test found that on the Picture Task, 8-year-olds (M = 6.71) demonstrated marginally better EFT than 4-year-olds (M = 4.84), $t(25) = -1.766$, $p = .090$. Additionally, Pearson's chi-square analyses found that 4-year-old children (53.8%, n = 7) were more likely than 8-year-old children (14.3%, n = 2) to provide a future-based response on the snack task, $X^2(1) = 4.747$, $p = .029$. No differences were found between the two groups on the juice task [$X^2(1) = 1.801$, $p = .180$] or the smiley task, $X^2(1) = 1.192$, $p = .275$. Additionally, since the inclusion of 8-year-olds in this age range was a novel addition, Pearson's and point-biserial correlations were repeated with children under the age of eight. However, age was not related to any of the EFT tasks ($p > .05$). These results suggest that the lack of age effects in the study are not associated with ceiling effects.

Table 5 – Regressions of Age and Memory on to EFT

	Picture Task 3 Total[1]		Smiley Explanation[2]		Snack Response[3]		Juice Explanation[4]	
	β	*p*	*Exp(B)*	*p*	*Exp(B)*	*p*	*Exp(B)*	*p*
Constant		.097	.034	.424	.023	.407	.007	.210
KBIT – Total	.036	.847	1.044	.151	1.105	.618	1.105	.558
EYIS	-.423	.008	1.107	.206	.922	.299	1.154	.053
0-back InhibInc	-.126	.632	.888	.209	.991	.922	1.124	.172
0-back InhibCom	.017	.946	.964	.834	1.165	.395	.704	.036
WRAML Total	.172	.428	.993	.665	1.031	.138	1.003	.861
Age by WRAML	-.115	.477	.999	.911	.976	.114	.998	.843
Age	.046	.807	.862	.681	.830	.630	1.405	.325

[1] R^2 = .291, Adjusted R^2 = .153 (p = .067); [2]Nagelkerke R^2 = .338 (p = .111); [3] Nagelkerke R^2 = .225 (p = .425); [4]Nagelkerke R^2 = .323 (p = .094)

Hypothesis 2: Controlling for age, IQ, and impulsivity, the better the memory of the child, the better their performance will be on EFT tasks

In addition to evaluating the independent effects of age in Hypothesis 1, the predictive ability of memory can be ascertained from the previously discussed regressions (Table 5). However, across the four analyses WRAML Total was not associated with any of the four EFT tasks (i.e., Picture 3 Total, Smiley Response, Snack Selection, and Juice Response) ($p > .1$). Additionally, as previously referenced, of children who either did not select the correct item for the juice task or did not exhibit EFT in their response, 61.3% (n = 19) were able to remember the cup on the table in the previous room when prompted. This percentage was lower when administering the Smiley task (41.5%, n = 17).

Though memory as measured by the WRAML was not related to any of the EFT tasks, evaluating the memory questions on the Juice and Smiley tasks suggest that motivation may have an effect on memory. Thus, difficulties with EFT on these tasks maybe associated with poor memory for the target items as opposed to an inability to engage in EFT overall, and this relationship may be impacted by the child's motivation to remember the task or problem.

Hypothesis 3: Controlling for memory, age, and IQ, and impulsivity, children will perform better on non-motivated tasks than motivated tasks.

To test the hypothesis that children would exhibit better EFT on a non-motivational task than a motivational task, two separate analyses were conducted. First, a Pearson's chi-square analyses found that children were marginally more likely to provide a future-based response on the juice task (44.6%, n = 25) than the smiley face task (28.6%, n = 16), $X^2(1)$ =

2.890, $p = .089$, suggesting that children may exhibit better EFT when motivated to do so. To control for confounding variables, a repeated-measures ANCOVA was conducted, inputting whether children referenced the smiley face and whether they referenced the juice as dependent variables, and controlling for age, memory, IQ, and impulsivity. Average scores for the Juice task ($M = .50$, $n = 44$) and the Smiley task ($M = .27$) represent the percentage of children who responded correctly (i.e., exhibited EFT) on each task. Therefore, in comparing the average of each variable (though both are scored on a 0-1 scale), the current analysis is one method to evaluate percentage differences between the two questions. Results found that after controlling for the other variables, there was no difference between the Juice task and Smiley task [$F(1, 37) = .996$, $p = .706$, Wilk's Lambda = .996], suggesting that EFT did not differ with motivational state after controlling for other variables.

Post-hoc Analyses. Additional analyses were conducted to determine if any of the other independent variables were associated with EFT and task motivation. Specifically, previously discussed correlations between impulsivity (TEC) and EFT (see Table 4) were statistically compared using an online calculator[92] that converts the correlation coefficients to z-scores and compares them based on Cohen (1983).[93] When comparing correlation coefficients between the number of incorrect items on the TEC 0-back inhibit task with both the Smiley Task and Juice Task, a one-tailed z-test found that the correlation was higher between impulsivity and EFT for the non-motivational task than the motivational task, $z = -1.35$, $p = .073$. However, when the relationship between the number of commission errors on the TEC 0-back inhibit task and both the Smiley Task and Juice Task were evaluated, there was no significant difference, $z = -.662$, $p = .254$. These results suggest that impulsivity may be more related to EFT under non-motivational conditions.

Hypothesis 4: Controlling for memory, IQ, age, and impulsivity, higher BMI will be associated with poorer performance on EFT

To evaluate the relationship between child BMIz and EFT, a Pearson's correlation was conducted between BMIz and Picture Task 3 Total (r = -.061, p = .650), and point-biseral correlations were conducted between BMIz and responses on the snack (r_{pb} = -.078, p = .564), juice (r_{pb} = -.171, p = .205), and smiley task (r_{pb} = -.008, p = .955). These results found no bivariate relationship between child BMIz and their performance on the EFT tasks. Additionally, linear regression and logistic regressions were also conducted to evaluate the unique contribution due to BMIz, controlling for age, IQ, memory, and impulsivity. Though univariate correlations were non-significant, these tests were conducted in the event of potential suppressor effects from other variables (e.g., impulsivity).

When predicting the total score for Picture Task 3, the model marginally significantly predicted the total number of points scored for Task 3 [F(7,36) = 2.110, p = .081, R^2 = .281, Adjusted R^2 = .141], but BMIz was not significant (p = .972). For the remaining tasks with bivariate outcomes (i.e., Smiley task, Snack task, and Juice task), three logistic regressions were conducted to evaluate the unique relationship between BMIz and EFT. First, independent variables were regressed onto the child's Smiley Task response, and the overall model was marginally significant predicting whether children demonstrated EFT [X^2(7) = 12.356, p = .089, Nagelkerke R^2 = .355], but BMIz was not significant (β = .005, p = .972). Second, when predicting whether children chose a snack or water, the overall model was not significant, X^2(7) = 3.467, p = .839, Nagelkerke R^2 = .115. Third, when all independent variables were regressed onto the child's Juice Task response, the overall model was significant [$X^2(7) = 14.618$, $p = .041$, Nagelkerke $R^2 = .377$], but BMIz was not a significant predictor ($\beta = .567$, $p = .218$). All regression weights and exponents are provided in Table 6. These results show that BMIz was not related to a child's ability to engage in EFT.

