

UNDERSTANDING DECEPTION: DEVELOPMENT
THROUGH EXECUTIVE FUNCTION
AND SOCIAL COGNITION

by

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ABSTRACT

In order to best prepare children for school, we need to know what factors contribute to their success, both academically and in social situations. Both executive functions and social skills are needed to get children ready for school and for the more socially ambiguous situations it will bring. One example of that would be deception; both understanding when someone else is deceiving you and knowing if it is appropriate to tell a lie yourself. The purpose of this study was to examine differences between children who tell lies for their own self-gain and those who lie to please others in terms of their age, vocabulary, executive functions, and social skills.

Additionally, the study examined which of those factors contributed to children being able to successfully detect when someone else was lying to them. Results showed that children who lie to please others tend to be younger and perform worse on executive functions, vocabulary and social skills. For deception detection, those who were older and had stronger executive functions were better able to detect when someone was deceiving them.

DEDICATION

This thesis is dedicating to all the hard-working people who contributed to this research study – from those who participated to those who read over this manuscript – thank you!

LIST OF ABBREVIATIONS AND SYMBOLS

ACI	Akaike's Information Criterion: used to select best fit model
B	Unstandardized regression coefficient
<i>df</i>	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
EF	Executive function
<i>F</i>	Fisher's F ratio: A ratio of two variances
FDS	Forward Digit Span: working memory task
GS	Grass Snow: inhibitory control task
<i>M</i>	Mean: the sum of a set of measurements divided by the number of measurements in the set; arithmetic average
<i>N</i>	Sample size
<i>p</i>	Probability under the null hypothesis of a value as extreme or more extreme than the observed value
<i>r</i>	Pearson correlation coefficient
<i>R</i> ²	Coefficient of determination: proportion of variability accounted for by the statistical model
ΔR^2	<i>R</i> ² change
<i>SD</i>	Standard deviation
<i>SE</i>	Standard Error
t	Computed value of t-test
<i>X</i> ²	Chi Square test result

< Less than

= Equal to

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1. INTRODUCTION

Young children are full of curiosity and excitement. In order to facilitate those traits, children need to be able to succeed in school. For children to be ready for school, they need a strong preschool foundation to help prepare them for the transition into kindergarten. Preschool is the beginning of a child's formal education, for it instills foundational learning skills and practices. Currently, more than one third of all kindergarten teachers believe that half of their class or more enter school with specific challenges, including difficulty following directions or working both independently and in groups (Rimm-Kaufmann, Pianta, & Cox, 2000). Many preschool programs in the United States use academic curricula that are out of date (more than 20 years old), which might explain why so many children are continuing to enter kindergarten unprepared (Rimm-Kaufmann, Pianta, & Cox, 2000). We need to improve children's school readiness by enriching preschool programs nationwide. This includes improving both children's academic knowledge in preschool (e.g., ABCs and 123s; No Child Left Behind, 2002) as well as improving their foundational social cognition to better prepare them for kindergarten.

Researchers have suggested that the most effective preschool programs give young children a strong cognitive foundation as well as social understanding (National Education Goals Panel, 1998; Ziy, 2013). A strong cognitive foundation comes from the ability to reason and achieve academically, while social cognition gives the child a basis for what is appropriate when interacting with both peers and adults. One example of a situation that children learn to navigate in school is socially ambiguous situations. Often socially ambiguous situations involve

deception, such as determining whether peers or teachers are more trustworthy informants on a particular topic. Children must identify who is more trustworthy in order to learn, so the understanding of deception is a key feature of a child's developing school readiness. Identifying aspects of social cognition that facilitate learning in preschool, such as deception detection, is a new direction for both researchers and curriculum development specialists; however little is known about their mechanisms of development.

As previously mentioned, the extant literature has examined school readiness in terms of domain-specific mechanisms focused on ABCs and 123s, such as literacy skills to facilitate school readiness in reading (Duncan et al. 2007; Lonigan, Burgess, & Anthony, 2000). Now developmental scientists, with experience examining mechanisms of development, are looking at more general skills that still facilitate school readiness skills by developing the foundational cognitive processes underlying these skills (Fuchs et al., 2005; Passolunghi, Vercelloni, & Schadee, 2006; Swanson & Sachse-Lee, 2001; Welsh, Nix, Blair, Bierman, & Nelson, 2010). In the field of cognitive development, psychologists continue to explore how domain general and domain specific processes contribute to development. For example, domain general theories, such as information processing theories, believe that there are basic cognitive skills, such as executive functions (EF), that underlie the development of most learning processes (Leslie, 1994; Leslie, 1995; Moses & Sabbagh, 2007), and that enhancing these domain general skills improves development across many domains. In contrast, others theories take a domain specific approach such as constructivist theory or Theory Theory, suggesting that children interact with their world to construct and revise their own theories about how domains in their world work (Gopnik, 1988; Gopnik & Wellman, 2012; Keil, 1989; Rhodes & Wellman, 2013; Wellman, 1990). In this way, children develop naïve theories about biology and psychology, such as the development of

Theory of Mind. Although development of these theories generally expands a child's world knowledge, the development of one theory does not necessarily enhance the development of another.

