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Abstract

The purpose of this study was to specify the development of and links between executive functioning and theory of mind during middle childhood. One hundred four 7- to 12-year-old children completed a battery of age-appropriate tasks measuring working memory, inhibition, flexibility, theory of mind, and vocabulary. As expected, spatial working memory and flexibility increased significantly with age, especially after 7 years. Moreover, flexibility predicted social understanding over and above effects of age, vocabulary, working memory, and inhibition. Together, these findings highlight improvements in and tight relations between complex aspects of executive functioning and theory of mind during middle childhood, suggesting executive functioning and theory of mind are linked beyond their emergence in early childhood.

Keywords: executive functioning; working memory; inhibition; flexibility; theory of mind; second-order false belief; middle childhood

Specifying Links Between Executive Functioning and Theory of Mind During Middle Childhood: Cognitive Flexibility Predicts Social Understanding

Executive functioning is necessary for goal-directed thought and behavior. To date, the vast majority of developmental research has focused on early childhood, documenting profound increases in executive functioning between 3 and 5 years (Carlson, 2005; Espy, 1997; Garon, Bryson, & Smith, 2008). Very little is known about the development of executive functioning beyond these early years. Specifying the developmental trajectory of executive functioning components and their correlates during middle childhood has the potential to inform theoretical and practical issues (Best & Miller, 2010; Best, Miller, & Jones, 2009). One important correlate is theory of mind—the ability to understand mental states. One goal of the current study was to specify the developmental trajectory of executive functioning components and theory of mind across middle childhood, focusing on identifying periods of rapid developmental change. Another goal was to determine the extent to which executive functioning components and theory of mind are related during middle childhood. Previous studies have demonstrated important links during early childhood (Carlson & Moses, 2001; Frye, Zelazo, & Palfai, 1995; Hughes, 1998; Hughes & Ensor, 2007), but extensions to middle childhood are needed (Miller, 2009).

Despite controversy regarding the core regulatory features of executive functioning, there is widespread agreement that executive functioning includes three distinct, yet overlapping, components—working memory, inhibition, and flexibility—during adulthood (Friedman & Miyake, 2004; Miyake et al., 2000). Recently, developmental scientists have extended this work, demonstrating the utility of similar three-component models during middle childhood (Brocki & Bohlin, 2004; Huizinga, Dolan, & van der Molen, 2006; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003). Ongoing research probes the utility of these models during the preschool years (Hughes, Ensor, Wilson, & Graham, 2010; Wiebe et al., 2008, 2011), leading some scientists to conclude that executive functioning begins as a unitary construct that becomes more differentiated across childhood (Garon et al., 2008). Research progress depends on age-appropriate tasks that can be utilized to measure executive functioning components across wide age ranges. The current investigation included measures of all three executive function components—working memory, inhibition, and flexibility—drawn from the existing literature and modified from research involving young children and adults to create a set of age-appropriate tasks for school-aged children. Extending the set of age-appropriate measures has the potential to facilitate empirical and theoretical work specifying the development of executive function components during the elementary years and beyond.

Working memory is the ability to maintain and manipulate information in the service of another task (Baddeley & Hitch, 1974). Often, span tasks are used to measure working memory, including sentence span or digit span measures that probe verbal aspects and spatial span measures that probe visuospatial aspects. This investigation utilized digit span and a spatial memory task to probe working memory. Previous research using these tasks has demonstrated developmental gains in working memory (Plumert, Hund, & Recker, 2007; Prencipe et al., 2011). Inhibition is the ability to engage in an appropriate response instead of a more probable, but less appropriate, response (Carlson, 2005). Inhibition improves dramatically during the preschool years (Reck & Hund, 2011) and continues to improve more gradually across the elementary years (Prencipe et al., 2011). The Color Word Stroop task was used to measure inhibition here (Stroop, 1935).