Table 6 – Regressions of BMIz on to EFT

	Picture Task 3 Total[1]		Smiley Explanation[2]		Snack Response[3]		Juice Explanation[4]	
	β	*p*	*Exp(B)*	*p*	*Exp(B)*	*p*	*Exp(B)*	*p*
Constant		.075	.018	.351	.348	.810	.008	.218
BMIz	.005	.972	1.340	.424	.825	.611	.567	.137
Age	.045	.815	.925	.831	.743	.443	1.451	.313
EYIS	-.419	.009	1.093	.279	.930	.336	1.179	.032
WRAML	.124	.555	.989	.518	1.015	.397	1.008	.635
KBIT	.022	.907	1.048	.126	1.009	.772	1.008	.745
0-back Inhibit Inc	-.148	.575	.887	.212	.973	.768	1.172	.100
0-back Inhibit Com	.009	.972	.956	.799	1.129	.483	.649	.028

[1]R^2 = .281, Adjusted R^2 = .141 (p = .081); [2]Nagelkerke R^2 = .355 (p = .089); [3]Nagelkerke R^2 = .115 (p = .115); [4]Nagelkerke R^2 = .377 (p = .041)

CHAPTER 4

DISCUSSION

With the rise in pediatric obesity,[1,2] it is imperative we gain a better understanding of mechanisms related to the development and maintenance of a chronic energy imbalance that leads to excess weight gain. Research has evaluated the role of cognitive processes responsible for self-control behaviors,[17] such as directed attention, attention regulation, and inhibition,[18-20] and their relationships to pediatric obesity.[29-34,38-45] Additional research has been done on moment-by-moment self-regulation for the benefit of future-based decisions and rewards (e.g., delay of gratification, delay discounting). [36,37,40] Thus, not only is there interest in children's ability to exhibit more temporally present impulse control but also how this relates to potential future decisions and particular situations. Along this vein, this study evaluated one potential mechanism of decision making in children, Episodic Future Thinking (EFT). EFT includes the ability of children to make future-based decisions, as a function of their ability to both access their episodic memory *and* perceive a future-based sense of "self" to that specific memory.[50-53] This study evaluated several different aspects of EFT and sought to expand the literature by examining the following hypotheses.

Episodic Future Thinking and Age

Early literature demonstrated that EFT develops between the ages of three and five[56,68-71] and continues to develop into middle childhood. [54-57,59,60,72] However, much of the work on EFT has focused on its initial development in preschool aged children, and less has been done with older children. Therefore, the first aim of the study was to evaluate EFT across a broader age range through the recruitment of children between the ages of four and eight. We successfully recruited children as young as 4.03 years up through 8.92 years.

Though there is an argument that a child toward the upper end of the age range of this study may be more accurately classified as a nine-year-old, as this study was concerned with evaluating age as a continuum, the upper age limit is not as important as the continuity of the age distribution.

Based on previous work showing that EFT improves with age,[69-71] it was hypothesized that older children would exhibit better EFT after controlling for other independent variables. Results found that older children demonstrated only marginally better EFT responses when asked to choose an item and explain their choice (i.e., Picture Book Task, Smiley Task, and Juice Task). Conversely, older children were also more likely to select water over a snack when presented with both future options, which demonstrates poorer EFT and contradicts our hypotheses and previous literature. In a previous study using the Snack Task in three to five year olds,[73] when presented with this choice in a future sense, children across all ages did poorly. Later work by Mahy et al.[77] found that seven-year-olds performed better than three-year-olds. We therefore expected that a positive age effect would be found in the older sample of this study. However, our results did not support that assertion and instead found that older children did more poorly on the snack task. Generally though, age was not related to any EFT measure after a family-wise error correction, and it was non-predictive of EFT after accounting for other independent variables (i.e., memory, impulsivity, intelligence).

There are a couple of potential explanations for this result. One is that though age was not related to thirst or juice preference ratings, we did not assess for the child's preference of water. Thus, it is possible that older children happened to prefer water to the snack and selected the option that was more motivating regardless of when the options are presented.

Future studies could account for this by assessing the relative reinforcing value of the child's chosen snack to water to determine if this difference is related to preference ratings.[94,95] Another explanation could be that older children in this study were more impulsive than younger children. However, the preliminary analyses of this study do not support this assessment. Last, it is also possible that this task is not appropriate for a sample of older children, and that another unaccounted for variable is responsible for the age difference. For instance, similar to our discussion above, though children expressed liking for their snack before consumption perhaps their liking of the snack decreased after consumption. All three of the snack choices were gluten-free, including two (i.e., pretzels and cheese crackers) which are not as commonly consumed in children. Thus, age differences could be attributed to coincidental food selectivity in older children in this sample. However, if this were the case, it would be contradictory to previous literature that has demonstrated that food selectivity decreases with age.[96]

Follow-Up Analyses and Future Hypotheses. Several supplemental analyses were conducted to further evaluate the relationships between EFT and age, and potential reasons for the null results in the primary analyses. One additional hypothesis was that the null result was due to the age range of the sample and that the lack of relationship between age and EFT may have been due to the lack of variability in EFT scores in older children, resulting in ceiling effects. First, scatter plots for age and EFT were examined and there was no visual evidence of ceiling effects. Additional analyses also were conducted comparing the oldest to the youngest children, and results were consistent with those obtained from the whole sample analyses. Correlations also were repeated with children under the age of eight, removing the oldest age group, but no age effects were found. Though the results do not support ceiling effects as a plausible explanation, it may warrant additional consideration given that these tasks were developed for a preschool age group, and the majority of this study consists of children over the age of five (77.2%, n = 44). However, a recent study by Nigro et al.[97] utilized the picture book task in a sample of four, five, six, and seven-year-old children, with a total sample of 160 children and demonstrated a continued improvement on the picture-book task across the age groups.

Another explanation for potential ceiling effects is that the picture book task presented in this study may have been uniformly easier than those presented by Nigro et al. and developed by Atance.[50,61] Given that children who completed all three picture-book tasks (n = 17) did better on Task 3 than Task 1 or 2, this is worth further consideration. The task consisted of six items developed specifically for this study and children were allowed to select and justify any item they would take, as opposed to making a forced choice. Thus, children may have selected items with which they were more familiar, rendering the task easier, resulting in better EFT responses. Additionally, the pictures presented to them were likely from scenes that were familiar (e.g., school, swimming pool, camping) and that they had previous experience with, although familiarity ratings were not taken. A better autobiographical reference for these scenes may have allowed for better EFT use.[98] Future studies should assess children's familiarity with new images and their experience level with specific scenarios. Given the difficulties with data collection for this aspect of EFT, it is difficult to make definitive generalizations from study results.

