COGNITIVE UNDERPINNINGS OF PRESCHOOLERS' ABILITY TO LEARN FROM OTHERS

By

JENNIFER M. TAMARGO

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2009

To my parents and “Nette’s House” (a place central to my initial interest in child development)

ACKNOWLEDGMENTS

I thank the participant parents, childcare centers, and research assistants for their cooperation and involvement in this study. I also appreciate the enthusiasm and contributions of my supervisory committee. Finally, I thank my family, John, and my friends for their emotional and financial support throughout this process.

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

COGNITIVE UNDERPINNINGS OF PRESCHOOLERS' ABILITY TO LEARN FROM OTHERS

By

Jennifer M. Tamargo

December 2009

Chair: M. Jeffrey Farrar
Major: Psychology

Many developmental theories include a social component when describing humans' ability to learn, but do not describe the cognitive processes necessary for humans to learn from others. According to cultural learning theory, advances in social cognition and self-regulation allow preschool children to uniquely engage in social learning. The current study examined how these achievements contribute to developmental differences in young children's ability to learn from others' instructions in a problem-solving situation. Children (N = 44, M = 4.4-years) observed either correct only (C-only) or incorrect + correct (I+C) instructions to solving the trap-tube task. All children also received measures of false belief understanding, inhibitory control, and receptive language. Children's performance on the false belief (FB) and inhibitory control (InhC) measures were expected to predict performance on the trap-tube task for those in the I+C condition due to the conflicting representations presented by I+C instruction. In addition, language was expected to partially mediate the relationship between FB and task performance.

For the I+C condition, InhC was the only variable significantly related to children's task performances at teaching, post-instruction1, and post-instruction2 sessions.

Instruction condition x InhC predicted task performance at the teaching and post-instruction1 sessions. Specifically, InhC was more influential on task performance for the I+C condition than for the C-only condition. In the I+C condition, children with greater InhC performed better during the teaching and post-instruction1 sessions than children with low InhC. Surprisingly, FB was not related to overall task performances. However FB was positively related to children's initial performance after I+C instruction. Children with greater FB understanding had better initial performance than children with low FB understanding in the I+C condition.

These reported patterns did not emerge in the C-only instruction condition; InhC and FB were not related to children's task performance at any session of measurement. In the C-only condition, age was positively related to children's task performance at post-instruction1, but was not related to performance at the teaching and post-instruction2 sessions. Across both instruction conditions, children's language ability did not relate to task performance at any session of measurement. These findings suggest that specific cognitive achievements in the preschool years influence children's learning abilities. Implications of these findings are discussed.

CHAPTER 1
INTRODUCTION

The process of how we learn has been of considerable interest in the developmental literature. Though there are various perspectives regarding the process of learning, many core developmental theories include a social component when describing our ability to learn. Freud's (1942) psychoanalytic theory, Erikson's (1950) psychosocial theory, Bandura's (1977) social learning theory, Vygotsky's (1978) sociocultural theory, Piaget's (1930) cognitive developmental theory, and Bronfenbrenner's (2005) bio-ecological systems theory, all describe the interactions we have with others from different perspectives. However, each of these perspectives is limited in specifying the process by which humans learn from others. Cultural learning theory builds on the core claims of Vygotsky and attempts to explain the process of social learning within a social cognitive context (Tomasello, Kruger, & Ratner, 1993). The current study used cultural learning theory as a theoretical framework for considering factors that may contribute to developmental differences in young children's ability to learn from others in problem-solving situations. Specifically, the study focused on the roles of false belief understanding, inhibitory control, and language on children's ability to engage in social learning involving another's correct and incorrect instruction.

Grounded in a Vygotskyian perspective, cultural learning theory provides a conceptual starting point for assessing which cognitive advancements influence the way humans engage in social learning settings. Vygotsky proposed that cultural "tools," especially the tool of language, change the way humans reason about the world and how they think about others and themselves mentally (Vygotsky, 1978). He also viewed social learning as a crucial element for one's internalization of knowledge and cognitive advancement (Rowe & Wertsch, 2002). However, Vygotsky did not provide an explanation for how humans are able to engage with others socially throughout development. Cultural learning theory describes the role of the learner and the elements of cognition that allow humans to engage in learning situations with others. In contrast to social learning, which involves the learner's attention to another's activity, cultural learning involves the learner's attempt to see a situation through another's perspective (Tomasello et al., 1993). Concretely, the learner internalizes both the activity being learned and the social interaction associated with the activity; in other words, humans learn through others rather than from others (Tomasello et al., 1993).

According to cultural learning theory, in order to learn through others and consider another's perspective, social cognitive skills are required. A considerable amount of research has focused on defining the development of social cognition, especially the aspect of "theory of mind," as coined by Premack and Woodruff (1978). Theory of mind refers to the understanding of mental states, both one's own and another's. There are multiple social cognitive skills that lead to one's understanding of the mind. Cultural learning theory defines one's learning ability in relation to major social cognitive achievements. Specifically, by about 12-months of age, infants initially demonstrate social understanding through joint attention, which leads to other social cognitive skills such as engagement in communicative gestures, attention following, imitation, and eventually referential language (Carpenter, Nagell, & Tomasello, 1998b). Each of these skills involves the child, another, and their common attention to an event or person (Carpenter et al., 1998b). Infants with this level of social cognition understand others as "intentional agents" (Tomasello, 1995, 1999; Tomasello et al., 1993). In effect, infants understand that the acts of others are influenced by the others' intended goal. During the preschool years, children's understanding of others expands beyond understanding another's intentions to understanding another's perspectives and beliefs. Primarily this shift takes place because of children's ability to understand representational change (Gopnik & Astington, 1988). Between the ages of 4- and 5-years, children typically understand the difference between appearance-reality and the false beliefs of self and others (Gopnik & Astington, 1988). The development of false belief understanding is a major component in the development of theory of mind. Children with this social cognitive understanding recognize others as "mental agents" (Tomasello, 1999; Tomasello et al., 1993). Concretely, children with false belief understanding recognize that others can have beliefs and perspectives that are different from their own and that behaviors are influenced by one's beliefs. Finally, once children understand others mentally, they begin to develop more sophisticated reasoning regarding how others think about mental states. Children come to understand that others not only have beliefs of their own, but that others can also have beliefs about another's beliefs, commonly referred to as second order beliefs (Perner & Wimmer, 1985). Children with this level of social cognitive understanding regard others as "reflective agents" (Tomasello et al., 1993). Considering these broad progressions in social cognitive understanding, cultural learning theory describes stages in which children are able to engage in learning situations. The central idea is that humans learn in fundamentally different ways at various stages of development because of their social cognitive understanding.

