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EXPLORING THE INFLUENCE OF SOCIOECONOMIC STATUS ON THE EXECUTIVE
FUNCTION AND THEORY OF MIND SKILLS OF PRESCHOOLERS

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of
Philosophy at Virginia Commonwealth University

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April, 2016

Acknowledgement

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Abstract

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FUNCTION AND THEORY OF MIND SKILLS OF PRESCHOOLERS

By Andrea Molzhon, M.S.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of
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Director: Geraldine Lotze, Ph.D., Associate Professor, Department of Psychology

Executive function (EF) and theory of mind (ToM) skills develop rapidly during the preschool

years and have been found to directly and indirectly contribute to school readiness. Evidence

indicates that EF may influence ToM development, though this relation may not be consistent

across children from different backgrounds. Additionally, socioeconomic status (SES) has been

shown to affect preschoolers' EF, while the literature is mixed regarding the effects – if any –

that SES may have on ToM development. Though the relation between EF and ToM appears

robust across the literature, the possible effects of SES on this relation have yet to be fully

explored. As children from low-SES homes are more likely to fall behind at the start of school,

and this achievement gap is likely to widen through the school years, it is important to

understand how the cognitive components that contribute to school readiness develop and are

affected by SES so that we may work toward improving preschool education for children across

all socioeconomic backgrounds. The primary purpose of the current study was to determine

whether SES affected the relation between EF and ToM among urban preschool children (ages 3-

5 years) from various SES backgrounds. In addition to examining the EF-ToM relation, relations among SES, general cognitive skills, EF, and ToM, as well as relations among age, EF, and ToM, were examined. Results from correlational and regression analyses indicated that SES was related to EF but not ToM, and that EF was not related to ToM after controlling for age. Inconsistent with the majority of previous findings, the results did not support the hypothesized link between EF and ToM. However, the findings from this study do add support to the large body of literature pertaining to the positive relation between SES and EF, and provide evidence that ToM may be relatively protected from the negative effects of low-SES among preschoolers. Results also support previous reports of large age-related changes in EF and ToM that occur during the preschool years. The implications for preschool development and education are discussed.

Exploring the Influence of Socioeconomic Status on the Executive Function and Theory of Mind

Skills of Preschoolers

During the preschool period, the mind of a typically developing child undergoes

substantial development in complex areas of cognition that are essential to the learning process

and that facilitate positive adjustment to the school environment. While cognitive development

ranges from the development of basic cognitive abilities, such as the ability to understand simple

causality and the basic understanding of time and space, to more complex cognitive abilities,

such as the ability to problem solve and think abstractly, the development of complex cognitive

abilities occurs along a more protracted course and is highly affected by a child's environment

and experiences (see Diamond, 2002; Piaget, 1937; Vygotsky, 1978). As such, development of

complex cognition, in particular, is not uniform across all children in our society; often

environmental circumstances play a large role in shaping a child's chances of success both

within and beyond the school environment. In fact, studies have shown that the socioeconomic

status (SES) of a child's family during the first five years of life is a strong predictor of that

child's probability for achievement throughout the school-aged years and the years that follow

(Duncan, Yeung, Brooks-Gunn, & Smith, 1998). Moreover, there is profound evidence that the

achievement gap between middle-income and low-income children widens with time and can

lead to serious learning difficulties, higher drop-out rates, and smaller chances of establishing

long-term employment (Ryan, Fauth, & Brooks-Gunn, 2006; Welsh, Nix, Blair, Bierman, &

Nelson, 2010). Without receiving the necessary support, it may be difficult for children who start

out life with social and economic disadvantages to overcome these obstacles and realize their full

potential. Yet, at present, the field of cognitive developmental psychology has failed to

adequately examine how socioeconomic status (SES) affects all of the areas of cognition that are

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evidenced to aid in the promotion of school readiness. In order to design programs that would effectively prepare children from various SES backgrounds for the cognitive challenges of the early school environment, we need to develop a better understanding of how SES relates to early cognitive skills, particularly those complex skills that promote school readiness and are highly influenced by environmental factors.

As stated, the development of complex or high-order cognitive skills plays an important role in learning and academic achievement. The current literature includes a wealth of evidence supporting the importance of general areas of complex cognition on school readiness and achievement, areas such as language (Forget-dubois, Dionne, Lemelin, Perusse, Tremblay, & Boivin, 2009; Prior, Bavin, & Ong, 2011), self-regulation (Bierman, Domitrovich, Nix, Gest, Welsh, Greenberg et al., 2008; Campbell & Stauffenberg, 2008; Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov et al., 2007; Miech, Essex, & Goldsmith, 2001), and more specific language skill areas such as reading (Duncan et al., 2007) and literacy (Whitehurst & Lonigan, 1998; Prior et al., 2011). Related to self-regulation, two areas of complex cognition that develop rapidly during the preschool years and also have been shown to influence school readiness are executive functions (EF) and theory of mind (ToM). Though these constructs represent complex cognitive skills that aid in the promotion of school readiness and positive adjustment to the school environment (Blair & Razza, 2007; Evans & Rosenbaum, 2008; Farrar & Ashwell, 2008; Welsh et al., 2010), compared to the extant literature on the influences of SES on early language and self-regulatory development, considerably less is known about the influence of SES-related contextual factors on early EF and ToM development.

EF and ToM represent two distinct forms of cognition, though both have been linked to the prefrontal cortex (Liu, Sabbagh, Gehring, & Wellman, 2009; Stuss & Anderson, 2004), i.e.,

the frontal lobe or front bilateral section of the brain (see Zelazo, Carlson, & Kesek, 2008). As a multifaceted cognitive construct, EF includes several processes that relate to cognitive control. In general terms, cognitive functions such as working memory, inhibition, cognitive flexibility or set shifting (of rules and/or response patterns), and planning skills underlying goal-directed responses – particularly when responses are generated under conditions of novelty and/or difficulty, reflect one's EF (Hughes, Ensor, Wilson, & Graham, 2010; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). ToM refers to one's ability to flexibly alternate between mental states, perspectives, and beliefs, both intrapersonally (pertaining to one's own cognition) and interpersonally (pertaining to the cognitions of others; e.g., Lucariello, Durand, & Yarnell, 2007). Unlike EF, ToM requires one to deviate or alter one's own current cognitive perspective to accommodate a new perspective, a previous perspective, or the perspective of another. Taken together, the constructs of EF and ToM are what allow us to control our cognitions when needed and shift our perspectives; and, among school children, they provide many of the tools needed for positive adaptation to the often-changing cognitive and social demands of the school environment. Moreover, based on considerable evidence that has emerged from the field of cognitive development, current theories suggest that the development of EF and ToM may be intimately linked (Carlson et al., 2002; Hughes, 1998a). However, at present, the nature of this link and the effects of this link on school readiness have yet to be fully explored.

The following literature review and subsequent study will focus on the EF and ToM skills of preschool children, with a special focus on the link between these two skill areas and the role SES background variables play on this link. In the sections that follow, the literature review will begin with an overview of the construct of EF, including the typical developmental course of EF skills during the preschool years, the importance of EF within the early academic context, and

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the effects of environmental forces on the development of EF. In discussing notable contextual influences on EF development, evidence of the direct and indirect influences of SES will be a particular focus and will inform the hypotheses and goals of the current study. The next section will describe the construct of ToM and will feature the same subsection themes and same general focus as the previous section on EF. After defining and describing these two constructs, the review will discuss evidence of the proposed link between EF and ToM development in young childhood, and will identify and describe environmental/contextual factors that may influence the relation between EF and ToM. Additionally, the review will include a detailed description of the way that the SES construct will be conceptualized in the proposed study and will provide relevant support from the literature for the planned method of conceptualization. The review will conclude with a summary of the key findings and implications of the reviewed literature and will be followed by a description of the purpose of the current study, the study's hypotheses, and the proposed methods that will be used to conduct the study.

Preschoolers' Executive Functions

  EF: Backgound. Though today, EF is commonly studied from the standpoints of cognitive and developmental psychology, the study of EF originated from neurological studies of adults with prefrontal cortex (PFC) damage (Goldstein, 1936, 1944; Goldstein & Scheerer, 1941; Luria, 1966). Specifically, the study of EF emerged from studies of individuals with PFC impairments who exhibited consistent difficulty in making sound judgments, planning, flexibly adjusting cognition, inhibitory control, and impulse control (Stuss & Benson, 1984; Tranel, Anderson, & Benton, 1994; Wise, Murray, & Gerfen, 1996; for a review, see Zelazo et al., 2008). Later, these adult cognitive functions were recognized as falling under the umbrella term *executive functions* – or the overarching control system of cognition. In the decades since these

early inquiries into the functionality of the PFC, EF – as a psychological construct – has become a prominent area of study for cognitive and developmental researchers alike (e.g., Welsh & Pennington, 1988; for a review, see Garon, Bryson, & Smith, 2008).

Based on psychological theory, EF may be defined as a higher-order cognitive process – or integration and coordination of controlled cognitive sub-processes – that is both functionally integrated and functionally diverse (Miyake et al., 2000; see Zelazo et al., 2008 for a review). Over the years, a number of theories have been proposed regarding the structure and development of EF. One subset of theories centers on the idea that EF represents a unitary construct with component sub-processes. For example, one unitary theory of EF holds that components of the working memory system (i.e., the active short-term storage, manipulation, and recall of visual and auditory information held in short-term memory) underlie all forms of EF (e.g., Baddeley, 1996; Baddeley & Hitch, 1974; De Rammelaere, Stuyven, & Vandierendonck, 2001; DeStefano & LeFevre, 2004; Luciana & Nelson, 1998; Oberauer, Süß, Schulze, Wilhelm, & Wittmann, 2000; Swanson & Sachse-Lee, 2001), and that developmental improvements in working memory foster developmental improvements in overall EF (Case, 1992; Pascual-Leone, 1970). Posner and Rothbart also have argued that improvements in EF skills during early childhood can be traced to a single system, though they suggest that a central attention system – rather than the working memory system – underlies EF development (Posner & Rothbart, 1998; Rothbart & Posner, 2001). Additionally, another theory (or subset of related theories) places a larger emphasis on the inhibitory control aspect of EF, stating that inhibition – potentially in concert with working memory – is required by all tasks of EF and that it facilitates developmental improvements in EF (Barkley, 1997; Dempster, 1992; Diamond, 2002; White, 1965). What these unitary theories have in common is that they posit somewhat of a domain

specific view of EF, asserting that all cognitive processes requiring executive control are driven by the same core, underlying cognitive system.

In contrast to the unitary views, others have suggested that EF is comprised of dissociable processes that develop along distinct trajectories (e.g., Diamond, 2006; Hughes, 1998a; Huizinga, Dolan, & van der Molen, 2006; Welsh, Pennington, & Groisser, 1991). Following from this diverse view of EF, many have suggested that the construct of EF be broken down into three separate but related components, namely: working memory, inhibition, and set shifting (Miyake et al., 2000; Huizinga et al., 2006). Based on the Baddeley (1986; 2000; 2002) model of working memory, working memory may be defined as the memory system responsible for briefly storing, updating, retrieving and/or manipulating auditory, visual, and temporal information. Miyake et al. (2000) defined inhibition, or inhibitory control, as one's ability to actively suppress a prepotent or dominant response, which may include the inhibition of a response over a delay period or the inhibition of a response in the face of distracting or conflicting stimuli (e.g., Carlson & Moses, 2001). Set shifting entails the active initiation of a new response pattern after suppression of a previous response pattern and the alternation between/among response sets (Miyake et al., 2000). The major distinction between complex inhibition and set shifting is in the initial trial phase. While complex response inhibition requires the suppression of a prepotent or dominant response, set shifting requires the suppression of an arbitrary rule or response pattern that was established in the initial task phase and initiation of a new – arbitrary – response (Garon et al., 2008).

From the field of neuropsychology, there is evidence to support the differentiation of EF in that components of EF have been found to be associated with different areas of the PFC (e.g., Anderson, Levin, & Jacobs, 2002; Chow & Cummings, 1999; Crone, Donohue, Honomichl,

Wendelken, & Bunge, 2006; Giedd, Blumenthal, Jeffries, Castellanos, Liu, Zijdenbos et al.,

1999; Stuss, Alexander, Floden, Binns, Levine, McIntosh et al., 2002; see Bunge & Zelazo, 2006

for a developmental review; see Figure 1). Within the PFC network, the orbitofrontal cortex, the

medial PFC (M-PFC), and the lateral prefrontal cortex (L-PFC), comprised of the ventrolateral

PFC (VL-PFC), the dorsolateral PFC (DL-PFC), and the rostrolateral PFC (RL-PFC), are

typically activated when one is engaging at least one component of EF (see Bunge & Zelazo,

2006 for a review). For example, while Tsujimoto and colleagues found that both children and

adults activated the L-PFC when completing a working memory task (Tsujimoto, Yamamoto,

Kawaguchi, Koizumi, & Sawaguchi, 2004), Wolfe and Bell (2004) found that when tasks

required both working memory and inhibition, children displayed neurological activity in the M-

PFC. Also, Eslinger, Flaherty-Craig, and Benton (2004) found that early damage to the PFC

affected long-term outcomes related to EF deficits in different ways depending on where in the

PFC the damage occurred. Furthermore, not only have these areas of the PFC been found to

display differential patterns of activation for different tasks of EF; studies also have shown that

differential patterns of neurological maturation mirror differential patterns of EF skill

development (for a review, see Anderson & Reidy, 2012). To provide a recent example of such

evidence, Moriguchi and Hiraki (2011) found that performance improvements among three- and

four-year-olds on a switching task coincided with increases in activation in the inferior PFC

region. In addition, Ezekiel, Bosma, and Morton (2013) reported that among children and adults,

activity within the network of connections associated with switching (specifically, connections

between the inferior PFC and areas located outside the PFC: the anterior cingulate, inferior

parietal cortex, and the ventral tegmental area) is stronger among adults than among children,
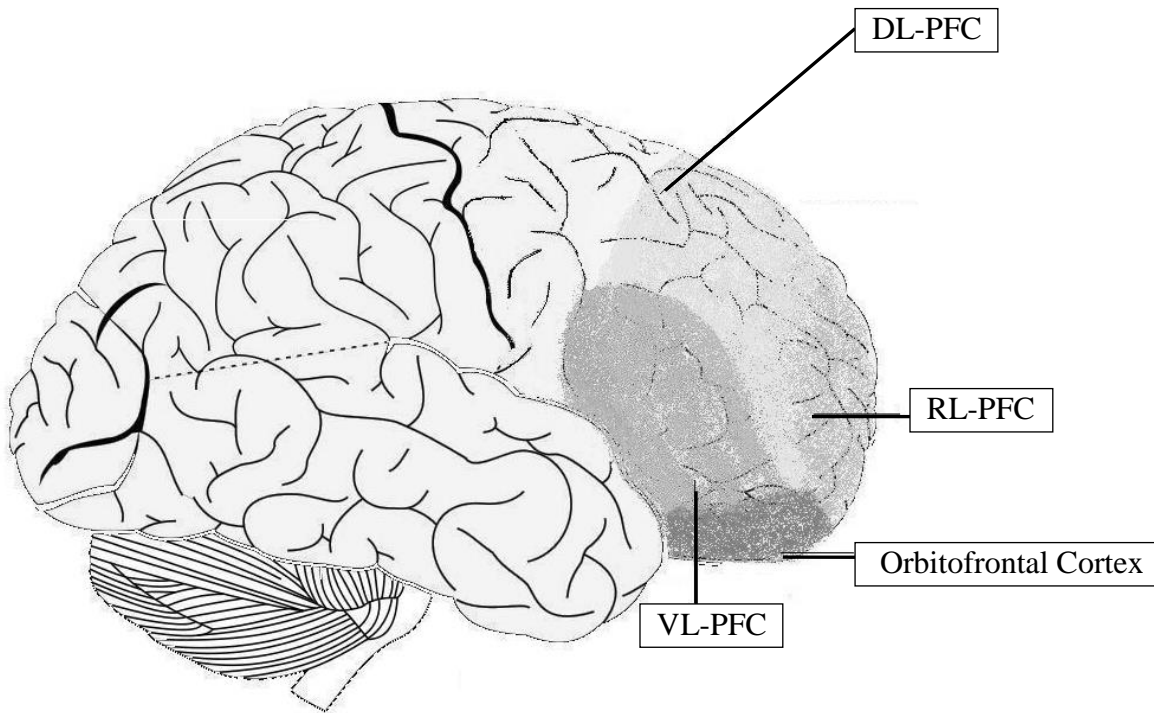
Figure 1. Lateral view of the approximate locations of the areas of the PFC (adapted from Molzhon, 2010).

indicating that this neurological network becomes more refined and functional with development.

In addition to evidence from neurocognitive studies supporting a diverse view of EF, the developmental literature also provides support for this perspective. To examine the developmental trajectories of component EF processes, Huizinga et al. (2006) investigated age-related differences in complex EF skills (i.e., planning, problem solving) as well as in components of EF (i.e., working memory, set shifting, and inhibition) across four age groups ranging from six to 26 years of age. In attempting to adequately measure each component across multiple age groups, the authors included a large battery of EF tasks (nine in total) tapping into the basic processes related to EF in addition to three complex EF tasks tapping into the

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coordination of multiple EF processes. Supporting a diverse view of EF development, they found that working memory performance reached an adult-like level by 12 years of age, while set shifting performance continued to develop until 15 years of age. Also, they found differentiation from within the construct of inhibition, suggesting that some factors related to inhibition are developed by 11 years of age while others continue to develop until about 15 years of age. These results are consistent with several other studies that have indicated that age has differential effects on different components of EF (e.g., Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Welsh et al., 1991). Such observed differences in the developmental trajectories of component EF processes indicate that the construct of EF does include dissociable components and is not driven by a single, unitary function.

Additionally, studies that have examined the contributions of EF to academic achievement provide further support for the multicomponent view of EF and EF development (e.g., Altemeier, Abbott, & Berninger, 2008; Blair & Razza, 2007; Bull & Scerif, 2001). To examine the contributions of EF to mathematic performance among primary school Year 3 students in Scotland, Bull and Scerif (2001) administered multiple measures of EF to children, including one measure of set shifting (the Wisconsin Card Sort Test-Revised and Expanded; Heaton, Chelune, Talley, Kay, & Curtiss, 1993), one measure of inhibition (the Stroop task; Salthouse & Meinz, 1995), and two measures of working memory (dual-task performance test and a counting span task; Baddeley, Della Sala, Papagno, & Spinnler, 1997; Case, Kurland, & Goldberg, 1982), as well as a measure of general mathematics ability (the Group Mathematics Test; Young, 1970). The authors conducted several multiple regression analyses and discovered that each individual measure of EF explained a unique portion of variance in math scores even after accounting for the variance from the other EF measures. However, after accounting for the

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contributions of the other EFs as well as the contributions of reading ability and general intelligence, working memory was the only EF variable that remained significant. In addition, Altemeier et al. (2008) longitudinally examined the unique effects of inhibition and set shifting on the reading and writing skills of typically developing children and children with dyslexia from Grade 2 through Grade 6. Results from multiple regression analyses indicated that inhibition and set shifting both uniquely contributed to word reading at Grade 3, to reading comprehension at Grades 2, 3, and 5, to spelling at Grades 3 and 4, and to written expression at Grades 3 and 4. Thus, consistent with the findings from a similar study conducted by Bull and Scerif (2001), they found that different components of EF provided unique contributions to academic performance – in this case, reading and writing skills. Taken together, these studies indicate that components of EF may have differential effects on academic achievement that may not be captured by singular definitions of the EF construct.