One way to investigate domain general versus domain specific development on children's developing social cognition is to examine a skill that social cognition affords, such as understanding deception. To do so, first we need to propose what the likely foundations of deception understanding are. One factor that may be related to deception understanding is the development of social skills, broadly defined. Social skills encompass how well children perceive others' emotions, thoughts, and behaviors in a way that enables them to understand how to create and maintain positive social relationships (Gresham, 2002; Katz, McClellan, Fuller, & Walz, 1995; Masten & Coatsworth, 1998). In particular, the ability to understand more complex social interactions such as deception enables a child to better comprehend and control their social world (Carlson, Mandel & Williams, 2004; Ding et al., 2015). Theory theorists would argue that the development of a naïve psychology, or Theory of Mind, is a foundational theory that underlies the development of social skills such as deception. However, more research is needed to pinpoint foundational cognitive and social skills that facilitate the development of deception understanding.

Social skills emerge in early childhood as children begin to interact more with their peers and teachers in preschool. One key foundational social skill is perspective taking, or Theory of Mind (ToM). ToM is an umbrella term that encompasses a child's ability to understand his/her own mental states and appreciate that others have their own, possibly differing, mental states (Wellman, 2014). It also helps children understand that we have diverse desires and beliefs, and to consider someone's intention when evaluating their behavior. ToM begins to develop around 3

years of age, and is mostly solidified by age 4-5 years. In school, children are required to work with other people and experience situations where people have different opinions, which requires them to use their social skills to navigate these social interactions. Previous research shows that children with an older sibling are more likely to advance their social skills quickly, as they are involved in conflict resolution from a very young age and thus need to understand their sibling's different opinions earlier than children without older siblings (Cassidy, Fineburg, Brown & Perkins, 2005). Having an understanding that other people can believe different things than themselves and being able to understand social interactions helps young children navigate the social world at school. Additionally, a stronger social understanding is also helpful in situations that are more socially ambiguous. For example, if a child is given a gift they do not like, they are still expected to react in a positive manner to protect the feelings of whoever gave them the gift (Williams, Moore, Crossman, & Talwar, 2016). By developing these foundational social skills, young children are better prepared to face the more ambiguous situations that they will encounter in school. Thus, domain specific skills such as Theory of Mind may serve as a mechanism of development for deception understanding.

On the other hand, domain general theorists would argue that general cognitive skills, such as EF, help develop a strong cognitive foundation for a myriad of skills, such as deception detection. EF skills demonstrate a person's cognitive control and show their ability to override automatic responses for responses that are more adaptive or goal oriented (Carlson, 2005). Some examples of EF skills are working memory and inhibitory control (Miyake et al., 2000; St Clair-Thompson & Gathercole, 2006). Working memory is temporary information processing and storage and the ability to retrieve that information on demand (Baddeley, 1983, 1992). Inhibitory

control is the ability to keep oneself from saying or doing one thing that is more automatic and instead doing something else that is more goal oriented (Stroop, 1935).

EFs are some of the building blocks that enable a person to acquire higher levels of thinking, both cognitively and socially (Cassidy, 2016; Eisenberg, Hofer, & Vaughan, 2007; Prager, Sera, & Carlson, 2016). For example, having the ability to inhibit one response and say another enables a child to inhibit more automatic responses and use more goal oriented or socially appropriate responses. In this vein, EFs may help with understanding social situations, including when it is appropriate to tell a lie by inhibiting their more automatic response and saying the more socially appropriate response – whether that be a lie or not (Evans & Lee, 2011; Evans & Lee, 2013; Talwar & Lee, 2002a). Working memory engages a person in understanding all that is happening around them, and the better people are at inhibition, the better they can pay attention to multiple things happening and once and understand how to properly react. Thus, these skills work together to enable a child to lie (Evans & Lee, 2013; Talwar & Lee, 2002a). In fact, it is difficult to isolate and measure both working memory and inhibitory control separately because they are both so dependent on each other. Young children are just beginning to learn these more advanced skills, but EFs help to facilitate development by providing a cognitive foundation useful in various social situations. Thus, domain general skills such as EF's may serve as a mechanism of development for deception understanding as well.