Cultural Learning Theory

According to cultural learning theory, there are three core stages of cultural learning: imitative learning, instructed learning, and collaborative learning. Each of these learning types depends on the learner's social cognitive concept of the person (Tomasello et al., 1993). Essentially cultural learning theory analyzes what the learner contributes to a social interaction rather than focusing on what the "teacher" or "model" contributes to the interaction. Initially, children engage in imitative learning. It is important to note that imitative learning as defined in a social learning context is completely different from imitative learning as defined by cultural learning theory, though the term is the same. Imitative *cultural* learning occurs when the learner repeats a model's behavioral strategies and understands these strategies in relation to the model's perspective (Tomasello et al., 1993). To engage in true imitative cultural learning, the learner has to understand others as intentional. In other words, the learner has to understand that another's behaviors are intended to produce some outcome. Therefore, imitative cultural learning is more than simply copying a model's behavior. However, a child who is participating in imitative cultural learning is still limited in social cognitive understanding. Learners in this stage are unable to apply a recently learned method to a similar situation simply because the learner has only internalized the perspective of the model and not the model's understanding or beliefs regarding the task (Tomasello et al., 1993).

One example of imitative cultural learning is found in Nagell, Olguin, and Tomasello (1993). Nagell et al. (1993) aimed to test the process of social learning in human and non-human primates within the context of tool use; however, the results of this study also offer a demonstration of imitative cultural learning in humans. Nagell et al. (1993) tested both chimpanzees and human 2-year-olds on a tool-use task. Participants from both groups watched as a model provided full, partial, or no demonstration on how to use a rake to retrieve a toy. Nagell et al. (1993) found 2-year-olds engaged in imitative learning even when doing so was ineffective. Children in the partial demonstration condition saw the model pull the rake to retrieve an object; however, the orientation of the model's rake was different from the orientation of the child's rake. The direction of the rake was critical for success on the task. Rather than changing the orientation of their own tool before using it, the 2-year-olds simply imitated the model's intentional behavior of pulling and did not successfully complete the task. In the full demonstration, children watched as the model flipped the rake then pulled it to retrieve an object. Consequently, children in the full demonstration condition were more successful at completing the task than children in the partial and no demonstration conditions because they observed the two behaviors necessary for success on the task, flipping and pulling in addition to the goal of retrieving the object. Though performance on the task was dependent on the type of demonstration observed, the learning method used by the child was the same in each condition. It is clear children used imitative learning because in each condition the model achieved an intended goal of retrieving the object; therefore, children performed the behavior they directly observed because this behavior produced the intended goal. Essentially, the 2-year-olds considered the model's behavior in relation the model's intended goal, but not the model's understanding of the task given that the children did not attend to the orientation of the rake.

Conversely, when learning a novel task or concept, children who are engaged in instructed cultural learning have internalized the instructor's understanding and regulate their own behavior to coordinate between their own understanding and the instructor's understanding of the novel task or concept. (Tomasello et al.,1993). Essentially, instructed learners understand others' behavior is intended to produce a particular outcome *and* that others have their own ideas about how to achieve that outcome. It is important to note that Nagell et al. (1993) tested the process of social learning in human and non-human primates and inadvertently provided support for imitative cultural learning in humans as it is defined within a cultural learning theory context. Their study did not focus on identifying cultural learning styles. However, using the same scenario presented in Nagell et al. (1993), we can consider the behavior differences between imitative cultural learning and instructed cultural learning. In the full demonstration condition, recall children observed the model flip then pull the rake to retrieve an object. Therefore, in this condition, the behavior of both an imitative learner and an instructed learner appears to be the same because the model demonstrated all behaviors necessary for completing the intended goal. In effect, the task did not require that the learner demonstrate an understanding of the task beyond the model's behavior and intended goal.

However, in the partial demonstration condition, recall that the model pulled the rake to retrieve an object, but the model's rake was already oriented correctly whereas the child's rake was not oriented correctly. Behavior differences between imitative learners and instructed learners would be observable in the partial demonstration condition because the task requires the learner to internalize more than the model's behavior in relation to the intended goal. Imitative learners understand another's behavior in relation to that person's intent goal. Therefore, if an intended goal is achieved by some observed behavior (e.g., pulling) the imitative learner will imitate the observed pulling behavior because it produced the model's intended goal. As mentioned previously, 2-year-old children in the partial demonstration condition imitated the pulling behavior, but did not consider the orientation of the model's rake. However, a child engaged in instructed learning would consider the orientation of the model's rake when completing the task because children in this stage of learning integrate another's understanding of a task with their own understanding of the task. The orientation of the model's rake conveys the model's thoughts about how to use the rake in order to obtain the object. Therefore, an instructed learner would flip then pull the rake to achieve the goal, even though the flipping behavior would not be observed and model's intended goal would be achieved with a pulling behavior. In effect, instructed learners internalize another's thoughts about a task, not just another's behavior in relation to an intended goal.

A study by Carpenter, Call, and Tomasello (2005) illustrates the information infants tend to focus on when imitating another's actions. Specifically, they found that infants imitate actions relevant to the intentional goal, but tend to overlook behaviors that are secondary to the goal. Twelve- and 18-month old infants observed a model move a mouse from one location into a house. In the process of relocating the object, the model made the mouse hop on its way to the house, a behavior that was not necessary for the mouse to enter the house. Consequently, infants of both age groups only copied the action of moving the mouse into the model's intended location, the house. However, neither age group reproduced the hopping motion when relocating the mouse. This finding suggests that infants tend to imitate actions that relate to a final goal, but will overlook behaviors not directly associated with the final goal. Applying this finding to the previous Nagell et al. (1993) imitative learning example, the 2-year-olds did not flip the rake because as the infants in the Carpenter et al. (2005) study, they only focused on the action relevant to the final goal (i.e., the pulling behavior). On the other hand, children engaged in instructed learning would consider all pieces of information to infer the model’s thoughts about the task. Children engaged in instructed learning would flip the rake over; even though this action would not be observed because they would perceive the orientation of the rake as related to the model’s understanding of the task. While young infants are capable of interpreting others’ intentional goals, they are limited in their understanding of others’ thoughts about how to obtain the goal. Children engaged in instructed learning are capable of considering not only others’ intentions, but others’ thoughts as well.