Episodic Future Thinking and Memory

A second aim for this study was to evaluate the role that memory plays in EFT. Under a framework of EFT, an individual must be able remember and reference past episodes or events in order to make future-oriented decisions based on those events. It has been proposed that this may be the case for younger children.[68] Thus this study evaluated whether children with better memory capabilities performed better on EFT tasks after accounting for other independent variables. Memory was evaluated through the use of a standardized general measure (i.e., the WRAML) as well as by asking specific episodic memory questions on the EFT tasks.

Results showed no significant relationship between the Total WRAML score and EFT task performance. This was true for both bivariate correlations without covariates and regression analyses. However, when evaluating specific episodic memory questions, of the children who did not provide an EFT response on either the Smiley Task or the Juice Task, approximately half of the incorrect responses can be attributed to a poor item-specific memory. Together, these results suggest that general memory is not related to EFT performance, but that specific autobiographical memory (i.e., for a specific item on the table in the previous room) may be related to EFT performance. This is supported by recent findings that better autobiographical memory is associated with better EFT in children and adolescents,[75] and that explicit item and context specific memories are related to performance on the Smiley and Juice Tasks.[99] Thus, while general memory was not related to EFT, the results of this study are consistent with previous literature in which item and context specific memory effects were found.

Episodic Future Thinking and Motivational State

Another goal of this study was to evaluate differences in EFT associated with motivational state. This paradigm was originally introduced by Atance and Meltzoff[73] to evaluate how an individual's current desires or "motivational state" affects their ability to think ahead. They likened this scenario to grocery shopping while on an empty stomach and proposed that non-motivated tasks involved "cool" executive functioning, which would be easier to elicit EFT. Conversely, during motivated tasks executive functioning would be inhibited by a "hot" or affective motivational state,[76] and children would rely too much on their current motivational state in these tasks. In previous research utilizing a motivational paradigm in preschool children, all children exhibited difficulty with the EFT task.[73] In another study with 7 and 3-year-old children, 7-year-old children outperformed 3-year-olds on a non-motivational task but not a motivational task.[77] It was therefore hypothesized that children would perform better on non-motivated tasks than motivated tasks.

The current study found that when comparing EFT responses for the Smiley Tasks (non-motivational) and Juice Tasks (motivational), children were marginally more likely to exhibit EFT for the Juice Task. The initial effect (before conducting multivariate analyses) was in the opposite direction expected from previous literature. Instead, children seemed to exhibit slightly better EFT responses when they were motivated by a task (i.e., post snack and pre-juice). Considering the broad interest and developing research in memory and EFT, potential differences in memory for the target item warrants consideration. In fact, this study also found children had a better memory for the cup on the table than they did the smiley face (i.e., 61% vs. 42%). This suggests that as far as memory is concerned, children may exhibit better memory if they are motivated by a task, and subsequently may be more able to engage in EFT.

Impulsivity and Motivational Tasks. Consistent with theory regarding the role of executive functioning processes in EFT[76] supplemental evaluations were conducted to determine potential relationships between other independent variables and task motivation.

Indeed, significant correlations were found between impulsivity measures on the Tasks of Executive Control (TEC) (i.e., 0-back inhibit incorrect and 1-back inhibit commission errors) and EFT performance on the Smiley Task, such that higher impulsivity was associated with poorer performance (see Table 4). However, no such relationship was found with the Juice Task. When engaged in a non-motivational task, more impulsive children had greater difficulty, but when engaged in a motivational task, difficulty was more equal among all of the children. It is possible that more impulsive children have a time perspective that is more present-focused.[100] This would suggest that impulsivity may not just be the inability to delay reward or exhibit self-control, but that is also a function of their ability to think ahead and anticipate the future. Thus, impulsivity and EFT would be related. Therefore, future studies should continue to evaluate the relationship between impulsivity and EFT, and additional studies should consider controlling for this construct.

Despite these findings, over generalizations regarding the comparison of impulsivity and across motivational to non-motivational tasks should be cautioned. First, the relationship between EFT and impulsivity was non-significant when evaluated using multivariate analyses, suggesting that impulsivity may interact with another variable and does not uniquely predict EFT. Additionally, medium strength correlations (see Table 4) were found between impulsivity and the Juice Task as well, but were non-significant after multiple test correction. Thus, it may be that with a larger sample, there would be no difference between the Snack and Juice task, and thus no interaction between motivation and impulsivity in episodic future thinking task performance.

Episodic Future Thinking and Weight Status

Because of previous studies implicating the usefulness of evaluating EFT in clinical populations,[51,78-80] the last aim of the study was to evaluate whether child weight status (i.e., Body Mass Index z-score; BMIz) is associated with EFT after controlling for other variables. Some research has shown that EFT can be trained in obese adults,[51] but initial weight-related associations with EFT were not reported in that study. Results from the current study found no association between BMIz and EFT tasks, either in bivariate analyses or multivariate regressions. Additionally, though it would be expected that impulsivity would be related to BMIz, only one significant association was found with the TEC inhibit 1-back number of incorrect items (r = .408, p = .048), which did not survive correction for family-wise error.

Despite these null findings, this study may be underpowered to investigate effects related to BMIz, as less than half of the sample (36.8%, n = 21) was overweight or obese, and only eight of those were obese. While the intent of this study was to recruit children across the weight continuum, the relationship between EFT and weight status may be better evaluated by investigating differences between discrete weight classes. Potential BMIz effects may not become apparent until higher levels of child overweight, necessitating a higher proportion of children toward the upper range of BMIz, which this study does not adequately represent. This is supported by the lack of relationship between impulsivity and BMIz,[31] suggesting that the attributes that may be expected in a child sample with obesity were not present in this study.

Strengths and Limitations

There are several strengths to this study. First, this study was able to successfully recruit a broader age range than other studies[50,68,73] which allowed for analyses expanding on the preschool age range and extending into school-aged children. Second, this study was able to administer a wider range of tasks and standardized measures, including the Kauffman Brief Intelligence Test-2, the screening form of the Wide Range Assessment of Memory and Learning-2, and Tasks of Executive Conrol. Whereas other studies have evaluated EFT and another variable, such as some form of memory,[75,97,99] and executive functioning,[101] this study is the first to evaluate these constructs at the same time and through multiple measures. In addition to utilizing memory questions from previous studies,[73,77] additional standardized measures of memory were administered, along with standardized measures of intelligence and impulsivity. By collecting such measures, this study allowed for the multiple constructs to be evaluated concurrently, as opposed to separately. Third, this study recruited a sample of overweight and obese children that is similar to what would be expected from the general population.[1,5] Last, this study provides information relevant to recent areas of question within the field of EFT, such as a more thorough evaluation of memory and exploring relationships with a pediatric population. Additionally, this study attempts to expand the literature by investigating relationships that have been evaluated with EFT (i.e., impulsivity).

