



SCHOOL of
GRADUATE STUDIES
EAST TENNESSEE STATE UNIVERSITY

East Tennessee State University
**Digital Commons @ East
Tennessee State University**

Electronic Theses and Dissertations

Student Works

8-2013

The EIIOS Task: Executive Function and Word Learning at 18-months

Leslie A. Patton

East Tennessee State University

Follow this and additional works at: <https://dc.etsu.edu/etd>

 Part of the [Developmental Psychology Commons](#)

Recommended Citation

Patton, Leslie A., "The EIIOS Task: Executive Function and Word Learning at 18-months" (2013). *Electronic Theses and Dissertations*. Paper 1197. <https://dc.etsu.edu/etd/1197>

This Thesis - Open Access is brought to you for free and open access by the Student Works at Digital Commons @ East Tennessee State University. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of Digital Commons @ East Tennessee State University. For more information, please contact digilib@etsu.edu.

The EIIOS Task: Executive Function and Word Learning at 18-months

A thesis

presented to

the faculty of the Department of Psychology

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Master of Arts in Psychology

by

Leslie A. Patton

August 2013

Wallace Dixon, PhD, Chair

Kerry Proctor-Williams, PhD

Andrea Clements, PhD

Keywords: executive function, language, vocabulary, infancy, word learning

ABSTRACT

The EIIOS Task: Executive Function and Word Learning at 18-months

by

Leslie A. Patton

This study was an investigation of the association between executive functioning (EF) ability and language development in the latter half of the second year. Fifty-five typically developing 18-month-olds were brought into the lab. The elicited imitation with inappropriate object substitution (EIIOS) task was used as a developmentally sensitive measure of EF. Language acquisition was assessed using a real-time word learning task as well as a parent report measure of vocabulary size (*MacArthur-Bates Communicative Development Inventory: Words and Sentences Version*). Contrary to expectations, very few statistically significant associations were found between the EF measure and either language measure. Despite these findings there is still a need for research to identify an appropriate measure of EF in the latter half of the second year.

ACKNOWLEDGMENTS

Foremost, I would like to express my sincere gratitude to my advisor, Dr. Wallace Dixon Jr. for his motivation, knowledge, and patience during the research and writing of this thesis. I would also like to thank the other members of my committee: Dr. Andrea Clements and Dr. Kerry Proctor-Williams for their encouragement and insightful comments that have helped shape this thesis.

I would like to thank my fellow labmates in the Program for the Study of Infancy: Elizabeth Johnson and Sarah Berry, for their help in recruiting and conducting this study. The many late nights, early mornings, and insightful discussions paid off. The relationships I formed with these two ladies helped me make it through the graduate school process.

I would like to thank my husband Sonny and my family, who have never stopped supporting and encouraging me. I would not be where I am today without these influential people who have always believed in me and my ability to succeed. Finally, I would like to dedicate this work to my daughter Lilly, she is my ultimate motivation.

TABLE OF CONTENTS

	Page
ABSTRACT	2
ACKNOWLEDGMENTS	3
LIST OF TABLES	6
Chapter	
1. INTRODUCTION	
Executive Function	7
Executive Function and Children	8
Executive Function and Temperament	11
Executive Function and Language	12
Executive Function and Vocabulary Development	14
The EIOS Task	16
Project Goals and Hypothesis	19
2. METHODS	
Participants.....	20
Materials	20
Executive Function.....	21
Vocabulary	21
Procedure	22
EIOS Task.....	22
Novel Word Learning	22
Data Analysis Plan	24
Independent Variables.....	24
Language Measures.....	25
Descriptive Statistics	26
Inferential Statistics.....	26

Chapter	Page
3. RESULTS	
Descriptive Statistics	27
Inferential Statistics	28
4. DISCUSSION	
Explanation for Lack of Significant Findings	30
EIIOS is an Insufficient Index of EF	30
EF is Not Associated with Language	31
EIIOS is Insufficiently Developed	31
Conclusions	33
REFERENCES	34
VITA	40

LIST OF TABLES

Table	Page
1. RTWL Task Objects and Labels.....	22
2. Mean Performance on EIIOS Measures.....	27
3. Mean Performance on Language Measures.....	28
4. Zero-order Correlations Among the EIIOS Task and RTWL Performance.....	29
5. Zero-order Correlations Among the EIIOS Task and CDI.....	29

CHAPTER 1

INTRODUCTION

Executive Function

Executive functioning (EF) refers to higher-level cognitive processes that aid in the monitoring and control of thoughts and behaviors (Carlson, 2005). EF is comprised of several components including: (1) inhibition, (2) working memory, (3) planning, (4) set-shifting, and (5) interference control (Pennington & Ozonoff, 1996). The majority of research on EF has focused on the adult population. Hughes and Graham (2002) describe two overlapping reasons for such a nondevelopmental focus that are of particular interest for this study. First, from a practical standpoint, most EF tasks are complex by design so as to tap into higher-level cognitive processes. But second, and perhaps more importantly, the prefrontal cortex, an area of the brain believed to be crucial for the development of many components of the EF system, has historically been regarded as developmentally immature until early adolescence thus preventing higher level processes from occurring. However, more recent research suggests that the prefrontal cortex begins maturation in the first year of life (Diamond, 1985; Diamond & Goldman-Rakic, 1989; Rothbart & Posner, 2006; Rueda, Posner, & Rothbart, 2005; Sheese, Rothbart, Posner, White, & Fraunddorf, 2008).

Because individual differences in EF have been linked to individual differences in a variety of social and cognitive outcomes, researchers who employ very early measures of EF may be in a position to identify infants and toddlers at risk for social and cognitive delay in later childhood. EF has been linked to the sense of self (Decety & Sommerville, 2003), emotional self-regulation (Zelazo & Cunningham, 2007), and emotional awareness (Ozonoff, Pennington, & Rogers, 1991). EF has also been linked to cognitive outcomes such as theory of mind

(Carlson, Moses, & Breton, 2002; Ozonoff et al., 1991) and math and reading ability (Blair & Razza, 2007). One cognitive outcome that may be linked to EF but that has generally not been the subject of study for many EF researchers is language development. Language delay affects 15% of all typically developing children. Hence, early identification of EF may help clinicians and researchers identify children at risk for language delay.

In the discussion that follows, I first briefly outline the recent history in the development of early measures of EF. I then consider the possibility that early measures of EF may be good predictors of subsequent language development, and identify the routes through which EF might be expected to impact language development. Finally, I propose a new nonlinguistic measure of EF that is developmentally sensitive for use with children in their second year and propose a study in which performance on this new EF task should predict children's language development.