It is important to emphasize that instructed learning is a style of cultural learning and, like all cultural learning stages, this stage is based on the learner’s level of social cognitive understanding. The term “instructed” does not indicate that a particular type of instruction has been provided to the child, but rather refers to what the child is processing during this stage of learning. The children are using their knowledge of another’s thoughts regarding a task or concept and coordinating these thoughts with their own thoughts to produce a particular outcome. Therefore, the term *instructed* refers to the fact that the children’s understanding of a task or concept is “instructed by another” in the sense that children are using another’s thoughts or beliefs about a task to change their own understanding about the task or concept. In other words, an imitative learner and an instructed learner can both be exposed to the same instruction (e.g., demonstration), and perform at completely different levels due to the information they as the learner are able to process from the learning interaction. As children's social cognitive skills become more sophisticated, these skills allow them to engage in learning situations in a fundamentally different manner than before.

To engage in instructed learning, cultural learning theory argues that two important skills are necessary: false belief understanding and self-regulation (Tomasello et al., 1993). As mentioned previously, children around 4 years of age begin to understand others have different thoughts and beliefs than their own. Understanding the beliefs of others is crucial for engaging in instructed cultural learning because the learners are required to consider both their own and another's perspective. In addition, the learners have to be able to regulate their own behavior when learning through the beliefs of others. Self-regulation provides evidence that the learner has internalized a new understanding of the task in that the learner is able to manage their behavior to match this new understanding. According to Vygotsky, private speech (i.e., self-directed speech that is intended for the self rather than for others) assists one in self-regulation (Rowe & Wertsch, 2002). Essentially, private speech is evidence for one's internalization of language, meaning one uses language as a tool for reasoning (Vygotsky, 1978). In reference to problem solving, studies have documented that private speech occurs in children as young as 3.5 years of age and note private speech tends to increase as the difficulty of a task increases (Duncan & Pratt, 1997; Goodman, 1981). Furthermore, studies such as Duncan and Pratt (1997) suggest children use private speech as a means for planning during problem solving tasks, thus supporting Vygotsky's (1978) claim. However, though children may use self-directed speech at ages younger than 4 years, it is not until the age of 4 that self-directed speech is coordinated with the child's behavior (Luria, 1961, as cited in Tomasello et al., 1993). The coordination of perspectives and self-regulation to accommodate these perspectives are central achievements that allow for engagement in instructed cultural learning.

Among the factors important for instructed cultural learning, executive function skills other than self-directed speech may play a role as well. Specifically, findings suggest the executive function skill of inhibitory control not only relates to one's self-regulation (e.g., compliance and effortful control), but is also linked to false belief development (Carlson & Moses, 2001). Inhibitory control requires one to inhibit a dominant response. Conflict inhibitory control tasks require one to act in conflict to one's natural response. For example, Gerstadt, Hong, and Diamond (1994) used a day/night stroop-like task, which required children to say "day" when shown a card representing night and to say "night" when shown a card representing day, thus conflicting with the child's natural response. Several studies have found children younger than 4 years of age, whose social cognitive skills are still somewhat limited, have difficulty on tasks of this type (e.g., Frye, Zelazo, & Palfai, 1995; Gerstadt et al., 1994). In particular, conflict inhibitory control tasks have been found to predict theory of mind performance (Flynn, 2007). In instructed learning, learners are required to coordinate between perspectives and in effect act in conflict to their original thoughts regarding the task. To engage in instructed learning, learners must understand another's beliefs (i.e., false beliefs) in order to coordinate between perspectives and inhibit their own original thoughts about a task or concept; thus, using self-regulation to act in accordance with the new understanding of the task or concept.

Though executive function skills and false belief understanding may play a major role in instructed learning, it is important to note one's language development is embedded within all stages of cultural learning. Vygotsky (1978) viewed language development as a crucial component in cognitive advancement. Initially language allows one to engage socially, but eventually the tool of language allows one to engage in more advanced reasoning (Vygotsky, 1978). Cultural learning theory applies Vygotsky's claim and considers language development in relation to social cognitive developments at each level of learning. In general, research has documented a relationship between language development and the development of social cognitive skills, which are critical components for how humans learn socially according to cultural learning theory. For example, Carpenter et al. (1998b) found engagement in joint attention, a social cognitive skill important for imitative cultural learning, was related to language comprehension, use of gestures, and language production. In reference to language production, the infant's chronological age did not relate to language production at all. Instead, only the age at which the infant began to spend a significant amount of time in joint engagement was related to the production of language (Carpenter et al., 1998b). These results support the notion that there is a relationship between social cognition and language, even within the earliest stages of language development.

As language development progresses, language ability has been found to predict the development of false belief understanding (Jenkins & Astington, 1996). Although it is clear social interactions provide an opportunity for exposure to language, research has found social interactions also provide an opportunity to learn about social cognitive skills, such as conflicting representation. Welch-Ross (1997) examined the relationship between mother-child conversations about the past and children's theory of mind development. The number of elaborative statements spoken by the child's mother was positively related to the child's ability to reason about conflicting mental representations (Welch-Ross, 1997). As discussed previously, instructed learning requires one to coordinate another's mental representations with one's own representations. The findings of Welch-Ross (1997) reflect the influence of language on one's ability to coordinate perspectives effectively as required by instructed cultural learning.

Though language, social cognition, and executive function are related to one another, it is unknown how each of these components influences children's ability to engage in social learning. The current study aimed to use a cultural learning perspective to examine factors that contribute to developmental differences in children's ability to learn from others in a problem-solving situation. Little research has examined the role of false belief understanding on cultural learning; therefore the current study is an important first step. Specifically, the current study examined the role of false belief, inhibitory control, and language on children's ability to learn from another's instruction.