Limitations. Despite the strengths of this project, there are several limitations that inhibit the generalization of results and conclusiveness of the findings. First, though the study was able to recruit a broader age range, the sample was demographically homogeneous. The sample lacked the variability in weight status needed to determine effects due to child weight, and was predominantly Caucasian and non-hispanic (84%). Additionally, 72% of parents reported an annual income greater than $100,000 and 60% of households had at least one parent with a graduate degree (Masters or Doctorate). Thus, the sample is not representative of what would be expected from the demographics of the greater

Kansas City area. Given that the cognitive functioning of children in this study was above average, the representativeness of the sample are questionable, limiting generalizability

Second, there may also be limitations due to the design of the study and measurement selection. While one goal of the study was to evaluate broad based memory in relation to EFT, more recent literature suggests that more specific types of memory (i.e., episodic, autobiographical) should be evaluated. Though sections of the WRAML may be considered episodic (e.g., Story Recall), it examines broader memory types as well (e.g., visual memory, visual recognition, verbal recall) and provides a more overarching general snapshot of memory abilities. Thus the type of memory assessment selected for this study may have limited use in the EFT literature. Also, in an attempt to evaluate a broader age range and connect to findings from previous literature, children as young as 4-years of age were recruited to the study. However, few screening measures of memory and standardized impulsivity exist for 4-year-old children. Because another goal of this study was to evaluate EFT across the age range, it was desired to utilize measures that could be compared across age ranges. Therefore, this study utilized standardized measures of memory and impulsivity, but analyzed raw scores instead of standard scores. Also, to be consistent with previous literature, tasks were used in this study that were originally developed for younger children; thus, it is possible that this study lacks variability in EFT responses, resulting in potential ceiling effects, and contributing to null findings, though this does not seem likely given the conducted analyses.

Third this study may be underpowered for the number of independent variables and the effects found in the study. Though the original proposal was powered for large effects, based on previous literature, the effects observed in this study were only small to moderate.

Additionally, based on the number of analyses conducted to evaluate relationships between these independent variables, several analyses were initially significant but did not survive correction for family-wise-error.

Last, there were significant data collection errors on one of the primary outcomes. This resulted in usable date from only one of the three tasks (Task 3) for the Picture Book Task. Additionally, Task 3 was an experimental task developed for this study and has not been evaluated in other studies. Therefore, the task cannot be compared to previous literature, nor can it be evaluated for validation purposes. Thus, though analyses with this task are presented in this study, results should be interpreted with caution and used to inform future studies, rather than to draw definitive conclusions.

Summary and Future Directions

In summary, this study found no relationship between general memory, age and EFT performance. It also suggests that it is not necessary to account for cognitive functioning in a sample of average children, but that child impulsivity may be a factor. Though no significant relationship between child weight status and EFT was found, the documented relationship between impulsivity and pediatric obesity provides further question about EFTs role in the development and maintenance of obesity in children. Thus, the current study provides future directions for several areas of EFT study, as well as methodological considerations.

Regarding methodological considerations, the sample in this study was fairly homogeneous. Sampling from a broader population base would allow for better generalization of results and would likely also provide more variability in EFT tasks. Though no specific group was targeted for this study, recruitment through university broadcast emails and word-of-mouth recruitment resulted in a high proportion of children from upper-middle class families, and is not likely representative of an average child.

Additionally, this study intended to recruit a significant number of overweight and obese children, and it was anticipated that due to the higher percentage of obese children in the general population these numbers would be reflected in recruitment for this study. However, due to a limited number of overweight and obese children initially participating in the study, it was necessary to modify recruitment strategies mid-way through the study to begin targeting overweight and obese children. Given the proportion of overweight and obese children in this study, and the lack of relationship between BMIz and constructs which have demonstrated a previous relationship (i.e., impulsivity), additional research is needed evaluating the relationship between weight status and EFT in pediatric obesity. Such studies should specifically recruit obese and overweight children and evaluate different forms of impulsivity and self-control.

The lack of relationship between memory and EFT in this study provides support for the role of specific memory types, such as autobiographical,[75] prospective,[97] and episodic[102] memory in EFT, as opposed to general memory. Additionally, a large percentage of children in this study did not provide an EFT response on the Smiley and Juice Tasks due to poor memory for the item, providing further support for the role of item specific or episodic memory in EFT. This suggests that future research should continue to evaluate the role of memory in EFT, but it may not be necessary to evaluate general memory.

As for cognitive functioning, it should be noted that a majority of these EFT tasks awarded credit on an occurrence/non-occurrence basis. For tasks such as the Picture Book Task, where verbal responses are coded according to the quality of EFT, it is possible that higher verbal ability could be associated with a better expression of EFT. This may be one area for continued research, particularly with older children and adolescents.

Finally, future research in episodic future thinking should include measures of impulsivity. As EFT involves future-based decisions, it is important to determine whether relatively less ability to engage in EFT is due to a conscious choice for a more immediate consequence. In the past few years, the literature has recognized and expressed the importance of investigating whether EFT effects may be explained by memory differences.[99] This study demonstrates that future studies should also begin to consider the relationship between impulsivity and EFT. Further, evaluating how EFT develops alongside executive processes such as self-control and impulsivity will provide future directions for the role that EFT and EFT training[51,53] may have in clinical populations, such as pediatric obesity.

APPENDIX A

List of Books Available to Children

Pete the Cat: A Pet for Pete – James Dean
Digger the Dinosaur – Rebecca Kai Dotlich
Danny and the Dinosaur – Syd Hoff
Pinkalicious and the Perfect Present – Victoria Kann
Sammy the Seal – Syd Hoff
A Bargain for Frances – Russell Hoban
Amelia Bedelia Goes Camping – Peggy Parish
Owl at Home – Arnold Lobel

APPENDIX B

Picture Book Task

1. Sample Items:

"What do you see in this picture?" Record response.

"Ok! Let's pretend that it's time to take a bath! You are about to get in the bath-tub. Which one of these items do you want to take with you?" Then show them the corresponding picture showing several objects.

Sample 1:

____

Choice: ___________ EFT SCORE: 0 1 2

NOTE: If the child does not choose the correct item, model the correct choice, such as by saying, "I would take the soap, because I will need the soap to get clean."