Executive Function and Children

Even though the infant prefrontal cortex is insufficiently developed to permit higher level cognitive processes such as planning or complex rule use (Hughes & Graham, 2002), components of the EF system can be measured by limiting the task to specific EF domains that are exhibited in infancy. For example, several researchers have been successful in measuring the EF components of attention allocation, working memory, and effortful control in children as young as 2 years (Carlson, Mandell, & Williams, 2004; Carlson & Moses, 2001; Davis & Pratt, 1996; Gerstadt, Hong, & Diamond, 1994; Kochanska, Murray, & Harlan, 2000; Reed, Pien, & Rothbart, 1984; Zelazo, Reznick, & Spinazolla, 1998).

Kochanska et al. (2000), for example, showed that the ability to inhibit a prepotent response in order to perform another response increased significantly between the ages of 22-and

33-months. Kochanska et al. are also responsible for developing the only published EF task employed specifically for children younger than two years, the Shape Stroop task. The Shape Stroop is described by Kochanska as an attention allocation task, adapted from the original Stroop task. In the original Stroop task, designed for literate older children and adults, participants are asked to name the color of ink in which an item is printed rather than naming the item itself. These items can be meaningless (e.g., a row of “Xs”) or they can be actual names of colors that may be congruent or incongruent with the color of ink in which the word is written (e.g., the word *green* may be in red ink). Success on the Stroop task requires reporting the color of ink while inhibiting reporting the actual color word itself.

Much like the original Stroop task, Kochanska et al.’s (2000) Shape Stroop assesses the child’s ability to activate a subdominant rather than a dominant response but instead uses pictures of three types of fruit. The experimenter shows the child three small and three big pictures of each of three different fruits. The experimenter reviews the name of each fruit along with the concepts “big” and “little.” The child is then shown three new pictures, each displaying a small fruit embedded on a different large fruit (e.g., a small banana on a large apple). The child is then asked to point to a specific little fruit (e.g., “Can you show me the little banana?”). This developmentally sensitive task includes both an attention element as well as an effortful control element.

Similarly, Carlson (2005) assessed children between the age of 22 and 36 months, and concluded that children in this age range demonstrate EF capacity by virtue of their successful completion of a variety of tasks including the Multilocation Search task (Zelazo et al., 1998), Snack delay (Kochanska et al., 2000), and the Gift Delay task (Kochanska et al., 2000). In her account Carlson gives a comprehensive picture of the many EF tasks that can be employed at

different ages and helps to identify the expected rate of development for EF through successful completion of tasks that incorporate more sophisticated aspects of EF. For example, Carlson found that at 24-months, children had more than 50% probability of passing the Multilocation Search, Gift Delay, and Shape Stroop (Kochanska et al., 2000) tasks, suggesting that these tasks are eliciting EF skills at this age. However, noticeably absent from Carlson's list are developmentally appropriate measures for measuring EF in the first half of the second year. McGuigan (2006) pointed out the irony of the fact that despite the number of critical developments in EF presumed to take place between the first and third years of life, this developmental period is also the least well understood.

This paucity of infant and toddler research notwithstanding, EF development in the first 18 months of life has not been completely ignored. Among the foundational accomplishments resulting from early infancy are the emergence of object permanence and the enhancement of retrieval memory; both of which illustrate the emergence of voluntary control over perception and action (Diamond, 1990). One of the earliest efforts in measuring EF in infants focused on attentional state in 8-month-olds. In this study Diamond (1990) suggested that the ability for memory-based intention to override habit and to exercise choice emerges at approximately 8-months of age, commensurate with the maturational spurt in development of the cerebral cortex (Goldman-Rakic, 1987). In Diamond's object retrieval task, the infant was presented with a transparent box that contained a small reward. The box was enclosed on three sides leaving one side open for retrieval of the reward. To succeed, the infant was required to inhibit the response to reach straight for the reward and instead detour to reach through the side opening. Diamond found that retrieval times decreased with age as working memory and effortful control ability increased.

Diamond's task illustrates the ability to measure early advancements in effortful control during the latter half of the first year of life when crucial cortical developments are taking place. To this end, effortful control is a key construct in identifying the development of executive function because it can be reliably measured in a lab setting (Carlson, 2005) and emerges at an early age. Although effortful control is the label Kochanska et al. (2000) gave to "the ability to suppress a dominant response in order to perform a subdominant response" (p221), the term is also identified as a dimension of individual difference within the overarching construct of temperament (Rothbart & Bates, 2006). Hence, development of effortful control can also be understood by reference to the temperament literature.

Executive Function and Temperament

Temperament can be defined as biologically-based "individual differences in reactivity and self-regulation, in the domains of affect, activity, and attention" (Rothbart & Bates, 2006, p100). Within the domain of temperament, the origins of Executive Function can be traced to the finding that as early as 5 or 6 months of age, the first signs of behavioral inhibition are present as infants are able to inhibit their approach responses to stimuli that are novel (Rothbart & Bates, 2006). Further, early into the second year, infants demonstrate a capacity for volitional attention allocation, which appears linked to the subsequent emergence of effortful control. Krakow, Kopp, and Vaughn (as cited in Rothbart & Bates, 2006) reported stability of individual differences in attention allocation to a set of toys between 12 and 18 months and also reported that early attention allocation was positively related to the later emergence of effortful control. Similarly, Kochanska et al. (2000) reported that attention allocation at 9 months predicted children's later effortful control. Hence, it may be that in very young children, attention allocation is an important precursor of the subsequent development of effortful control and,

accordingly, EF. However, given that only a handful of EF studies have focused on children before the age of 2, and of these studies, only a limited number of EF tasks have been employed, potential infant precursors of later EF development have not been the subject of much study.

Executive Function and Language

The implementation of a developmentally sensitive measure of executive function in children before the age of 2 is important because it may contribute to our understanding of processes linked to vocabulary acquisition. There is considerable reason to believe that certain EF components, especially attention allocation, working memory, and effortful control, may contribute to or enable language proficiency in children (Gathercole & Baddeley, 1993). Rose, Feldman, and Jankowski (2009) conducted a longitudinal study with 12-month-olds to determine whether language proficiency was linked solely with language-specific processes or whether this skill might also depend on domain-general, EF-type processes. In their study they investigated whether four types of memory (i.e., immediate visual recognition, delayed recognition, and short-and long-term recall), attention allocation, and inappropriate object substitution were linked to language proficiency. Rose et al. found that higher scores on inappropriate object substitution and working memory performance at 12-months were generally related to better language proficiency concurrently and longitudinally at 36-months. Although working memory is a well-known component of EF, inappropriate object substitution also reflects another component of EF: inhibition of a dominant response (using an object appropriately) to enact a subdominant response (using an object inappropriately). Hence, this finding supports the possibility that advances in EF supports or enables advances in language proficiency.