Instruction and Problem-Solving

Children benefit from various types of instruction in a variety of problem solving contexts including planning, rule use, and tool use. In regard to tool use, several studies indicate developmental differences in children's ability to problem-solve when tasks of tool use are novel (e.g., Horner & Whiten, 2007; Nielsen, 2006; Want & Harris, 2001). In addition, some findings demonstrate that children can benefit more from instruction that provides both the correct and incorrect solutions to a task. According to a study conducted by Want and Harris (2001), 3-year-old children did better on a novel task after witnessing demonstration of an incorrect solution followed by a correct solution. One goal of their study was to demonstrate that learning from another's mistake is an indicator of a child's awareness of causal effects (Want & Harris, 2001). The trap-tube task was one problem type used to assess children's ability to benefit from incorrect and correct solution demonstrations (Want & Harris, 2001). The trap-tube used in Want and Harris (2001) was a clear horizontal tube with a trap located underneath one end of the tube. A reward was placed in the middle of the tube for the child to retrieve. A stick was provided as a "tool" to push the reward out of the tube. If the tool were inserted into the side nearest to the trap, the reward would be pushed out of the tube for retrieval. However, if the tool were inserted into the side opposite the trap, the reward would fall into the trap. In principle, to get the object out of the tube, one has to consider where the object is located in relation to the trap.

According to the findings of Want and Harris (2001), 3-year-olds benefited when exposed to demonstrations of solutions to this task. Initially, all 3-year-olds were unable to complete the task. Their performance improved once they observed the correct-only solution. However, the 3-year-olds benefited most when exposed to both the incorrect and correct solutions than when they observed the correct-only solution. Other studies have also indicated young children benefit from observing the intentions and mistakes of others. Carpenter, Call, and Tomasello (2002) tested 2-year-olds' ability to learn from another's prior intentions. They provided information about another's intentions during a problem-solving task. Children were presented with a wooden birdhouse in which the goal was to open the door of the house. To open the door, a pin had to be removed. Children observed a variety of conditions in which a model intended to complete the task. In one condition, children observed the model pull on the door with no success. They then saw the model pull out the pin, which successfully opened the door. Carpenter et al. (2002) argued that the incorrect solution provided extra information about the task, therefore assisting children in their performance of the task. However, benefiting from another's intentions or mistakes in performance does not necessarily indicate one gained a sophisticated understanding of the task. From the findings of Want and Harris (2001) and Carpenter et al. (2002), it could be argued that the children were using cues and imitation to assist in task performance rather than using a "gained" understanding of the task. Therefore, the full benefits gained by observing another's mistake are not clear.

The studies of Want and Harris (2001) and Carpenter et al. (2002) only provide evidence that observing another's mistake can help on simple tasks in which imitative learning is effective, but the extent to which another's mistake can help on tasks that require more complex reasoning is unknown. The task used in Carpenter et al. (2002) was much simpler than the trap-tube task. The trap-tube task requires conditional reasoning skills. One has to consider where the object is in relation to the trap to succeed at obtaining the object. In the Carpenter et al. (2002) study, the task never changed, pulling the pin out always made the door open, there were no other conditions to consider. In each condition, children always observed the model remove the pin to open the door. Therefore, the task did not require the children understand how to open the door beyond the behavior observed because the observed behavior always produced the intended goal of opening the door. The task was not altered in a manner that required children understand the task beyond the model's behavior and intentional goal. In other words, observing another's mistake did help children's performance on the specific task because imitative cultural learning was an appropriate learning style in order to succeed on the task. Though observing another's mistake and intention does seem to assist children's imitative abilities (Carpenter et al., 2002; Want & Harris, 2001), more research is needed in order to determine the effect of another's mistake on a child's understanding of more complex novel tasks.

Considering the relatively complex nature of the trap-tube task, Horner and Whiten (2007) attempted to expand on the results of Want and Harris (2001); however, they were unable to replicate the findings. Horner and Whiten (2007) found children ages 3- to 4-years show limited benefit from watching another's mistake followed by a correct solution during the trap-tube task. Specifically, the children were not performing above what would be expected by chance, regardless of whether they observed correct only instruction or incorrect + correct instruction. In contrast, they found children ages 5- to 6-years were able to perform the task with little or no errors and therefore these children did not benefit much from instruction in any condition because they were able to understand the task on their own.

Comparing the results of Horner and Whiten (2007) to the results of Want and Harris (2001), there is evidence to suggest differences in performance on the trap-tube task may be due to developmental differences in the way children learn from another's correct and incorrect instruction. Although both studies indicate young children are capable of improving performance on the trap-tube task once they receive instruction, the two studies differ in the benefits gained from observing incorrect and correct instruction. As mentioned previously, Want and Harris (2001) found 3-year-olds not only performed better with instruction, but they performed better than chance when they observed both correct and incorrect solutions to the task. Thus, it appears that the 3-year-olds not only gained knowledge about how to perform the task, but they also gained knowledge regarding the nature of the task. In other words, the findings of Want and Harris (2001) seem to provide evidence that observing another's mistake can help one understand complex tasks, such as the trap-tube task.

However, the trap-tube and testing method used by Want and Harris (2001) make it difficult to determine what knowledge 3-year-olds actually gained from observing correct and incorrect instruction. Horner and Whiten (2007) noted the trap-tube apparatus in the Want and Harris (2001) study was rotated after each trial, possibly cuing children to alter their tool insertion and therefore interfering with the need to understand the causal effects of the task. In order to assess children's understanding of the task, the tube needed to be altered in a different way. Although it appears children can perform better after witnessing a mistake as well as a correct solution, children in the Want and Harris (2001) study did not necessarily indicate they gained understanding regarding the complex nature of the task.

Horner and Whiten (2007) slightly altered the trap-tube used by Want and Harris (2001). Horner and Whiten (2007) constructed the trap in the center of the tube rather than at the end of the tube; therefore, the trap-tube was similar to the shape of a "T." Instead of rotating the trap-tube apparatus between testing trials as done by Want and Harris (2001), Horner and Whiten (2007) changed the location of the object to either the left or the right of the trap intermittently throughout a trial block. This slight change removed the possibility of cuing children to alter the side of tool insertion because the apparatus never moved and the location of the object was moved sporadically. Thus, these differences in the design of the trap-tube may account for the differences in children's performance between the two studies. To succeed on the trap-tube task in the Horner and Whiten (2007) study, it was much more critical for children to consider the location of the object in relation to the trap.