Flexibility can be defined in two ways: (a) the ability to modify thought processes based on a shift in rules or demands (Deák, 2003; Hund & Foster, 2008) or (b) the ability to think about multiple things simultaneously (Cartwright, 2002; Piaget, 1972). Much contemporary research has focused on the emergence of flexibility during early childhood, utilizing sequential rule-switching tasks such as the dimensional change card sorting (DCCS) task. In the DCCS, children sort cards based on one dimension (color) then switch to a second dimension (shape). Marked improvement is evident between 3 and 5 years (Frye et al., 1995; Kirkham, Cruess, & Diamond, 2003; Towse, Redbond, Houston-Price, & Cook, 2000). In this investigation, we modified the DCCS in two ways to measure flexibility during middle childhood. First, we increased the number of dimensions and values from two to three (i.e., color, shape, and size dimensions, each with three values). Second, we included a mixed block of trials in which children needed to select the appropriate rule on each trial depending on border cues (Deák, 2003).

Recent research examining simultaneous aspects of flexibility has identified marked increases across middle childhood. For example, Cartwright (2002) probed the developmental trajectory of flexibility using an object multiple classification task in which children were shown object cards and asked to sort them into a 2 x 2 matrix based on color and kind of object. Seven-year-old children focused on the two dimensions separately, whereas 11-year-old children sorted based on these two dimensions simultaneously (see also Piaget, 1972). Similar developmental gains across middle childhood were evident using a reading multiple classification task where children sorted words based on initial phoneme and meaning (Cartwright, 2002). We included these object and reading multiple classification tasks to determine whether developmental improvement is evident in simultaneous and sequential aspects of flexibility during middle childhood.

In addition to the profound increase in interest in executive functioning in recent years, developmental scientists have been interested in probing the development of theory of mind and in understanding the relation between executive functioning and theory of mind as they emerge during early childhood. Theory of mind is the ability to understand mental states, such as thoughts, desires, beliefs, and emotions, in ourselves and others. It improves dramatically during early childhood (Frye et al., 1995; Hughes, 1998; Wellman, Cross, & Watson, 2001). Many researchers have shown that executive functioning is related to theory of mind during their emergence in early childhood (Carlson & Moses, 2001; Carlson, Mandell, & Williams, 2004; Frye et al., 1995; Hughes & Ensor, 2007; Hughes & Graham, 2002; Oh & Lewis, 2008; Sabbagh et al., 2006; Zelazo & Frye, 1998). For instance, Carlson and Moses (2001) found that performance on the DCCS was highly related to performance on theory of mind measures, supporting a strong relation between executive functioning and theory of mind. Like executive functioning, theory of mind continues to improve throughout middle childhood and beyond, though much less is known about the specific trajectory during the elementary years (Miller, 2009). Second-order false belief tasks measure children's ability to understand another person's thinking about a third person's perspective (Perner & Wimmer, 1985). To date, results demonstrate improvement in higher-order theory of mind abilities across middle childhood (Miller, 2009). Moreover, children show increased abilities to detect and understand subtleties in conversations and social interactions, such as irony, sarcasm, and figures of speech (Devine & Hughes, 2013; Happé, 1994). The present investigation utilized two common second-order false belief scenarios and seven social stories (i.e., Strange Stories) to specify improvements in complex theory of mind. It is important to probe the link between executive functioning and theory of mind during middle childhood to improve empirical and theoretical clarity.

Theoretically, it is possible that executive functioning and theory of mind are linked (only) during their emergence in early childhood because executive functioning scaffolds the emergence of theory of mind skills. In fact, Carlson, Moses, and colleagues assert that domain-general executive functioning skills enable children to benefit from social experiences that foster conceptual aspects of theory of mind (Carlson & Moses, 2001; Moses & Tahiroglu, 2010; Sabbagh et al., 2006). This view does not posit specific details about relations later in development, such as middle childhood, though it is possible that additional theoretical explication could focus on these details. In contrast, it is possible that executive functioning and theory of mind are linked across the lifespan because these skills are inextricably linked through cognitive competencies and/or performance factors (Apperly, Samson, & Humphreys, 2009; Apperly et al., 2011). This theoretical position predicts strong relations between executive functioning and theory of mind in middle childhood and beyond.