While studies that have investigated the latent structure of EF among normal and brain-injured adults largely have supported the diverse view of EF (e.g., Duncan, Johnson, Swales, & Freer, 1997; Godefroy, Cabaret, Petit-Chenal, Pruvo, & Rousseaux, 1999; Miyake et al., 2000), studies examining the latent structure of EF among preschoolers have produced mixed results. Within the literature pertaining to adolescent and adult EF, the most commonly utilized model is the tripartite model proposed by Miyake and colleagues (2000). Based on a sample of adults, Miyake et al. (2000) collected data from nine common EF tasks and, through latent variable analysis, found the most statistically validated model to be the model with three separate but correlated factors, labeled: working memory updating, shifting, and inhibition. Following this model, Hughes (1998a) administered a battery of EF tasks (including: two measures of working memory, two measures of inhibitory control, and two measures of attentional flexibility/set

shifting) to children between three and four years of age and found that results from a principle

components analysis (controlled for age and verbal ability) supported the tripartite model of EF.

In addition, Lehto and colleagues conducted a similar study with older children (ages 8-13) and,

based on results from exploratory and confirmatory factor analysis, determined that children's

EF was best represented by three separate but related factors, factors that were conceptually

consistent with the factors identified in the previous study involving preschoolers (Lehto,

Juujärvi, Kooistra & Pulkkinen, 2003). However, Fuhs and Day (2011) and Wiebe, Espy, and

Charak (2008) both examined the factor structure of preschoolers' EF using confirmatory factor

analysis (Fuhs & Day: response inhibition and attention shifting as separate factors; Wiebe et al.:

inhibitory control and working memory as separate factors) and found that multicomponent

models did not significantly fit the data better than a single-component model. Although neither

of these two more recent studies followed the exact methodology of Hughes (1998a) in

administering to children multiple measures of each purported component of EF (working

memory, inhibition, and set shifting), taken together, the results suggest that set shifting may not

be clearly distinguishable from inhibition which, in turn, may not be entirely distinguishable

from working memory among preschoolers.

Despite the uncertainty surrounding the dissociable structure of working memory,

inhibition, and set shifting in preschoolers, Carlson and her colleagues consistently have found

that preschoolers' inhibition skills may be divided into two categories: inhibition in the face of a

conflicting prepotent response (conflict inhibition) and inhibition requiring the delay of a

prepotent response (delay inhibition; e.g., Beck, Schaefer, Pang, & Carlson, 2011; Bernier,

Carlson, & Whipple, 2010; Carlson & Moses, 2001; Carlson et al., 2002; Davis-Unger &

Carlson, 2008). For example, while attempting to examine the relations between preschoolers'

inhibitory control and ToM skills, Carlson and Moses (2001) included a battery of 10 inhibitory control tasks that were theoretically divided into delay tasks and conflict tasks. The delay battery consisted of four tasks, each with task demands that ranged from requiring children to delay or withhold a dominant response or delay gratification until they received a signal from the experimenter, to wait through a protracted delay period until it was their designated turn to provide a response, or to slow themselves down in order to reflect on response choices before choosing a response. Dependent measures from these tasks included average waiting time, number of rule violations, latency to response, and/or relative proportion of rule compliance. The conflict battery consisted of six tasks in which children were instructed to provide a response that was in direct conflict with a given stimulus (i.e., say "day" when shown a picture of the moon, say "night" when shown a picture of the sun), to override the tendency to assume stimulus/location congruence and respond to stimulus/location incongruence (i.e., press right "doll" key and not left "elephant" key when shown doll picture on left side of screen), to follow the instructions of one puppet and not another, to ignore a dominant dimension and sort cards based on a non-dominant dimension, and to whisper rather than shout a series of responses. After conducting a principle components analysis, they found that the hypothesized two-factor structure of the inhibition battery was supported by the data. In addition to Carlson's research, the distinction between conflict and delay inhibition has been supported by the results from several other studies that also used principle components analysis to explore the structure of preschoolers' inhibitory control skills (e.g., Bernier et al., 2010; Kochanska, Murray, & Harlan, 2000). Thus, given that the literature on the structure of EF among preschoolers is mixed – with some evidence indicating that EF is a fully dissociable construct (Hughes, 1998a; Lehto et al., 2003), some evidence indicating that EF is a unitary construct (Fuhs & Day, 2011; Wiebe et al.,

2008), and other evidence indicating that EF is at least partly dissociable within this age group (Bernier et al., 2010; Carlson & Moses, 2001) – the current study tentatively will conceptualize EF as a multifaceted construct, including both conflict and delay inhibition, working memory, and set shifting, but will explore the possibility of overlaps within this construct, as well.

EF development through preschool. Evidence indicates that children undergo tremendous age-related improvements in EF during the preschool years (e.g., Diamond & Taylor, 1996; Frye, Zelazo, & Palfai, 1995; Gerstadt, Hong, & Diamond, 1994; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). Although children ages three-to-four typically have difficulty holding two rules in mind simultaneously and inhibiting a prepotent response (e.g., Diamond, Kirkham, & Amso, 2002; Diamond & Taylor, 1996; Gerstadt et al., 1994), switching to a new rule and resisting the urge to perseverate (e.g., Kirkham, Cruess, & Diamond, 2000; Zelazo, Frye, & Rapus, 1996), and delaying gratification (e.g., Kochanska et al., 1996; Mischel & Mischel, 1983), these cognitive tasks are relatively simple for children ages five-to-seven (e.g., Gerstadt et al., 1994; Passler, Isaac, & Hynd, 1985). These EF skills do not spontaneously come "online" once children enter the school-age years; rather, they develop gradually and substantially over the first few years of life, perhaps reflecting the protracted growth of the PFC from infancy through childhood (e.g., Luria, 1973; Stuss, 1992; Thatcher, 1992; see Diamond et al., 2002 and Huttenlocher & Dabholkar, 1997 for reviews).

As previously noted, areas of the PFC associated with EF display age-related patterns of maturation that coincide with improvements in EF skills (for a review, see Tsujimoto, 2008). These patterns of maturation include: increases in white matter indicating increased myelination of the axons in the PFC, which facilitates efficient neuronal activity (Giedd et al., 1999; Pfefferbaum, Mathalon, Sullivan, Rawles, Zipursky, & Lim, 1993; Yakovlev & Lecours, 1967),

initial increases in grey matter followed by decreases over childhood and adolescence –
indicating a protracted period of synaptic pruning (Huttenlocher, 1990; Pfefferbaum et al., 1993),
and increased localization of patterns of brain activity associated with EF as well as increased
specialization within the PFC (Bunge, Dudukovic, Thomason, Vaidya, & Gabrieli, 2002; Crone,
Donohue, Honomichl, Wendelken, & Bunge, 2006; Durston, Davidson, Tottenham, Galvan,
Spicer, Fossella et al., 2006; Tamm, Menon, & Reiss, 2002). Tamm et al. (2002) examined age-
related differences in patterns of brain activation associated with performing an inhibition task
(the Go/No Go task; Donders, 1868/1869) among children, adolescents, and young adults
(ranging in age from 8 to 20 years) while the participants underwent functional magnetic
resonance imaging (fMRI). At the performance level, they found that inhibition improved
significantly with age as indicated by decreases in reaction times. Also, they found that children
were more likely to demonstrate patterns of activity in various regions of the PFC during the task
whereas older participants demonstrated more confined patterns of activity—specifically in the
left inferior frontal gyrus (the orbitofrontal cortex). These results imply that as the brain matures
with age, the PFC gradually becomes more specialized for carrying out functions associated with
EF, leading to protracted age-related increases in EF efficiency.

Despite the fact that the majority of neuroimaging studies on the PFC have been limited
to participants of school-age or older, evidence indicates that early childhood represents an
important time period for PFC development, as well (Diamond & Goldman-Rakic 1989;
Diamond, 2002; see Anderson & Reidy, 2012 and Tsujimoto, 2008 for reviews). Postmortem
studies have revealed that while synaptic density in the PFC reaches its peak at around 3.5 years
of age (Huttenlocher & Dabholkar 1997), neuronal density gradually but significantly decreases
from age two to age seven (Huttenlocher, 1990). In addition, Tsujimoto and colleagues used

near-infrared spectroscopy (an imaging technique that is less invasive than fMRI) on children aged four-to-seven years while the children performed a working memory recognition task (Tsujimoto, Yamamoto, Kawaguchi, Koizumi, & Sawaguchi, 2003). The authors found that, in addition to the better performance rates of the older participants, PFC activation increased linearly as a function of age. The important implications of their results are that the PFC is active and functional among children at least as young as age four and that significant maturation of the PFC (as demonstrated by increased localization) does occur prior to the school-age years (see also Tsujimoto et al., 2004).

Pertaining to the behaviorally observed development of EF, studies have demonstrated that rudimentary EF skills develop very early in life (e.g., Diamond, 2002; Espy & Kaufmann, 2002; Munakata, 1998). While contemporary studies of EF often utilize large task batteries with each task tapping a specific component of EF, researchers interested in studying EF in the youngest of populations tend to utilize tasks that focus on two or more components, such as working memory and inhibition, rather than a single EF component. This tendency perhaps reflects the difficulty in establishing a "pure" measure of EF suitable for infants and toddlers, as cognitive tasks are more difficult to design for very young children and EF components often overlap in this age group. Among these tasks, the A-not-B task (Piaget, 1937) and the delayed response task (Jacobsen 1935; 1936) are two of the most commonly used measures and are purported to tap into early working memory and inhibition skills (for a review, see Diamond, 1990). In a standard A-not-B task, an infant watches as an object is hidden in one of two locations – *location A* – and the infant is immediately allowed to then reach for the hidden object. In plain view of the infant, the object is retrieved from location A and re-hidden in a second location – *location B*. Similarly, the delayed response task involves an initial trial, a short

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delay period, and the retrieval of an object after it has been moved to a new location; the difference being that the order or series in which the trials occur and the number of hiding locations are slightly different in the delayed response task than in the A-not-B task (see Diamond, 1990 for task description).

Although the A-not-B task and the delayed response task were developed separately, they are remarkably similar and yield similar patterns of developmental progression (Diamond, 1990; Diamond & Doar, 1989). Studies have found that infants typically "perseverate," or incorrectly look to the initial hiding location of the object after the object has been moved, until 9-to-12 months of age (Diamond, 1990; Espy & Kaufmann, 2002). Additionally, when the delay period between hiding the object in the second location and allowing infants to search for the object is sufficiently increased, infants have more trouble producing a correct response (Diamond, 1990). By 12 months of age, typically developing infants are capable of tolerating a delay of 12 seconds or more; from 7 months to 12 months, infants generally can tolerate delays of two additional seconds per month (Diamond, 1990). The so-called "A-not-B error" (Piaget, 1937) of perseveration may reflect an infant's inability to update information in working memory and/or inhibit a habitual response (Diamond, 1990; Munakata, 1998); likewise, age-related improvements on this task are thought to reflect a child's developing executive abilities (Welsh, Friedman, & Spieker, 2006). Beyond infancy, EF becomes more complex and refined; thus – as mentioned previously in relation to the conceptualization of the construct of EF – many measures have been designed for use with young children that attempt to tap into the separate components of EF, including: delay and conflict inhibition, working memory, and set shifting.

Delay and conflict inhibition. Studies have found that abilities related to suppressing a dominant response, stopping one's self from engaging in an enjoyable or rewarding activity, and

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delaying or slowing a response emerges within the first year of life and improves through toddlerhood (Kochanska, Coy, & Murray, 2001; Kochanska et al., 2000; Kochanska, Tjebkes, & Forman, 1998). During the preschool years, two areas that undergo notable improvement among typically developing children are the aforementioned delay and conflict inhibition skills. Concerning delay inhibition, Kochanska and colleagues (1996) reported that children's waiting ability (represented as resistance to peeking and latency to peeking) on a gift delay task (i.e., children are instructed to wait to receive a gift and not to peek while the experimenter is wrapping it) improved significantly from the time children were first tested – at 2.5-to-3.5 years of age – to the time they were tested again – at 3.5-to-4.5 years of age – indicating that delay inhibition develops significantly prior to the school-age years. Reck and Hund (2011) found evidence supporting these results among three- to six-year-olds, and a previous study conducted by Toner and colleagues (1977) found that older preschool children were able to delay a prepotent response for significantly longer than younger children (Toner, Holstein, & Hetherington, 1977). Moreover, Toner et al. (1977) reported that – for both three- and four-year-olds – children with higher delay abilities consistently exhibited more resistance to temptation and greater delay of gratification across multiple delay measures than children with poorer delay skills.

Abilities related to conflict inhibition gradually emerge during the first two years of life and show significant signs of improvement over the preschool years, as well (e.g., Clohessy, Posner, & Rothbart, 2001; Gerardi-Caulton, 2000; Kochanska et al., 1996; Kochanska, Murray, & Coy, 1997; Rothbart, Ellis, Rueda, & Posner, 2003; Rueda, Fan, McCandliss, Halparin, Gruber, Lercari et al., 2004). Gerstadt and colleagues (1994) reported that children's performance on a sun and moon conflict task (described previously as used by Carlson & Moses,

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2001) underwent significant age-related improvements from age three through age seven. In addition, Carlson (2005) found that when children were faced with the task of providing a response that conflicted with both a dominant *and* prepotent response (i.e., sort each card into a bin that is labeled with a contrasting stimuli; sort cards using a method that is opposite to a previously used method), few two-year-olds were able to pass while, in contrast, the overwhelming majority of three-year-olds succeeded in the task. Thus, increasing the complexity of conflict inhibition tasks can affect the developmental trajectories associated with performance on these tasks. In fact, some have suggested that the growing ability to overcome cognitive conflict represents the most critical aspect of EF development during the preschool period (Zelazo & Frye, 1998; Zelazo & Müller, 2002; Zelazo, Qu, & Müller, 2005). Many other studies have generated support for Gerstadt et al.'s finding that the ability to manage cognitive conflict improves dramatically over the preschool years (e.g., Jones, Rothbart, & Posner, 2003; Rothbart & Posner, 2001; Zelazo & Frye, 1998; Zelazo & Müller, 2002; Zelazo et al., 2005; for a review, see Garon et al., 2008).

  Working memory. In addition to developmental improvements in delay and conflict inhibition, early childhood entails significant age-related improvements in the working memory and set shifting areas of EF, as well. Findings from factor analyses on data collected from children and adolescents indicate that tasks that tax one's memory span and/or require one to hold information in mind during a delay period represent a different component of working memory than tasks that require one to update and manipulate items held in mind (Alloway, Gathercole, Willis, & Adams, 2004; Gathercole, Pickering, & Ambridge, & Wearing, 2004), and these working memory components develop along different trajectories (see Garon et al., 2008 for a review). Evidence from the delayed response task indicates that while infants younger than

six months of age demonstrate a rudimentary ability to hold information in mind over a brief

delay period (Johnson, 2005; Pelphrey, Morris, & McCarthy, 2004; Reznick, Morrow, Goldman,

& Snyder, 2004), from six months to 12-14 months of age, infants become more capable of

holding information in mind for increasingly longer periods of time (Diamond, 1990; Diamond

& Doar, 1989; Slaughter & Boh, 2001). By early childhood, most children have developed the

ability to recognize previously-viewed simple and complex stimuli if there is no delay between

the stimulus presentation and recognition phases, and Diamond and colleagues found that 5.5-

year-olds demonstrate 85-percent accuracy on immediate recognition trials of both simple and

complex stimuli (Diamond, Prevor, Callender, & Druin, 1997). Additionally, Diamond et al.

(1997) reported that among three- to seven-year-olds, the ability to recall the temporal order of

stimuli did not reach above chance level until six-to-seven years of age. The authors also found

that while recognition memory for simple stimuli was unaffected by a 25-minute delay

regardless of age, the ability to recognize complex stimuli was worsened by a 25-minute delay

for all children, though performance did show signs of improvement with age. These results

indicate that through early childhood, though children's recognition memory skills are not yet

fully developed, they become increasingly more adept at recognizing and responding to complex

stimuli with age.

In a cross-sectional study, Luciana and Nelson (1998) examined age-related differences

in the performance of four- to eight-year-olds and adults on a computerized battery of tests that –

among other things – measured working memory span and recognition. They found that working

memory recognition skills for spatial stimuli were significantly poorer for four-year-olds than for

all other age groups, though performance reached adult level by seven years of age. Working

memory skills in relation to pattern recognition, again, were significantly worse among four-

year-olds than among all other age groups, and performance reached adult level by eight years of age. On a spatial working memory span task, they found that four-year-olds did not significantly differ from the other age groups when the memory load of the task was low (i.e., when one must search between two locations), but that they performed significantly worse than older children and adults as the load increased (i.e., three or more locations). With larger demands on memory load (i.e., six locations), five- and six-year-olds were not significantly different from each other but were significantly worse than seven- and eight-year-olds; and at six or more locations, all age groups performed significantly worse than adults. Based on these and previous findings (e.g., Diamond & Doar, 1989; Diamond et al., 1997; Slaughter & Boh, 2001), it seems that the ability to perform simple recognition and delay tasks develops during infancy and toddlerhood, while the ability to perform increasingly complex span and delay tasks continues to develop through early and middle childhood.

The updating component of working memory also shows signs of development during the preschool years and beyond (e.g., Diamond et al., 1997; Hongwanishkul et al., 2005; Luciana & Nelson, 1998; see Gathercole, 1998 and Garon et al., 2008 for reviews). A common measure of working memory updating for children and adults is the Self-Ordered Pointing task (Petrides & Milner, 1982), in which participants are presented with multiple visual stimuli (i.e., and array of pictures) that alternate positions on each trial. Participants are instructed to point to one stimulus per each trial and are told not to point to the same stimulus more than once. As the task progresses, participants must maintain their previous choices while consistently updating their new choices, all in the face of changing stimuli locations. Hongwanishkul et al. (2005) included this measure in their cross-sectional study of children ages three, four, and five and found that while three-year-olds were able to recall between four and five items, four-year-olds recalled

around six items and five-year-olds recalled between six and seven items (the difference between four- and five-year-olds was not significant). In a study of older children, Archibald and Kerns (1999) demonstrated that performance on the Self-Ordered Pointing task continued to improve through middle childhood (i.e., age seven to age nine) before beginning to level off at around ten years of age. Thus, early and middle childhood represents an important and prolonged period of development for the updating component of working memory, as well.