The factors that contribute to developmental differences in children's ability to learn from instruction, specifically incorrect and correct (I+C) instruction, were of central interest for the current study. Though observing another's mistake in addition to a correct solution seems most beneficial when completing simple tasks (Carpenter et al., 2002; Want & Harris, 2001), the findings of Horner and Whiten (2007) suggest that for children ages 3- to 4- years, observing another's mistake is not as beneficial when a task is more complex. Essentially, I+C instruction presents the learner with two conflicting representations of a solution whereas correct-only instruction presents one correct representation of a solution. Children with low false belief understanding are unable to coordinate representations effectively; therefore, it can be expected that it is more difficult for these children to gain understanding of a complex task when exposed to another's I+C instruction. On the other hand, children with greater false belief understanding can coordinate between conflicting representations; therefore, it is expected they benefit more from another's I+C instruction. As mentioned previously, it is around the age of 4-years that children are beginning to expand their understanding of the mental states of others. However, the Horner and Whiten (2007) study did not include children ages 4.5- to 5-years, which is a crucial period for the development of false belief understanding.

According to Tomasello et al. (1993), false belief understanding plays a central role in children's ability to gain understanding of a task when learning from another's instruction. Thus, when success on a task requires more complex reasoning (e.g., trap-tube task), the differences in children's ability to learn from I+C instruction may be influenced by false belief understanding. In addition, executive function skills related to false belief understanding, such as inhibitory control, may also play a role in learning from another's I+C instruction. While false belief understanding may be influential in the processing of instruction, self-regulation is expected to be influential in one's ability to act in accordance with the instruction processed. In other words, understanding the instruction and acting in accordance with the instruction are considered separate, but related processes in one's ability to engage in learning. This is not to suggest that one is not engaged in learning if these processes are not present, but rather to suggest that these processes allow for advancements in how one engages in learning. It is argued that there are primary changes in one's ability to engage in learning and as proposed by cultural learning theory, these changes are expected to be related to specific advancements in social cognition and executive function.

The current study examined cognitive factors that influence developmental differences in the way children learn from others in a problem-solving context. In reference to instruction, it was expected that children exposed to both correct and incorrect solutions to the trap-tube task would perform better on a posttest than their peers exposed to a correct-only solution. Of primary interest was whether developmental differences in children’s ability to learn through another’s mistake are related to false belief understanding, inhibitory control, and language. Children with greater false belief understanding were expected to benefit more from another’s mistake than those with less false belief understanding. In addition, children with greater inhibitory control were expected to benefit more from another’s mistake than those with less inhibitory control. Finally, language development was expected to mediate the relationship between false belief understanding and children’s ability to learn through another’s mistake.

CHAPTER 2
METHOD

Participants

Participants were recruited from local childcare centers. All children participating were required to speak English as their primary language due to the standardized language measure used in this study. No direct compensation was offered for participation, though child participants were offered stickers after testing sessions. Parents of participants completed a 13-item demographic questionnaire upon consent (see Appendix A & B). Fifty-one preschoolers were recruited from local childcare centers. Eighteen females and 26 males between the ages of 43- and 62-months (*M* = 4.4-years, *SD* = 5.07-months) were included for analysis. Among the seven participants withdrawn from the study, two children had a perfect baseline performance on the task, two children refused to participate for the duration of Session 1, two children received the wrong trial sequence during the teaching session due to experimenter error, and there was a loss of contact with one participant prior to testing sessions. Majority of the participants were Caucasian (86.4%). Parent report of income indicated most participants were from middle- to upper-income households with the exception of one participant who was from a low-income household as determined by 2008 Federal Poverty Guidelines.

Apparatus

Clear plastic material was used to construct the trap-tube. The tube was roughly 4.5cm in diameter and 60cm in length. Similar to Horner and Whiten (2007), a trap was located underneath the center of the tube. The trap was 13.5cm in length and contained two flaps on each end in order for the experimenter to retrieve the object from the trap if needed (see Appendix C). The tool was a stick, about 4cm in diameter and roughly 61cm in length. Two 15cm wooden supports held the trap-tube in order for the trap-tube to be placed on a table during testing sessions (see Appendix C).

Measures

Parent Questionnaire

The parent questionnaire was included in the study to collect demographic information and information regarding the child's guardian, home environment, and experience within the childcare setting (see Appendix B).

Problem Solving: Trap-Tube Task

The trap-tube task was modeled after the task used in Horner and Whiten (2007). Children were required to remove a small object from the clear horizontal tube by using the tool provided. Modeled after the trap-tube used in Horner and Whiten (2007), the trap was placed underneath the middle of the tube; thus, serving as an obstacle to obtaining the object. The object's location in relation to the trap determined where the tool should be placed in order to successfully retrieve the object from the tube. An altered version of the trap-tube task was also presented in order to assess whether children formed a procedural rule regarding side of tool insertion (e.g., push object away from trap). In the altered version, the same trap-tube apparatus was used, but the trap was rotated to the top of the tube. When the trap was inverted, there was no need to consider the location of the object in relation to the trap because the trap is no longer an obstacle (see Appendix C).

False Belief Tasks

Two types of false belief tasks were used to measure children's false belief understanding. Children received two unexpected location and two unexpected content false belief tasks.

The *Unexpected Location* false belief tasks were based on the *Sally-Anne* unexpected location false belief task. The basic story is that Sally hides an object and Anne changes the location of the object while Sally is away. The unexpected location false belief tasks were presented in a picture book format. The experimenter read statements to the child while showing the child the corresponding pictures. Throughout the story, two characters hid the same object. However, one character was unaware the object had been moved from its original location (see Appendix D). Each version of the unexpected location task had the following sequence: *This is Emma. She loves to play with her toy truck. Emma wanted a snack. So Emma put her truck under a hat. Then she left. Emma's grandma walked in. She thought that the truck would roll off the table and be broken. So she took the truck from under the hat and put it in a bag. Then she left the room. Emma came back to play with her toy truck.* Upon completion of the story, children were asked a false belief question regarding where the naïve character would look for the object. In addition, children were asked two memory control questions regarding the old location of the object and the new location of the object.

The *Unexpected Content* false belief tasks involve tangible objects. One version of the unexpected content task, involved Band-Aid box that contained a small ball and the other version of this task involved a crayon box that contained ribbons. During each unexpected content task, the experimenter asked the child what they thought was inside the box. The experimenter then showed the contents of the box to the child and asked the child to name the contents. Next, the experimenter put the contents back in the box and closed the lid. The experimenter then asked the child a false belief question regarding his/her own original thoughts about the contents and a memory control question regarding the actual contents of the box. Finally, the experimenter asked the child a second false belief question regarding a naïve puppet's thoughts about the contents of the box (see Appendix D).