Wolfe and Bell (2007) also studied the relationship between children's working memory and effortful control (which they labeled working memory/inhibitory control) and language

proficiency at ages 3 ½-, 4-, and 4 ½ - years of age. They found working memory and effortful control to be associated with language proficiency at all ages and reported that the strength of the association increased over time. Working memory and effortful control also maintained a strong association with language proficiency when controlling for demographic variables, supporting past research suggesting that working memory capacity facilitates word learning (Gathercole & Baddeley, 1993). Wolfe and Bell reported further that children with the greatest ability to allocate attention, maintain task-relevant information, and implement the correct response despite the presence of distraction, had the highest score on the language proficiency measure (i.e., the *Peabody Picture Vocabulary Test* [Dunn, & Dunn, 2007]).

Finally, McClelland et al. (2007) studied 3 and 4-year olds' EF ability and its correlation with vocabulary. They measured EF ability using the Heads-to-Toes task in which the child is asked to first respond appropriately to the request of the experimenter (i.e., touch the toes when experimenter asks them to do so) and then to switch the rules when directed to do so by the experimenter (i.e., touch the head when asked to touch the toes). McClelland et al. claimed that the task taps into executive function by requiring children to exhibit three skills; first, to pay attention to the rules; second, to use working memory to hold the rules in mind; and third, to inhibit their natural (i.e., dominant) response and instead respond in the correct, albeit unnatural (i.e., subdominant) way. McClelland et al. reported a significant correlation between executive functioning and vocabulary size, supporting their hypothesis that executive function promotes vocabulary acquisition.

Given the lack of developmentally sensitive EF measures available for children at ages when words are first being learned, typically the first half of the second year, the relationship between EF and early word learning has yet to be the subject of rigorous investigation. The

problem is further compounded by the fact that most potentially applicable EF tasks (i.e., those used with 2-year-olds) require children to have some facility with language, rendering them unusable with children in the early stages of language acquisition. A nonlinguistic measure of EF would allow for the opportunity to explore the relationship between EF and language proficiency during the critical period of first-word acquisition. First signs of word comprehension appear at around 9-months, and spontaneous production of words is typically seen around 13-months (Fenson, Dale, Reznick, & Bates, 1994). At approximately 18-months of age, infants begin expanding their vocabulary at a rapid pace, acquiring up to nine new words per day (Hollich et al., 2000). The few studies that have been conducted involving EF and language proficiency suggest that it may be worthwhile to explore further whether EF plays a foundational role in the emergence and early development of vocabulary, especially during the first half of the second year of life.

Executive Function and Vocabulary Development

A child's ability to learn language has not yet been explicitly linked to EF ability but individual components of EF have been linked to language. For example, Dixon and Salley (2006) found that children at age 21 months with focused attentional allocation, as determined by mother report, were better able to learn new words in the presence of environmental distractors. The foundational role of attention allocation for word learning is present in many word-learning theories. In her model of "dumb attentional mechanisms," for example, Smith (1995) posits that a child has an increased ability to attach labels to items that gain and maintain the child's attention. Word-referent associations are then formed because of this focused attention. Novel items are especially likely to gain a child's attention and therefore increase the probability of the child mapping a novel word that the child hears to the novel object that has maintained the

child's attention (Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992). The importance of joint attention between the child and the adult speaker for word learning has also received empirical attention (Baldwin, 1995, Salley & Dixon, 2007; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). When a label is spoken the child will attempt to direct attention to the item the child believes the speaker is labeling. Without the capacity for joint attention, the child may map the novel word onto any object the child happens to have attention focused on. Joint attention helps to prevent this error in word-learning (Woodward & Markman, 1998).

Working memory has also been associated with word-learning. Gathercole, Hitch, Service, and Martin (1997), for example, have suggested that the phonological loop, a subsystem of the overarching working memory system, is significantly related to children's capacity for learning novel labels. They found that phonological loop performance, as measured by nonword repetition and digit span tasks, was significantly associated with the rate the child was able to learn a new word. Wolfe and Bell (2007) also found a positive correlation between working memory and language proficiency in a longitudinal study of children 8-months through 4.5 years.

In addition to working memory, effortful control, as measured by a Stroop-like task, was found to be positively correlated with both receptive and productive vocabulary (Wolfe & Bell, 2007). McClelland et al. (2007) discovered that higher effortful control in preschoolers was significantly associated with higher levels of emergent literacy and vocabulary. Finally, Carlson et al. (2002) found that conflict effortful control tasks (i.e., tasks that require the child to inhibit a dominant response and instead use a subdominant response) were significantly related to verbal intelligence during preschool.

It is clear, then, that developmental research has been hinting at the association between EF and language proficiency, but formal investigations of EF-language relationships in the first half of the second year have been lacking largely because of the lack of an age-appropriate EF measure when language acquisition arguably proceeds at its most rapid pace. The purposes of the present investigation are to identify a developmentally sensitive measure of EF in the second year of life and to explore the extent to which children's performance on this measure is associated with concurrent language development. A developmentally sensitive measure of EF would incorporate components of EF that are available in very early childhood (e.g., attention allocation, working memory, and effortful control) and ensure that these components are not confounded with language facility. Past research has identified at least three components of EF that can be identified during the second year of life: attention allocation (Diamond, 1990), working memory (Reznick, Morrow, Goldman, & Snyder, 2004), and effortful control (Kochanska et al., 2000). Although each of these component abilities of EF has been identified on an individual basis, to date there has been no measure of the joint functioning of these component abilities in a single measure akin to those employed to index EF in older children.

The EIIOS Task

One task that would appear to meet the criteria for indexing EF in the second year is one previously used to measure representational competence (Bates, Bretherton, Snyder, Shore, & Volterra, 1980; Shore, O'Connell, & Bates, 1984), and recently employed by Rose et al. (2009). This task, presently referred to as the Elicited Imitation with Incongruent Object Substitution task (EIIOS), incorporates the three target components of attention allocation, working memory, and effortful control. The EIIOS was developed by Bates et al. (1980) to investigate the development of elicited gestures in symbolic play at 13-months using appropriate objects, neutral

objects, and inappropriate objects (the latter of which had conventional meanings of their own). For example, a drinking gesture was elicited with an empty cup, a plain wooden block, and a toy car. Results showed that the strongest relations between language and gestural production were when the child was asked to produce a familiar gesture with an inappropriate object. Therefore, those children who were better able to engage in a play scenario using familiar gestures with contradictory perceptual support (i.e., using the toy car instead of the doll) had greater language proficiency than those children who only engaged in the scenario with the appropriate perceptual support (i.e., a cup).