Deception as a whole might seem a counter-intuitive skill when school readiness in young children is discussed. However, research shows that understanding and engaging in deception can be a sign of increased social skills and cognitive progress, regardless of whether the intent of the lie is pro-social or not (Ding et al., 2015; Warneken & Orlins, 2015). Young children begin to understand and tell basic lies at around 3 years of age, and their skills in this

area develop rapidly from ages 3-7 (Evans & Lee, 2013; Evans, Xu, & Lee, 2011; Lee, 2013; Lewis & Sullivan, 1989). Research shows that children who engage in these behaviors are more aware of others' behaviors and intentions (Ding et al., 2015; Talwar & Lee, 2008). Additionally, as discussed previously, children do not always tell lies for negative reasons (i.e., telling a little white lie also known as a pro-social lie; Williams, Moore, Crossman, & Talwar, 2016; Talwar & Lee, 2002b). Indeed, the skill of telling pro-social lies also develops in this same age range (Williams et al., 2016). However, little research has examined the development of children's understanding of deception, in both pro-social lie telling and basic lie telling. If a child understands the nuances of deception from a young age and is able to detect when someone else is lying to them, their social skills may be greater than that of their peers, even for those that recognize deception but do not fully understand it. This may lead them to better succeed in school, both in interacting with their teachers and peers.

Another interesting facet of deception that needs to be further explored is whether children deceive for their own self-gain or to please others. For example, a child who engages in a pro-social lie is deceiving as to not upset the other person. In contrast, a child who does not want to get caught disobeying an adult might tell a basic lie so that they do not get in trouble, thus the lie is for their own self-gain. This study aimed to look at these types of liars and see where differences lie.

The purpose of this study was to examine the development of children's understanding of deception, both in their ability to engage in deception as well as their ability to detect it. This more advanced aspect of social cognition was explored to examine constructs developing at the same time to see if any are related to its development. Intelligence is also something that comes into play when school readiness is examined. Previous research shows the importance of

intelligence in terms of vocabulary for academic school success (Duncan et al. 2007; Lonigan, Burgess, & Anthony, 2000), but this research aimed to explore it in relation to this more advanced facet of social cognition and see if and how it is related.

Scientists have found that both EF skills and social skills are essential in a child's ability to form deception, and this study aimed to confirm that and explore if it holds true for deception detection as well. Deception engagement may require the ability to inhibit one response to say another, and deception detection may require that and working memory, which are all EF skills (Evans & Lee, 2011; Evans & Lee, 2013; Talwar & Lee, 2002a). Deception detection also may require that a person be able to take on and understand different perspectives, which is an important part of the social skills developing for these children (Bigelow & Dugas, 2008; Chandler, Fitz & Hala, 1989; Sabbagh, Moses, & Shiverick, 2006; Wardlow, 2013).

This study intended to clarify previous research concerning these constructs, and explore their relationships more specifically. I hypothesized the following:

- **Aim 1.** Examine predictors of lying engagement
 - I hypothesized that there would be differences in vocabulary, EF and social skills between liars who told lies for self-serving reasons and those who lied to please others, specifically that the liars who lie to please others would score higher in measures of vocabulary, EF and social skills.
- **Aim 2.** Examine predictors of deception detection
 - I hypothesized that children who score higher in measures of vocabulary, EF and social skills would be more likely to be successful in detecting deception.

2. METHODOLOGY

Participants

One hundred typically developing children (ages 3, 4, and 5) were recruited for this study from various preschools in the greater Tuscaloosa community. An a priori decision was made to exclude any participants whose vocabulary scores were lower than the 20th percentile to ensure that participants had sufficient language skills to understand task directions. Thus, three participants (two 3-year-olds, and one 4-year-old) were excluded from analyses. The remaining 97 participants included 54 males and 43 females. This included 39 three-year olds ($M = 42.33$ months; range 37-47 months; 23 boys and 16 girls), 34 four-year-olds ($M = 53.20$ months; range 48-59 months; 18 boys and 16 girls), and 24 five-year-olds ($M = 63.12$ months; range 60-69 months; 13 boys and 11 girls). The vast majority of participants were Caucasian at 94.8%, 4.1% were Asian, and 1.1% were African American. IRB and school administration approval was obtained before entering the schools. Parental written consent, child verbal assent, and teacher written consent were also obtained before assessments began.