Set shifting. The ability to shift from one mental set/rule to another, or set shifting, emerges within the first year of life and continues to develop through childhood and adolescence (e.g., Espy, Kaufmann, McDiarmid, & Glisky, 1999; Luciana & Nelson, 1998; Overman, Bachevalier, Schuhmann, & Ryan, 1996; Somsen, 2007). Overman et al. (1996) found that one-year-olds eventually were able to shift to a new stimulus/response pattern after a reward reversal; as in, they eventually adjusted their behavior after they stopped being rewarded for responding to one stimulus and starting receiving a reward for responding to the adjacent stimulus. However, Espy et al. (1999) used two similar reversal tasks and found that several preschool-aged children were unable to establish the first stimulus/response pattern when allowed only four trials, and they found few age-related performance effects from 30-to-60 months of age. Thus, infants and young children may be capable of eventually reversing stimulus/response associations only if given ample practice or training opportunities, though these abilities become more refined and efficient with age. Additionally, it is important to note that such reward-based reversal tasks may be more complex than simply shifting to a new rule. These tasks require that children infer rules based on feedback (rather than simply holding defined rules in mind) and infer rules for the purpose of receiving affectively rewarding stimuli (such as snacks, stickers, or candy), indicating that the tasks involve both cognitive and affective components. In this way, reversal tasks are

more similar to complex tasks of adult set shifting ability (such as the Wisconsin Card Sort Task

and the Iowa Gambling Task) than to other set shifting tasks designed for children (i.e., the

Dimension Change Card Sort, the Flexible Item Search Task, etc.). As such, young children may

be less capable and less efficient on reversal tasks than they would be on other, less demanding,

set shifting tasks.

In contrast to the more complex, reward-based reversal tasks, the Dimension Change

Card Sort (DCCS) task is a commonly used measure of preschoolers' set shifting skills and

involves sorting affectively neutral cards based on stimulus dimensions (i.e., the general defining

characteristics of the object presented on a card; Frye, Zelazo, & Palfai, 1995). The DCCS

requires that children sort each card presented into one of two locations/piles according to a rule

provided by the experimenter. During the first phase, children are instructed to sort cards into the

correct piles based one dimension associated with the object displayed on the card (i.e., shape).

In the "shape" game (phase one), cards with red bunnies and cards with blue bunnies would both

be sorted into the same pile, while cards with red trucks and cards with blue trucks would be

sorted into a different pile. In the second phase, children are told that the rule has changed and

they now must sort the cards based on a different dimension (i.e., color). Typically, young

children display perseverative errors after the rule has changed – they continue to place the red

bunnies with the blue bunnies during the "color game" – until around five years of age (Frye et

al., 1995; Jacques, Zelazo, Kirkham, & Semcesen, 1999). Specifically, while three-year-olds

perform well in the first phase, they fail during the second phase, and while four-year-olds can

perform the second phase, they perform worse than five-year-olds (Dick, Overton, & Kovacs,

2005; Frye et al., 1995; Hongwanishkul et al., 2005; Kirkham, Cruess, & Diamond, 2003; Kloo

& Perner, 2005; Perner & Lang, 2002; Zelazo et al., 1996).

Studies involving manipulations of the standard DCCS have revealed that three-year-olds' failures can be attributed to two task features: (1) perceptual conflict in the pre-switch phase (i.e., some test cards that are to be sorted with their corresponding target cards still differ from the target cards on one dimension), and (2) conflict between the stimulus-response pattern used during the pre-switch phase and the stimulus/response pattern used during the post-switch phase (e.g., Perner & Lang, 2002; Rennie, Bull, & Diamond, 2004; Zelazo, Muller, Frye, & Marcovitch, 2003; see Garon et al., 2008 for a review). For example, Perner and Lang (2002) found that three-year-olds could pass the second phase of the task if they did not see the target cards and Zelazo et al. (2003, Experiment 9) found that using full test card/target card congruence during the pre-switch phase (i.e., no pre-switch perceptual conflict) improved three-year-olds performance on the post-switch phase. Pertaining to a second reason for failures, evidence indicates that three-year-olds cannot shift from the stimulus-response pattern of the pre-switch phase to the conflicting stimulus-response pattern of the post-switch phase when the same stimuli are used in both phases, but they are able to perform this action if the stimuli used in the post-switch phase differ from the stimuli used in the pre-switch phase (e.g., Zelazo et al., 2003, Experiments 7 and 8). Zelazo et al. (2003) had children sort: (1) red triangle test cards onto blue triangle target cards and blue circle test cards onto red circle target cards during the pre-switch phase, and (2) yellow diamond test cards onto yellow octagon target cards and green octagon test cards onto green diamond target cards during the post-switch phase, and found that the majority of three-year-olds could pass this version. Therefore, as with conflict inhibition, improvements in the ability to overcome conflict allow for age-related improvements in set shifting skills.

In summary, EF development begins within the first year of life and continues through childhood, with marked improvements occurring during the preschool years. The extended

development of behaviorally observed EF skills is facilitated by developments in the PFC that occur over first few years of life, as the PFC develops at a more protracted rate than other brain regions (Diamond, 2002). Some of the earliest observed EF skills include the ability to hold information in mind over a delay period and the ability to inhibit a previous response, though these skills continue to improve and become more refined over toddlerhood and early childhood. Over the preschool years, children become increasingly capable of holding multiple items in mind, inhibiting a prepotent response or inhibiting a response during a delay period, and shifting mental sets, while more complex EF skills continue to develop beyond the preschool years. Preschoolers' performance on EF tasks is influenced not only by age, but by the degree of complexity and the amount of conflict involved in each task. In addition, Hughes (1998b) found that the correlations between EF skills increased from three to four years of age, indicating that EF skills become increasingly more coordinated and coherent during the preschool period.

EF and achievement. As previously suggested, evidence across several studies indicates that developments in cognitive control processes during the preschool years promote school readiness and later academic achievement (e.g., Blair & Razza, 2007; Evans & Rosenbaum, 2008; Guajardo & Cartwright, 2016; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Support for a link between children's EF skills and their concurrent and later academic achievements has been largely consistent across a number of longitudinal studies (Altemeier et al., 2008; Blair & Razza, 2007; Bull, Espy, & Weibe, 2008; Bull & Scerif, 2001; Guajardo & Cartwright, 2016; McClelland et al., 2007; Monette, Bigras, & Guay, 2011; Welsh et al., 2010). In one such study, Monette et al. (2011) reported that children's working memory and inhibition skills in kindergarten each uniquely predicted reading and writing performance at the end of Grade 1, and working memory,

additionally, predicted math performance. In another longitudinal study, Welsh et al. (2010) tested children from preschool through kindergarten in areas related to working memory, attention control, early literacy, and numeracy. Similar to the results of Monette et al. (2011), the authors found that children's initial working memory and attention control skills predicted growth in their early literacy and numeracy skills during preschool. Also, they reported that growth in children's domain-general skills (i.e., working memory and attention control) predicted reading and math achievement in kindergarten. Moreover, McClelland et al. (2007) found that the ability to inhibit a propotent response action at the beginning of kindergarten was significantly and positively correlated with beginning and end of the year literacy, vocabulary, and math skills. These reports, along with several similar reports (e.g., Bull et al., 2008; Clark, Pritchard, & Woodward, 2010), provide empirical evidence that developments in the ability to hold relevant information in mind (related to working memory) and ignore irrelevant or distracting information (related to inhibition) during early childhood enhance or facilitate a child's ability to learn literacy and math skills during the early school years, academic skills that are essential to long-term school achievement.

Though the findings of Monette et al. (2011) and Welsh et al. (2010) – in addition to several others (e.g., Blair & Razza, 2007; Bull et al., 2008; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Clark et al., 2010; Espy et al., 1999) – indicate links between working memory and early academic achievement and inhibition and achievement, empirical support for a link between set shifting and achievement has been less consistent across studies (e.g., Blair & Razza, 2007; Bull et al., 2008; Bull & Scerif, 2001; Espy et al., 1999). In support for a link, Clark et al. (2010) assessed children at four years of age and again at age six and found that better performance on an item selection task – similar to the DCCS – at age four was associated with

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greater fluency in math and higher teacher ratings of math performance at age six. In regard to reading skills, Guajardo and Cartwright (2016) found that cognitive flexibility in preschool predicted later reading comprehension skills in elementary school after controlling for age, maternal education, and vocabulary knowledge. In contrast, Blair and Razza (2007) examined longitudinal relations between EF (inhibitory control and set shifting) at the end of preschool and academic ability at the end of kindergarten (i.e., math skills, phonemic awareness, and letter knowledge) and reported that when set shifting was included with inhibitory control, language ability, effortful control skills, and false belief understanding (both preschool and kindergarten) in a single regression analysis, set shifting did not account for significant variance in any of the three academic areas over and above what was accounted for by the other predictors. Similarly, in a longitudinal study of children from four to seven years of age, Bull et al. (2008) found that at all three testing points (i.e., at the end of the final year of preschool, the first year of primary school, and the third year of primary school), set shifting did not account for significant portions of variance in math scores after controlling for reading ability. To provide a possible interpretation of these findings, one may suggest that set shifting skills are not as routinely embedded within the typical academic learning environment as are working memory or inhibition skills. In other words, perhaps the ability to efficiently switch between and among content areas in a rapid fashion is not as consistently utilized throughout the school day as the ability to hold relevant information in mind and to inhibit attention to irrelevant information or distractions.

Taken together, studies of the relations between children's EF skills during the preschool and early school years and academic achievement at the start of school and beyond indicate that it is important for children to develop strong EF skills – particularly in the components of

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working memory and inhibition – prior to the start of school. Unfortunately, just as EF and ToM-related social skills have been found to promote positive academic development, deficits in these areas – particularly those deficits that have been found to be related to environmental disadvantage – have been shown relate to poorer academic outcomes at the onset of school and beyond (Brody & Flor, 1997; Clark et al., 2010; Evans & Rosenbaum, 2008). Moreover, these deficits have been shown to increase over time (Welsh et al., 2010), though intervention efforts that target children identified as at-risk prior to the start of school (i.e., during the preschool period) may aid in the prevention of this problem (e.g., Diamond, Barnett, Thomas, & Munro, 2007).

In fact, already there is evidence for the effectiveness of preschool programs that promote self-regulation and cognitive control. As an example, *Tools of the Mind* (Bodrova & Leong, 1996; 2001) is a preschool program that is centered on various play activities that are thought to be linked to self-regulatory skill development, skills that include processes related to EF (Vygotsky, 1962). It has been estimated that the curriculum includes 40 EF-promoting activities, ranging from verbal self-instruction (i.e., *self-regulatory private speech*; Luria, 1965) to collaborative dramatic play (Diamond et al., 2007). Evidence indicates that that the *Tools* program is effective in improving preschoolers' early language and literacy skills (Bodrova & Leong, 2001; Barnett, Jung, Yarosz, Thomas, Hornbeck, Stechuk et al., 2008), social self-regulatory skills (Barnett et al., 2008), and EF skills (Diamond et al., 2007). Bodrova and Leong (2001) found that preschool children who participated in the *Tools* program showed improvements in several areas of early literacy (i.e., letter recognition, sound-to-symbol recognition, pattern comprehension, symbolic representation, and word-letter separation) that were significantly greater than their counterparts in control classrooms. Diamond et al. (2007)

compared the EF skills (based on performance on two measures of EF) of preschoolers participating in *Tools* with the performance of children who were participating in an intervention that focused only on academic content. While performance on the more difficult condition of one of the EF measures was significantly better in the *Tools* group than in the group receiving the alternate intervention (84-percent correct versus 65-percent correct, respectively), even larger gains were found on the other EF measures, with *Tools* children performed almost twice as well. Moreover, Barnett et al. (2008) found that children who participated in *Tools* were rated (by teachers) as having significantly fewer behavioral problems overall than children in control classrooms by the end of the school year. In addition, the *Tools* children experienced a greater reduction in externalizing and internalizing problems over the course of the school year compared to the control group children (as rated by teachers). While Barnett et al. (2008) interpreted their findings as evidence that the *Tools* program improves self-regulatory skills, Diamond et al.'s (2007) findings imply that *Tools* improves EF skills, as well. Though more studies need to be conducted to determine the long-term effectiveness of this program, these studies indicate that effectively promoting the development of EF and self-regulation in preschool promotes school readiness at the start of kindergarten.

Sociocultural and socioeconomic influences on EF. The current literature indicates that EF development is not uniform across all groups of children; rather, individual and contextual differences have significant impacts on the developmental course of EF among typically-developing children (e.g., Hughes et al., 2010; Lan, Legare, Ponitz, Li, & Morrison, 2011; Mezzacappa, 2004; Rhoades, Greenberg, Lanza, & Blair, 2011; Oh & Lewis, 2008; Sarsour, Sheridan, Jutte, Nuru-Jeter, Hinshaw, & Boyce, 2011). For example, several studies have found that children's level of skill in different components of EF varies according to culture (e.g., Lan

et al., 2011; Oh & Lewis, 2008; Sabbagh, Xu, Carlson, Moses, & Lee, 2006b). In a cross-cultural study of Korean and British preschoolers (all White), both from predominately middle class families, Oh and Lewis (2008) found that the majority of Korean preschoolers (roughly 74-percent) performed at ceiling or made only one mistake on a day/night measure of conflict inhibition while the majority of British preschoolers performed below ceiling and made more than one error (roughly 78-percent). Also, the authors reported that the older (4.5-year-old) preschoolers in the British sample still did not perform as well as the younger (three-year-old) Korean children on this measure. Pertaining to group differences in performance on two measures of working memory (an updating task and a span task), they found significant main effects for culture on both measures; specifically, Korean children performed significantly better on both tasks than did British children. Similar to Oh and Lewis (2008), Lan et al. (2011) found that Chinese preschoolers surpassed their American counterparts in their inhibitory control skills; however, in contrast to Oh and Lewis, they found no significant cross-cultural differences in preschoolers' working memory skills. Lan et al. (2011) suggested that, perhaps, children from East Asian cultures (specifically, Chinese and Korean) develop inhibitory control skills – in particular – at a faster and higher rate than their Western counterparts due to the greater emphasis that is placed on self-control and behavioral inhibition in Chinese (Lan, Ponitz, Miller, Li, Cortina, Perry et al., 2009) and Korean (Kwon, 2004) preschool classrooms, compared to American preschool classrooms where freedom of expression is more highly valued (Chen, Hastings, Rubin, Chen, Cen, & Stewart, 1998).

In addition to variance due to sociocultural factors, studies have found that a child's socioeconomic background may account for significant variance in EF development, as well (e.g., Kishiyama, Boyce, Jimenez, Perry, & Knight, 2009; Mezzacappa, 2004; Rhoades et al.,

2011; Stevens, Lauinger, & Neville, 2009). For example, Rhoades et al. (2011) found that African American children from low-income families and families headed by an unmarried parent fared significantly worse on measures of EF than children from higher income homes and families headed by married parents. Considering their sample included only African American children, differences found across socioeconomic variables (i.e., income level, parental marital status) could not be attributed to racial/ethnic differences in this study. In fact, there is little evidence that racial/ethnic status – on its own – influences EF development. Moreover, in the scant literature pertaining to racial/ethnic disparities, ethnic minority status often is confounded with low-SES. As an example, Li-Grining (2007) examined differences in EF-related skills across different racial/ethnic groups of U.S. preschoolers, all from low-income homes. Though non-significant, the author reported a "trend" in the data, such that Latino preschoolers performed better on EF tasks than European Americans, while she found no significant differences in task performance between African American and Latino children. In this study, African Americans and Latinos comprised 41 and 51 percent of the sample, respectively, while European Americans and "other" comprised only 5 and 4 percent, respectively. Perhaps, with more equivalent group sizes, the trends the author reported may have gained statistical significance, which would indicate that among children of low-income homes, racial/ethnic differences contribute to individual differences in EF that are not directly accounted for by economic factors. However, at present, there simply is not enough evidence from this study or from the current literature at large to substantiate such a claim. Thus, while the results of Li-Grining's (2007) study indicated that different groups of ethnic minority children from low-income homes develop EF skills at a similar rate, it remains unclear whether European American

– or ethnic majority – children differ from their ethnic minority counterparts in terms of their EF development in preschool once SES is taken into account.

Providing additional support for the significant influence of SES on the EF skills and EF skill development of young children, Mezzacappa (2004) noted across-group performance differences on a measure of EF among a longitudinal study of White, African American, and Latino children. The sample consisted of six-year-olds from diverse SES backgrounds, though the sample was not evenly distributed across ethnic groups. Based on the results of children's performance on a conflict inhibition task (i.e., a Flanker task), the author found that children from higher SES backgrounds demonstrated greater resistance to interference (i.e., performed with greater accuracy and faster reaction times) than children from lower SES backgrounds. Furthermore, from the area of neuropsychology, noted differences in patterns of brain activation provide another source of evidence of executive processing differences across groups of children from different SES backgrounds. Kishiyama et al. (2009) found that children of high-SES showed higher levels of activation in the attentional network of the PFC while performing tasks requiring EF than did children of low-SES, which coincided with the finding that performance on measures of EF was worse in the low-SES group than in the high-SES group (Kishiyama, Boyce, Jimenez, Perry, & Knight, 2009). These results are consistent with the results of Stevens et al. (2009) who found that low-SES children displayed higher patterns of activation in the PFC when presented with irrelevant stimuli than their higher-SES counterparts, indicating that the children from lower-SES may have found it more difficult to ignore distracting stimuli. In addition, Li-Grining (2007) found that variables related to low-income status as well as residential risk factors significantly predicted poorer EF skills. As EF skills have been shown to influence school readiness and later academic outcomes (e.g., Blair & Razza, 2007; Welsh et al.,

2010), discrepancies in the development of these skills across different socio-economic groups may contribute significantly to the income achievement gap documented between low-and high-SES children.

Preschoolers' Theory of Mind

ToM is a term used to describe an individual's basic ability to comprehend mental states, particularly in regards to understanding beliefs and desires (Taylor, 1996). To have a "theory of mind" means to have an understanding that beliefs and desires drive behavior and to understand that one's own mental state may differ from another's. In the field of child development, researchers have long been interested in the question of how children develop an understanding of the mind and form mental representations (e.g., Flavell, 1979; Klhlstrom & Cantor, 1984; Wellman & Johnson, 1979). While over the past several decades there has been some debate concerning whether preschooler's ToM is best represented as an organized theory versus a less advanced collection of heuristics used to explain the thoughts and behaviors of one's self and of others (see Taylor, 1996; Moses & Chandler, 1992), most agree on the general premise that acquiring knowledge of the mind is a fundamental aspect of early child development (Wellman & Gelman, 1992).