In a follow-up study Shore and colleagues (1984) modeled three versions of typical event scenarios (e.g., giving dolly a bath) for the child. In one version of each scenario a realistic target object (e.g., the doll) was replaced with either a plain wooden block or a substitute object (e.g., a shoe). The child was then given a period of time to play with the objects. Children's abilities to reproduce the modeled gestures with the substitute objects were assumed to reflect their ability to engage in symbolic play with minimal perceptual support. Similar to Bates et al. (1980), Shore and colleagues found that at 20-months, children's ability to produce a familiar gesture with an inappropriate object was found to have a strong relationship with their language proficiency. In addition, Shore (1986) later found that inappropriate object substitution not only correlated with language but proved to be a stronger predictor of language than the child's ability to imitate with appropriate objects.

Implementation of the EIIOS task consists of two phases. In the elicited imitation phase, a familiar gesture is modeled by an experimenter, using household props, while the child is watching (and presumably attending). The child is then given the props and provided an opportunity to produce the modeled gesture. Success in elicited imitation is marked when a child

imitates the target actions correctly. In the inappropriate object substitution phase of the EIIOS task, the familiar gesture is again modeled but this time with an inappropriate object (e.g., replacing a brush with a cup, and “brushing” one’s hair with the cup). As already noted, children as young as 13-months of age are capable of reproducing the inappropriate gesture (Bates et al., 1980).

Successful completion of the EIIOS task requires that children exhibit each of the three EF components of attention allocation, working memory, and effortful control. First, attention allocation is necessary for the child to be able to encode the action that is modeled. A child has to be able to attend to the model while inhibiting attention to ambient environmental distractions, so as to observe the unusual gesture being applied to the inappropriate object. A child who is distracted while the experimenter models the gesture with the inappropriate object will be less likely to attend to the gesture and thus less likely to encode the gesture into working memory. Thus, working memory is also needed. With insufficient working memory capacity, a child may be able to attend to the model but would not be able to hold the gesture in mind long enough to consolidate the image of the gesture being applied to the inappropriate object. Lack of consolidation would result in a decreased probability of being able to reproduce the gesture. Finally, successful completion of the task through reproduction of the inappropriate object gesture requires the child to exhibit effortful control. That is, to succeed in the task, the child must inhibit the typical gesture associated with an object, and engage the object with an otherwise incongruent gesture. Without effortful control, when the child is given a shoe, the child may produce the conventional gesture (e.g., putting it on the foot) rather than produce the inappropriate gesture modeled by the experimenter (e.g., hugging the shoe).

In sum, the EIIOS task incorporates all three elements of EF typical of the kind of tasks used with slightly older children. Moreover, because no aspect of the EIIOS task requires children to be competent in language, EIIOS can also be used with children early in the second year, and, more importantly, does not confound EF sophistication with linguistic sophistications as do other measures such as the Shape Stroop, (Kochanska et al., 2000). The prospect of capturing EF in the second year, in turn, leads to the possibility of identifying children at risk for language delay in later childhood.

Project Goals and Hypothesis

The purpose of the present investigation is to employ the EIIOS task as a developmentally sensitive measure of EF in the second year so as to explore whether performance on this EF measure is associated with language proficiency in the second year. Specifically, this investigation is designed to explore the extent to which performance on the EIIOS task is associated with concurrent vocabulary development using both real-time word learning and parent-reported vocabulary size. To the extent that the EIIOS indexes EF, and to the extent that EF supports or enables language proficiency, children who perform well on the EIIOS task should also perform well on real-time word-learning tasks and parent-report measures of vocabulary size.

CHAPTER 2

METHODS

Participants

Data for the present investigation were derived from an archival sample of children who participated in a longitudinal study in the ETSU Program for the Study of Infancy (PSI). As part of a larger study, 55 children drawn from a population of typically developing children in the surrounding area were brought into the lab at 18-months. The names of potential participants were derived from area newspaper birth announcements, advertisements in local physicians' waiting rooms, and through word of mouth. Parents were contacted first by mail and then by phone. During phone calls a research assistant explained the nature of the study. After parent(s) expressed interest, an informed consent document was mailed, along with a self-addressed stamped envelope for parent(s) to return to the lab. After receiving the signed informed consent document, lab personnel contacted parents again to schedule a convenient time to visit the lab. Lab sessions lasted approximately 1 hour and were scheduled to correspond to children's alert times as reported by their parents.

Materials

Upon arrival at the PSI, children and their parents were escorted to the observation room. The observation room contained a testing table at which the experimenter, parent, and child were seated for the duration of the appointment, and a wooden wardrobe that contained the stimulus materials. The lab is fitted with audio and video recording capability comprised of two color cameras in opposite corners of the lab and a centrally located microphone hanging from the ceiling. Adjacent to the lab is a control room where the audio and video recordings were mastered.

Executive Function

The EIIOS task used four objects well-known to children of this age: a cup, a hairbrush, a car, and a teddy bear. Objects were individually presented to children in the context of unusual, incongruent gestures. The four gestures included: (1) brushing hair with cup, (2) drinking from a hairbrush, (3) hugging a car, and (4) driving a teddy bear. Order of modeling was counterbalanced. Half the children observed the modeled actions 1 and 3 first, followed later by actions 2 and 4. The other half received 2 and 4 first, followed by 1 and 3 later.

Vocabulary

Vocabulary development was assessed both through parental report and through a real-time word-learning task. Parents were mailed the *MacArthur-Bates Communicative Development Inventory: Words and Sentences Version* (CDI; Fenson et al., 1993) to complete prior to their lab visit. The CDI examines grammar and sentence production in five sections that can be characterized as indexing vocabulary production (i.e., words the child says), use of words to express aspects of displacement (e.g., does the child ask for a missing toy), use of irregular nouns and verbs (e.g., the child says “fell” or “ran”), use of overregularizations (e.g., the child says “teeths” or “tooths”), ability to combine words (e.g., child says “doggie bite”), sentence length (i.e., mean length utterance of three sentences the parent heard the child say recently), and sentence complexity (e.g., does the child say “two foot” or “two feet”).