Child Direct Assessment Measures

EF measures. In order to assess inhibitory control, the Grass/Snow task was used (Gerstadt, Hong, & Diamond, 1994). This Stroop-like task assesses how well children can inhibit an automatic response in order to say something else. They were presented with a picture of grass and a picture of snow. The experimenter said either “grass” or “snow” and the child was supposed to then point to the picture that is the opposite of whatever the experimenter says, thus

inhibiting the more automatic response of pointing to the picture that is the same as what is said. For every correct answer, the child got one point, and no points were given for incorrect answers. If a child self-corrected, meaning they initially pointed to one but then corrected themselves before the next question is read, they got a half a point. Higher scores indicated better inhibitory control performance on this task.

Forward Digit Span was used to assess working memory (Davis & Pratt, 1996). For this task, the experimenter spoke a certain number of digits (0-9), beginning with 2 digits, and the child was asked to repeat them back to the experimenter. If the child was correct, the next string of digits would be one digit longer than the last. This process continued until the child incorrectly repeated the numbers back. The longer the string of numbers remembered, the better the working memory performance on this task.

Deception measures. There were three different measures of deception; the first assessed whether or not the participant engaged in telling a pro-social lie, the second examined whether or not the participant engaged in telling a basic lie, and the third assessed whether or not the participant detected when someone else was deceiving them. The Pro-Social Lie Task was adapted from Williams, Moore, Crossman, & Talwar (2016), as a version of the disappointing gift task. For this task, the first experimenter had the child rank eight prizes from the one that they like the most to the one that they like the least. Prizes ranged from more desirable toys like a sticky hand or monkeys in a barrel, to less desirable toys like a baby toy and an old sock with holes in it. Once the participant ranked their toys, the first experimenter put the toys away, and the second experimenter came in and administered the unrelated EF tasks (described above). When those tasks were completed, the second experimenter said “Thank you so much for helping me! I want to give you a prize that I picked out for you all by myself!” and gave the

participant the prize they ranked the least desirable. The experimenter then asked the child how they like the prize and what they like about it. Following that, the first experimenter came back in and asked the child how they like the prize and if they want to trade it for a different prize. This tested to see if the participant lied to the person who gave them the gift. The responses were video recorded and coded as 1 for a pro-social lie and 0 for truth telling.

The basic lie engagement task was adapted from Talwar & Lee (2002a), and it involved a guessing game. A stuffed animal was placed behind participants so that they cannot see it, and a noise associated with that animal was played (e.g. if the animal is a duck, a quacking noise would be played). The participants were expected to guess what animal the toy was. They guessed twice with two different stuffed animals that have fairly obvious noises associated with them. Then for the third time, the toy was placed behind the participant, but the sound byte played was one that does not easily associate with any kind of animal (e.g. classical music playing while the child has to guess a bunny stuffed animal). The experimenter told the child before playing the noise “I have to go get **E2’s name** from the hallway so she can help us with our next game. I will play the noise for you while I am gone, but remember to not turn around and look at the toy while I am gone. Remember, no peeking!” The experimenter then went into the hallway and stood there for 60 seconds while the video recorded the child’s behavior. The video recording showed whether or not the child peeked at the toy. In order to see whether or not the child tells the truth or engaged in an act of deception, the experimenter asked “While I was getting **E2’s name**, did you turn around and peek at the toy?” If the participant peeked and admitted it, they were considered a confessor (score of 0). If they denied it, they engaged in an act of deception (score of 1). If they did not peek throughout the task, they didn’t have an opportunity to lie (score of 2).

The deception detection task was adapted from the implausible lie task, taken from Lee and colleagues (2002). For this task, a confederate sat reading a book with a monster on the cover, while the experimenter read another book out loud with the participant. After reading, the experimenter placed a pencil on the table and asked the participant if they want to go stretch their legs in the hallway before playing the next game. While they went in the hallway, the confederate switched the regular pencil with an identical but broken pencil. The experimenter then returned with the participant and asked what happened to the pencil. The confederate claimed that the monster on the cover of the book jumped out of the book, picked up the pencil and dropped it, thus breaking it. Then the confederate left the room, while the experimenter asked the child what they think happened to the pencil. The task will be scored based on whether or not the child can understand who they were told broke the pencil, and if they can understand who actually broke the pencil (correct = 1, incorrect = 0).

Vocabulary measure. The NIH Toolbox Picture Vocabulary Test was used as a proxy measure of children's intelligence. This measure has good psychometric properties with a reliability rate of 90% (NIH Toolbox Cognition Assessment; Weintraub et al., 2013). Participants played a game on an iPad where they were shown four pictures on a screen (NIH Toolbox Cognition Assessment; Weintraub et al., 2013). They were told a word, and were instructed to select the picture on the screen that most closely represents that word. The task used computer adaptive testing to quickly identify the participant's skill level (Weintraub et al., 2013). Standardized scores for each child were calculated based on normative data. Higher scores indicate better receptive vocabulary performance.