"Great! Now, look at this picture. What do you see?" [Record response]. Now, let's pretend that it is time to go to bed. Which one of these things do you want to take with you?"

Sample 2:

____

Choice: ___________ EFT SCORE: 0 1 2

NOTE: If the child does not choose the correct item, model the correct choice, such as by saying, "I would take the pillow so I would have something soft to put my head on."

2. Next, you will present children with a series of 18 photographs, 12 in the first group and 6 in the second group. Follow the same format of presenting the picture, asking for response.

"Ok! Let's pretend that you are going to across this desert. It's time to get ready to go! Which one of these items do you want to take with you?"

Picture 1:

____

Choice: ___________ EFT SCORE: 0 1 2

AFTER THE FIRST QUESTION: "Now look at this picture. Tell me what you see." (Record response) "Ok, now lets pretend _________. NOW, look at these things. Which one of these would you want to take with you?"

"Let's pretend that you are going to walk across these rocks…"

Picture 2:

____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend that you are going to walk down the long dirt road…"

Picture 3:

____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to this snowy forest…"

Picture 4:

____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to hike across these mountains…"

Picture 5:

____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to see these waterfalls…"

Picture 6:

____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to visit a friend in the hospital…"

Picture 7: ____
__

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to a friend's birthday party…"

Picture 8: ____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you and your class are going to the cafeteria…"

Picture 9: ____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to the movies…"

Picture 10: ____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to the swimming pool…"

Picture 11: ____

Choice: ___________ EFT SCORE: 0 1 2

"Let's pretend you are going to a play soccer…"

Picture 12: ____

Choice: ___________ EFT SCORE: 0 1 2

3. BEFORE PICTURE 13: "Now we are going to something a little different. I am going to show you a picture. Then I want you to tell me what you would want to take with you and WHY you would want to take that item."

"Let's pretend you are going to the beach…"
Picture 13: Item: ___________________

Why?:

____
____

"Let's pretend you are going camping in the forest…"
Picture 14: Item: ____________________
Why?:

____
____

"Let's pretend you are on your way to school…"
Picture 15: Item: ____________________
Why?:

____
____

"Let's pretend you are planting a garden…"
Picture 16: Item: ____________________
Why?:

____
____

"Let's pretend it is time for PE or recess at school…"
Picture 17: Item: ____________________
Why?:

____
____

"Let's pretend you are going to church…"
Picture 18: Item: ____________________
Why?:

____
____

APPENDIX C

Smiley Face

1. Tell the child: “Hey! I have something that I want to give you!” Retrieve the smiley face.

   “Oh no! I have this smiley face to give you, but one of the eyes has fallen off! (Show them the eye). Now I can’t give it to you. Oh, well. Let’s go do something else then.”

2. Take child to the other room and play with toys of choice for 10-15 mins.

3. After playing with toys, say to the child:

   “Hey! It’s time to go back to the other room now! First, I have some other things to show you (Pull out **Scissors, Eraser, Shovel, and Glue**). Which one of these do you want to take with you?”
   CHOICE RESPONSE: ____________ 0 1

4. “Why did you choose the ___________?” RECORD ANSWER:

____

____

   EXPLANATION SCORING: 0 1

5. (For children who choose incorrect item or don’t respond) – “What is on the table in the other room?”

   MEMORY RESPONSE: _______________
   MEMORY SCORING: 0 1

6. Take children back to the room. If the child guessed glue, give them the glue and let them glue the eye. For children that did not pick the glue, present the items again:

   “Which one of these can you use to fix the smiley face?”
   CHOICE: _____________
   PROBLEM SOLVING SCORING: 0 1

APPENDIX D

Snack and Juice Task

1. Ask the child what they like best: cheese crackers, pretzels, or potato chips?

2. Provide a **<u>SMILEY FACE SCALE</u>**, asking them how much they like the snack.

3. Provide the child 30oz of snack in a bowl

4. Read one of the stories (approx 10-15 mins)

5. After the story, say to the child:

   "Ok! Now let's do something different!" – Remove their snack, putting the remainder into the plastic bag.
   "But first, I have a question for you. Let's pretend that you are going to come back here tomorrow and we are going to play a game with these bouncy balls. [Show the toy] We're not going to play with them now, we're going to play with them tomorrow. What would you like to have for the bouncy-ball game tomorrow? Some _______ or some _______?"

   RESPONSE: ____________
   REMAINING SNACK: ____________

6. Give **<u>VISUAL ANALOG SCALE</u>**

7. Ask the child what juice they like best: apple, grape, or orange

8. Provide a **<u>SMILEY FACE SCALE</u>**, asking them how much they like the juice.

9. Pour juice to the blue line of the cup that is glued to the plate. "Attempt" to hand the cup to the child and say:

"Oh no! The glass is stuck to the plate, so you can't drink it! Well, I'm sorry. Let's go do something else, but the cup and juice will stay here."

10. Take child to the other room and play with toys of choice for 10-15 mins.

11. After playing with toys, say to the child:

"Hey! It's time to go back to the other room now! First, I have some other things to show you (Pull out **Ruler, Straw, Paintbrush, Pencil**). Which one of these do you want to take with you?"
CHOICE RESPONSE: ____________ 0 1

12. "Why did you choose the ___________?" RECORD ANSWER:

____

____

EXPLANATION SCORING: 0 1

13. (For children who choose incorrect item or don't respond) – "What is on the table in the other room?"

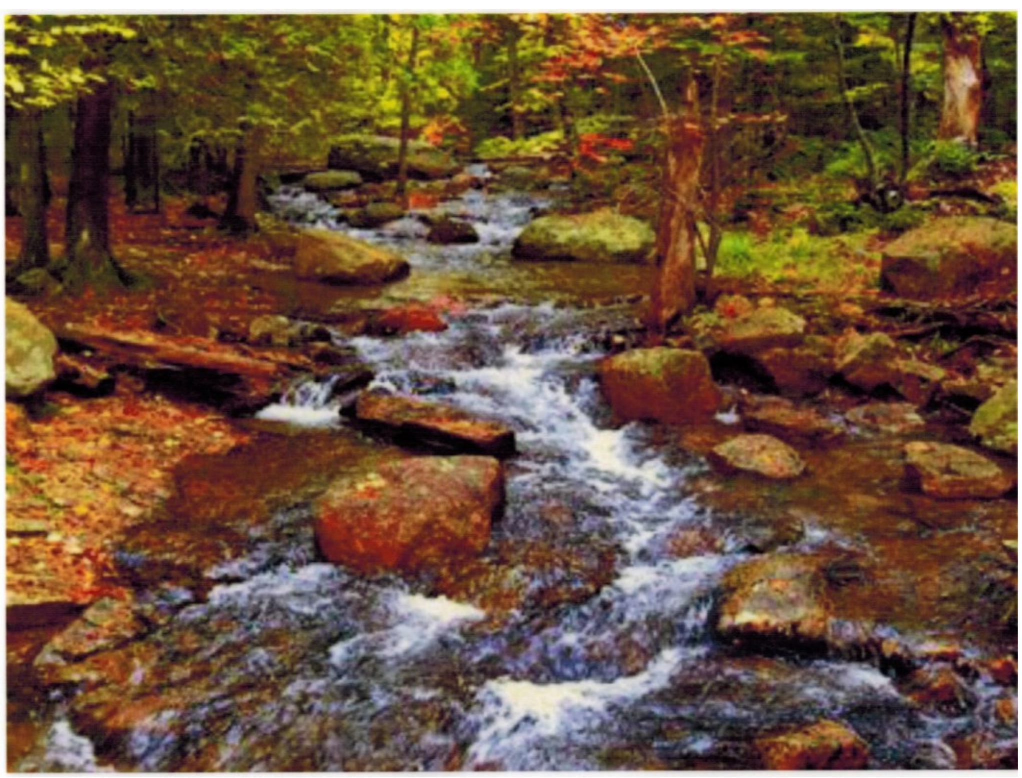
MEMORY RESPONSE: _______________
MEMORY SCORING: 0 1