The real-time word-learning task (based on Baldwin, 1991 and described in more detail below) incorporated 16 household objects that were assumed to be novel to the child (see Table 1) and were presented to the child in a paired-comparison format. A colored plastic bucket was also used for the discrepant labeling aspect of the task.

Table 1
RTWL Task Objects and Labels

Novel Labels	Target Object	Foil Object
“Bem”	Tire gauge	Honey dipper
“Roop”	Bar strainer	Pastry blend
“Dax”	Sink stopper	Toothbrush holder
“Mot”	Door stop	Over-the-door hook

Procedure

EIOS Task

The experimenter gave the first of four objects (e.g., car then bear; cup then brush) to the child for a 30-second familiarization period. Subsequently, the experimenter modeled the inappropriate object gesture (i.e., brushing hair with a cup, drinking from a brush, hugging a car, and driving a bear) while the child observed. The object was then given back to the child for a period of 30-seconds and the experimenter prompted the child by saying “Your turn.” After the first inappropriate object-gesture model, the second object was given to the child, and its inappropriate gesture was modeled. The child was then given the object back for 30-seconds and the experimenter again prompted the infant. At this time, the first object was returned for 30 more seconds followed by the second object for 30 seconds. No verbal prompts were included with these latter presentations.

Novel Word Learning

Children’s novel word learning capacity was assessed in a three-phase task adapted from two well-established word learning paradigms (Baldwin, 1991; Mervis & Bertrand, 1994). Baldwin’s (1991) word-learning procedure was adapted for use in this study and was reflected in

the first two phases of the task. The first, “familiarization” phase, began when the experimenter gave the child two novel objects: a target object that would be subsequently labeled, and a foil object that would not be subsequently labeled. The child was allowed 20 seconds to interact with the two objects. The target object was then provided a novel label in accordance with Baldwin’s “discrepant labeling” procedure. In this procedure, after the initial 20-second familiarization, the child was given the “foil” object while the experimenter placed the target object in the bucket, which the experimenter held, and looked into the bucket. When the child was not looking at the experimenter’s bucket, the experimenter labeled the object in the bucket. While gazing at the object in the bucket, the experimenter said, “It’s an X,” where X was the novel word such as Bem or Roop (see Table 1). Labeling occurred four times per target object, with the only caveat being that the experimenter only labeled the object while the child was not looking at the experimenter’s bucket. Because the experimenter could not see the child’s line of visual regard while looking into the bucket, the experimenter was cued by an experimenter in an adjacent control room.

The second phase occurred after the experimenter applied the novel label onto the target object. During this “comprehension” phase, the two novel objects were again presented to the child side by side, and the child was asked to put the target (i.e., labeled) object into the bucket (e.g., “One of these is a Roop. Can you put the Roop in the bucket?”). Baldwin argued that the child has correctly mapped the novel word onto the novel object when the child places the correctly identified target object in the bucket. The target object was requested on three additional trials, subject to the constraint that the target object was arranged spatially using a Left-Right-Right-Left placement.

The final “generalization” phase of the word-learning procedure was adapted from Mervis and Bertrand (1994) and included the two novel objects being replaced by taxonomically similar objects (e.g., instead of a metal tire gauge and a plastic yellow honey dipper as listed in Table 1, the child was given a plastic tire gauge and a wooden honey dipper). After these new objects were placed in front of the child, the comprehension question was asked again. In order for successful generalization to occur, the child needed to apply the newly learned novel word to the new target object and place it in the bucket. For these generalization trials the target object was arranged spatially using a Right-Left-Left-Right placement.

Using this three-phase procedure, children were asked to learn a total of four novel words (i.e., Bem, Roop, Dax, Mot). Order of word training was the same across all children. However, due to other empirical questions of interest at the time the archival data were collected, children were asked to learn these novel words under two conditions. Two of the words were presented in a “baseline” condition in which environmental distractions were held to a minimum, and two of the words were presented in a “distraction” condition in which a sudden-onset mechanical toy was turned on during the word-referent mapping portion of the familiarization phase. Because these two conditions are not relevant to the present investigation, they will not be considered further. Thus, any effects of the distraction condition are statistically controlled.

Data Analysis Plan

Independent Variables

The EIIOS task served to produce some of the predictor variables used for data analysis. The initial phase of the task results in four individual variables – each one reflecting specific object-gesture performance – and one composite variable. Success on each of the four inappropriate object-gesture models was defined by the number of correct gestures (e.g.,

drinking gesture with a brush) the child produced during the 30-second period that occurred after modeling in which the child was presented the inappropriate object. Trials completed successfully were counted for number of drives, drinks, brushes, and hugs individually. In addition, a composite measure was formed by summing across all the trials completed successfully across all four inappropriate object-gesture models.

EIIOS “memory” measures were also derived. After the initial phase that followed modeling of the object-gesture combinations, the child received the first object again for a period of 30 seconds, then the second object for 30 seconds. The number of trials that contained successful reproductions of the modeled object-gesture combinations was counted again for the individual inappropriate object-gesture models, and a composite measure of total trials completed successfully was again derived.

Language Measures

The real-time word learning task (RTWL) and parent report language measure were used to generate the language-based outcome measures. RTWL variables included the trials successfully completed for each of the four words defined in two ways; first by the correct object put in the bucket, and second by the correct object being the first touched. An additional RTWL variable used to index word learning was the number of trials successfully completed for the word generalization phase of the task. Finally, the MacArthur Bates CDI produced six variables of interest: (1) vocabulary production, (2) irregular word forms, (3) overregularized words, (4) Mean length utterance based on three sentences, (5) sentence complexity, and (6) a composite measure created by converting each of the five variables of interest into a z -score and adding these z -scores together.

Descriptive Statistics

The first step in data analysis was to explore the descriptive statistics. Means and standard deviations of all variables were calculated.

Inferential Statistics

To determine whether a concurrent association existed between the EIIOS task and the two language measures, Pearson product-moment correlations were calculated between the EIIOS task variables and each set of language measures. EIIOS task variables included both success on the individual trials (e.g., drinking gesture with a brush) as well as the composite measure of the success across all trials. Success on the individual trials, as well as success overall on the task, was expected to positively correlate with each of the language measures. Using modeled inappropriate gestures both immediately after modeling and after the delay was expected to have a positive association with word learning, measured in both real-time, and through parent report.

CHAPTER 3

RESULTS

Descriptive Statistics

Means and standard deviations of the variables for the EIIOS task are located in Table 2.