Teacher Measures

Social Skills Questionnaire. There were two surveys that the teachers filled out exploring participants' social skills. The Children's Social Understanding Scale (CSUS; Tahiroglu et al., 2014) contains 18 questions on a 4 point Likert scale, with 1 indicating "definitely untrue" and 4 indicating "definitely true." This assesses a child's ToM skills and social understanding. Higher scores indicate stronger social skills ($\alpha = .84$).

The Social Competence and Behavior Evaluation in Children Ages 3 to 6 Years: The Short Form (SCBE-30; LaFreniere & Dumas, 1996) was also used to assess social skills. Of particular interest was the social competence scale ($\alpha = .80$ to $.92$), which assesses the positive qualities of a child's adaptation in social situations. This measure consists of 10 questions on a 6 point Likert scale with 1 indicating "never" and 6 indicating "always."

Procedure

Once the parent signed a consent form and their child verbally assented, children completed the battery of tasks above, containing measures of EF and deception detection/engagement. The measures were given in a fixed random order, as previous research shows that studies involving individual differences should avoid counterbalanced designs (Carlson & Moses, 2001). Once the child completed the battery, the teacher was given the social skills questionnaire to fill out. Table 1 describes the order of child measures and how they were scored.

Table 1

Order and Coding Scheme of Child Measures

Task	Coding Scheme
1. Disappointing Gift Task Part 1 (ranking of the toys)	n/a
2. Executive Function Measures	
a. Grass Snow Task (inhibitory control)	0 = Incorrect 1 = Correct Summary Score Range: 0-16
b. Forward Digit Span (working memory)	0 = Incorrect 1 = Correct Summary Score Range: 0-7
3. Disappointing Gift Task Part 2 (pro-social lie task)	0 = Did Not Tell Lie 1 = Told Lie
4. Animal Guessing Game (basic lie task)	0 = Did Not Tell Lie 1 = Told Lie 2 = Did Not Peek
5. Implausible Lie Task (deception detection)	0 = Did Not Detect Deception 1 = Did Detect Deception
6. NIH Toolbox Picture Vocabulary Test (receptive vocabulary)	n/a

3. RESULTS

All data was analyzed using SPSS statistics software. Three participants were excluded because they scored are lower than the 20% percentile on the vocabulary measure, as a score that low calls into question how well they understood the verbal instructions of the tasks in the battery.

Composite Variables: Two composite variables were formed to represent EF and Social Skills. Before forming these composites, Pearson's correlations were run to determine if children's performance on these tasks were correlated. For EF, the Grass/Snow Task and Forward Digit Span Task were significantly correlated ($r = 0.22, p = 0.03$). For Social Skills, teacher reports of children's social skills using the Children's Social Understanding Scale and The Social Competence and Behavior Evaluation in Children Ages 3 to 6 Years: The Short Form were significantly correlated ($r = 0.66, p < .01$). To form the composite variables, scores for each measure were standardized (z -scores) and averaged to form the EF composite and Social Skills composite variables.

Means, standard deviations, and possible ranges for the child variables are included in Table 2, with the remaining sample of 97 participants.

Table 2

Descriptive Statistics

Variable	Age	<i>M</i>	<i>SD</i>	Possible Range	Actual Range
Picture Vocabulary Raw Score	3 years	55.88	6.67	20-160	45-82
	4 years	62.85	6.68		
	5 years	66.38	5.34		
	Total	60.85	7.69		
Grass Snow (Inhibitory Control)	3 years	2.85	4.36	0-16	0-16
	4 years	8.92	6.52		
	5 years	10.35	6.44		
	Total	6.77	6.56		
Forward Digit Span (Working Memory)	3 years	3.18	1.39	0-7	0-6
	4 years	4.03	0.98		
	5 years	4.33	1.52		
	Total	3.75	1.38		
Social Skills Composite	3 years	72.59	11.35	0-100	23-95
	4 years	75.20	9.71		
	5 years	76.73	16.18		
	Total	74.50	12.30		
Basic Lie Task	3 years	1.25	.70	0-2	0-2
	4 years	1.33	.69		
	5 years	1.42	.58		
	Total	1.32	.67		
Polite Lie Task	3 years	0.54	0.50	0-1	0-1
	4 years	0.41	0.49		
	5 years	0.29	0.46		
	Total	0.43	0.49		
Deception Detection	3 years	0.13	0.33	0-1	0-1
	4 years	0.48	0.50		
	5 years	0.75	0.44		
	Total	0.40	0.49		