The vast majority of research, to date, has utilized a correlational approach to demonstrate tight links between executive functioning and theory of mind. Nonetheless, increasing evidence supports causal accounts in which executive functioning impacts theory of mind (Miller, 2009), suggesting that executive functioning is necessary, but not wholly sufficient, for theory of mind understanding. Executive functioning may impact the emergence of theory of mind during early childhood by providing competencies necessary for understanding self and others, such as holding in mind multiple perspectives and resisting interference from one’s own perspective and reality to focus on mental states. In particular, Sabbagh et al. (2006) assert that domain-general executive functioning skills enable children to capitalize on specific experience factors (such as interactions with others that may involve explanations relying on mental states) that support reasoning using mental states.

By expanding research to focus on middle childhood, we hope to add theoretical clarity regarding the development of and relation between executive functioning and theory of mind.

First, charting the developmental trajectory across the elementary years adds clarity to facilitate understanding the relation between executive functioning and theory of mind. Based on previous research using psychological and neuroscience methods (Anderson, 2002; Miller 2009), we expect rapid development of executive functioning and theory of mind between 7 and 9 years. Second, it is important to test whether the same patterns of correlations evident with simpler executive functioning and theory of mind aspects also are evident when we assess more complex aspects during middle childhood and beyond. We expect tight relations during middle childhood even after controlling for vocabulary. These findings would refute a strict emergence view by demonstrating that correlations between executive functioning and theory of mind are robust in middle childhood, well after these abilities emerge during early childhood. Finally, we hope to provide important descriptive details about task performance that can be useful in pursuing research utilizing longitudinal, training, cultural, and developmental psychopathology approaches that can more precisely specify the mechanisms underlying the links between executive functioning and theory of mind.

Method

Participants

One hundred four children between 7 and 12 years (54 girls, 50 boys; *M* = 8 years 11 months, *SD* = 17 months) completed an age-appropriate battery of tasks in counterbalanced order as part of two laboratory sessions approximately 7 days apart. Forty-four children completed two working memory tasks (digit span, location memory), one inhibition task (color word Stroop), three flexibility tasks (object multiple classification, reading multiple classification, dimensional change card sorting), two theory of mind tasks (second-order false belief, social stories), and one vocabulary task. Sixty children completed a smaller task battery without digit span, Stroop, social stories, or vocabulary.[1] Data from 6 additional participants were omitted because they were unable to return for the second session. Equipment problems or incomplete sessions led to additional missing data for some tasks (see below for sample sizes for all measures). Details regarding participant race/ethnicity and family socioeconomic status were not collected, but the sample was drawn from a community that is predominantly White and middle class.

Procedure

Digit Span. Forty-four participants repeated sequences of digits in serial order. Two trials were administered for each sequence length, starting with 2 and discontinuing when participants incorrectly recalled both sequences of a given length. Digit span scores represented the largest number of digits for which participants recalled both sequences correctly prior to discontinuation. [2]

Location Memory. Ninety-eight children watched the researcher place 20 objects on marked locations in a square box. Lines divided the box into four regions. The researcher removed the objects and asked children to put the objects back in their places one at a time in a random order. If children had trouble remembering, the researcher helped them find the correct places. Learning trials continued until children could correctly place all of the objects one time through. Then, children attempted to place the objects in the correct locations without the markers or boundaries. Placements were measured to the nearest half inch, yielding an error score representing the average distance between each remembered location and its actual location (Plumert et al., 2007).

Color Word Stroop. Forty-four participants viewed two sets of 25 color words presented on a computer monitor and were asked to say the font color aloud (Stroop, 1935). In the congruent set, the word and font color matched, whereas in the incongruent set, the word and font color did not match. Response time for congruent trials was subtracted from incongruent trials, yielding a Stroop difference score.

Object Multiple Classification. Ninety-two participants sorted four sets of 12 cards containing drawings of objects based on two dimensions simultaneously (color and object type) following one practice set completed by the researcher. Two sticks on a placemat were used to create a 2 x 2 matrix into which participants sorted the cards. No feedback was provided during the testing phase. Participants received one point for each correct sort, yielding 4 points possible (Cartwright, 2002). Inter-rater reliability was assessed for 17 of the 92 participants (18.48% of the sample). Kappa for sorting outcome was .94.