Though the study of the human capacity for and development of ToM has generated much interest over the past several decades, the term itself emerged from a study involving an adult chimpanzee named Sarah (Premack & Woodruff, 1978). In this study, the researchers had Sarah view several videos that depicted a human actor who was attempting to work through a series of problems. At the end of each video, they presented Sarah with several photographs, and one of these photographs contained the solution to the problem the actor in the video appeared to have been facing. Premack and Woodruff observed that Sarah consistently was capable of

providing a response (i.e., selecting a photograph) that reflected the needs of the human actor; for example, Sarah would select a picture of a key in response to witnessing the actor try to escape from a locked cage. The authors concluded that – as mental states are not directly observable, and as Sarah was able to make inferences about another's mental state and form predictions based on these inferences – Sarah demonstrated that she had formed a primitive "theory" – or organized collection of hypotheses based on observation and inference – of "mind" (i.e., an understanding of the causal link between mental states and behavior).

Shortly after Premack and Woodruff (1978) published their findings, several researchers brought up the question of whether Sarah truly had formed an understanding of another's mental representation of the world or, rather, if she simply had demonstrated an understanding of the world as it is, the world from her own perspective. In other words, they questioned if Sarah had based her responses on the scene she observed or, as Premack and Woodruff would suggest, on her understanding of another's interpretation/perspective of the scene, given the information available to the other individual (Bennett, 1978; Dennett, 1978; Pylyshyn, 1978). Those who questioned Premack and Woodruff's conclusions argued that in order to sufficiently measure ToM, researchers must determine whether an individual is capable of understanding that another's perspective of a given situation may differ from one's own perspective, and that another person's decisions will be dependent on the specific information available to him/her (see Call & Tomasello, 2008). Following from this line of reasoning, several researchers suggested that an individual with a developed ToM should be able to demonstrate an understanding of false beliefs, an understanding that another may form beliefs that are inconsistent with reality due to limitations or inaccuracies in the information available to him/her (see Call & Tomasello, 2008; Wellman, Cross, & Watson, 2001).

Thus, to study the presence of and development of ToM – specifically among humans – modern researchers largely rely on false belief paradigms. To provide an example of a false belief task, consider the popular "Sally/Anne" task in its original form (Baron-Cohen, Leslie, & Frith, 1985). In this task, a child is presented with a simple story involving two characters, "Sally" and "Anne." In the story, Sally plays with a toy (i.e., a ball) and decides to conceal the toy inside a container (fully occluded) before she leaves the room. Once she has left the area, Anne arrives and retrieves the hidden toy from the first container and proceeds to re-hide the toy in a second container. Anne leaves the room and Sally returns. The child subject is told that – upon Sally's return – Sally wishes to retrieve her toy. At this point, the "story" portion of the task is over, and the child is asked where he/she thinks Sally will look for her toy: will she look in the location in which she hid the toy or will she look in the new location where Anne re-hid the toy while Sally was not present? A child who understands the concept of false beliefs would state that Sally would look for the toy in the location that she had originally hidden it, because Sally does not know that Anne moved the toy. A child who does not have a developed ToM and who – as a result – does not understand that others can hold false beliefs, would be expected to reply that Sally would look for her toy where Anne hid it, ignoring the fact that Sally was not privy to the re-hiding of the toy. In other words, to pass this task, a child should know that Sally's actions depend on her *beliefs*, or her own understanding of reality, and not on the reality of the child (Wellman et al., 2001).

In a review of clinically relevant measures of ToM, Sprung (2010) provided a fairly comprehensive list of over 30 different tasks that have been used to tap into some aspect of ToM; though it is worth noting that there are several additional tasks that have been used to measure ToM among non-clinical populations that were not included in this review. Considering the

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plethora of measures available, coupled with the predominant view that ToM is best represented

as a multifaceted construct, researchers typically use multiple measures to tap into children's

ToM. For example, in addition to common "locations false belief" tasks like the Sally/Anne task,

studies of children's ToM commonly also use "contents false belief" tasks and deception tasks

(for an example of each of these forms of measures, see Carlson & Moses, 2001). Measures that

require a child to ascertain the false belief of another, when another's false belief is in regards to

the contents of an object, are highly similar to locations false belief tasks but involve unexpected

contents rather than a secretive location change. As an example, Gopnik and Astington (1988)

presented three-to-five-year-old children with a familiar object (i.e., a candy box) and

individually asked each child to state what he/she thought was inside the object (i.e., candy).

Then, the researchers revealed that an unexpected object was inside the box (i.e., pencils). After

revealing the unexpected items, the researchers placed the items back in the box and re-covered

it, all in plain view of the child. Finally, each child was asked what someone else who has not

seen the actual contents of the box will probably think is inside the box. Like a locations false

belief task, passing this task would require children to ignore their own knowledge and respond

on the basis of the limited knowledge of another.

In addition to location and contents false belief tasks, children's ToM often is measured

using tasks that measure deceptive ability. In order to deceive another, children not only must

understand that others can hold beliefs that differ from their own, but they also must understand

that they can induce these false beliefs in others by providing false information. Peskin (1992)

designed a measure of deception that required children to deceive a "mean" puppet in order to

gain a reward. In this task, children (between the ages of three to five years) were told that they

could choose among three sticker options, and they were instructed to tell the research which

sticker was their favorite. Then, the researcher told the each child that a "nice" puppet would be coming to pick one of the stickers, too, but that this puppet would never pick the one that the child liked the most. Consequently, each child typically would tell the "nice" puppet the truth about his/her preferred sticker. Following this trial, the children were told that a "mean" puppet would be coming to pick a sticker, but that this puppet would always pick the one that the child liked the most. When the "mean" puppet asked each child which sticker he/she liked the most, the child was given the opportunity to deceive the puppet and, as a result, keep his/her preferred sticker. Similar to the findings from locations and contents false belief measures, developmental studies of performance on measures of deception indicate that this ability improves dramatically from three to five years of age (Peskin, 1992; Heyman, Sritanyaratana, & Vanderbilt, 2013; Smith & Lafreniere, 2013). In other words, over the preschool years, children become increasingly aware of the fact that others can hold beliefs that differ from their own, and that they can use misinformation to induce false beliefs in others.

ToM development through preschool. The preschool years represent an important period not only for children's EF development, but for ToM development as well. In fact, the majority of the literature on ToM development indicates that this aspect of cognition may reach full maturity by middle childhood (e.g., Carlson et al., 2002; Carlson & Moses, 2001; Frye et al., 1995). Developmental studies of ToM indicate that goal-action representation is present by as young as three months of age (Sommerville, Woodward, & Needham, 2005; Woodward, 1998) and basic perspective taking skills may be present by as young as six months of age (Luo & Johnson, 2009; Sodian, Thoermer & Metz, 2007). As an example of evidence for early rudimentary perspective taking skills, Luo and Johnson (2009) found that six-month-old infants were able to demonstrate knowledge of the preferences of another person. In the first part of this

study, infants viewed a scene in which an adult actor repeatedly reached for a given object either a) in the presence of another object (i.e., another object that the adults could see but repeatedly did not choose), or b) in the presence of only the chosen object (i.e., the second object was visible to the infant but hidden from the adult). Using a visual looking-time paradigm, they found that infants looked significantly longer during the second part of the experiment (i.e., when both objects were visible to the adults across both conditions) when the adult chose the object that differed from the previously chosen object only when the adult was able to see both objects during the initial trials. In other words, if the adult continued to reach for the same object even when another object was present during the first part of the experiment, the infants seemed to assume that this suggested a preference for the reached-for object. When the adult then reached for the other object in the second part of the experiment, the infants demonstrated surprise. On the other hand, when the adult continued to reach for the same object during the initial phase of the experiment but was unable to see the other object – then, once the other object came into view, the adult chose the other object – the infants were not surprised at this change in behavior. This implies that the infants did not assume that the adult preferred the originally reached-for object because, since the second object was originally hidden from the adult, the adult would not have been able to make this preferential choice during the initial phase.

Beyond basic perspective taking abilities, studies indicate that children develop the ability to understand that another may hold beliefs that are based on a perspective that differs from that of the child (i.e., false beliefs) by around four years of age (Wellman, Cross, & Watson, 2001). While children as young as three years of age typically can demonstrate an understanding that another's beliefs guide that person's actions (Wellman & Bartsch, 1988; Wellman & Liu, 2004), they have a difficult time understanding another's beliefs can differ from

their own until four-to-five years of age (Carlson & Moses, 2001; Wellman et al., 2001). In addition, though children typically are able to reason about the desires of others by three years of age (Wellman & Woolley, 1990), it is much more difficult for them to reason about the desires of others when those desires strongly conflict with one's own until around five or six years of age (Moore, Jarrold, Russell, Lumb, Sapp, & MacCallum, 1995). Improvements in deceptive ability – which is related to false belief understanding – typically are significant from three to four years of age, and significant improvements have been found from four to five years of age, as well (Peskin, 1992). Taken together, these findings suggest that children develop the capacity to understand the relation between the desires or beliefs and action of others when those desires or beliefs are perceived to be "true" and/or consistent with one's own before they are capable of understanding the false beliefs of others (Wellman & Liu, 2004). This indicates that, like EF, ToM development over the preschool years typically occurs in a logical sequence, progressing from a simple or basic understanding to a more complex, higher-order level of understanding.

ToM and achievement. In contrast to the wide body of literature pertaining to EF and early academic achievement, very few studies have sought to examine the direct contributions of ToM skills to academic competence. Though the literature is sparse, one such study conducted by Blair and Razza (2007) reported that false belief understanding among preschoolers in Head Start was significantly correlated with scores in math, phonemic awareness, and letter knowledge in kindergarten, and that it accounted for a significant portion of variance in letter knowledge scores when entered into a regression. Additionally, Farrar and Ashwell (2008) found that the ToM skills of four-year-old preschoolers were significantly related to their phonological awareness skills, particularly for the rhyming component of phonological awareness. Similarly, Guajardo and Cartwright (2016) found that false belief understanding significantly predicted

ability to comprehend phrases and sentences among preschoolers, and that phrase and sentence comprehension in preschool significantly predicted later reading comprehension skills in elementary school. However, although the evidence demonstrating a direct link between ToM and early academic competence is limited, to say that a child is "ready" for the school environment suggests more than just academic competence, and the influence of ToM on school readiness is more apparent when one examines non-academic aspects of school readiness.

Expanding a bit beyond the literature that strictly pertains to ToM and its relation to academic competence, the wider literature base indicates that there may be at least an indirect link between ToM and achievement, such that ToM directly relates to social skills and social competence which, in turn, relate to school readiness and achievement (Blair & Peters, 2003; Iannotti, 1985; Miller, Eisenberg, Fabes, & Shell, 1996; Ginsberg, Ogletree, Silakowski, Bartels, Burk, & Turner, 2003). For example, Lalonde and Chandler (1995) found that that a prominent aspect of ToM development – understanding of false beliefs – positively related to teacher ratings of social competence. Similarly, in another study of preschool children, Cassidy and colleagues (Cassidy, Werner, Rourke, Zubernis, & Balaraman, 2003) found that mental state understanding was significantly correlated with peer perceptions of children's social skills even after accounting for children's language abilities. In a study involving an older sample (preadolescents), Bosacki and Astington (1999) reported that ToM was positively associated with both peer ratings of social skills (which would fit within the realm of social competence) and general vocabulary skills. Thus, children with better ToM skills may, in turn, develop better social skills and social competence prior to and following the start of school. As a result, these children may find it easier to adapt to the social environment of the classroom than children with poorer social skills.

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Sociocultural and socioeconomic influences on ToM. Like cross-cultural studies of EF development, some studies have found that ToM development is not consistent across Western versus East Asian cultures (Liu, Wellman, Tardif, & Sabbagh, 2008; Naito & Koyama, 2006). As an example, while most studies of typically developing Western children have shown that children develop the ability to understand the false beliefs of others by around four to five years of age, Naito and Koyama (2006) reported that Japanese children did not reliably demonstrate knowledge of others' false beliefs until around six years of age. Additionally, a meta-analysis conducted by Liu and colleagues (2008) found that while the trajectory of ToM development largely is consistent across Western and Eastern cultures, the onset of the ability to understand false beliefs often varies by culture. However, it is worth noting that cross-cultural differences are not always observed. For instance, Callaghan and colleagues (Callaghan, Rochat, Lillard, Claux, Odden, & Itakura, et al. 2005) found that the onset of the ability to pass a false belief task among three to five year olds was consistent across children from five distinct cultural groups: Canadian, Indian, Peruvian, Samoan, and Thai.

In addition to possible cross-cultural differences in ToM development, several studies have reported that SES may be significantly related to ToM development, as well. Specifically, some have found that children of low-SES backgrounds have difficulty understanding false beliefs, an essential aspect of ToM (Cutting & Dunn, 1999; Shatz, Diesendruck, Martinez-Beck, & Akar, 2003); although other studies have not found support for a link between SES and false belief understanding (Garner, Curenton, & Taylor, 2005; Weimer & Guajardo, 2005; Yagmurlu, Berument, & Celimli, 2005). For example, while Cole and Mitchell (1998) reported significant correlations between four- to five-year-olds' deceptive ability and mother's reported financial distress and single-parent stress, they did not report a significant correlation between the

deceptive abilities and overall family SES. Likewise, Lucariello et al. (2007) reported no differences in intrapersonal aspects of ToM (i.e., reasoning about one's own mental states) or interpersonal aspects of ToM (i.e., reasoning about other's mental states) between middle-SES and low-SES five-to-six-year-olds. Moreover, the study found that both middle- and low-SES children performed significantly better on tasks of interpersonal ToM than on tasks of intrapersonal ToM. The authors offered two attempts to account for differences between the results from this study and the results of previous studies: (1) previous studies reporting SES differences in ToM have focused on children's performance on FB tasks, and the present study examined ToM performance across a range of tasks assessing mental state understanding, and (2) previous research has examined this relation in preschoolers, and the present study included a slightly older sample. Thus, though SES may relate to specific ToM skills among preschoolers, the general relation between SES and ToM may be less strong and less long-lasting than what has been reported for EF.

Although the majority of evidence available to date indicates that preschool children of low-SES are less capable of understanding and reasoning about FBs than their higher SES counterparts (e.g., Cutting & Dunn, 1999; Shatz et al., 2003), there is some evidence indicating that children of low-SES do not experience any significant difficulties in other areas of ToM relative to their higher SES counterparts (e.g., Garner et al., 2005; Weimer & Guarjardo, 2005). While Weimer and Guarjardo (2005) found that preschool children from middle SES homes performed significantly better on some measures of ToM than their lower SES counterparts (i.e., unexpected contents task, unexpected change task, and active deception task), there were no significant differences between groups on a basic measure of deception. Additionally, on another study involving preschoolers from different SES backgrounds, Garner et al. (2005) found that

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there were no significant differences in performance on two measures of false belief understanding as a function of SES group. In sum, the role of SES in the ToM development of preschoolers remains ambiguous and in need of further study.

Relations between EF and ToM in Young Childhood

In the literature, the construct of ToM has been closely associated with EF (Carlson et al., 2002; Hughes, 1998a; Razza & Blair, 2009; for a review, see Perner & Lang, 1999). EF and ToM share many similarities; namely, both constructs have been linked to the prefrontal cortex, both have been found to develop along similar trajectories, and similar deficiencies have been found in both constructs among individuals with certain neurodevelopmental disorders (Carlson et al., 2002; Perner & Lang, 1999). In addition, several studies have found statistical support for the link between these two constructs among typically developing children (Carlson et al., 2002; Fizke, Barthel, Peters, & Rakoczy, 2014; Flynn, O'Malley, & Wood, 2004; Hughes, 1998a; Hughes, 1998b; for a meta-analysis, see Devine & Hughes, 2014). For example, Hughes (1998a) found that preschoolers' working memory skills were significantly correlated with false belief understanding, inhibition skills were significantly correlated with both false belief understanding and deception, and set shifting (labeled "attentional flexibility") was significantly correlated with deception, with the strongest correlation being between inhibition and deception. Moreover, through regression analyses, she found that inhibition and age accounted for 47-percent of the variance in deception scores, and that the variance associated with age became non-significant when inhibition was entered as a second step in the analysis. Similarly, Carlson (1997) found an average correlation of .66 between ToM performance (as measured by an appearance-reality task, a deception task, and several false belief tasks) and performance on the DCCS among preschoolers ages three to five years (correlation estimate based on a meta-analysis conducted by

Perner & Lang, 1999), a result that largely was replicated in a similar study conducted by Perner, Lang, and Kloo (2002).

From a theoretical standpoint, current theories pertaining to the relation between EF and ToM state that EF must precede the development of ToM, either in the sense that developments in EF produce developments in ToM (i.e., the *emergence* account) or that developments in EF allow for the expression of existing developments in ToM (i.e., the *expression* account; see Carlson et al., 2002). As an example of the predictive relation between EF and ToM, Carlson and colleagues (2005) reported that the relation between EF and ToM skills was not significantly related among two-year-olds, but that EF skills at two years of age predicted ToM skills at three years of age. The emergence account has been gaining popularity in recent years, largely due to the fact that several studies have found that children's EF and ToM skills do not always develop in a one-to-one manner. More specifically, cross cultural studies have found that while the trajectory and rate of EF and ToM development among typically developing children in Western cultures tend to be highly correlated (e.g., Carlson et al., 2002; Frye et al., 1995; Hala, Hug, & Henderson, 2003; Hughes, 1998a; Perner, Lang, & Kloo, 2002), EF skills may develop earlier and at a faster rate than ToM skills among typically developing children in several East Asian cultures (Oh & Lewis, 2008; Sabbagh et al., 2006b). Thus, the relation between EF development and ToM development may vary as a function of environmental context, though – based on the current literature – it is difficult to say which aspects of a child's environmental context influence this relation.

Sociocultural and socioeconomic influences on EF/ToM relation. As mentioned above, recent evidence indicates that sociocultural factors may significantly influence the predictive developmental relation between EF and ToM (Oh & Lewis, 2008; Sabbagh et al.,

2006b). For example, Sabbagh et al. (2006b) found that advanced EF skills promoted advanced

ToM skills in a sample of preschoolers from middle-income homes in the U.S. but not in a

similar sample of preschoolers in China. These results suggested that there may be a stronger

predictive relation between EF and ToM development among young children from the U.S.

versus among children from China. Similarly, Oh and Lewis (2008) found that Korean

preschoolers demonstrated high inhibition and set shifting skills but average working memory

and false belief understanding skills. In this study, when the Korean preschoolers were compared

with a sample of British preschoolers, they found that the link between EF skills and mental state

understanding (ToM) was significantly stronger for the British children. However, unlike studies

that have examined differences between East Asian and Western/Western European cultures,

Chasiotis et al. (2006) found that the predictive relation between the conflict aspect of inhibitory

control on ToM skills among preschoolers from Germany, Costa Rica, and Cameroon was

independent of culture (Chasiotis, Kießling, Hofer, & Campos, 2006). Thus, cross-cultural

differences in the relation between EF and ToM may depend upon more than simply cultural

differences, and there is reason to suspect that this relation may be subject to differences across

socioeconomic groups, as well. However, although several studies have examined relations

between SES and EF, and SES and ToM, to date, no studies have specifically addressed the role

of SES in the relation between EF and ToM.