Preliminary Analyses

Multiple analyses were run to examine the relations among the constructs. First, gender was examined in relation to the constructs of interest (age, vocabulary, EF, and social skills), and it was confirmed that there were no significant differences across gender. Next, Pearson correlations were run to see if deception detection was correlated with either of the deception engagement measures, and all of those correlations were non-significant (detection with basic

lie: $r = -.01, p = .88$; detection with polite lie: $r = -.07, p = .446$; basic lie with polite lie: $r = -.15, p = .12$). Additionally, almost half of the participants did not peek in the Basic Lie task, so the constructs of interest (age, vocabulary, EF and social skills) were examined to determine if any variables of interest predicted peeking behavior. Results confirmed that no variables of interest were related to peeking behavior in the basic lie task. The same predictors were analyzed to look at their performance on the basic lie task (after peeking), and again the overall model was not significant $X^2(4) = 6.07, p = .19$, nor were any of the individual predictors.. Similarly, analyses were also conducted to see if age, vocabulary, EF, or social skills were predictors of their performance in the polite lie task, and the overall model was not significant $X^2(4) = 7.60, p = .10$, with no significant individual predictors.

Primary Aims

Aim 1. In order to analyze the relations among self-serving liars and pleasing others liars, new variables were created. Any child who told a basic lie (Basic Lie Task), but did not tell a pro-social lie (Polite Lie Task) was classified as a Self-Serving liar. Any child who did not tell a basic lie, but did tell a pro-social lie was classified as a Pleasing Others liar. Additionally, almost half of the participants did not peek in our Basic Lie Task, so we classified those participants in a post-hoc third category called Rule Followers. Preliminary analyses indicated that Rule Followers who did not tell a pro-social lie and Rule Followers who did tell a pro-social lie did not differ on any of the variables in question, so they were collapsed into one category for the following analyses. Lastly, participants whose responses did not fit into any of these patterns were classified as Random. The descriptive statistics for each liar type are listed in table 3.

Table 3

Descriptive Statistics by Liar Category

		Age in Months	Picture Vocabulary Raw Score	Social Skills	Forward Digit Span	Grass Snow
Self Serving	Mean	52.91 (SD 9.24)	62.33 (SD 7.02)	72.22 (SD 11.94)	4.04 (SD 1.51)	6.02 (SD 6.58)
	N	24	24	24	24	24
Pleasing Others	Mean	40 (SD 3.95)	52.29 (SD 2.87)	65.61 (SD 13.61)	2.29 (SD 1.70)	4.42 (SD 5.62)
	N	7	7	6	7	7
Rule Followers	Mean	52.71 (SD 8.83)	61.43 (SD 8.28)	76.25 (SD 11.20)	3.74 (SD 1.32)	7.45 (SD 7.07)
	N	42	42	39	42	42
Random	Mean	50.45 (SD 7.00)	60.83 (SD 6.89)	76.15 (SD 13.47)	3.92 (SD 1.01)	7.04 (SD 6.00)
	N	24	24	24	24	24
Total	Mean	51.28 (SD 8.80)	60.85 (SD 7.69)	74.50 (SD 12.30)	3.75 (SD 1.38)	6.77 (SD 6.56)
	N	97	97	93	97	97

To examine the differences among these 3 liar types, Pearson correlations were used to see if the differences among these liar types existed in age, vocabulary, EF skills (composite of FDS and GS), and social skills. Pleasing Others liars were found to be significantly younger, and to have significantly worse skills in EF and vocabulary. The correlations among these variables are recorded in Table 4.

Table 4

Correlations Among Variables of Interest by Liar Category

Variable	2	3	4	5	6	7
1. Pleasing Others Liars	-.160	-.244*	-.359**	-.312**	-.252*	-.191
2. Self Serving Liars		-.501**	.107	.112	.032	-.110
3. Rule Followers			.142	.067	.053	.122
4. Age in Months				.562**	.523**	.176
5. Picture Vocabulary Raw Score					.390**	.109
6. EF Composite						.315**
7. Social Skills Composite						

Note. * $p < .05$, ** $p < .01$

No significant differences were found between the Self-Serving liars and the Rule Followers.

Aim 2. Hierarchical Logistic Regression using Akaike's Information Criterion (AIC) to select the best fit model to predict deception detection revealed that age and the EF composite, but not receptive vocabulary or social skills composite, form the best model for predicting children's Deception Detection performance on the Implausible Lie Task. Details of the model are included below in Table 5. The overall model was significant $X^2(2) = 30.25, p < .01$.