Children received one point for each false belief question they answered correctly on the unexpected location and unexpected content tasks. There were two false belief questions referring to unexpected location (i.e., naïve other's belief). If the child indicated the naïve other will look for the object in the original location, the answer was be coded as correct. There were also four false belief questions referring to unexpected content regarding the child's own beliefs and a naïve other's beliefs. If the child identified his/her own original belief, the answer was coded as correct. In addition, if the child indicated a naïve other is unaware of the actual contents of the box, the answer was coded as correct. Therefore, children's false belief scores ranged from 0 to 6 points. The memory control questions on both the unexpected location and unexpected content tasks were used to check false belief responses. The memory questions were included to control for random responses to the false belief questions. There were four memory control questions referring to unexpected location and two memory control questions referring to unexpected content. If a child answered the memory control question incorrectly, the false belief question associated with the memory control question was coded as incorrect.

Inhibitory Control

The day/night stroop-like task (Gerstadt et al., 1994) was used as a measure of conflict inhibitory control. The experimenter showed children two types of picture cards, one with a picture of the sun representing “day” and one with a picture of the moon and stars representing “night” (see Appendix E). This task required children to say “day” when shown the night card and to say “night” when shown the day card. The experimenter trained each child on the task prior to administering the testing trials. For example, the experimenter said, “*When you see this card, I want you to say ‘day.’ Can you say day?”* The experimenter assessed the child’s understanding of the task by showing the child each card separately and asked the child, *“What do you say for this card?”* If the child failed to answer correctly, the experimenter repeated the training. Once the child demonstrated they understood the task, they received three testing blocks of 10 trials. Each testing block contained 10 cards, five "day" cards and five "night" cards. During each block, the experimenter reminded the child of the rules at the beginning of the block and after administering five cards. Children’s initial responses during the task were coded as “correct” or “incorrect.” Responses were coded as “correct” if they corresponded to the rule provided. Children received one point for each correct response they provided. The scores ranged from 0-30 points.

Language

Children’s receptive language was measured using the standardized Peabody Picture Vocabulary Task, Fourth Edition (PPVT; Dunn & Dunn, 2007). The experimenter showed the child a page with four pictures and asked the child to point to the pictures specified by the measure. Standard procedures were followed to establish the child’s initial base set. The number of items the child got correct provided a raw score for each child.

Procedure

All testing occurred at the child's childcare center. Children were assigned to either a correct only instruction group (C-only) or an incorrect and correct (I+C) instruction group for the trap-tube task as described below. Performance on the traditional trap-tube task was measured over four sessions: baseline, teaching, post-instruction1, post-instruction2. Performance on the inverted trap-tube was measured on one session. Each trap-tube measurement session contained 10 trials (e.g., 10 trials at baseline, 10 trials at teaching, etc.). Throughout each testing block of 10 trials, the location of the object was sporadically altered. However, placement of the object to the left or the right of the trap was held equal for each testing block. In other words, though the object was moved intermittently throughout the sessions, the object was to the left of the trap for five trials and to the right of the trap for five trials (see Appendix F). The trap-tube sessions, language assessment, false belief tasks, and the inhibitory control task were administered over two separate testing sessions. Each testing session lasted roughly 30 minutes.

Session 1

A video camera was positioned to record the child's attempts on the trap-tube task. During the initial baseline testing session, the experimenter presented the child with the goal of the trap-tube task, but no instruction on how to do the task. The experimenter explained, "*Today we have a game to play. To play the game, we have to get the mouse [object] out of the tube*. *It's your turn first."* Occasionally, children did not initially pick up the tool to attempt the task; thus, at times the experimenter had to sensor children's actions on the tube. For example, the experimenter discouraged children from putting their hands in the tube and from lifting the tube off the support stand. If a child had not attempted to use the tool after 2-minutes, the experimenter drew the child's attention to the tool by saying, "*You can use that stick to help you*." The location of the object was altered intermittently (i.e., trials 2, 4, 5, 6, 8, 9, and 10) throughout the baseline testing block.

Immediately following the 10 baseline trials, the experimenter transitioned to instruct the child on the task. Half the participants received correct only (C-only) instruction on the task and half received incorrect + correct (I+C) instruction. For each instruction condition, the experimenter demonstrated and verbalized instruction (see Appendix G). As in the baseline session, this teaching session was one block of 10 trials. Instruction was provided four times throughout the 10 trial block. The experimenter demonstrated and stated the instructions before the child attempted Trials 1, 3, 6, and 8 (refer to Appendix F). Once the experimenter provided the instruction, the child attempted to solve the problem. The location of the object was altered on Trials 2, 4, 5, 6, 8, 9, and 10 of the instruction block. Upon completing the trap-tube baseline and teaching sessions, children were given either the inhibitory control task or false belief tasks. Children were not videotaped during the false belief tasks.

Once children completed either the inhibitory control task or false belief tasks, their trap-tube performance was measured again in a post-instruction1 session. The post-instruction1 session was conducted in the same manner as the baseline session. The experimenter provided children with the goal of the task and no further instruction. The location of the object was altered on Trials 2, 3, 4, 6, 7, 8, and 10 of the testing block. As with the baseline and the instruction testing blocks, this block consisted of 10 trials.

Session 2

Session 2 was conducted on a separate day. The time between Session 1 and Session 2 was dependent on child attendance. Majority of the sample received Session 2 within one to three days after Session 1. At Session 2, children received two additional trap-tube measurements--post-instruction2 and inverted. The order of these sessions was counterbalanced. Again, a video camera was positioned to record the child's attempts for each trap-tube session. As in the baseline and post-instruction1 sessions, the experimenter provided children with the goal of the task, but no further instruction for both the inverted session and the post-instruction2 session. Children's performance on the inverted trap-tube was measured for one block of 10 trials. The location of the object was altered on Trials 2, 3, 4, 6, 8, 9, and 10 of the testing block. Post-instruction2 also consisted of 10 trials in which the location of the object was altered on Trials 2, 4, 5, 6, 8, 9, and 10. Upon completion of the inverted and post-instruction2 sessions, children were given either the inhibitory control task or false belief tasks, depending on which measure was provided during Session 1, and the PPVT. Children were not videotaped during the PPVT and false belief tasks.