14. Take children back to the room. If the child guessed straw, give them the straw and let them access the juice. For children that did not pick the straw, present the items again:

"Which one of these can you use to get the juice?"
CHOICE: _____________
PROBLEM SOLVING SCORING: 0 1

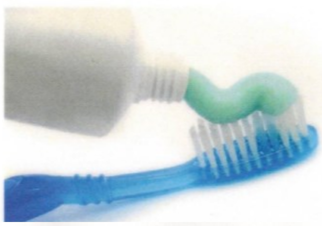
APPENDIX E

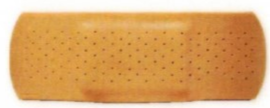
Pictures Used for Picture Book Task 1





Irish
Spring





THANKS
HELLO! WE'D JUST LIKE TO SAY...


Shampoo
2in1
smooth & silky



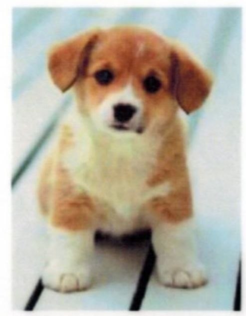
Lunch
CHOCO MILK




Pictures Used for Picture Book Task 2










8
Crayola
MARKERS
CLASSIC COLORS





0560418
ADMIT
ONE
0560418

Pictures Used for Picture Book Task 3


SCHOOL BUS
12-765

REFERENCES

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA.* Feb 1 2012;307(5):483-490.
2. WHO. Childhood overweight and obesity. 2014.
3. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA.* Jan 20 2010;303(3):235-241.
4. Olds T, Maher C, Zumin S, et al. Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *Int J Pediatr Obes.* Oct 2011;6(5-6):342-360.
5. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA.* Jan 20 2010;303(3):242-249.
6. Freedman DS, Wang J, Ogden CL, et al. The prediction of body fatness by BMI and skinfold thicknesses among children and adolescents. *Ann Hum Biol.* Mar-Apr 2007;34(2):183-194.
7. Hannon TS, Rao G, Arslanian SA. Childhood obesity and type 2 diabetes mellitus. *Pediatrics.* Aug 2005;116(2):473-480.
8. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med.* Sep 25 1997;337(13):869-873.
9. Rossner S. Childhood obesity and adulthood consequences. *Acta Paediatr.* Jan 1998;87(1):1-5.

10. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics.* Mar 1998;101(3 Pt 2):518-525.

11. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. *Int J Obes Relat Metab Disord.* Mar 1999;23 Suppl 2:S2-11.

12. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics.* Dec 2007;120 Suppl 4:S164-192.

13. Spear BA, Barlow SE, Ervin C, et al. Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics.* Dec 2007;120 Suppl 4:S254-288.

14. Whitlock E, O'Connor E, Williams S, Beil T, Lutz K. Effectiveness of weight management programs in children and adolescents. *Evid Rep Technol Assess.* Sep 2008(170):1-308.

15. Whitlock EP, O'Connor EA, Williams SB, Beil TL, Lutz KW. Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF. *Pediatrics.* Feb 2010;125(2):e396-418.

16. Dolinsky DH, Armstrong SC, Kinra S. The clinical treatment of childhood obesity. *Indian J Pediatr.* Mar 2013;80 Suppl 1:S48-54.

17. Carlson SM. Developmentally sensitive measures of executive function in preschool children. *Dev Neuropsychol.* 2005;28(2):595-616.

18. Pannacciulli N, Del Parigi A, Chen K, Le DS, Reiman EM, Tataranni PA. Brain abnormalities in human obesity: a voxel-based morphometric study. *Neuroimage.* Jul 15 2006;31(4):1419-1425.

19. Maayan L, Hoogendoorn C, Sweat V, Convit A. Disinhibited eating in obese adolescents is associated with orbitofrontal volume reductions and executive dysfunction. *Obesity.* Jul 2011;19(7):1382-1387.

20. Reinert KR, Po'e EK, Barkin SL. The relationship between executive function and obesity in children and adolescents: a systematic literature review. *J Obes.* 2013;2013:820956.

21. Reynolds B, Penfold RB, Patak M. Dimensions of impulsive behavior in adolescents: laboratory behavioral assessments. *Exp Clin Psychopharmacol.* Apr 2008;16(2):124-131.

22. ISRI ISfRiI. 2011.

23. Power JD, Fair DA, Schlaggar BL, Petersen SE. The development of human functional brain networks. *Neuron.* Sep 9 2010;67(5):735-748.

24. Somerville LH, Casey BJ. Developmental neurobiology of cognitive control and motivational systems. *Curr Opin Neurobiol.* Apr 2010;20(2):236-241.

25. Casey BJ, Tottenham N, Liston C, Durston S. Imaging the developing brain: what have we learned about cognitive development? *Trends Cogn Sci.* Mar 2005;9(3):104-110.

26. St Clair-Thompson HL, Gathercole SE. Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *Q J Exp Psychol.* Apr 2006;59(4):745-759.

27. Best JR, Miller PH, Jones LL. Executive Functions after Age 5: Changes and Correlates. *Dev Rev.* Sep 1 2009;29(3):180-200.

28. Hongwanishkul D, Happaney KR, Lee WS, Zelazo PD. Assessment of hot and cool executive function in young children: age-related changes and individual differences. *Dev Neuropsychol.* 2005;28(2):617-644.

29. Epstein LH, Leddy JJ, Temple JL, Faith MS. Food reinforcement and eating: a multilevel analysis. *Psychol Bull.* Sep 2007;133(5):884-906.