Table 5

Hierarchical Logistic Regression Analysis Details

Variable	Beta	S.E.	Wald	df	Sig.	Exp(B)
Constant	-5.083	1.688	9.071	1	.003	.006
Age in Months	.087	.032	7.433	1	.006	1.091
EF Composite	1.030	.391	6.933	1	.008	2.800

4. DISCUSSION

Exploring the developmental trajectories of deception understanding in young children is paramount for the building blocks of preschool programs that best promote school readiness. One skill that develops in preschool is the understanding of the mind and how it facilitates social understanding. A hallmark of children's social cognition development is lying and basic understanding of deception more broadly. This study explored both the engagement in deception as well as the detection of deception in relation to age, vocabulary, social skills, and EF. Engaging in and detecting deception is an indicator of developing social cognition in young children. Children use a combination of skills, such as EFs, social skills, and world knowledge to engage in deception and to detect it. For example, to engage in deception, children must inhibit one response and say another; additionally, children must actively engage their working memory to keep track of the true and false information. Indeed, developing skills like deception detection should not be viewed as inappropriate behavior; instead, adults should scaffold children's understanding of deception so they learn when it is appropriate to tell a lie themselves and know how to detect when someone lies to them. Interestingly, most of the research in this area so far has focused on ToM development, along with emotion understanding and social skills, without considering the basic cognitive skills such as EF. This study is one of the first to provide insight in that area and show that EFs do relate to the development of deception detection. Thus, this study was one of the first to consider both domain specific and domain general processes in the investigation of how deception detection and engagement develop in early childhood.

The first aim of this study intended to clarify differences in how children choose to tell lies, whether that be for self-serving interests or to please others. Almost half of our sample ($n = 43$) did not peek during the basic lie task (Talwar & Lee, 2002a), which we were not anticipating. Other studies that used this task also had similar problems with children not peeking (Lavoie et al., 2017; Talwar et al., 2017). Future research looking at basic lie tasks might consider creating a task in which children all lie. To address this issue, we grouped participants into three main categories: Self Serving liars, Pleasing Others liars, and Rule Followers. Results indicated that the only group that differed significantly from the others was the Pleasing Others liars, who were younger and performed worse than the other two groups on every measure. It is important to note that our Pleasing Others liars group consisted of only 7 participants, which is a limitation, but it was examined and confirmed that none of these 7 participants were outliers and that this group was cohesive in that they all did perform significantly worse on the measures of interest. This is a fascinating finding that contributes to the literature, where previous research has been inconsistent. Talwar & Lee (2002b) also found that 3 year olds were successful in telling white lies, but multiple other studies found that the polite liars were the oldest participants with more advanced skills (Broomfield, Murphy & Murphy, 2002; Lavoie et al., 2017; Talwar, Murphy & Lee, 2007; Warneken & Orlins, 2015). However, it is important to note that the age range of these studies varied greatly. Lavoie et al. (2017) had their youngest participants at our oldest age of 5 and went all the way through age 14, whereas the current study and Talwar & Lee's study (2002b) started with participants at age 3. Our study, along with Talwar & Lee (2002b), suggests that polite lying might have a quadratic trend in that younger children (approx. 3 years old) appear to polite lie as a function of their previous experience (perhaps relying on scripts to determine what to say, but not necessarily demonstrating a solid understanding of their

seemingly prosocial behavior). This finding arguably supports Theory Theory as it demonstrates children constructing and reconstructing their own naïve theory of the mind. When children develop a more solid ToM in later preschool, they might value their own desires over others, and not care as much about protecting others' feelings if it means it will keep them from getting what they want. Later in childhood, when children have a solid ToM and strong social skills, they may polite lie for actual altruistic reasons. Thus it is possible that there is a quadratic relationship in the behavior, but that the motives for the behavior differ as a child develops. This supports a more domain specific view in the development of polite lie-telling, as the child may construct new theories about social interactions as they learn more about their world. Future research should explore this possibility.

In this study, there were no clear differences between the self-serving liars and the rule followers. In addition, we had a number of participants ($n = 24$) who we were not able to classify, as they did not fit into one of our categories. However, our results indicated that these children were no different from the self-servers and rule-followers in their responses to the primary measures. Thus, it is clear that further research is needed. Future research should include a wider range of older children, such as ages 3-8, to provide deeper insight into these categorizations and also highlight the role that EFs may serve in providing a cognitive foundation for this aspect of social cognition (engaging in deception), which little research in this area has done yet.