Reading Multiple Classification. Ninety-one children sorted cards containing printed words by initial phoneme and meaning (Cartwright, 2002). This task was identical to the object multiple classification task, except for the stimuli used. Kappa for sorting outcome was 1.0.

Dimensional Change Card Sorting. One hundred participants sorted cards facedown into three trays based on specified dimensional rules (similar to Deák, 2003; Hund & Bock, 2009; Zelazo, 2006). Trays and cards were presented in a different random order for each participant. The researcher first described each sorting tray marked with two yellow triangles, four red squares, and six blue circles. The sorting cards differed on three dimensions (number: 2, 4, or 6 items; shape: triangles, squares, or circles; and color: yellow, red, or blue) such that no cards were identical to the tray markings, and equal numbers of cards belonged in each tray. There were three training trials (one demonstration then sorting with feedback), six Pre-switch trials (first rule), six Post-switch I trials (second rule), and six Post-switch II trials (third rule), three Border training trials (demonstrations), and 12 Border trials (mixed block using all three rules depending on card border). No feedback was provided during test trials. The order of sorting rules was counterbalanced across participants. The researcher introduced a new sorting rule at the beginning of each trial block and described each tray based on the specific dimensional rule prior to each trial "(Red ones go here…"). Then, the researcher introduced the card (e.g., "This card is blue, where would it go?"). The border phase was a mixed block in which solid borders, dashed borders, and no borders were used to indicate which sorting rule should be utilized. Sorting rules were counterbalanced. The researcher reminded participants of the border rules prior to each trial and noted the particular border when presenting the card. Sorting errors were coded from video recordings. Only errors during the border phase were analyzed here. Inter-rater reliability was assessed using an intraclass correlation, yielding a coefficient of .99.

Second-order False Belief. One hundred four participants watched two videotaped scenarios enacted using toy props and verbal narration (birthday puppy story drawn from Sullivan, Zaitchik, & Tager-Flusberg, 1994 and ice cream truck story drawn from Perner & Wimmer, 1985). Each scenario contained questions probing knowledge, first-order false belief, second-order ignorance, second-order false belief (e.g., "Where does John think that Mary went to buy an ice cream cone?"), and justification (e.g., "Why does John think that?"). Participants received one point for each second-order false belief question answered correctly, yielding 2 points possible. Inter-rater reliability yielded an intraclass correlation of .91.

Social Stories. Forty-four participants listened as the researcher read seven vignettes from picture cards presented in a specified random order: pretend, white lie, joke, irony, figure of speech, lie, and double bluff, followed by a control physical story (Strange Stories, Happé, 1994). A comprehension question was included at the end of each story ("Is it true what X says?"). Next, a justification question was asked ("Why does X say this?"), and participants' responses were recorded. Justifications for social stories were considered correct if children referred to mental states, yielding 7 points possible. Inter-rater reliability for 29 participants yielded an intraclass correlation of .96.

Vocabulary. Forty-four participants provided definitions orally for 10 words (tractor, bread, chain, harp, bonnet, spinach, dentist, panda, cream, president). Participants were asked orally, "What is a (n) ___?" for each word. The set of words was selected from the Reading Multiple Classification stimuli to represent a diverse set of age-appropriate words and evinced acceptable internal consistency (Cronbach's alpha = .81). Participants received one point for each correct definition, yielding 10 possible points. Mean vocabulary scores for each age group were 4.26 (*SD* = 2.51) for 7-year-olds, 6.64 (*SD* = 3.20) for 8- to 9-year-olds, and 4.85 (*SD* = 3.00) for 10- to 12-year-olds. Inter-rater reliability for 17 participants (38% of the sample) yielded an intraclass correlation of .95. This measure was utilized as a control variable.