30. Epstein LH, Salvy SJ, Carr KA, Dearing KK, Bickel WK. Food reinforcement, delay discounting and obesity. *Physiol Behav.* Jul 14 2010;100(5):438-445.

31. Thamotharan S, Lange K, Zale EL, Huffhines L, Fields S. The role of impulsivity in pediatric obesity and weight status: a meta-analytic review. *Clin Psychol Rev.* Mar 2013;33(2):253-262.

32. Nederkoorn C, Braet C, Van Eijs Y, Tanghe A, Jansen A. Why obese children cannot resist food: the role of impulsivity. *Eat Behav.* Nov 2006;7(4):315-322.

33. Nederkoorn C, Coelho JS, Guerrieri R, Houben K, Jansen A. Specificity of the failure to inhibit responses in overweight children. *Appetite.* Oct 2012;59(2):409-413.

34. Braet C, Claus L, Verbeken S, Van Vlierberghe L. Impulsivity in overweight children. *Eur Child Adolesc Psychiatry.* Dec 2007;16(8):473-483.

35. Mischel W, Ebbesen EB. Attention in delay of gratification. *J Pers Soc Psychol.* 1970;16(2):329-337.

36. Mischel W, Shoda Y, Peake PK. The nature of adolescent competencies predicted by preschool delay of gratification. *J Pers Soc Psychol.* Apr 1988;54(4):687-696.

37. Mischel W, Shoda Y, Rodriguez MI. Delay of gratification in children. *Science.* May 26 1989;244(4907):933-938.

38. Bonato DP, Boland FJ. Delay of gratification in obese children. *Addict Behav.* 1983;8(1):71-74.

39. Sobhany MS, Rogers CS. External responsiveness to food and non-food cues among obese and non-obese children. *Int J Obes.* 1985;9(2):99-106.

40. Bruce AS, Black WR, Bruce JM, Daldalian M, Martin LE, Davis AM. Ability to delay gratification and BMI in preadolescence. *Obesity.* May 2011;19(5):1101-1102.

41. Evans GW, Fuller-Rowell TE, Doan SN. Childhood cumulative risk and obesity: the mediating role of self-regulatory ability. *Pediatrics.* Jan 2012;129(1):e68-73.

42. Graziano PA, Calkins SD, Keane SP. Toddler self-regulation skills predict risk for pediatric obesity. *Int J Obes.* Apr 2010;34(4):633-641.

43. Graziano PA, Kelleher R, Calkins SD, Keane SP, Brien MO. Predicting weight outcomes in preadolescence: the role of toddlers' self-regulation skills and the temperament dimension of pleasure. *Int J Obes.* Jul 2013;37(7):937-942.

44. Seeyave DM, Coleman S, Appugliese D, et al. Ability to delay gratification at age 4 years and risk of overweight at age 11 years. *Arch Pediatr Adolesc Med.* Apr 2009;163(4):303-308.

45. Duckworth AL, Tsukayama E, Geier AB. Self-controlled children stay leaner in the transition to adolescence. *Appetite.* Apr 2010;54(2):304-308.

46. Francis LA, Susman EJ. Self-regulation and rapid weight gain in children from age 3 to 12 years. *Arch Pediatr Adolesc Med.* Apr 2009;163(4):297-302.

47. Steinberg L, Graham S, O'Brien L, Woolard J, Cauffman E, Banich M. Age differences in future orientation and delay discounting. *Child Dev.* Jan-Feb 2009;80(1):28-44.

48. Prencipe A, Kesek A, Cohen J, Lamm C, Lewis MD, Zelazo PD. Development of hot and cool executive function during the transition to adolescence. *J Exp Child Psychol.* Mar 2011;108(3):621-637.

49. Green L, Fry AF, Myerson J. Discounting of delayed rewards: A life-span comparison. *Psychol Sci.* 1994;5(1):33-36.

50. Atance CM, Meltzoff AN. My future self: Young children's ability to anticipate and explain future states. *Cogn Dev.* Jul 1 2005;20:341-361.

51. Daniel TO, Stanton CM, Epstein LH. The future is now: comparing the effect of episodic future thinking on impulsivity in lean and obese individuals. *Appetite.* Dec 2013;71:120-125.

52. Schacter DL, Addis DR, Buckner RL. Remembering the past to imagine the future: the prospective brain. *Nat Rev Neurosci.* Sep 2007;8(9):657-661.

53. Daniel TO, Stanton CM, Epstein LH. The future is now: reducing impulsivity and energy intake using episodic future thinking. *Psychol Sci.* Nov 1 2013;24(11):2339-2342.

54. de Haan M, Mishkin M, Baldeweg T, Vargha-Khadem F. Human memory development and its dysfunction after early hippocampal injury. *Trends Neurosci.* Jul 2006;29(7):374-381.

55. Perner J, Ruffman T. Episodic memory and autonoetic consciousness: developmental evidence and a theory of childhood amnesia. *J Exp Child Psychol.* Jun 1995;59(3):516-548.

56. Busby J, Suddendorf T. Recalling yesterday and predicting tomorrow. *Cogn Dev.* 2005;20(3):362-372.

57. Suddendorf T, Busby J. Making decisions with the future in mind: Developmental and comparative identification of mental time travel. *Learn Motiv.* 2005;36(2):110-125.
58. Suddendorf T, Corballis MC. Mental time travel and the evolution of the human mind. *Genet Soc Gen Psych.* 1997;123(2):133-167.
59. Martin-Ordas G, Atance CM, Louw A. The role of episodic and semantic memory in episodic foresight. *Learn Motiv.* 2012;43(4):209-219.
60. Hudson JA, Mayhew EM, Prabhakar J. The development of episodic foresight: emerging concepts and methods. *Adv Child Dev Behav.* 2011;40:95-137.
61. Atance CM, O'Neill DK. Episodic future thinking. *Trends Cogn Sci.* Dec 1 2001;5(12):533-539.
62. Tulving E. How many memory systems are there? *American Psychologist.* 1985;40(4):385-398.
63. Tulving E. Episodic memory and common sense: how far apart? *Philos Trans R Soc Lond B Biol Sci.* Sep 29 2001;356(1413):1505-1515.
64. Tulving E. Episodic memory: from mind to brain. *Annu Rev Psychol.* 2002;53:1-25.
65. Baddeley A, Eysenck MW, Anderson MC. *Memory.* New York, NY US: Psychology Press; 2009.
66. Suddendorf T, Corballis MC. The evolution of foresight: What is mental time travel, and is it unique to humans? *Behav Brain Sci.* Jun 2007;30(3):299-313; discussion 313-251.