Trap-Tube Task Coding and Scoring

Children's performance on the trap-tube task was coded in terms of "successful" or "unsuccessful" attempts. During the baseline, teaching, and post-instruction1, and post-instruction2 sessions, insertion of the tool to the side nearest the object was coded as an "unsuccessful" attempt. Consequently, insertion of the tool opposite the object and retrieval of the object was coded as a "successful" attempt. For each trial, attempts were coded according to the action that was followed through by the child. In other words, some children began to enter the tool on one side, but switched the side of tool insertion prior to completing an action on the object. To avoid ambiguity, the side of tool insertion in which the full action of either pushing the object into the trap or pushing the object out of the tube was coded as successful or unsuccessful. Children received one point for each successful attempt per trial. Performance scores ranged from 0-10 points per session.

During the inverted trap-tube session, altering the side of tool insertion was unnecessary considering the trap had no function. Thus, attempts during this inverted session were considered successful if children did not alter the side of tool insertion. Children received one point for each time they *did not alter* the side of tool insertion relative to the side of insertion at Trial 1 of this session. Each time children altered the side of tool insertion relative to the side they chose at Trial 1; the attempt was coded as "unsuccessful." Performance scores on the inverted trap session ranged from 0-9 points. A score of zero indicated that the child altered the side of tool insertion throughout the 10 trials, whereas a score of nine indicated that the child *never* altered the side of tool insertion relative to Trial 1.

Teaching Trials 2 and 4. In addition to overall performance scores, children's performances on Trials 2 and 4 of the *teaching session* were also considered. Arguably, these trials are the most crucial trials for understanding how children processed the instruction provided without the influence of practice. Children received instruction for how to achieve on Trial 1. However, at Trial 2, the location of the object was switched; thus, children did not have any direct instruction for this situation. They had to apply the instruction that was provided at Trial 1to this new situation. By Trial 4, children had received direct instruction for each situation (i.e., object located to left of trap and object located to right of trap). Trial 4 is the first measure of children's performance once they received all the instruction necessary to succeed on the task throughout the session. At Trial 4 children had to decide which instruction to apply to the current situation. Thus, for both of these trials, if children simply copied the experimenter's "correct" attempt from the preceding teaching trial, they would not succeed in these subsequent trials considering the object was located on the opposite side of what children observed. Children received one point for each successful attempt; thus, performance scores were either 0 or 1 for each trial.

CHAPTER 3
RESULTS

The trap-tube performance variables were not normally distributed as determined by normality tests. Log, square-root, inverse, and squared transformations were applied to the non-normal variables, but none of these methods significantly improved the normality of the variables; thus the GLM normality assumption was violated. In order to demonstrate robust patterns, multiple analyses were conducted for the subsequent study aims. Although no transformation significantly improved the distribution of the trap-tube performance variables, square-root transformations provided the largest improvement for each variable; thus, square-root transformed trap-tube performance variables were examined as well. Aims requiring repeated measure ANOVA analysis were assessed separately using untransformed (raw) performance variables, square-root transformed performance variables, and non-parametric tests. Considering all the mentioned analyses provide the same basic findings, only the non-parametric tests are reported. Aims requiring regression analyses were assessed by untransformed hierarchical regression (i.e., raw performance variables were used), robust bootstrapped regression, and hierarchical logistic regression (trap-tube performances were split at medians). Again, across all three methods of analysis, majority of findings were consistent, thus, only the robust and hierarchical regression results are reported.

Table 3-1 presents the raw medians, means, and standard deviations for each instruction condition on all trap-tube performances (i.e., baseline, teaching session, post-instruction1, post-instruction2, inverted session) and individual variables (i.e., age, language, inhibitory control, and false belief). Medians are reported in addition to the means and standard deviations due to the use of non-parametric tests. Although participants were randomly assigned to instruction condition, initial group differences (i.e., differences in baseline trap-tube performance, age, language, inhibitory control, and false belief) were examined. Taking into account the non-normal distribution of the data, non-parametric Wilcoxon Rank-Sum tests were conducted. There, were no significant instruction group differences in age, W_s = 481, *ns,* r = -.13; language, W_s = 504.50, *ns,* r = -.05; inhibitory control, W_s = 428.50, *ns,* r = -.16; or false belief, W_s = 419, *ns,* r = -.08. In addition, there were no significant differences in trap-tube performance at baseline between the instruction conditions, W_s = 437, *ns*, r = -.13.

Instruction Group Differences

Using the binomial distribution, children's individual performance scores were compared to chance performance scores. Each occasion of measurement contained 10 trials. For each trial, children had a .5 probability of success (i.e., each trial was either right or wrong) and all trials were independent. Chance performance on the task is a score of 5. The probability of achieving performance scores at/below 2 and above 8 is less than .05, that is, scores in these ranges indicate *statistical* difference from chance when alpha is .05. Performance scores ranging from 3 to 7 were not *statistically* different from chance using the same alpha criteria. Relative to the C-only condition, the proportion of children with statistically *above* chance performance was .10 (baseline), .81 (teaching), .76 (post-instruction1), and .71 (post-instruction2). Relative to the I+C condition, the proportion of children with statistically *above* chance performance was 0 (baseline), .61 (teaching), .65 (post-instruction1), and .57 (post-instruction2).

Separate Pearson chi-square tests were conducted to examine the association between instruction condition (C-only, I+C) and trap-tube performances at all occasions of measurement. Performance at each occasion was categorized as statistically above chance (≥ 8) and not statistically above chance (< 8). There was no significant association between instruction condition and above chance performance at teaching session, χ^2 (N = 44, df = 1) = 2.13, *ns*; post-instruction1, χ^2 (N = 44, df = 1) = .64, *ns*; or post-instruction2, χ^2 (N = 44, df = 1) = 1.05, *ns*.