Results

One goal of this study was to specify the developmental trajectory of executive functioning components and theory of mind from 7 to 12 years in response to recent calls for additional research focusing on middle childhood (Anderson, 2002; Best & Miller, 2010; Best et al., 2009). We hypothesized that working memory, inhibition, flexibility, second-order false belief, and social understanding would increase over age, with especially rapid gains from 7 to 9 years. We tested this hypothesis by comparing performance across age groups and gender for each task using Age (7 years, 8 to 9 years, and 10 to 12 years) x Gender (girls, boys) ANOVAs. We used data from the smaller sample for analyses of digit span, Stroop, and social stories, and data from the full sample for the remaining analyses. The results can be seen in Table 1. Overall, the analyses revealed dramatic improvements in executive functioning, especially spatial working memory and flexibility, after 7 years. There were no significant main effects or interactions involving gender, so gender was not included in subsequent analyses.

Another goal was to specify the relations between executive functioning components and theory of mind during middle childhood. We expected to find tight correlations between executive functioning components and theory of mind even after controlling for effects of vocabulary and age. These findings would refute a strict emergence view by demonstrating that correlations remain well beyond early childhood. Again, we used data from the smaller sample for analyses involving digit span, Stroop, social stories, and vocabulary, and data from the larger sample for the remaining analyses. Pearson correlations are noted in the upper right portion of Table 2. The present findings yielded strong correlations involving sorting in the multiple classification and DCCS tasks with theory of mind, demonstrating relations between both simultaneous and sequential aspects of flexibility and theory of mind. It is important to note that flexibility (DCCS errors) remained correlated with theory of mind performance even after controlling for effects due to vocabulary and age (see bottom left Table 2).

To further specify the relation between executive functioning and theory of mind, two sets of hierarchical multiple regression analyses were used to assess the extent to which working memory, inhibition, and flexibility scores predicted theory of mind scores (second-order false belief and social understanding) over and above age and vocabulary. Given strong correlations among flexibility measures, a flexibility composite score was created from object and reading multiple classification sorting scores and DCCS error scores (reversed). The scores were subjected to z-score transformations and combined to form a flexibility composite score that evinced adequate internal consistency (Cronbach's alpha = .67). Higher scores indicated better performance. Age (in months) and vocabulary were entered in the first step, accounting for 44%

of the variance in social stories performance. Working memory scores were entered in the second step, and inhibition was entered in the third step, but they were not significant predictors of social understanding. Finally, flexibility composite scores were entered in the fourth step, yielding a model that accounted for 52% of the variance in social understanding. After accounting for effects of age, vocabulary, working memory, and inhibition, flexibility accounted for significant variance in social stories performance (see Table 3). No predictors were significant for second-order false belief, probably due to a restriction in range in these scores resulting from a ceiling effect.

Discussion

This is one of the first demonstrations of strong relations between executive functioning components and complex aspects of theory of mind during middle childhood (Charman, Carroll, & Sturge, 2001; Miller, 2009; Perner, Kain, & Barchfeld, 2002). These robust correlations suggest that executive functioning and theory of mind are linked beyond their emergence in early childhood. As such, our findings refute a strong emergence theoretical account focused only on early childhood and instead support a hybrid account in which executive functioning is related to the emergence of basic theory of mind understanding in early childhood but also is related to the emergence and/or expression of complex aspects of social understanding across middle childhood and beyond. An important next step is to explicate the nature of this relation across the lifespan.

It is interesting to consider specific links between flexibility and social understanding. In particular, our findings demonstrate that flexibility predicts social understanding even after controlling for age, vocabulary, and other executive functioning components. This novel finding is important in shedding light on the nature of inter-relations among these complex constructs.

Why might flexibility predict understanding of complex mental states? Perhaps making simultaneous judgments along multiple dimensions (e.g., my view vs. your view and reality vs. mental states) and sequentially shifting among these distinctions (e.g., thinking about your desire, rather than mine) is critical for making use of beliefs and desires in everyday interactions. These complex abilities we call flexibility may subsume aspects of working memory and inhibition, but it is our contention that flexibility involves more than the sum of these other components. It is perhaps this unique, emergent combination of flexible cognitions and actions that is most critical for social understanding (see also Baker, Friedman, & Leslie, 2010; Liszkowski, 2013). Future research could extend these notions by focusing not only on sorting outcomes in the card sorting tasks probing flexibility, but also on response times and verbal justifications evident in these tasks to explicate subtle differences across the lifespan (see also Apperly et al., 2011).