The ratio of success on the individual trials was as large as 4:1 with drinking from the brush having the highest mean ($M = .96$) and hugging the car having the lowest mean ($M = .22$).

Looking at the means of the second phase of the EIIOS task (memory), it is evident that the participants had very little success at producing the appropriate gesture during the memory phase. The memory phase also resulted in a smaller sample size due to resistance from some children in completing this portion of the EIIOS task. When the objects were given during the memory phase, several children became distressed and the experimenter moved on to the second set of objects or to the next task in the protocol depending on when the child expressed disinterest during the EIIOS task. Table 3 includes the means and standard deviations of the language measures.

Table 2
Mean Performance on EIIOS Measures

Measure	Mean	SD	Min	Max	N
<i>The EIIOS task</i>					
<i>Trials completed successfully:</i>					
Drives	.81	1.03	0	4	54
Drinks	.96	1.16	0	4	54
Brushes	.56	0.78	0	3	52
Hugs	.22	0.57	0	3	54
Total across trials	2.54	2.64	0	9	54
<i>Trials from memory completed successfully:</i>					
Drives	.10	0.30	0	1	50
Drinks	.20	0.54	0	1	46
Brushes	.09	0.36	0	2	44
Hugs	.00	0.00	0	0	47
Total across trials	.33	0.73	0	4	54

Table 3
Mean Performance on Language Measures

Measure	Mean	SD	Min	Max	N
<i>Novel Word Learning</i>					
<i>Immediate Recall Phase:</i>					
First Touched	.41	.22	.10	.70	34
First in Bucket	.43	.18	.13	.67	34
<i>Generalization Phase:</i>					
First Touched	.41	.12	.00	.75	40
First in Bucket	.48	.14	.00	1.00	39
<i>Parent Report - MCDI</i>					
Vocabulary Production	85.83	85.04	4.00	385.00	52
Irregular Word Forms	.82	1.35	.00	6.00	51
Overregularized Words	.27	.66	.00	2.00	51
MLU of 3 longest sentences	1.26	1.53	.00	4.66	52
Sentence Complexity	.63	1.43	.00	5.00	52
Composite measure (Z-scores)	.14	4.01	3.25	13.64	49

Inferential Statistics

Contrary to expectations, Pearson product-moment correlations revealed that only three of the EIOS task measures were significantly associated with either language measure. Successful completion on the EIOS task, either immediately or after the delay, showed no relationship with any of the variables of interest during the real time word learning task's (RTWL) immediate recall phase. The children's successful immediate reproduction of the object gesture models, drinking from the brush and hugging the car, as well as the overall immediate EIOS composite measure, were significantly associated with putting the correct object in the bucket during the generalization phase of the RTWL task (see Table 4). However, these correlations were significant at the $\alpha = .05$ level, which renders them fairly likely due to chance given the experimentwise error rate. Performance on the EIOS task also showed no significant associations with any of the CDI parent-report language measures (see Table 5).

Table 4

Zero-order Correlations Among the EIIOS Task and RTWL Performance

<i>EIIOS Task</i>	<i>RTWL</i>		<i>RTWL</i>	
	<i>Immediate Recall</i>		<i>Generalization Phase</i>	
	<i>First Touched</i>	<i>First in Bucket</i>	<i>First Touched</i>	<i>First in Bucket</i>
Drives	-.125	-.017	-.022	.149
Drinks	-.052	.183	.049	.397*
Brushes	-.122	.097	-.175	.169
Hugs	.068	.073	.256	.316*
Total across Trials	-.083	.134	.022	.338*
Drives from Memory	-.320	.135	-.188	-.002
Drinks from Memory	-.276	-.243	-.150	.043
Brushes from Memory	.017	-.130	.159	-.023
Hugs from Memory	.000	.000	.000	.000
Total across Trials -Memory	-.333	-.114	-.106	.025

Note.* p < .05

Table 5

Zero-order Correlations Among the EIIOS Task and the CDI

<i>EIIOS Task</i>	<i>CDI</i>					
	<i>Vocabulary Production</i>	<i>Irregular Word Forms</i>	<i>Overregularized Words</i>	<i>MLU</i>	<i>Sentence Complexity</i>	<i>Composite Measure</i>
Drives	.074	.145	.049	.011	.181	.109
Drinks	-.198	-.150	-.138	-.117	-.035	-.180
Brushes	.018	.097	-.098	.032	.126	.042
Hugs	-.023	-.062	-.169	.119	-.055	-.061
Total across Trials	-.050	.014	-.106	-.002	.086	-.029
Drives from Memory	-.190	-.144	-.031	-.136	-.149	-.177
Drinks from Memory	.086	.118	.040	.012	.178	.095
Brushes from Memory	-.036	-.175	-.122	.144	-.128	-.092
Hugs from Memory	.000	.000	.000	.000	.000	.000
Total across Trials -Memory	-.005	-.034	-.028	.040	.008	-.019

CHAPTER 4

DISCUSSION

This study was an exploration of the association between language proficiency and EF in the second year. Given the lack of developmentally sensitive EF measures available for children during this time, the EIIOS task incorporated three important elements of EF and was used as a measure to index 18-month-old children's EF ability. As already noted, past research has shown strong associations between language proficiency and EF ability in older children and it was expected that strong associations would also be revealed in earlier childhood. However, findings revealed that there were no significant associations between performance on the EIIOS task and either language measure.

Explanation for Lack of Significant Findings

At least three explanations may account for the lack of significant associations between performance on the EIIOS task and both the real-time and parent report language measures. First, it could be that the EIIOS task is an insufficient index of EF. Second, it could be that EF performance is not associated with language outcomes. Third, it could be that the EIIOS task is insufficiently developed for use with children of this age range.

EIIOS is an insufficient index of EF

It is possible, although I believe unlikely, that the EIIOS task is an insufficient index of EF ability. The EIIOS task was originally developed to measure representational competence (Bates et al., 1980) but, as argued above, it still requires competence in areas specific to EF performance (i.e., attention allocation, working memory, effortful control). It is possible that at 18-months children are unable to use these three skills at the same time. Research has shown that children at this age can demonstrate competence in these three areas independently but given that

the EIIOS task requires the child to use the areas simultaneously or in quick succession, this may result in the EIIOS task, as employed in the present investigation, being an insufficient index of EF ability. I believe this explanation unlikely because success on the EIIOS task would nevertheless indicate performance in all three areas of executive functioning, and the EIIOS task has been shown to be measurable in the second year (Bates et al., 1980; Shore et al., 1984). Requiring the use of the three subskills simultaneously may be too complex at this age but the ability to do so is required in other EF measures that have been successful when used with children as young as 22-months (Carlson, 2005; Kochanska et al., 2000).