Components of SES and General Cognitive Development

The proposed study will define a child's SES background using two family-based

indicators: household income and parental education. These two variables are perhaps the most

consistently used indicators of SES across the literature and have demonstrated robust relations

with many aspects of child development, including early developments in general cognitive

skills (e.g., Brooks-Gunn & Duncan, 1997; Haveman & Wolfe, 1994; McLoyd, 1998). Dilworth-Bart (2012) reported that the household income level of preschoolers was significantly – and positively – associated with variables related to cognitive control and school readiness, namely: attentional control, working memory, composite EF, and general math skills, even after controlling for child verbal ability. Pertaining to a broader dimension of cognition – general intelligence – Klebanov et al. found that children of low-income homes had significantly lower IQ scores than children of high-income homes when controlling for both cumulative family risk and neonatal health (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998). When children were first tested at one year of age, the authors noted that these IQ effects were not pronounced; rather, effects emerged once children reached two years of age and remained stable through three years of age. These findings indicate that while the relation between low income status and IQ may not be significant in infancy, notable effects may manifest early on and may be present by the start of the preschool years.

In addition to household income, several studies also have found parental education level to be significantly associated with cognitive-developmental outcomes (e.g., Duncan & Magnuson, 2003; Kohen, Brooks-Gunn, Leventhal, & Hertzman, 2002; Schofield, Martin, Conger, Neppl, Donnellan, & Conger, 2011). In a large-scale longitudinal investigation involving children and their families over three generations, Schofield et al. (2011) found that both parental education and income were significantly related to child and adolescent academic competence and receptive vocabulary. Also, they found that both variables related to SES – though moderately correlated – provided unique contributions to the prediction model. Similarly, Kohen et al. (2002) reported a moderate but significant correlation between household income and maternal education, and they found that each was significantly associated with verbal ability

in preschoolers. Therefore, while household income and parental education may be related

constructs, they each may be useful in determining the overall relations between family SES and

cognitive-developmental outcomes.

Purpose of the Study

The association between EF and ToM development has been studied in children of

middle-income families (e.g., Carlson et al., 2002; Sabbagh, Moses, & Shiverick, 2006a), and of

low-income families (e.g., Blair & Razza, 2007; Guajardo, Parker, & Turley-Ames, 2009; Razza

& Blair, 2009), though comparative analyses are scarce. At present, though studies have found

that sociocultural differences may affect the relation between EF and ToM (Oh & Lewis, 2008;

Sabbagh et al., 2006b), the possible role of SES in the association between early developments in

EF and developments in multiple aspects of ToM has yet to be explored. Based on previous

studies of individual and cultural differences, the current study will examine whether the relation

between ToM and EF varies across socioeconomic groups. Potentially, while EF skills may be

more advanced than, or as advanced as, ToM skills in higher SES children, ToM skills may be

more advanced than EF skills in lower SES children. Not only would such a result cause one to

question the popular emergence account of the association between EF and ToM, which states

that a certain degree of development in EF skills must occur before ToM skills can begin to

develop and advance, it would illuminate an area of cognition in which children are generally

protected from the effects of socioeconomic disadvantage. Thus, the overall goals of this

research study are to identify the interactions between preschoolers' EF and ToM skills and to

examine how these skills and the interactions between them may be influenced and/or moderated

by SES.

Hypotheses

Based on the goals of the current study, the hypotheses are as follows: (1) Preschoolers' EF skills will be significantly related to their ToM skills, regardless of age, SES, or general cognitive skills. (2) SES will moderate differences between preschoolers' EF and ToM skills, regardless of age and general cognitive skills. (3) SES will have an effect on the amount of variance in ToM scores that is accounted for by EF scores. In addition and in line with previous evidence, the study also will test the hypotheses that performance on EF and ToM measures will vary as a function of (4) age and (5) general cognitive skills.

Methods

Participants

After receiving approval from the Institutional Review Board (IRB), English-speaking participants between the ages of three and five years were recruited from six local preschool programs in a large city in the Southeastern United States. All of these programs offered curriculum-based instruction, though curricula differed across sites. As all of the assessments were to be administered in English, children with low English proficiency (as identified by teachers) were excluded from the study. Additionally, the study did not include any participants with identified learning disabilities. See Table 1 for child demographic and SES characteristics by site.

The goal of the recruitment process was to identify and gain access to a socioeconomically diverse sample of at least 100 participants. A power analysis was conducted to determine the sample size that would be necessary to ensure adequate statistical power for multiple regression analyses. The analysis revealed that with an anticipated effect size of 0.51 (medium), a power level of 0.80, a desired probability level of 0.05, and five total variables (age, SES, general cognitive skills, EF, and ToM), a sample size of 91 would be needed (Cohen,

Table 1.

Demographic and SES Characteristics of Total Sample by Site

Site ID	n_{males}	$n_{females}$	Age range (years)	SES Index range
1	6	9	3.56 - 5.45 ($M = 4.55$, $SD = .57$)	16.33 - 20.00 ($M = 18.83$, $SD = 1.10$)
2	8	14	3.37 - 5.43 ($M = 4.20$, $SD = .57$)	11.00 - 20.00 ($M = 17.38$, $SD = 2.65$)
3	15	16	3.01 - 5.13 ($M = 3.77$, $SD = .64$)	1.83 - 20.00 ($M = 13.49$, $SD = 5.38$)
4	2	8	3.00 - 5.54 ($M = 4.10$, $SD = .71$)	3.83 - 10.17 ($M = 7.20$, $SD = 2.25$)
5	4	3	3.09 - 5.25 ($M = 4.15$, $SD = .70$)	1.83 - 16.33 ($M = 9.83$, $SD = 4.42$)
6	4	3	3.20 - 4.75 ($M = 3.88$, $SD = .55$)	1.83 - 17.00 ($M = 6.76$, $SD = 4.74$)
Total N	40	53	3.00 - 5.54 ($M = 4.07$, $SD = .66$)	1.83 - 20.00 ($M = 13.75$, $SD = 5.65$)

1992). Thus, the research team attempted to achieve an initial sample size of at least 100 children in order to account for possible issues of missing data or dropped cases at the conclusion of data collection.

Prior to the commencement of live recruitment at each site, recruitment flyers were distributed to parents either electronically (through email) or on paper that included brief information regarding the nature of the study, the opportunity for compensation, the dates and times that the research team would be on-site to collect consents and child information, and the investigator's contact information (Appendix A). With permission from each site, members of the research team – consisting primarily of the primary investigator (myself) and occasionally trained undergraduate research assistants –recruited child subjects through their parents or legal guardians during daily child pick-up and drop-off times. Child consent forms and parent questionnaires also were sent home to parents in children's daily folders or in children's

backpacks. Up to three additional attempts were made to acquire parent questionnaire data among children who were consented to participate but for whom we had not received completed questionnaires (with moderate success).

Measures

This study included one parent-report measure and nine child measures. A table of each measure, the theoretical components associated with each measure, and the approximate length of administration for each measure is presented in Table 2.

SES. A parent or legal guardian of each participating child was asked to complete a parent questionnaire (PQ) pertaining to the SES of the child's residential family that was based largely on recommendations of Entwisle and Astone (1994), including questions pertaining to total household income and parental education. Household income was coded based on a 10-point scale (the highest score being 10), with "below $10,000" in income over the past year constituting a score of "1" and "$90,000 or more" in income over the past year constituting a score of "10." Two questions were used to assess parental education: highest degree attained and amount of school completed (Entwisle & Astone, 1994). Highest degree attained included six possible choices, with each choice receiving the following weight/code: 1) "None," weight of 0, 2) "High school degree or equivalent/GED," weight of 1, 3) "Associate degree or trade/technical degree," weight of 2, 4) "Bachelor's degree," weight of 3, 5) "Master's degree," weight of 4, and 6) "Ph.D., J.D., M.D. or other doctoral degree," weight of 5. Amount of school completed included six possible choices, with each choice receiving the following weight/code: 1) "Did not complete high school," weight of 0, 2) "Completed high school, no college or additional schooling," weight of 1, 3) "Completed high school, some college/additional schooling – not completed," weight of 2, 4) "Completed two year-college – received degree," weight of 3, 5)

Table 2.

List of Measures, Corresponding Components, and Approximate Length of Administration

Measures	General Component Measured	Specific Component Measured	Approx. Length of Administration
Parent Measure			
PQ	SES	N/A	5-10 min.
Child Measures			
BSRA-III	General cognitive skills	N/A	30 min.
BDS	EF	Working memory	5-10 min.
Day/Night	EF	Conflict inhibition	5 min.
Bear/Dragon	EF	Conflict inhibition	5 min.
DC	EF	Delay inhibition	10 min.
CS	EF	Set shifting	15 min.
LFB	ToM	False beliefs	5 min.
CFB	ToM	False beliefs	5 min.
DP	ToM	Deception	10 min.

Note. Measure names provided in abbreviation form. For full measure names, see following sections.

"Completed four-year college – received degree," weight of 4, 6) "Completed college, completed graduate program post-college – received degree," weight of 5. If the respondent indicated that the child lived in a two-parent household, the parental education score was computed as an average of the two parents' scores (per the recommendation of Hollingshead, 1975). Participants were blind to the weighted values associated with their responses to each of these SES items.

The child's overall SES index score was computed by adding *household income* and *parental education* and dividing the sum by the total number of points possible (20). Thus,

household income and *parental education* each represents approximately 50-percent of the total score, and the dependent variable taken from this measure, *SES Index*, ranges from 0 (lowest) to 1.00 (highest). In addition, the questionnaire included questions related to the child's socio-demographic characteristics and family composition, though these questions were not included in the computation of SES scores. For a copy of the questionnaire, see Appendix B.

General cognitive skills. General cognitive skills were measured with the Bracken School Readiness Assessment, Third Edition (BSRA-III; Bracken, 2007), a measure of preschoolers' understanding of basic concepts that are related to school readiness. This standardized measure includes five subtests: color, number, letter, size/comparison, and shapes. The measure yields a standardized school readiness composite that is based on a child's performance in relation to his/her age as compared to the normative sample of 750 children who were representative of the U.S. population by age, sex, race/ethnicity, geographic region, and parent education level. A follow-up reliability study of the measure reported that test-retest reliability was relatively high across all age groups (*a* ranged from.76 to .92), and internal consistency, based on split-half reliability, was reported to be exceptionally high for the total sample (*a* = .95; Panter & Bracken, 2009). Standardized school readiness composite score was used as a covariate in the regression analyses.

EF. Three components of EF were measured: working memory, inhibition, and set shifting. Two components of inhibition were measured on the basis of previous reports that inhibition is best represented as a dual construct among preschoolers (i.e., conflict inhibition and delay inhibition; Beck et al., 2011; Bernier, et al., 2010; Carlson & Moses, 2001; Carlson et al., 2002; Davis-Unger & Carlson, 2008; Hala et al., 2003). Four total EF measures were included.

Working memory. The Backward Digit Span (BDS) task (Davis & Pratt, 1995) was used to assess participants' skills in the working memory aspect of EF. This task requires brief storage, recall, and manipulation of items held in the mind. In the version of the BDS task used in the present study, participants are asked to repeat strings of single-digit numbers in reverse order. In order to continue on to the test trials, participants need to answer at least one practice trial, out of four, correctly. Digit strings start at 2-digits and increase by 1-digit with each successful trial; digits were read at a rate of one per second. The test is discontinued when children fail to recall a digit or recall a digit incorrectly. The highest number of digits correctly recalled was the dependent measure taken from this measure. The BDS has been used across a number of studies of children's EF (e.g., Carlson, 2005; Carlson et al., 2002; Davis & Pratt, 1995; Guajardo et al., 2009), and both Carlson et al. (2002) and Guajardo et al. (2009) reported high correlations between this measure and two other measures of working memory (backward word span and counting and labeling) among children ages three-to-five.

Conflict inhibition. The Day/Night Stroop task (Gerstadt, Hong, & Diamond, 1994) and the Bear/Dragon task (Reed, Pien, & Rothbart, 1984) were used to assess conflict inhibition. Both tasks were included based on the findings of Carlson and Moses (2001) that – though both measures were significantly correlated within a sample of three- and four-year-olds – children found the Bear/Dragon task to be more challenging than the relatively simple Day/Night task.

In the Day/Night Stroop task, participants complete two practice trials (with corrective feedback) and 16 test trials (with no feedback) in which they are shown a picture card of a sun and asked to say "night" (n) and a picture card of a moon and stars and asked to say "day" (d). In order to begin the test trials, children must correctly perform at least one of the practice trials. The test trials include eight *n* cards and eight *d* cards presented in the following order: n, d, d, n,

d, n, n, d, d, n, d, n, n, d, n, d (Reck & Hund, 2011). Each correct response is given a score of

"1," with "16" representing the highest and "0" representing the lowest overall score. The

dependent measure will be calculated as child's score divided by highest score possible (16), and

will range from 0 (lowest) to 1.00 (highest). Across previous studies involving young children,

this task has been found to be significantly correlated with other measures of conflict inhibition,

including the Whisper task (Reck & Hund, 2011) and the Grass/Snow task (Carlson, 2005). See

Appendix C for examples of test cards.

The Bear/Dragon task entails telling participants to follow the instructions provided by

the "nice" bear (i.e., "touch your nose") and not to follow the instructions provided by the

"mean" dragon. The children are administered two practice trials with the bear picture card (with

corrective feedback) and two practice trials with the dragon picture card (with corrective

feedback). If the children are unable to successfully perform at least one of the dragon practice

trials, up to three additional practice trials are administered. If a child fails all five dragon

practice trials, the child is told that the experimenter will help him/her by holding his/her hands

down as the child is administered another practice trial (Carlson et al., 2002). After a verbal rule

check, children are administered 12 test trials: six "bear" trials (b) and six "dragon" or inihibition

trials (d) presented in a fixed order: b, b, d, b, d, d, d, b, d, b, d, b (Reck & Hund, 2011).

Responses on each inhibition trial (d) were scored as 0 (fully or partially completed command)

or 1 (did not complete the command/inhibited response). Scores on the inhibition trials (d), only,

were summed to form an overall score for this measure, with 0 representing the lowest potential

score and18 representing the highest potential score. The dependent variable from this measure

was calculated as child's score divided by points possible (18), and ranged from 0 (lowest) to

1.00 (highest). Like the Day/Night task, Carlson et al. (2002) reported a high correlation between

performance on this measure and performance on the Whisper task among a sample of preschoolers.

Delay inhibition. The Delay of Choice task (DC) was developed by the Carlson Child Development Lab (Beck et al., 2011) and is part of a larger battery of EF tasks that are in the pre-validation phase. This task is similar to a delay of gratification task in that it requires children to make a choice as to whether they want a moderately rewarding stimulus immediately or would rather have a more rewarding stimulus later. There are a total of nine trials, with the child scoring either a 1 (for a delay reward choice) or a 0 (for an immediate reward choice) on each trial; thus, the highest score that a child can receive on this measure is a score of 9. The dependent variable was calculated as child's score divided by highest score possible (9), and ranged from 0 (lowest) to 1.00 (highest). A sample of the task protocol is included in Appendix D.

Set shifting. Set shifting was assessed using EF Conflict Scale for Preschoolers (CS), which is included in the same EF battery as the DC task (Beck et al., 2011). This assessment currently is in the pre-validation stage, though it is highly similar to the Dimension Change Card Sort and was chosen for the fact that it includes additional increasingly complex task phases that have the potential to tap into a wider range of set shifting skills. Specifically, this task requires children to attend to one stimulus or stimulus dimension while ignoring another stimulus or stimulus dimension in order to sort cards on the basis of two or more alternating rules, while the number of sorting rules and the number of stimulus dimensions become increasingly more complex as the task progresses.

The CS includes six levels, each with at least one sub-part. Children ages three and younger begin at Level 1, Part A, which entails categorizing one of two shapes on the basis of only one rule (i.e., matching the fish cards with the fish box in the presence of a fish box and an

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elephant box, when the rule is simply to match the fish card with the fish box). The highest level children can reach is Level 6, Part B, which entails categorizing cards on the basis of one of two conflicting dimensions represented on the cards while alternating between two conflicting rules (i.e., alternating between/among four possible sorting rules: categorizing based on the color – red or blue – of the object represented on the card if there is a border around the card; categorizing based on the shape – stars or trucks – of the object represented on the card if there is no border). Levels 1 through 4 include two sub-parts, each with five trials. Children must correctly respond to at least four of the five trials per each sub-part in order to advance to the next sub-part or level. Level 5 includes 10 trials: five color trials and five shape trials, and children must correctly respond to at least four of the five color trials and four of the five shape trials in order to advance to Level 6. Level 6 includes two sub-parts, each with 10 trials (color and shape). Total number of levels passed divided by total number of levels (out of six) was used as the dependent measure.

ToM. Three tasks were used to measure children's ToM: a locations false belief (LFB) task, a contents false belief (CFB) task, and a deceptive pointing (DP) task. Both LFB tasks and CFB tasks have been used in conjunction across a number of studies investigating preschoolers' ToM skills (e.g., Carlson & Moses, 2001; Thoermer, Sodian, Vuori, Perst, & Kristen, 2012), and they both were used here on the basis of the relatively small amount of data that is garnered from both measures. The LFB task (adapted from Wimmer & Perner, 1983) involves asking participants where they think a puppet will think that his ball is after it has been moved from its original location – by a second puppet – during the first puppet's absence. This task is similar to the traditional Sally/Ann task with the exception of the stimuli that is used. So as to avoid the possibility of unevenly skewed relational biases toward the puppets with personal characteristics represented in the sample, stimuli were gender- and race-neutral hand puppets, and were labeled

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with silly and uncommon names ("Loo Loo," Puppet 1 and "Bop," Puppet 2). After "Bop"

moves the ball, participant are asked: 1) where "Loo Loo" will look for the ball and 2) where the

ball is really (see Carlson & Moses, 2001). Per the procedure of Carlson and Moses (2001),

children will receive two scores on this task: either a 1 (correct response) or a 0 (incorrect

response) to the belief question and either a 1 (correct response) or a 0 (incorrect response) to the

reality question.