The present findings add to a growing body of research demonstrating that executive functioning is an important contributor to theory of mind understanding (Flynn, O'Malley, & Wood, 2004; Frye et al., 1995; Hughes, 1998; Moses, 2005; Pellicano, 2007; Perner & Lang, 2000). Future research is needed to further specify causal relations between executive functioning components and theory of mind across the lifespan, focusing particularly on the directionality of the relations. We suspect that the dynamic nature of cognitive and social development will yield answers more complex than simple single-cause explanations. As such, future experimental research could utilize longitudinal and microgenetic approaches, developmental psychopathology approaches (focusing especially on Autism Spectrum Disorders and Attention-deficit/Hyperactivity Disorder), and training/intervention analyses to specify the nature of this important relation across development, especially during periods of rapid reorganization of the prefrontal cortex in early and middle childhood and the transition to adolescence (Diamond & Lee, 2011; Kray & Ferdinand, 2013; Zelazo & Carlson, 2012). Moreover, path analysis and structural equation modeling would facilitate understanding of complex causal relations. In addition, systematic research is needed to provide strong tests of working memory and inhibition, given the methodological and statistical limitations evident here. Future research should continue to probe the role of gender, family, and cultural factors (Devine & Hughes, 2013).

Overall, our findings highlighted dramatic improvements in spatial working memory and flexibility after 7 years, confirming that executive functioning improves during middle childhood. It is important to note that our findings and interpretation are somewhat speculative given the sample characteristics evident here. Including a larger, more diverse sample of children is important for future research to systematically track development from 7 to 12 years. Moreover, our vocabulary and inhibition measures did not evince sensitivity across development despite well-documented gains in these domains across middle childhood. It is important to note that vocabulary was a robust predictor of executive functioning in the regression analyses, suggesting it tapped important individual differences. Future research should include a variety of measures of vocabulary, executive functioning, and theory of mind, including standardized instruments for children and parents. In spite of these limitations, our findings generally are consistent with Anderson's (2002) claims that executive functioning components show rapid gains across childhood. In particular, his findings suggested that the development of cognitive flexibility and goal setting evince rapid growth between 7 and 9 years and executive control improves dramatically between 11 and 13 years. Additional empirical and theoretical work is necessary to further specify and explain these developmental trajectories.

The present results make major contributions to our understanding of the development of executive functioning and theory of mind during middle childhood. First, flexibility and spatial working memory increased significantly across middle childhood. The most rapid improvements were evident after 7 years. These findings provide important details about the developmental trajectory of executive functioning during middle childhood. Second, flexibility predicted social understanding even after accounting for effects of age, vocabulary, working memory, and inhibition. These findings indicate that executive functioning and theory of mind are linked beyond their emergence during early childhood, setting the stage for future research specifying the causal mechanisms linking executive functioning and theory of mind across the lifespan.

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Footnotes

[1] We chose to counterbalance task order to limit effects of fatigue, given the challenging nature of our task set. We recognize that design issues limit the statistical power of our analyses. Moreover, we acknowledge that task impurity issues limit the scope of our theoretical conclusions (Anderson, 2002; Best & Miller, 2010). Nonetheless, the promising nature of our findings led us to report the entire set of results as a gateway to future research.

[2] We acknowledge limitations based on inclusion of only forward, not backward, digit span. Our decision to include only one measure was based on pragmatic considerations about session length.