The second aim of this study showed that age and EF skills significantly relate to a child's ability to *detect* deception. This is a new and unique contribution to the discussion between constructivists and information processing psychologists that was addressed in the introduction. Again, most of the research done in this area has focused on how social skills serve

as a foundation for deception detection, such as ToM understanding (Lee et al., 2002; Nancarrow et al., *under review*) and emotion knowledge and emotion regulation (Lee et al., 2002). The current study shows that cognitive skills, such as EF, also play a role, but not social skills. It was surprising that social skills and ToM were not significant in our model but instead that, at this young age, EF skills play a larger role in detecting deception. It is likely that as children grow older, social skills would become more prominent and relevant in detecting deception, but that is another avenue to pursue in future research. It was also interesting that vocabulary was not significant in our model and age was. This suggests that there might be something beyond vocabulary and basic intelligence that comes with age that helps with deception detection, and future research should aim to explore what that might be. The current results in this younger age group support the domain general approach to ToM development.

When considering the application of this research, one can examine the mechanisms of change that are used in school interventions to facilitate development. Indeed, there are many school intervention programs that already incorporate domain general skills such as EF in their curriculum: Promoting Alternative Thinking Strategies (PATHs), Tools of the Mind (Bodrova & Leong, 1996), and Unstuck and On Target (Cannon et al., 2011) all use elements of EF skills to promote school readiness. For example, Tools of the Mind uses activities to help children attend to and solve problems, along with planning and remembering (Bodrova & Leong, 1996). EF skills have been found to be largely predictive of school success (Fuchs et al., 2005; Passolunghi, Vercelloni, & Schadee, 2006; Swanson & Sachse-Lee, 2001; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Future research should pursue the use of these interventions to increase children's development of engaging in and understanding deception, thus using experimental methods to directly test deception understanding's impact on school readiness.

This study was limited by having only correlational results; as discussed above, interventions would be a better way to continue to expand this area of research and show its relevance and importance in helping to improve school readiness. Children that are able to detect deception and know how to handle themselves in more socially ambiguous situations are in a better place to take on the new social situations they will face in elementary school. Longitudinal studies would be able to look at these relationships and clarify whether domain general skills, such as EF, can play a significant role in predicting these more socially and cognitively advanced outcomes. In this exciting and relatively new area of research, this study is an important first step in clarifying the relationships among these constructs.

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IRB Project #:

UNIVERSITY OF ALABAMA
INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS
REQUEST FOR APPROVAL OF RESEARCH INVOLVING HUMAN SUBJECTS

I. Identifying information

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Title of Research Project: Theory of Mind, Executive Function, and Interacting with Others

Date Submitted: ?

Funding Source: Psychology Department Research Overhead, Applying for RGC

Type of Proposal	<input checked="" type="checkbox"/> New	<input type="checkbox"/> Revision	<input type="checkbox"/> Renewal Please attach a renewal application	<input type="checkbox"/> Completed	<input type="checkbox"/> Exempt
Please attach a continuing review of studies form					
Please enter the original IRB # at the top of the page					

UA faculty or staff member signature: _____

II. NOTIFICATION OF IRB ACTION (to be completed by IRB):

Type of Review: _____ Full board Expedited

IRB Action:

____ Rejected Date: _____

____ Tabled Pending Revisions Date: _____

____ Approved Pending Revisions Date: _____

Approved-this proposal complies with University and federal regulations for the protection of human subjects.

Approval is effective until the following date: 11-6-17

Items approved: Research protocol (dated 11-7-16)

Informed consent (dated 11-7-16)

____ Recruitment materials (dated _____)

____ Other (dated _____)

Approval signature _____

Date 11/8/2016

**UNIVERSITY OF ALABAMA
INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS
REQUEST FOR APPROVAL OF RESEARCH INVOLVING HUMAN SUBJECTS**

I. Identifying information

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Title of Research Project: Theory of Mind, Executive Function, and Interacting with Others

Date Submitted:

Funding Source: Psychology Department Research Overhead, Applying for RGC

Type of Proposal	<input type="checkbox"/> New	<input checked="" type="checkbox"/> Revision	<input checked="" type="checkbox"/> Renewal Please attach a renewal application	<input type="checkbox"/> Completed	<input type="checkbox"/> Exempt
Please attach a continuing review of studies form					
Please enter the original IRB # at the top of the page					

UA faculty or staff member signature:

II. NOTIFICATION OF IRB ACTION (to be completed by IRB):

Type of Review: _____ Full board Expedited

IRB Action:

Rejected Date: _____

Tabled Pending Revisions Date: _____

Approved Pending Revisions Date: _____

Approved-this proposal complies with University and federal regulations for the protection of human subjects.

Approval is effective until the following date: 10-9-1865

Items approved: _____ Research protocol (dated _____)

_____ Informed consent (dated _____)

_____ Recruitment materials (dated _____)

_____ (dated _____)

Approval signature

Date 10/10/2017