67. Tulving E. Episodic Memory and Autonoesis: Uniquely Human? In: Terrace HS, Metcalfe J, eds. *The missing link in cognition: Origins of self-reflective consciousness.* New York, NY US: Oxford University Press; 2005:3-56.

68. Atance CM, Sommerville JA. Assessing the role of memory in preschoolers' performance on episodic foresight tasks. *Memory.* Jan 2014;22(1):118-128.

69. Redshaw J, Suddendorf T. Foresight beyond the very next event: four-year-olds can link past and deferred future episodes. *Front Psychol.* 2013;4:404.

70. Suddendorf T, Nielsen M, von Gehlen R. Children's capacity to remember a novel problem and to secure its future solution. *Dev Sci.* Jan 2011;14(1):26-33.

71. Russell J, Alexis D, Clayton N. Episodic future thinking in 3- to 5-year-old children: the ability to think of what will be needed from a different point of view. *Cognition.* Jan 2010;114(1):56-71.

72. Wang Q, Capous D, Koh JBK, Hou Y. Past and future episodic thinking in middle childhood. *J Cogn Dev.* 2014;15(4):625-643.

73. Atance CM, Meltzoff AN. Preschoolers' current desires warp their choices for the future. *Psychol Sci.* Jul 2006;17(7):583-587.

74. Scarf D, Gross J, Colombo M, Hayne H. To have and to hold: episodic memory in 3- and 4-year-old children. *Dev Psychobiol.* Mar 2013;55(2):125-132.

75. Gott C, Lah S. Episodic future thinking in children compared to adolescents. *Child Neuropsychol.* 2014;20(5):625-640.

76. Bunch KM, Andrews G. Development of relational processing in hot and cool tasks. *Dev Neuropsychol.* 2012;37(2):134-152.

77. Mahy CE, Grass J, Wagner S, Kliegel M. These pretzels are going to make me thirsty tomorrow: Differential development of hot and cool episodic foresight in early childhood? *Br J Dev Psychol.* Nov 13 2013.

78. Lind SE. Memory and the self in autism: A review and theoretical framework. *Autism.* Sep 2010;14(5):430-456.

79. Hanson LK, Atance CM. Brief Report: Episodic Foresight in Autism Spectrum Disorder. *J Autism Dev Disord.* Jul 27 2013.

80. Miloyan B, Pachana NA, Suddendorf T. The future is here: A review of foresight systems in anxiety and depression. *Cogn Emot.* Dec 9 2013.

81. Burley VJ, Kreitzman SN, Hill AJ, Blundell JE. Across-the-day monitoring of mood and energy intake before, during, and after a very-low-calorie diet. *Am J Clin Nutr.* Jul 1992;56(1 Suppl):277s-278s.

82. Wells WD. Communicating with children. *J Advertising Res.* 1965;5(2):2-14.

83. Eysenck SB, Easton G, Pearson PR. Age norms for impulsiveness, venturesomeness and empathy in children. *Pers Indiv Differ.* 1984;315:321.

84. White JL, Moffitt TE, Caspi A, Bartusch DJ, Needles DJ, Stouthamer-Loeber M. Measuring impulsivity and examining its relationship to delinquency. *J Abnorm Psychol.* 1994;103(2):192-205.

85. Kaufman AS, Kaufman NL. *Kaufman Brief Intelligence Test, Second Edition.* Bloomington, MN: Pearson, Inc.; 2004.

86. Sheslow D, Adams W. *Wide Range Assessment of Memory and Learning Second Edition Administration and Technical Manual.* Lutz, FL: Psychological Assessment Resources; 2003.

87. Isquith PK, Roth RM, Gioia GA. *Tasks of executive control.* PAR; 2009.

88. Gioia GA. *BRIEF: Behavior rating inventory of executive function: Professional manual.* Psychological Assessment Resources; 2000.

89. Warner RM. *Applied statistics: from bivariate through multivariate techniques: from bivariate through multivariate techniques.* Sage; 2012.

90. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J Roy Stat Soc B Met.* 1995:289-300.

91. Faul F, Erdfelder E, Lang A-G, Buchner A. GPower 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007;39(2):175-191.

92. Preacher K. Calculation for the Test of the Difference Between Two Independent Correlation Coefficients. 2002; http://quantpsy.org/corrtest/corrtest2.htm. Accessed May 31, 2015.

93. Cohen J. Cohen. P.(1983). Applied multiple regression/correlation analysis for the behavioral sciences. *Hillsdale, NJ: Erlbaum.*

94. Best JR, Theim KR, Gredysa DM, et al. Behavioral economic predictors of overweight children's weight loss. *J Consult Clin Psychol.* Dec 2012;80(6):1086-1096.

95. Temple JL, Legierski CM, Giacomelli AM, Salvy SJ, Epstein LH. Overweight children find food more reinforcing and consume more energy than do nonoverweight children. *Am J Clin Nutr.* May 2008;87(5):1121-1127.

96. Carruth BR, Skinner JD. Revisiting the picky eater phenomenon: neophobic behaviors of young children. *J Am Coll Nutr.* Nov-Dec 2000;19(6):771-780.

97. Nigro G, Brandimonte MA, Cicogna P, Cosenza M. Episodic future thinking as a predictor of children's prospective memory. *J Exp Child Psychol.* Nov 2014;127:82-94.

98. Kuwabara KJ. *Can autobiographical memory facilitate children's social problem solving?* US, ProQuest Information & Learning; 2015.

99. Atance CM, Louw A, Clayton NS. Thinking ahead about where something is needed: New insights about episodic foresight in preschoolers. *J Exp Child Psychol.* 2015;129:98-109.

100. Wittmann M, Paulus MP. Decision making, impulsivity and time perception. *Trends Cogn Sci.* 2008;12(1):7-12.

101. Hanson LK, Atance CM, Paluck SW. Is thinking about the future related to theory of mind and executive function? Not in preschoolers. *J Exp Child Psychol.* 2014;128:120-137.

102. Cuevas K, Rajan V, Morasch KC, Bell MA. Episodic memory and future thinking during early childhood: Linking the past and future. *Dev Psychobiol.* 2015.

VITA

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After completing his Masters, he moved to the Kansas City area and worked as a research assistant for Dr. Ann Davis at the University of Kansas Medical Center. In the Fall of 2010, he began work toward his Ph.D. in Clinical Psychology at the University of Missouri – Kansas City. Since 2010, Mr. Black has worked on a variety of project pertaining to pediatric obesity, including evaluating quality of life in children enrolled in pediatric obesity programs, and evaluating brain mechanisms associated with pediatric obesity. He was awarded a Student Research grant from the UMKC School of Graduate Studies. Mr. Black will complete his clinical internship in Pediatric Psychology at Nemours/Alfred I. duPont Hospital for Children, and upon completion of his internship and degree, will pursue post-doctoral opportunities in pediatric psychology.