Table 1: *Age Differences in Dependent Measures*

Measure	Age			*F*	*df*	*Partial Eta*^{2}
	7 yrs *n* = 42 22 girls 20 boys	8 to 9 yrs *n* = 35 21 girls 14 boys	10 to 12 yrs *n* = 27 11 girls 16 boys			
DCCS Errors [a]	4.90 (.38)	2.88 (.41)	2.88 (.48)	8.58**	(2, 93)	.16
Object Mult Class [a]	1.97 (.21)	2.81 (.22)	3.08 (.25)	7.04**	(2, 85)	.13
Reading Mult Class [a]	1.69 (.23)	2.68 (.24)	3.13 (.27)	9.10**	(2, 84)	.19
Stroop Difference	18.88 (4.15)	18.15 (5.45)	16.69 (5.01)	.06	(2, 37)	.01
Digit Span	5.00 (.29)	5.09 (.38)	5.92 (.35)	2.34	(2, 37)	.16
Spatial Mem Error [b]	2.52 (.08)	2.36 (.08)	2.23 (.09)	3.16*	(2, 91)	.07
Sec-ord False Belief	1.44 (.09)	1.63 (.10)	1.63 (.12)	1.22	(2, 97)	.03
Social Stories	4.32 (.39)	5.55 (.51)	5.46 (.47)	2.57	(2, 37)	.11

Note. Mean values are listed followed by standard errors in parentheses. Asterisks denote significant results from Age x Gender ANOVAs (* $p < .05$, ** $p < .01$). Superscript letters denote significant pair-wise differences resulting from LSD follow up tests comparing the age groups ([a] = 7 years significantly different from other two age groups, [b] = 7 years significantly different from 10-12 years). There were no significant gender differences.

Table 2

Correlations for Age, Vocabulary, and Dependent Variables

	1	2	3	4	5	6	7	8	9	10
1) Age (Months)	---	.18	-.35**	.40**	.45**	-.10	.27	-.27**	.15	.36*
2) Vocabulary	---	---	-.01	.38*	.24	-.15	.05	.02	.19	.57**
3) DCCS Errors	---	---	---	-.35**	-.35**	.13	-.39*	.08	-.31**	-.38**
4) Object Mult Classification	---	---	-.37*	---	.50**	-.14	.04	-.15	.17	.41**
5) Reading Mult Classification	---	---	-.09	.48**	---	-.21	.04	-.19	.23*	.33*
6) Stroop Difference Score	---	---	.10	-.04	-.23	---	.19	.02	-.30	-.12
7) Digit Span	---	---	-.31+	-.01	-.15	.21	---	-.01	.17	.20
8) Spatial Memory Error	---	---	-.11	.18	-.03	-.00	.03	---	.07	-.11
9) Second-order False Belief	---	---	-.29+	.16	.21	-.32+	.09	.07	---	.25
10) Social Stories	---	---	-.35*	.28	.09	.01	.14	-.12	.14	---

Note. Bivariate correlations are presented in the upper right portion of the table (*df* = 38 to 100). Partial correlations controlling for age and vocabulary are presented in the lower left portion of the table (*df* = 33). Asterisks denote significant correlations (* $p < .05$, ** $p < .01$). Plus signs denote marginally significant partial correlations (+ $p < .09$).

Table 3: *Hierarchical Multiple Regression Analyses Predicting Social Understanding and Second-order False Belief From Age, Vocabulary, and Executive Functioning Components*

	Second-order False Belief		Social Understanding	
Predictor	R^2	ß	R^2	ß
Model 1	.08		.44	
Age (in Months)		.21		.27*
Vocabulary		.16		.56**
Model 2	.10		.45	
Age (in Months)		.20		.23
Vocabulary		.15		.56**
Digit Span		.10		.11
Spatial Working Memory		-.09		.07
Model 3	.18		.45	
Age (in Months)		.16		.22
Vocabulary		.10		.56**
Digit Span		.17		.11
Spatial Working Memory		-.09		.07
Inhibition		.29		.01
Model 4	.18		.52	
Age (in Months)		.10		.06
Vocabulary		.09		.51**

Digit Span	.17	.10
Spatial Working Memory	-.08	.09
Inhibition	.27	-.05
Flexibility Composite	.12	.33*

Note. Asterisks denote significant results (* $p < .05$, ** $p < .01$).