The Contents False Belief task (adapted from Gopnik & Astington, 1988) involves

showing participants a familiar container (a juice box) with unfamiliar contents (stickers) and

asking the participants what they thought the boxed contained before it was opened, and then

asking them what someone else (a puppet) who has not seen the box's contents would think is

inside it. Specifically, the children first are asked a control question ("Can you tell me what is

really inside this box?") that will not be used for scoring purposes. Then they are asked two test

questions: 1) "What did you think was inside the box before I opened it?" (assessing children's

understanding of their own false belief) and 2) "The puppet has not seen inside this box; what do

you think the puppet will think is in it?" (assessing children's understanding of another's false

belief). Like the LFB task, children receive two scores: either a 1 (correct response) or a 0

(incorrect response) to the "self" question and either a 1 (correct response) or a 0 (incorrect

response) to the "other" question. The LFB and the CFB measures have been found to be highly

correlated (Carlson & Moses, 2001). Total scores (two) on both of these measures were

calculated based total number correct divided by total number of scored item per each measure.

In the Deceptive Pointing task (adapted from Peskin, 1992), participants choose among

three stickers and are told that they will be sharing stickers with a "nice" puppet and a "mean"

puppet. Each participant is told that the "nice" puppet never chooses the sticker that the child

wants, because the nice puppet wants the child to be happy. In contrast, he/she is told that the "mean" puppet always chooses the sticker that the child wants. The child is then given the opportunity to tell both puppets which sticker he/she wants the most, and the puppet gets to pick a sticker first. The purpose of the measure is to assess whether children are able to deceive the mean puppet into choosing the unwanted sticker, knowing that the mean puppet will pick whichever sticker the child says he/she wants. This task contains two control trials and two test trials: control trial 1 involves telling the child to pick which sticker he/she wants, control trial 2 involves telling the child to tell the "nice" puppet which sticker he/she wants, and test trials 1 and 2 both involve telling the child to indicate his/her sticker preference to the "mean" puppet. The full task (i.e., all four trials) will be repeated four times per the procedure of Peskin (1992). Only proportion of correct deception test trials (out of four) was used for scoring purposes. A sample task protocol is included in Appendix E.

Procedure

Prior to formal recruitment, participating sites sent letters or emails to parents informing them of the impending study and encouraging participation. Once recruitment began, parents/legal guardians were approached in the weeks prior to and at the start of the study by members of the research team who were present at each site during child pick-up and drop-off times. At the time of recruitment, parents were informed of the nature of the study and of what would be expected of them and their child/children should they choose to participate. Then they were be asked to sign a copy of the informed consent document and to fill out the parent questionnaire. They each received raffle tickets for their participation, with the potential to win one of three prizes ($25 gift certificates for Amazon.com) at the end of the study. Additionally, participating sites helped the research team send consents packets home with students who were

not able to be recruited during pick-up and drop-off times. With teacher permission, children received stamps or stickers as rewards at each time of testing.

Child recruitment and testing was conducted over the duration of one semester by the graduate researcher and trained undergraduate research assistants, and two additional summers by the graduate researcher. Each participating child completed approximately three testing sessions, ranging from 10 minutes to 40 minutes. If children were non-compliant, the researcher first encouraged the child to engage in the task. If sufficient encouragement was not effective, the child was returned to his/her classroom and testing was attempted again later in the day or on a different day. If this occurs three or more times for a given child, the participant was dropped from all analyses – this occurred on only one occasion.

Tasks were administered in counterbalanced order across participants. Tasks were individually administered to each child in a quiet area of his/her preschool center during the regular hours of the preschool day. At the end of each session and with teacher permission, participants were able to choose a stamp or a sticker as compensation and the experimenter accompanied the child back to his/her classroom. Participant data was scored twice and stored in a locked cabinet, and de-identified data was entered on a secure, password protected computer.

Results

Data Cleaning, Prior Analyses, and Description of Data

Excluded variables. Prior to working on missing data computations or data analyses, two variables were excluded, both within the theoretical EF construct. The first variable, Backward Digit Span (used to measure working memory) was dropped due to a high floor effect. More than 30% of the sample did not make it past the practice trials, and of those who made it to the test trials, more than 50% did not reach the minimum span of 2 digits and received a score of

"0." The second excluded variable, the Day/Night task (used to measure conflict inhibition), was excluded for several reasons. First, more than 10% of the sample gave responses that were inconsistent with the required responses. For example, when children were instructed to say "day" in response to the picture of the moon, several children responded with the word "sun" or something similar. In this example, it is possible that the children were, in fact, displaying flaws in their working memory skills more than their inhibition skills; they did correctly inhibit responding to the actual image on the card (i.e., they did not respond with "moon" or "night"). In addition, several children also displayed some issues with perseveration in that they would respond correctly to one card but continue to provide the same response on all subsequent trials (i.e., they would say "day" for every trial). In these cases, the child would receive a score of 50% correct, because they correctly responded to half of the trials; though, it is unclear whether the children were correctly inhibiting or mistakenly perseverating. For these reasons, and for the fact that the EF battery included other usable measures, these variables were deemed unnecessary in the subsequent data cleaning and analyses.

Missing data. Before conducting the analyses, the dataset was screened for missing data. When possible, the research team first attempted to complete the missing fields through additional data collection. In cases of unavoidable missing data, participant cases either were dropped from future analyses or missing fields were estimated when possible. Prior to calculating missing data values for EF and ToM variables, a preliminary Principal Components Analysis (PCA) was conducted to determine which variables shared the same latent characteristics. The PCA indicated that Bear/Dragon and CS scores were best represented by a single factor, with Eigen values all greater than 1 (Tabachnick & Fidell, 1996), while DC scores were best represented as an individual (i.e., not combined factor) variable. Thus, missing values

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for the Bear/Dragon ($n = 2$) and CS ($n = 2$) variables were calculated and imputed based on regression equations using complete data from the other variable within the factor as the predictor (independent) variable. Missing DC data remained missing and, as such, individuals who were missing DC data were excluded from all subsequent regression analyses ($n = 9$). For the three ToM variables, the PCA indicated that all three variables belonged on the same factor (Eigen values greater than 1). Missing values from each of these variables (FB Contents, $n = 1$; FB Locations, $n = 3$; Deceptive Pointing, $n = 1$) were calculated and imputed based on regression equations using the other two variables within the ToM factor as IVs within the prediction model. To determine how to best calculate missing BSRA values, a correlational analysis was conducted that included age, gender, site, SES index, and BSRA scores. Site and SES index were both significantly correlated with BSRA scores at the $p < .01$ level, while age and gender were not significantly correlated with BSRA scores. Therefore, site and SES index were used as IVs in a regression equation to predict BSRA scores, and missing values were imputed ($n = 8$).

Variable structure. Principal components analysis (PCA) with varimax rotation was used to determine the independence of each EF variable from each other, and each ToM variable from each other. The factor loadings, Eigen value, and percent of variance explained for both PCAs are presented in Table 3. The first PCA included the variables from each measure of EF (Bear/Dragon, DC, and CS). Two factors were extracted, each with Eigen values greater than or approaching 1. Together, these two factors accounted for 84.3% of the variance in these data. Both measures involving conflict inhibition loaded onto factor 1, while the one measure of delay inhibition loaded onto factor 2 on its own, with negative cross-factor loadings. Computed factor scores for factor 1 ("Conflict Inhibition") were saved from this analysis and will be used in conjunction with delay percentage (percentage of trials for which "delay" was chosen) from the

Table 3.

Results from Two Principal Components Analyses (PCA) for EF and ToM Variables: Unrotated Factor Loadings, Eigenvalues, and Percentages of Variance

Variables	EF PCA			ToM PCA		
	Factor 1	Factor 2	Communality	Factor 1	Factor 2	Communality
Bear/Dragon	.859	.161	.764			
DC	-.298	.954	1.000			
CS	.858	.170	.765			
Eigenvalues	1.563	.966				
% of variance	52.103	32.201				
CFB				.826	-.015	.682
LFB				.652	-.646	.842
DP				.601	.721	.882
Eigenvalues				1.468	.938	
% of variance				48.935	31.262	

Note. Measure names provided in abbreviated form. For full measure names, see *Measures* section.

Delay of Choice task (alone) to represent EF in the subsequent analyses. The second PCA included the three variables related to ToM: Contents FB, Locations FB, and Deceptive Pointing. This analysis indicated that the ToM variables each load highly onto a single factor, accounting for 48.9% of the variance in these data. As Deceptive Pointing loaded highly onto both factor 1 an factor 2, I decided to favor the single-factor ("ToM") variable on the basis of the theoretical coherence of this construct.

Assumptions of regression. Prior to conducting the analyses, the data were checked to ensure that they conformed to the assumptions of regression. Linearity in the relation between the IVs and the DV was checked by plotting each IV against the DV with scatterplots, and the relations appeared to be linear. The same check was conducted with the CVs and the DV, and these relations appeared linear as well. The independence of errors assumption was checked by conducting a Durbin-Watson test, which resulted in an acceptable value of 1.42 (Durbin & Watson, 1950). Homoscedasticity of errors was checked through several steps. First, I ran a regression that included the two EF variables as IVs and the ToM variable as a DV and saved the residuals from this analysis. Then, I plotted both the Conflict Inhibition factor and the Delay Inhibition variable against the residuals from the prior analyses to check for linearity. Both of these plots appeared to show linearity; thus, the assumption was met. To check for normality of the distribution, I looked at a histogram of the ToM DV and determined that it appeared adequately normally distributed. I checked for the presence of univariate outliers by looking at boxplots for each IV, CV, and DV (no outliers present), and I checked for multivariate outliers using Mahalanobis distance. With five predictor variables (IVs and CVs), thus five degrees of freedom, the Mahalanobis distance threshold is 11.07 (De Maesschalck, Jouan-Rimbaud, & Massart, 2000). Two cases exceeded this threshold, so they were dropped from the regression analysis. I also checked the data for issues of multicollinearity using collinearity diagnostic tests (VIF) and found that all values fell within the acceptable range (less than 10 is acceptable, less than 5 is preferred, all values were less than 3; O'Hagan & McCabe, 1975).

Descriptive statistics. Descriptive statistics were calculated for all IVs and DVs that were included in the subsequent analyses. Table 4 displays a list of the individual (i.e., non-aggregated) variables included in the subsequent analyses, including their means, standard

Table 4.

Descriptive Statistics for Individual CVs, IVs, and DVs (N = 89)

Variable	M	SD	Range
Age (years)	4.07	.66	3.00-5.54
SES (index score)	13.75	5.65	1.83-20.00
General Cognitive Ability			
BSRA (Std. Score)	106.82	17.91	52.0-141.0
EF			
Bear/Dragon (% passed)	.72	.41	0.0-1.0
Conflict Scale (% levels passed)	.52	.21	.17-1.0
Delay (% passed)	.50	.35	0.0-1.0
ToM			
FB: Contents (% passed)	.33	.39	0.0-1.0
FB: Locations (% passed)	.48	.27	0.0-1.0
Deceptive Pointing (% passed)	.37	.39	0.0-1.0

deviations, and ranges for the overall sample. Additionally, in order to more fully describe

possible age-related differences in average performance per each IV and DV, a frequency

analysis was conducted on age in order to determine how best to divide the sample into separate

age groups so as to calculate estimated means by age. This analysis indicated that the sample

could be separated into four theoretically supported and roughly equivalent age groups: 3.0-3.49

years (25.3% of total sample), 3.5-3.99 years (27.4% of total sample), 4.0-4.49 years (23.1% of

total sample), and 4.5-5.6 years (23.3% of total sample). After creating an "age group"

categorical variable with four categories, estimated marginal means were calculated per each

individual (i.e., non-aggregated) IV and DV by age group. These estimated marginal means are

displayed in Figure 2. However, it is important to note that the continuous version of the "age" variable was used in all subsequent analyses.

Results: Hypothesis 1

The hypothesis that preschoolers' EF skills would be significantly related to their ToM skills, regardless of age, SES, or general cognitive skills was tested using hierarchical regression. In this regression, age, SES, and BSRA were entered as covariates in Step 1. The two EF variables, Delay and Conflict, were entered in Step 2 as the IVs. The ToM factor variable was included as the DV. The results from this analysis are displayed in Table 5. The results indicate that once the variance from the covariates was accounted for, the EF variables did not account for a significant amount of additional variance in ToM scores. More specifically, age was the only predictor variable to account for a significant amount of variance in ToM. These results lead to the rejection of hypothesis 1.

Results: Hypothesis 2

The second hypothesis, that SES would moderate differences between preschoolers' EF and ToM skills, regardless of age and general cognitive skills, was rejected ipso facto by the non-significant results of the initial hierarchical regression analyses used to test hypothesis 1; though this hypothesis was explored further through correlational analyses. Correlational analyses were conducted to determine the relations between child age, SES, general cognitive skills, EF skills, and ToM skills within the overall sample (results in Table 6). Although SES was significantly correlated with both EF variables, and Conflict EF was significantly correlated with ToM, ToM was not significantly correlated with SES or with Delay EF. Thus, the results from the correlational analysis support the results from the regression analysis and provide further evidence for the rejection of hypothesis 2.
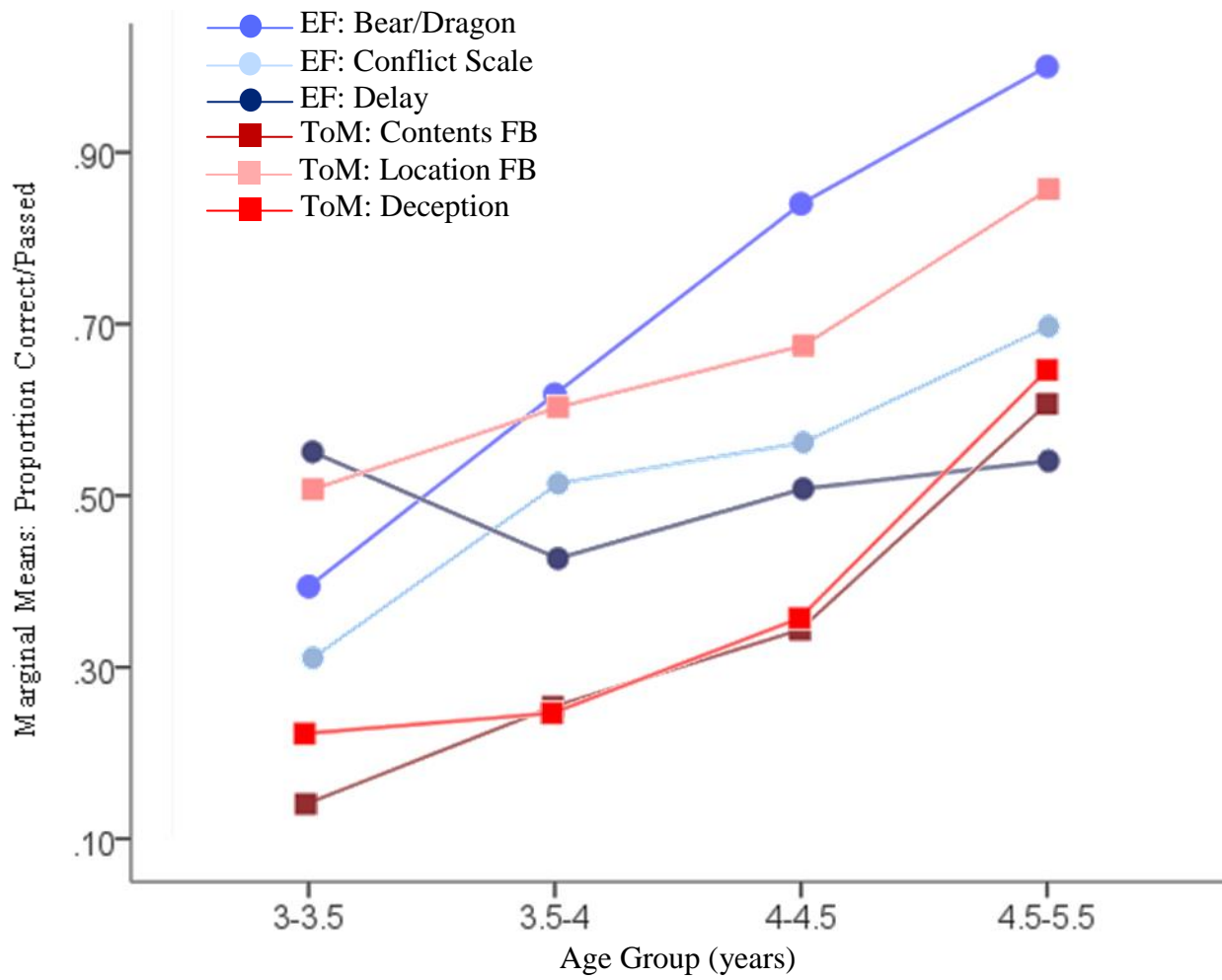
Figure 2. Estimated marginal means of individual EF and ToM variables included in subsequent analyses by age group.

Table 5.

Results of Hierarchical Regression Analysis Predicting Theory of Mind Scores (DV) from Age, SES, General Cognitive Skills, and Executive Functions

Variable	B	$SE(B)$	β	r	ΔR^2
Step 1					.376**
Age	.915	.130	.618**	.607	
SES Index	-.007	.021	-.039	-.035	
BSRA	.006	.007	.101	.090	
Step 2					.001
Age	.895	.197	.605**	.447	
SES Index	.005	.021	-.039	-.041	
BSRA	-.008	.007	.101	.072	
Conflict Inhibition	.023	.144	.023	.017	
Delay Inhibition	-.073	.250	-.026	-.032	

Note. **$p < .01$. Step 2 $R^2 = .377$, adjusted $R^2 = .339$; Step 2 $F(2,83) = 10.034$, $\Delta F = .062$, $p = .940$. r: partial correlation coefficient.

Table 6.

Results from a Two-Tailed Correlational Analysis Including all Variables (N = 89)

	Age	SES Index	BSRA	Delay	Conflict Inh. Factor	ToM Factor
Age	1					
SES Index	.113(.294)	1				
BSRA	-.058(.587)	.693(<.001)	1			
Delay	.029(.790)	-.218(.040)	-.123(.250)	1		
Conflict Inh. Factor	.648(<.001)	.405(<.001)	.429(<.001)	-.112(.297)	1	
ToM Factor	.608(<.001)	.100(.349)	.038(.725)	-.013(.905)	.438(<.001)	1

Note. Values represent Pearson's product-moment correlation coefficient (r); values in parentheses represent significance level (p).

Results: Hypothesis 3

The regression analysis that was used to test Hypothesis 1 also tested Hypothesis 3 – that SES would affect the amount of variance in ToM that is accounted for by EF. Due to the finding that neither SES nor EF accounted for a significant amount of variance in ToM once age was taken into account, this hypothesis also is rejected.