EF is Not Associated with Language

Another unlikely possibility for the lack of significant associations is that EF is not associated with language outcomes. This is unlikely because there is literature supporting the association between EF and language in older populations of children. McClelland et al. (2007) argued that EF promotes vocabulary acquisition at the ages of 3 and 4 years. Wolfe and Bell (2007) found similar results when they tested preschoolers' EF ability and language proficiency. In their study the children with the greatest EF ability had the highest scores on the PPVT. While this explanation is possible, it is not likely the case for the lack of association found in this study. Still, it must be acknowledged that there is a lack of research regarding EF's association with language when words are first being learned. Further research on the link between EF and language learning during first word acquisition would help address this gap.

EIIOS is Insufficiently Developed

Finally, and I believe most likely, it is possible that the present adaptation of the EIIOS task resulted in the task being insufficiently developed for use with children of this age range. The adaptation of the EIIOS task could have resulted in the task being too simple to identify

differences in EF ability in children at 18 months of age. I originally argued that multiple steps in an EIIOS type task may be too difficult for children at this age. However, adapting the EIIOS task to employ only single gestures may have inadvertently removed the difficulty needed to tap into the more complex components of EF. For one thing, an overly simplified EIIOS task may not have captured children's interests in replicating the object-gestural actions they saw modeled.

My findings illustrate that the performance during the memory trials of the task paled in comparison to performance during immediate testing. This lowered performance could have reflected a lack of motivation and interest in reproducing the target gestures a second time after the initial opportunity to produce them. Similar tasks implemented by Shore et al. (1984) used familiar scenarios involving multiple steps that the experimenter modeled and the child was asked to reproduce. These multistep sequences may have attracted the attention of children at this age, whereas a single act gesture may have been less appealing. However, given the unusual nature of the object-gesture combinations modeled by the experimenter, it still seemed reasonable to expect that children would have found the modeled gestures at least minimally interesting.

Ironically, it is also possible that the adaptation of the EIIOS task made the task too complex for some children. In Shore and colleagues version of the task (1984), the child observed the experimenter modeling the gesture with three different objects (i.e., an appropriate object, a neutral object, and an inappropriate object). When adapting the EIIOS task for present purposes, only an inappropriate object-gesture model was used. My rationale for using only this step of the sequence was to prevent the child from reproducing the gesture simply out of rote memory, as a result of seeing the gesture modeled repeatedly. However, by not providing a contrasting gesture model using the familiar gesture first, it may have made the task too hard.

For the child to recognize that the gesture was used incongruently, the child would have had to generate from memory the appropriate gesture for the object. This forced recall may have imposed an extra burden on the children in the present study relative to the task structure as employed by Shore and colleagues. Thus the appropriate contextual frame-work may not have been in place for the child to recognize that the experimenter knew the appropriate gesture for the object, and then decided to use the inappropriate gesture with the object anyway.

Conclusions

Despite the null findings resulting from this study, there is still a need for researchers to develop a measure of EF for the latter half of the second year. Links have been found between EF ability and general intelligence and the research is growing. Willoughby et al. (2010) found that at 3 years, children who performed better on EF tasks also performed better on the WPPSI-III. These EF tasks tapped into components that are similar to those in the EIIOS task: working memory, inhibitory control, and attention shifting. Identifying individual differences in EF at a young age can impact cognitive, language, and academic skills. The impact EF ability has on language proficiency (Gathercole & Baddeley, 1993), emotional self-regulation (Zelazo & Cunningham, 2007), and math and reading ability (Blair & Razza, 2007) proves that the need for an appropriate measure of EF in the latter half of the second year is crucial to early identification and intervention.

REFERENCES

- Baldwin, D.A. (1991). Infants' contribution to the achievement of joint reference. *Child Development, 62*, 875-890.
- Baldwin, D.A. (1995). Understanding the link between joint attention and language. In C. Moore & P.J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 131-158). Hillsdale, NJ: Lawrence Erlbaum.
- Bates, E., Bretherton, I., Snyder, L., Shore, C., & Volterra, V. (1980). Vocal and gestural symbols at 13 months. *Merrill-Palmer Quarterly, 26*, 407-423.
- Blair, C., & Razza, R.P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*, 647-663.
- Carlson, S.M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28*, 595-616.
- Carlson, S.M., Mandell, D.J., & Williams, L. (2004). Executive function and theory of mind: Stability and prediction from age 2 to 3. *Developmental Psychology, 40*, 1105-1122.
- Carlson, S.M., & Moses, L.J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032-1053.
- Carlson, S.M., Moses, L.J., & Breton, C. (2002). How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory. *Infant and Child Development, 11*, 73-92.
- Davis, H.L., & Pratt, C. (1996). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology, 47*, 25-31.

- Decety, J., & Sommerville, J.A. (2003). Shared representations between self and other: a social cognitive neuroscience view. *Trends in Cognitive Sciences*, 7, 527-533.
- Diamond, A. (1985). Development of the ability to use recall to guide action, as indicated by infants' performance on AB. *Child Development*, 56, 868–883.
- Diamond, A. (1990). The development and neural bases of memory functions as indexed by the AB and Delayed Response task in human infants and infant monkeys. In A. Diamond (Ed.), *The Development and neural bases of higher cognitive functions, annals of the New York Academy of Sciences* (pp. 267-317). New York, NY: New York Academy of Sciences.
- Diamond, A., & Goldman-Rakic P.S. (1989). Comparison of human infants and rhesus monkeys on Piaget's AB task: Evidence for dependence on dorsolateral prefrontal cortex. *Experimental Brain Research*, 74, 24-40.
- Dixon, W.E., & Salley, B.J. (2006). "Shhh! We're tryin' to concentrate": Attention and environmental distracters in novel word learning. *The Journal of Genetic Psychology*, 167, 393-414.
- Dunn, L.M., & Dunn, D.M. (2007). *PPVT-4 Manual*. Bloomington, MN: NCS Pearson.
- Fenson, L., Dale, P., Reznick, J., & Bates, E. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 59, v-173.
- Fenson, L., Dale, P., Reznick, J., Bates, E., Pethick, S., Hartung, J., Reilly, J. (1993). MacArthur Communicative Development Inventory. In *MacArthur Communicative Development Inventories: User's guide and Technical Manual*. San Diego, CA: Singular/Thomson Learning.
- Gathercole, S.E., & Baddeley, A.D. (1993). *Working memory and language*. Hillsdale, NJ:

Lawrence Erlbaum Associates.