Results: Hypotheses 4 & 5

The hypotheses that performance on EF and ToM measures would vary as a function of age and general cognitive skills were tested ipso facto from the correlational analyses that were used to test Hypothesis 2 (see Table 6). High positive correlation coefficients were estimated between age and Conflict Inhibition ($r = .648$, $p <.001$), age and ToM, ($r = .608$, $p <.001$), and BSRA and Conflict Inhibition ($r = .429$, $p <.001$), lending partial support for this hypothesis. Three simple regression analyses also were conducted to further explore this hypothesis (results in Table 7). Results from these analyses are consistent with correlational results, indicating that

Table 7.

Results of Three Simple Regression Analyses Predicting EF and ToM from Age and General

Cognitive Skills

IVs	DV	*B*	*SE(B)*	*β*	*r*	ΔR^2
Model 1	Delay					.016
Age		.011	.335	.022	.022	
BSRA		-.002	.002	-.122	-.122	
Model 2	Conflict Inh.					.653
Age		1.023	.545	.680**	.755	
BSRA		.026	.003	.462**	.616	
Model 3	ToM					.361
Age		.907	.129	.599**	.599	
BSRA		.005	.005	.093	.115	

Note. **p < .01. Model 1 R^2 = .016, adjusted R^2 = -.007; $F(1,86)$ = .682, *p* = .508. Model 2 R^2 = .653, adjusted R^2 = .645; $F(1,90)$ = 84.496, *p* < .001. Model 3 R^2 = .361, adjusted R^2 = .346; $F(1,88)$ = 24.832, *p* < .001. *r*: partial correlation coefficient.

age and BSRA are significant predictors of Conflict Inhibition, and that age is a significant predictor of ToM. Inconsistent with this hypothesis, results from both the correlational analysis and the simple regression analyses indicate that age and BSRA were not significantly related to, nor predictive of, Delay Inhibition performance, nor were BSRA scores related to ToM performance. Therefore, this hypothesis was partially supported.

Discussion

Summary of Results and Conclusions

The overarching goal of the field of cognitive developmental psychology is to form an in-depth understanding of how the mind develops and changes from infancy through adulthood. A popular area of study that has emerged over the past several decades is in the development and function of the cognitive control processes – executive functions – that are governed by the prefrontal cortex. Much is known about the role that EFs play in promoting positive adjustment to school and school achievement during early childhood (Blair & Razza, 2007; Evans & Rosenbaum, 2008; Farrar & Ashwell, 2008; Monette et al., 2011; Welsh et al., 2010), promoting later achievement in school and beyond (Altemeier et al., 2008; De Rammelaere et al., 2001), as well as the socioeconomic and sociocultural factors that relate to EF development (Hughes et al., 2010; Lan et al., 2011; Mezzacappa, 2004; Oh & Lewis, 2008; Rhoades et al., 2011; Sarsour et al., 2011). Additionally, a growing body of evidence supports the notion that EF development is linked with similar developments in social cognition, specifically theory of mind (Carlson et al., 2002; Hughes, 1998a; Razza & Blair, 2009; meta-analysis: Devine & Hughes, 2014; review: Perner & Lang, 1999). In conducting a search of the literature on this topic, one would easily find ample evidence to support the claim that children from low-SES homes are at a disadvantage when it comes to EF development (e.g., Kishiyama et al., 2009; Mezzacappa, 2004;

Rhoades et al., 2011; Stevens et al., 2009), just as one could easily find many articles supporting the link between EF and ToM. However, as there have been very few published studies that have examined the relation between SES and ToM, little is known about how SES might influence the seemingly robust relation between EF and ToM. If children's SES background affects their EF skills, and EF development affects ToM development, it would stand to reason that SES background may – if indirectly – relate to ToM development, as well. Examining this hypothesis was the central premise of the current study.

The results suggest that after accounting for age-related variance shared by both constructs, EF was not significantly related to ToM, regardless of SES background. The lack of a significant relation between EF – particularly Conflict Inhibition – and ToM was an unexpected finding, though it may be at least partially due to the overwhelming effects of age. Once the variance from age, alone, was taken into account, only 8.5-percent of unexplained variance remained in ToM scores. To further explore the effects of age, Appendix F shows the results of four correlational analyses that were separated by age group. While, within the overall sample, the ToM factor is significantly correlated with Conflict Inhibition (see Table 6), when broken down by age group, this relation is no longer significant within any group. This supports the overall findings of the study, indicating that EF and ToM were not significantly related within this sample after accounting for the shared effects of age. One possibility is that there may not have been enough statistical power to detect potential subtle relations between EF and ToM within age groups, as the sample size for each age group ranged from 21 to 24. If the study had taken a multi-group approach and viewed each age group as an individual sample nested within the overall model, a power analysis would have indicated that there would need to be roughly 100 participants in each age group, rather than roughly 100 participants total (Cohen, 1992).

However, as the evidence from the current study does not provide any support for the EF-ToM relation within age groups, even with more power one could expect that if any relations did emerge, these relations would be small.

Several previous cross-sectional studies have found that controlling for age affects the apparent relation between EF and ToM in various ways. Hughes (1998a) conducted a study that was highly similar to the current study in both measures used and sample demographic characteristics, and she found that the correlation between conflict inhibition and ability to predict a false belief was no longer significant after accounting for age, though ability to explain false beliefs and ability to deceive remained significantly correlated with conflict inhibition. However, Hughes conceptualized conflict inhibition differently from the current study, in that she included set shifting (termed "attentional flexibility") as a separate factor. Moreover, consistent with the findings from the current study, she found that set shifting did not significantly correlate with any measures of ToM after accounting for age. Similarly, Carlson et al. (2002) reported that the correlation between appearance-versus-reality understanding (an aspect of ToM) and conflict inhibition became non-significant once the effects of age were included; though the correlation between conflict inhibition and false belief understanding remained significant. Also similar to the current study, Fizke et al. (2014) found that preschoolers' performance on the Bear/Dragon task went from being significantly correlated with performance on the Contents False Belief task to non-significantly correlated once they included age. While the current study clearly is not the first to encounter significant overlapping age effects in EF and ToM, in a meta-analysis that included 48 studies within which age effects were taken into account, Devine and Hughes (2014) found that the relation between EF and false belief understanding remained significant, with a small-to-moderate effect size. Thus, the

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findings of the current study – or lack thereof – may be not entirely unique, though these findings

are not highly prevalent across the published literature (it is worth noting that null results are less

likely to be published).

Apart from the lack of a link between EF and ToM, the finding that EF was significantly

related to SES while ToM was not was expected, though that was not included as a hypothesis in

the current study and, as such, was not officially examined in the analyses. Yet, as the

correlational analyses indicated that Conflict Inhibition was moderately-to-highly correlated with

SES in the expected direction (positive), the analysis revealed the surprising finding that Delay

Inhibition was slightly, but significantly, negatively correlated with SES. To explore this

unexpected finding a bit further, I separated the sample into three roughly equivalent SES groups

(SES index for Group 1, "Low" = 1.0-10.0, n = 31; SES index for Group 2, "Middle" = 10.1-

17.9, n = 32; SES index for Group 3, "High" = 18.0-20.0, n = 35) and conducted a one-way

analysis of variance (ANOVA) using SES group as the IV and Delay Inhibition as the DV.

Results from this analysis are displayed in Appendix G. The results indicated that the low-SES

group delayed on significantly more trials than the middle-SES group, but not in comparison to

the high-SES group. These results are based on a limited and simplistic analysis, and sample size

within each SES group was low, so should be interpreted with caution; though, this does indicate

that the positive relation between SES and preschoolers' EF may not be ubiquitous across all

components of EF.

Unlike EF, ToM was not significantly correlated with SES. This finding is not surprising,

given that the literature pertaining to this relation paints a murky picture at best. While some

have reported that low-SES is negatively related to ToM (e.g., Cutting & Dunn, 1999; Shatz et

al., 2003), others have found that children do not tend to differ on measures of false belief

understanding (Garner et al., 2005) or on measures of deception (Cole & Mitchell, 1998; Weimer & Guajardo, 2005) as a function of their SES background. In sum, the results from the current study lend additional support to the theory that, when it comes to the potential negative implications of low-SES on child development, ToM may be a protected component of cognition, at least during the preschool years.

Implications and Future Directions

As executive, self-regulatory, and social-cognitive skills have been shown to relate to school readiness and later academic achievement (Blair & Razza, 2007; Evans & Rosenbaum, 2008; Guajardo & Cartwright, 2016; Welsh et al., 2010), it is important to understand the mechanisms that influence the development of these processes. Understanding how family and individual background characteristics might directly and indirectly affect these developments in cognition would allow researchers and educators to design preschool curricula to more closely match the cognitive and social cognitive needs of children with different potential weaknesses and strengths. While the current study did not find evidence of a direct relation between EF and ToM among preschoolers, and, as a result, was not able to examine whether SES-related variance might influence the relation between EF and ToM, the study did generate evidence that, unlike EF, ToM may not be related to SES background. In addition, the study adds to the body of literature pertaining to the large age-related changes that occur in both EF and ToM during the preschool years (see Diamond et al., 2002 and Huttenlocher & Dabholkar, 1997 for reviews). As preschool is meant to prepare children for the start of school, so that all children – regardless of SES background – enter school on an even playing field, preschool educators and program developers could benefit from considering what children are and are not likely to be capable of at

a given age, as well as the aspects of learning that may need to be more strongly promoted among children from low-SES communities.

In conjunction with the findings from previous studies (e.g., Kishiyama et al., 2009; Mezzacappa, 2004; Rhoades et al., 2011; Stevens et al., 2009), the findings from the current study indicate that young children from low-SES homes may benefit from early education efforts geared toward training and strengthening EF skills. Conversely, preschool children may develop the ability to understand the thoughts and beliefs of others, even when these thoughts and beliefs differ from their own, at a similar rate regardless of SES background. This information is relevant to those who are interested in improving children's EF skills in the context of early education, particularly for those children who may be at a disadvantage. Perhaps practicing EF skills within the context of a ToM activity, such as role-playing when one has to frequently change roles, could help children of all backgrounds improve their EF skills. This type of EF-promoting activity that includes aspects of ToM, along with many other similar examples, has been implemented within the *Tools of the Mind* preschool program (Bodrova & Leong, 1996; 2001) as well as in Montessori classrooms (Montessori, 1976) and has been found to be successful in improving EF skills (Diamond et al., 2007; Lillard, 2012).

While the current study failed to find a relation between EF and ToM, future studies could expand upon the current study either by including more participants per each age group and taking a multi-level approach or by focusing on one age group and recruiting more participants that fit within those specific age parameters. Additionally, the data could be collected longitudinally – perhaps once at the beginning of the preschool year and once at the end – rather than cross-sectionally, as was done in the current study. Conducting the study longitudinally would clarify whether patterns of change in EF scores might be related to patterns

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of change in ToM scores over time. Furthermore, future studies could include children who are enrolled in preschool – as with the current study – as well as children who participate in center-based daycare, home-based daycare, or who are cared for in their own homes by parents or relatives and who are not in a formal early education program. By including children from various early educational contexts, one could examine how early education, in general (as compared to the lack thereof) may impact EF and ToM development and the possible relation between these developments.

In terms of possible further explorations of the role of SES in the development of EF and ToM, one could expand upon the concept of "SES" by including variables related to overall family context. While low levels of family income and parental education can have significant implications for cognitive development throughout childhood, these relations may be mediated by numerous proximal environmental variables that tend to be highly – and positively – associated with low SES. For example, studies have shown that income level may be indirectly and positively associated with factors related to maternal support (Jackson, Brooks-Gunn, Huang, & Glassman, 2000; Weis & Toolis, 2010). In addition to parental support or warmth, studies have shown that there is a link between family SES and cognitively stimulating resources within the home (Bradley, Corwyn, Pipes, McAdoo, & Garcia Coll, 2001; Korenman, Miller, & Sjaastad, 1995; Smith, Brooks-Gunn, & Klebanov, 1997). Resources within the home that can stimulate cognitive functioning among young children include material resources like toys for learning and children's books (Becker, 1991; Bradley et al., 2001; Entwisle, Alexander, & Olson, 1997), but also less tangible resources like maternal time availability (Baydar & Brooks-Gunn, 1991; Bornstein, Hendricks, Haynes, & Painter, 2007) and amount of time parents spend engaging with their children on cognitively stimulating activities, such as home book reading

(Whitehurst, 1997). In the future, studies could include more parent self-report measures as well as observational measures to examine various home and family factors that are related to SES and that may relate to differences in EF and ToM across children from different backgrounds, differences that are not explained by SES, alone. Ultimately, as the results from this study did not support the study's hypotheses or much of the previous literature on this topic, it is clear that more work needs to be done to improve our methods of measurement and sampling techniques in order to form a more precise understanding of the relation between these two aspect of cognition, as well as how socioeconomic differences may influence their development.

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Sample Recruitment Flyer

Appendix B

Sample Parent Questionnaire

Parent Questionnaire

Thank you for answering the questions below! Your honest answers are important to us and will be kept confidential.

YOUR NAME: _____ Phone #: (_____) _____ - _____

CHILD'S NAME: _____

CHILD'S DATE OF BIRTH: MONTH _____ DAY _____ YEAR _____

CHILD'S GENDER: ☐ Boy ☐ Girl

YOUR RELATIONSHIP TO THE CHILD: (Please check one box below)

☐ Mother ☐ Father ☐ Grandparent ☐ Other: _____

ARE YOU THE CHILD'S PRIMARY CAREGIVER (THE PERSON WHO SPENDS THE MOST TIME WITH THE CHILD)?

☐ Yes ☐ No

PLEASE INDICATE THE RACE/ETHNICITY THAT BEST DESCRIBES YOUR CHILD:

☐ African-American or Black   ☐ Caucasian or White   ☐ Latin American   ☐ Asian or Asian American   ☐ Bi-Racial or Multi-Racial   ☐ Other: _____

•••

1. **Check one box that represents the highest grade in school that you have <u>completed</u>.** *Please Circle <u>One</u>*

   A.) Have not completed high school

   B.) Completed high school, no college or additional school

   C.) Completed high school, some college/additional school (not completed)

   D.) Completed two year-college (received degree)

   E.) Completed four-year college (received degree)

   F.) Completed college, completed graduate program post-college (received graduate degree)

   G.) Other: _____

2. *Two-parent home:* complete Question 2. *One-parent home: skip to Question 3.*
   Check one box that represents the highest grade in school that <u>your partner</u> has <u>completed</u>. *Please Select <u>One</u>*

   A.) Have not completed high school

   B.) Completed high school, no college or additional school

   C.) Completed high school, some college/additional school (not completed)

   D.) Completed two year-college (received degree)

   E.) Completed four-year college (received degree)

   F.) Completed college, completed graduate program post-college (received graduate degree)

   G.) Other: _____

Double sided, more questions on back →

3. **Check the box that represents the highest degree that you have obtained.** *Please Circle* <u>*One*</u>

 A.) None

 B.) High school degree or equivalent/GED

 C.) Associate degree or trade/technical degree

 D.) Bachelor's degree

 E.) Master's degree

 F.) Ph.D., J.D., M.D. or other doctoral degree

 G.) Other: _____

4. *Two-parent home: Complete Question 4. One-parent home: Skip to Question 5.*
   Check the box that represents the highest degree that <u>your partner</u> has obtained. *Please Circle* <u>*One*</u>

 A.) None

 B.) High school degree or equivalent/GED

 C.) Associate degree or trade/technical degree

 D.) Bachelor's degree

 E.) Master's degree

 F.) Ph.D., J.D., M.D. or other doctoral degree

 G.) Other: _____

5. **Which statement best describes the structure of your child's primary household?** *Please Circle* <u>*One*</u>
   The child lives with…

 A.) No birth parents.

 B.) One birth parent; no additional adults live in the home.

 C.) One birth parent and a non-related adult.

 D.) One birth parent and an adult relative (grandparent, aunt, uncle, etc.).

 E.) One birth parent and one step-parent.

 F.) Both birth parents in the same home.

 G.) Other: _____

6. **Please describe the structure of your child's home.** *Provide numbers in the corresponding boxes.*
   **If response is "zero," please write a 0 in applicable box(es)!*

	Total Number		Total Number	Ages of Siblings (List if applicable)
How many total people live with the child?		How many **older FEMALE** siblings does the child have?		
How many **adults (18+)** live with the child?		How many **younger FEMALE** siblings does the child have?		
How many **children (under 18)** live with the child?		How many **older MALE** siblings does the child have?		
Is your child a twin? ____ YES ____ NO		How many **younger MALE** siblings does the child have?		

7. **On average, how often do you read aloud to your child?** Please Circle Une

    A.) Never

    B.) Several times a year

    C.) Several times a month

    D.) Once a week

    E.) About 3 or more times a week

    F.) Every day

8. **Please estimate the total number of children's books in your home.** Please Circle One

    A.) None

    B.) 1-5

    C.) 5-10

    D.) 10-15

    E.) 15-20

    F.) 20 or more

9. **Are you currently employed?** _____ Yes _____ No

10. **On average, how many hours per week do you spend working outside the home?** _____
                                                                            # of hours per week

11. **What is your total household income per year?** Please Select One

❑ Less than $10,000	❑ $20,001 - $25,000	❑ $40,001 -$50,000	❑ $70,001 -$80,000
❑ $10,001 - $15,000	❑ $25,001 - $30,000	❑ $50,001 -$60,000	❑ $80,001 -$90,000
❑ $15,001 - $20,000	❑ $30,001 - $40,000	❑ $60,001 -$70,000	❑ $90,001 or more

→

Double sided,
more questions on back

For questions 1-10, please circle the response that best represents your typical relationship with your child.

1. I have pleasant talks with my child.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

2. I try to teach my child new things.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

3. My child and I hug and kiss each other.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

4. I laugh with my child about things we find funny.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

5. My child and I play games, do crafts, and/or read together.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

6. I thank or praise my child.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

7. I help my child with things he/she is doing.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

8. I comfort my child when he/she seems scared or upset.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

9. I hold or touch my child in a loving way.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

10. I listen to my child's feelings and try to understand them.

1	2	3	4	5	6
Never	Seldom	Sometimes	Often	Usually	Always

Thank you for your time!

Once we receive your completed survey, we will send you home a raffle ticket!

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Appendix C

Sample Day/Night Stroop Stimuli
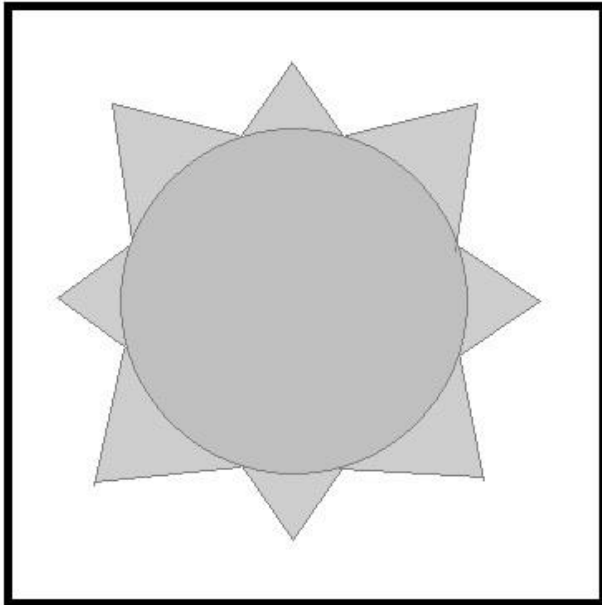
Appendix D

Sample Delay of Choice protocol (Beck et al., 2011)

Delay of Choice   Participant #:_____

Delay Choice Paradigm

Throughout task, emphasize phrases "right now" and "for home." Children are handed objects that they choose for "now;" objects they choose for "home" go in their "Home" envelope to their right.

"One for now" choice should always be on Exp's right. All choices should be of same type/color throughout task (same treat, pennies, & same sticker).

I've got some different kinds of treats for you today. I have _____, _____, and _____ . (*Show 3 ziplocks of treats.*) What treats do you like the best?

Okay, so we'll use the _*treat choice*_ in our game today. In this game, you'll have the chance to make some choices. For each choice you will need to decide whether you want to have the treat right now or wait until you go home, after we're all done. If you want something right now, you get it right away. If you want to save things for home, they go in this Home envelope- for when we're all done and it's time to go home (*place Home envelope at child's right*).

Demonstration Trials:

Now I'm going to make some choices first to show you how this game works and then it will be your turn to make some choices.

E: One fruit loop/goldfish/raisin now or four later (1 v. 5)
So I get to choose between one _*treat choice*_ now which means that I get to eat it now, or four *treat choice* later which means that I get to put it in this envelope (*touch Home envelope*) and have them for later. Later means that I get to have them after we've finished all of our games for the day – when we're all done. Okay?

> 1) So, I'll choose one now *(immediate reward- one)*. So I get to eat it! *(E eats treat)*

Now let me show you how one more choice might look, and then it will be your turn to make some choices.

E: One sticker now or two later (1 v. 2)
So I get to choose between one sticker now which means that I can put it on this paper right here (*place a small post-it to child's left*). Or, I can choose to have it later which means that I get to put them in this envelope (*touch Home envelope*) to have them later after I've finished all of our games for the day – when we're all done.

> 2) This time I'll choose two later. So I have to put them in this envelope and save them until we've finished all of our games for the day.

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Test trials

Ok, now it's your turn to choose. You'll get to make some choices as to whether you want some stickers, pennies, or *treat choice* now or later. Here's a cup for you that we'll put right here *(place cup to child's left)*. If you decide to have pennies now then they will go in this cup. If you want to save things for home, they go in this Home envelope- for when we're all done and it's time to go home *(place Home envelope at child's right)*. So, if you decide to have stickers, pennies, or *treat choice* later then they will go in this envelope until we're done with all of our games for the day. Okay?

What do you want to do?

Fruit loop/goldfish/raisin: now = eat it; later = put in envelope
Stickers: now = put on piece of paper; later = put in envelope
Pennies: now = in clear cup; later = put in envelope

Test Trials:

1) Do you want to choose one **penny** now or four later?	One (0)	Four (1)
2) Do you want to choose one **sticker** now or two later?	One (0)	Two (1)
3) Do you want to choose one **penny** now or six later?	One (0)	Six (1)
4) Do you want to choose one **sticker** now or four later?	One (0)	Four (1)
5) Do you want to choose one **fruit loop** now or two later?	One (0)	Two (1)
6) Do you want to choose one **sticker** now or six later?	One (0)	Six (1)
7) Do you want to choose one **fruit loop** now or four later?	One (0)	Four (1)
8) Do you want to choose one **penny** now or two later?	One (0)	Two (1)
9) Do you want to choose one **fruit loop** now or six later?	One (0)	Six (1)

Total Delay Score for self (out of 9): _____

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Appendix E

Sample Deceptive Pointing Task Protocol (Adapted from Peskin, 1992)

Child's Name _____   Site _____

EXECUTIVE FUNCTION & THEORY OF MIND STUDY: 2013

Deceptive Pointing Task (AKA Mean Puppet)

Date of Testing _____   Examiner _____

ID # _____   Date of Birth _____

1. Introduction

You're going to get to choose one of these stickers *[show 3 stickers]*. The __(A)__ puppet is going to choose one of the stickers, and so is the __(B)__ puppet, and the two puppets get to choose first.

The __(A)__ puppet <u>never</u> chooses the one that you like because he doesn't want you to be sad, but the __(B)__ puppet <u>always</u> chooses the sticker that you want. He doesn't care if you're sad.

2. Preference Control Question

Let's put the puppets in another room so that they won't know which one you really like. *[Remove puppets]*

Tell me, which sticker do you <u>really want</u>?
Which sticker do you think is the <u>worst</u>?

Adapted from Peskin, 1992   1

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3. Reveal Control Question

I'm going to bring in the __(A)__ puppet. Remember he <u>never</u> chooses the sticker that you really like. He doesn't want you to be sad.

__(A)__ puppet: "Which sticker do you want?" [Speak <u>*as the puppet*</u>]

Child's response to puppet A's question *(check mark in space provided)*:

Most Liked_____   **Unpreferenced**_____   **Least Liked**_____

[the "puppet" then <u>*pleasantly*</u> states: "Oh, ok, then I will take this one" *as he chooses a different sticker*]

[__(A)__ *puppet selects sticker that was not chosen,* **most liked** *sticker and* **disliked** *sticker* **remain**]

Note. If the child misinforms the puppet (i.e., the child lies about which sticker he/she really wants) the puppet **then chooses the sticker that the child really wants.** *Follow same script as above.*

4. Conceal Test Question

I'm going to bring in __(B)__ puppet. Remember he always chooses the one that you really like. He doesn't care if you're sad.

(Prompt) Think of what you can say or do so that he doesn't choose the one you want.

__(B)__ puppet: "Which sticker do you want?" *[Speak **as the puppet**]*

Child's response to puppet B's question *(check mark in space provided)*:

Most Liked_____   **Unpreferenced**_____   **Least Liked**_____

[the "puppet" then (in a duplicative tone) states: "Ohhhh, then I will take this one!" *as he chooses the sticker the child is pointing to]*

Appendix F

Correlations Among All Included Variables Separated by Age Group

Age group: 3.0 – 3.49 years

	SES	BSRA	Bear/Dragon	Conflict Scale	Delay	Deceptive Pointing	FB Contents	FB Locations	Conflict Inh. Factor	ToM Factor
SES	1									
BSRA	.663**	1								
Bear/Dragon	.143	.639**	1							
Conflict Scale	.267	.497*	.382	1						
Delay	-.486*	-.489*	-.296	-.520*	1					
Deceptive Pointing	-.080	-.480*	-.605**	-.184	.174	1				
FB Contents	.177	.379	.320	.309	-.348	-.045	1			
FB Locations	-.439*	.025	.357	-.107	.178	-.307	.000	1		
Conflict Inh. Factor	.238	.690**	.869**	.789**	-.475**	-.501*	.378	.180	1	
ToM Factor	-.220	.036	.159	.049	-.032	.277	.686**	.533*	.132	1

Note. *p < .05; **p < .01; N = 21.

Age group: 3.5 – 3.9 years

	SES	BSRA	Bear/Dragon	Conflict Scale	Delay	Deceptive Pointing	FB Contents	FB Locations	Conflict Inh. Factor	ToM Factor
SES	1									
BSRA	.603**	1								
Bear/Dragon	.183	.389	1							
Conflict Scale	.460*	.665*	.183	1						
Delay	.054	.087	-.063	-.105	1					
Deceptive Pointing	.043	-.373	-.426*	-.105	-.131	1				
FB Contents	.184	.570**	.384	.307	-.277	-.298	1			
FB Locations	-.008	.008	.232	-.030	.023	-.242	.296	1		
Conflict Inh. Factor	.399	.667**	.817**	.717**	-.107	-.363	.453*	.147	1	
ToM Factor	.148	.222	.195	.148	-.249	.151	.735**	.679**	.225	1

Note. *$p < .05$; **$p < .01$; $N = 24$.

Age group: 4.0 – 4.49 years

	SES	BSRA	Bear/Dragon	Conflict Scale	Delay	Deceptive Pointing	FB Contents	FB Locations	Conflict Inh. Factor	ToM Factor
SES	1									
BSRA	.752**	1								
Bear/Dragon	.580**	.359	1							
Conflict Scale	.610**	.594**	.677**	1						
Delay	-.316	-.158	-.107	-.100	1					
Deceptive Pointing	-.069	-.144	-.130	-.255	-.017	1				
FB Contents	-.097	.003	-.270	.060	.206	-.119	1			
FB Locations	.270	.126	.349	.249	.196	-.069	.233	1		
Conflict Inh. Factor	.647**	.507*	.933**	.897**	-.113	-.203	-.133	.332	1	
ToM Factor	.043	-.005	-.059	.040	.229	.393	.713**	.641**	-.016	1

Note. *p < .05; **p < .01; N = 23.

Age group: 4.5 – 5.6 years

	SES	BSRA	Bear/Dragon	Conflict Scale	Delay	Deceptive Pointing	FB Contents	FB Locations	Conflict Inh. Factor	ToM Factor
SES	1									
BSRA	.812**	1								
Bear/Dragon	--	--	--							
Conflict Scale	.506*	.531*	--	1						
Delay	-.093	.053	--	.290	1					
Deceptive Pointing	.220	.188	--	.010	.039	1				
FB Contents	.061	.030	--	-.120	-.103	.643**	1			
FB Locations	-.199	-.160	--	-.205	-.310	-.196	-.074	1		
Conflict Inh. Factor	.506*	.531*	--	1.00**	.290	.010	-.120	-.205	1	
ToM Factor	.056	.038	--	-.153	-.173	.767**	.878**	.273	-.153	1

Note. *$p < .05$; **$p < .01$; $N = 21$
Bear/Dragon task ceiling effect (all children in this age group had perfect scores), unable to compute correlations.

Appendix G

Results of a One-Way ANOVA and Post-Hoc Analysis (Tukey's HSD) Comparing Delay

Inhibition Performance across SES Groups: ANOVA Table and Figure

	F(df)	p	η^2	Mean Difference (I-J)	Std. Error	p
Between-Subjects Effects						
Overall Model	4.14(2, 88)	.019	.088	--	--	--
Post-Hoc Results						
Low-SES – Middle-SES	--	--	--	.262	.092	.015
Low-SES – High-SES	--	--	--	.111	.089	.427
Middle-SES – High-SES	--	--	--	-.151	.087	.201

Note. N = 89; Low-SES *n* = 27; Middle-SES *n* = 29; High-SES *n* = 33.
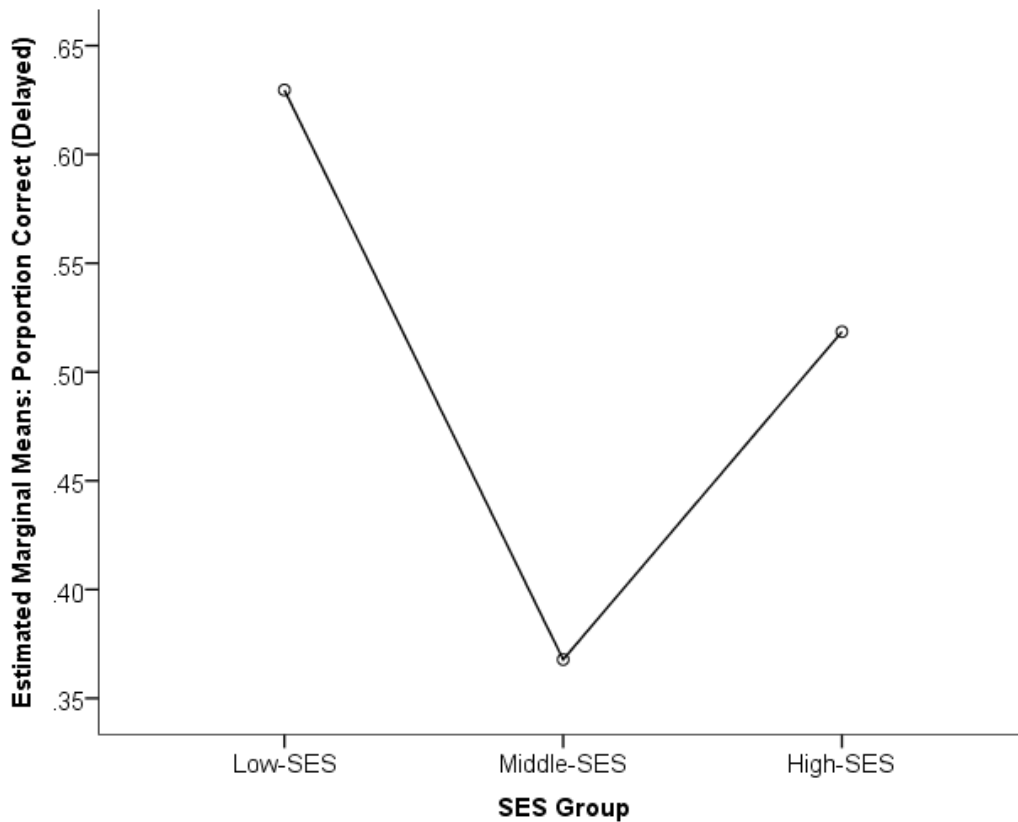
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Psychology

RESEARCH AND PROFESSIONAL EXPERIENCE

JUVENILE ANXIETY STUDY   July 2015 –
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     EDUS 605-901, Child and Adolescent Development

TEACHING EXPERIENCE: UNDERGRADUATE

VIRGINIA COMMONWEALTH UNIVERSITY   Summer Session III
Course Instructor   2014
     EDUS 301, Child Development & Learning

VIRGINIA COMMONWEALTH UNIVERSITY   Spring 2014
Lab Instructor
     PSYC 317-905 & -906, Experimental Methods: Writing Lab

VIRGINIA COMMONWEALTH UNIVERSITY   Summer Session III
Course Instructor   2013
     EDUS 301, Child Development & Learning

VIRGINIA COMMONWEALTH UNIVERSITY   Summer Session I
Course Instructor*   2012
       PSYC 491, Cognitive Development
       *All-online course

VIRGINIA COMMONWEALTH UNIVERSITY   Fall 2011 –
Graduate Teaching Assistant/Instructor*   Spring 2012
       PSYC 492, Service-Learning in Child Psychology
       *Served as full course instructor

VIRGINIA COMMONWEALTH UNIVERSITY   October 2009
Guest Lecturer
       PSYC-Special Topics, Cognitive Development
       Lecture topic: *Executive Functions and Metacognition*

VIRGINIA COMMONWEALTH UNIVERSITY   November 2008
Guest Lecturer
       PSYC 301, Child Psychology
       Lecture topic: *Cognitive Development*

TEACHING EXPERIENCE: OTHER

DEPARTMENT OF CORRECTIONS, THROUGH VCU   August 2012 –
Instructor   May 2013
       Parents of Promise Program (*Moms, Inc./Dads, Inc.*)
       Parenting course for incarcerated mothers and fathers

COMMITTEE MEMBERSHIP AND SERVICE

FACULTY SEARCH COMMITTEE   September 2012 –
Student Representative   May 2013
       Virginia Commonwealth University, Dept. of Psychology
       Developmental Psychology Program

PROMOTION AND TENURE COMMITTEE   March 2013 –
Student Representative   June 2013
       Virginia Commonwealth University, Dept. of Psychology
       Developmental Psychology Program (Re: Zewelanji Serpell, Ph.D.)

CURRENT CERTIFICATIONS

Classroom Assessment and Scoring System (CLASS) – Certified Coder
Individualized Classroom Assesssment Scoring System (inCLASS) – Certified Coder

Technical Skills

Microsoft Office Applications (2014 and prior): Word, Excel, PowerPoint
SPSS (version 22 and prior)
LILY data collector
Teacher–Child Interaction Direct Observation System (TCIDOS)
INTMAN Interval Manager for Windows

Additional Experience

The Boys and Girls Club of Virginia   January 2008 –
After-School Education Volunteer   July 2008

Piedmont Psychological Services   August 2005 –
Intern   May 2006
Child Psychology

Conference Posters and Presentations

Molzhon, A., Barron-Rojas, E., Algina, J., Sutherland, K., & Conroy, M. (2015, March). *Effects of an early social-behavioral intervention on the student-teacher relationship.* Paper symposium, presented as part of student symposium, *The Interplay between Student-Teacher Relationships, Peer Ecologies, and Classroom Experiences* (Kristen Granger & Laura Hanish, co-chairs) at the 76th Biennial Meeting of the Society for Research in Child Development. Philadelphia, PA, USA.

Molzhon, A., Ellefson, M., Blagrove, E., & Chater, N. (2011, April). *Differential influences of age and executive functions on arithmetic efficiency and achievement.* Poster symposium, presented as part of student symposium, *Executive functions and education* (Michelle Ellefson, chair) at the 74th Biennial Meeting of the Society for Research in Child Development. Montreal, QC, Canada.

Molzhon, A., Kuznetsova, M., & Chin, C. (2011, April). *Predicting children's early literacy development from parent and teacher ratings of their social skills and problem behaviors.* Poster presented at the 74th Biennial Meeting of the Society for Research in Child Development. Montreal, QC, Canada.

Molzhon, A. & Kuznetsova, M. (2010, December). *Examining the effects of summer break on the early literacy skills of preschoolers from low SES.* Paper symposium, presented at the 60th Annual National Reading Conference. Fort Worth, TX, USA.

Kuznetsova, M., **Molzhon, A.,** Xu, Y., Chin, C. (2010, April). *Examining the relationship between preschoolers' language ability and social skills.* Poster presented at the Annual

Conference on Human Development. New York, NY, USA.

Molzhon, A., Ellefson, M.R., Blagrove, E., & Chater, N. (2009, July). *Do executive functions predict performance on all switch tasks?* Poster presented at the 31st Annual Conference of the Cognitive Science Society. Amsterdam, The Netherlands.

Ellefson, M., Blagrove, E., Molzhon, A., & Chater, N. (2009, April). *Contributions of age and executive functions on task switching performance*. Paper submitted as part of the symposium, *Executive functions and task switching* (Michelle Ellefson, chair) at the 73rd Biennial Meeting of the Society for Research in Child Development. Denver, CO, USA.

HONORS/AWARDS

Travel grant, Department of Psychology ($400)   Fall 2010
Virginia Commonwealth University

Travel grant, Department of Psychology ($400)   Spring 2009
Virginia Commonwealth University

Psi Chi, Psychology National Honors Society, Inductee   2004

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Society for Research in Child Development (Student Member)   2010 – 2015

Ad Hoc Reviewer, *Journal of Experimental Child Psychology*   2010
    Special Issue: *Executive Functions*