- Gathercole, S.E., Hitch, G.J., Service, E., Martin, A.J. (1997). Phonological short-term memory and new word learning in children. *Developmental Psychology, 33*, 966-979.
- Gerstadt, C.L., Hong, Y.J., & Diamond, A. (1994). The relationship between cognition and action: Performance on children 3.5-7 years old on a Stroop-like day-night test. *Cognition, 53*, 129-153.
- Goldman-Rakic, P.S., 1987. Development of cortical circuitry and cognitive functions. *Child Development, 58*, 601-622.
- Golinkoff, R.M., Hirsh-Pasek, K., Bailey, L.M., Wenger, N.R. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology, 28*, 99-108.
- Hollich, G.J., Hirsh-Pasek, K., Golinkoff, R.M., Brand, R.J., Brown, E., Chung, H.L., Hennon, E., Rocroi, C. (2000). Breaking the language barrier: An emergentist coalition model for the origins of word learning. *Monographs of the Society for Research in Child Development, 65*, v-123.
- Hughes, C., & Graham, A. (2002). Measuring executive functions in childhood: Problems and Solutions?. *Child and Adolescent Mental Health, 7*, 131-142.
- Kochanska, G., Murray, K.T., & Harlan, E.T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology, 36*, 220-232.
- McClelland, M.M., Cameron, C.E., Connor, C.M., Farris, C.L., Jewkes, A.M., Morrison, F.J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*, 947-959.

- Mervis, C.B., & Bertrand, J. (1994). Acquisition of the novel name-nameless category (N3C) principle. *Child Development, 65*, 1646-1662.
- Ozonoff, S., Pennington, B.F., Rogers, S.J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry, 32*, 1081-1105.
- Pennington, B.F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 37*, 51-87.
- Reed, M., Pien, D.L., & Rothbart, M.K. (1984). Inhibitory self-control in preschool children. *Merrill Palmer Quarterly, 30*, 131-147.
- Reznick, J.S., Morrow, J.D., Goldman, B.D., Snyder, J. (2004). The onset of working memory in infants. *Infancy, 6*, 145-154.
- Rose, S.A., Feldman, J.F., & Jankowski, J.J. (2009). A cognitive approach to the development of early language. *Child Development, 80*, 134-150.
- Rothbart, M.K., & Bates, J.E. (2006). Temperament. In N. Eisenberg, W. Damon, & R. Lerner (Eds.), *Handbook of child psychology: Vol. 3, Social, emotional, and personality development* (6th ed.). (pp.99-166). Hoboken, NJ: John Wiley & Sons.
- Rothbart, M.K., & Posner, M.I. (2006). Temperament, attention, and developmental psychopathology. In C. Dante, & D.J. Cohen (Eds.), *Developmental psychopathology: Developmental neuroscience* (2nd ed.). (pp.465-501). Hoboken, NJ: John Wiley & Sons.
- Rueda, M.R., Posner, M.I. & Rothbart, M.K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology, 28*, 573-594.

- Salley, B.J., & Dixon, W.E. (2007). Temperamental and joint attentional predictors of language development. *Journal of Developmental Psychology, 53*, 131-154.
- Sheese, B.E., Rothbart, M.K., Posner, M.I., White, L.K., Fraundorf, S.H. (2008). Executive attention and self-regulation in infancy. *Infant Behavior & Development, 31*, 501-510.
- Shore, C. (1986). Combinatorial play, conceptual development, and early multiword speech. *Developmental Psychology, 22*, 184-190.
- Shore, C., O'Connell, B., & Bates, E. (1984). First sentences in language and symbolic play. *Developmental Psychology, 20*, 872-880.
- Smith, L.B. (1995). Self-organizing processes in learning to learn words: Development is not induction. In C. A. Nelson (Ed.), *Basic and applied perspectives on learning, cognition, and development* (pp. 1-32). Hillsdale, NJ: Erlbaum.
- Tomasello, M., & Farrar, M.J. (1986). Joint attention and early language. *Child Development, 1986*, 1454-1463.
- Tomasello, M., & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language, 4*, 197-211.
- Willoughby, M.T., Blair, C.B., Wirth, R.J., & Greenberg, M. (2010). The measurement of executive function at age 3 years: Psychometric properties and criterion validity of a new battery of tasks. *Psychological Assessment, 22*, 306-317.
- Wolfe, C.D., & Bell, M.A. (2007). The integration of cognition and emotion during infancy and early childhood: Regulatory process associated with the development of working memory. *Brain and Cognition, 65*, 3-13.

- Woodward, A.L., & Markman, E.M. (1998). Early word learning: In Damon, W. (Ed.), *Handbook of Child Psychology: Cognition, perception, and language* (2nd ed.). (pp. 371-420). Hoboken, NJ: John Wiley & Sons.
- Zelazo, P.D., & Cunningham, W.A. (2007). Executive Function: Mechanisms underlying emotion regulation: In Gross, J. (Ed.), *Handbook of emotion regulation* (pp. 135-158). New York, NY: Guilford Press.
- Zelazo, P.D., Reznick, J.S., & Spinazolla, J. (1998). Representational flexibility and response control in a multistep multilocation search task. *Developmental Psychology*, *34*, 203-214.

VITA

LESLIE PATTON

- Education: M.A. General Psychology, East Tennessee State University, Johnson City, Tennessee 2013
- B.S. Psychology, East Tennessee State University, Johnson City, Tennessee 2008
- Professional Experience: Instructor, Abnormal Psychology Research Lab; East Tennessee State University, Johnson City Tennessee, 2009-2010
- Graduate Research Assistant, Program for the Study of Infancy; East Tennessee State University, Johnson City, Tennessee, 2008-2010
- Research Assistant, Skin Cancer Prevention Lab; East Tennessee State University, Johnson City, Tennessee, 2006-2008
- Publications: Dixon, W. E., Lawman, H. G., Johnson, E. B. H., May, S., Patton, L. A., Lowe, A. K., & Snyder, C. M. (2011). Effects of Exogenous and Endogenous Distracters on Immediate and Long-Term Recall in Toddlers. *Infancy*, 1-33. doi: 10.1111/j.1532-7078.2011.00090.x
- Honors and Awards: James H. Quillen scholarship, 2009
The Honor's College Student/Faculty Research Grant, 2008
Appalachian Student Research Forum,
3rd Place: Undergraduate Division, 2007