Due to violations of normality, average performance could not be compared to chance using the standard one sample *t*-test. Wilcoxon Signed Rank tests were conducted to assess performance relative to chance, but these tests are limited in that they analyze *median* performances rather than *average* performances (see Table 3-1 for median values). To assess if median performances were *significantly* greater than statistical chance, median performance scores were compared to above chance (≥ 8) and not statistically above chance (< 8). For both instruction conditions at baseline measurement, above chance performance (i.e., scores ≥ 8) occurred significantly less, z = -3.75, $p < .001$, r = -.59 (C-only); z = -4.32, $p < .001$, r = -.67 (I+C). At teaching session, the instruction conditions differed in the amount of above chance performance. The C-only condition had significantly more above chance performances (i.e., scores > 7) during the teaching session, z = -3.48, $p < .001$, r = -.54. The I+C condition did not have significantly more above chance performances at this occasion, z = -1.27, *ns*, r = -.20. Relative to both post-instruction sessions, the patterns of above chance performance were the same between conditions. Both instruction conditions did have significantly more above chance performances at post-instruction1, z = -2.33, $p < .05$, r = -.36 (C-only); z = -2.28, $p < .05$, r = -.35 (I+C). Neither instruction condition had significantly more above chance performances at post-instruction2, z = -1.58, $p < .12$, r = -.24 (C-only); z = -1.39, *ns*, r = -.21 (I+C).

One specific aim of the study was to examine young children's ability to learn from another's correct and incorrect instruction. Children exposed to I+C instruction were expected to perform better on the trap-tube task than children exposed to C-only instruction. Non-parametric tests were conducted to examine between and within group performance differences. First, Wilcoxon Rank Sum-tests were conducted to examine the effect of instruction condition (i.e., C-only and I+C instruction) on trap-tube performances across all occasions of measurement (teaching, post-instruction1, post-instruction2). Instruction group did not significantly affect trap-tube performance during the teaching session $W_s = 457$, *ns,* $r = -22$; post-instruction1 $W_s = 502.50$, *ns,* $r = -.06$; or post-instruction2, $W_s = 473$, *ns,* $r = -.16$ sessions.

Wilcoxon Signed Rank tests were conducted to examine within-subject differences in raw trap-tube performances. There was a significant difference between trap-tube performances for both instruction conditions. Baseline performance was significantly lower than teaching (C-only: $z = -3.93$, $p < .001$; I+C: $z = -3.72$, $p < .001$), post-instruction1(C-only: $z = -3.63$, $p < .001$; I+C: $z = -3.74$, $p < .001$), and post-instruction2 (C-only: $z = -3.43$, $p < .001$; I+C: $z = -3.67$, $p < .001$) performances. However, there were no significant differences in performance between the teaching session, post-instruction1, and post-instruction2 sessions for either instruction condition. Thus, across all reported methods of examination, children significantly improved performance after receiving any form of instruction, but the claim that children benefit more from I+C instruction than C-only instruction was not supported. When considering the amount of *above chance* performance during the teaching session, children benefited more from C-only instruction.

Cognitive Influences on Trap-Tube Performance

Correlations

The primary aim of the study was to identify the factors that contribute to developmental differences in children’s ability to learn from another’s instruction. Specifically, it was expected that false belief understanding and inhibitory control would influence children’s ability to benefit from correct and incorrect (I+C) instruction. First, the relationships between individual variables and trap-tube session performances were examined. Due to the non-normality among the variables of interest, Spearman’s rho correlations are reported. Table 3-2 presents the relationships between individual variables and trap-tube performances for each instruction condition.

In addition, performance on Trials 2 and 4 of the teaching session was explored. As mentioned, Trials 2 and 4 were the trials in which the object was located on the opposite side of what was taught in the prior teaching trials (i.e., Trials 1 and 3). Considering that these individual trials were dichotomous variables, point biserial correlations are reported. Table 3-3 presents the relationships between performance on Trials 2 and 4 and the individual variables.

In reference to the C-only condition, there were only two significant relationships between individual variables and trap-tube performance across all sessions. Specifically, false belief was negatively related to baseline performance, r_s (18) = -.55, $p < .05$ and age was positively related to post-instruction1 performance on the trap-tube task, r_s (19) = .44, $p < .05$. Relative to the teaching session, performance on Trial 4 was significantly related to age, r_{pb} (19) = .48, $p < .05$ (see Table 3-3). Performance during the inverted trap session was negatively related to teaching session performance, r_s (19)

= -.53, $p < .05$. However, it is important to note inhibitory control did not have a strong relationship with any trap-tube session for this instruction condition (see Table 3-2).

In reference to the I+C condition, inhibitory control was the only individual variable that was significantly related to trap-tube session performances at teaching session, post-instruction1, and post-instruction2 sessions. Specifically, inhibitory control was positively related to teaching performance, $r_s\,(21) = .60$, $p < .01$; post-instruction1 performance, $r_s\,(21) = .54$, $p < .05$; and post-instruction2 performance, $r_s\,(21) = .52$, $p < .05$. In addition, inhibitory control was related to children's performance on the inverted trap, $r_s\,(21) = .42$, $p < .05$. False belief performance was not significantly related to trap-tube performance at any occasion for the I+C group, although the trend for a negative relationship with baseline performance is present. However, false belief was the only individual variable significantly related to Trial 4 of the teaching session $r_{pb}\,(21) = .54$, $p < .01$ (see Table 3-3).

Across both instruction conditions, there were three similar patterns of relationships. Baseline trap-tube performance was not significantly related to any subsequent measures of performance on the trap-tube task (see Table 3-2). Performance on Trial 2 was not significantly related to any individual variable (see Table 3-3). In addition, there were no significant relationships between inverted trap-tube performance and the individual variables for either condition (see Table 3-2).

Regression Analyses

Due to the small sample size, both instruction groups were included simultaneously in all subsequent regression analyses. To avoid overlooking possible suppressor effects, all individual variables were considered in each subsequent regression analyses regardless of Spearman's rho correlation coefficient significance.

The independent variables of interest (i.e., age, language, inhibitory control, and false belief) were centered at their respective means prior to analysis in order to reduce collinearity (Jaccard, Wan, & Turrisi, 1990). As mentioned previously, multiple types of regression analyses were conducted for each session of trap-tube performance to examine consistent findings.

Robust bootstrapped regressions were conducted considering the variables of interest are not normally distributed. It has been argued that modern robust methods, such as robust regression, provide more accurate estimates for non-normal distributions because parametric tests are not robust to assumption violations (Erceg-Hurn & Mirosevich, 2008; Wilcox, 1998). In order to conduct the robust bootstrapped regressions, the data for each trap-tube variable was transformed using the winsorizing technique (see Keselman, Algina, Lix, Wilcox, & Deering, 2008). The data for each trap-tube session was ordered from lowest to highest. The bottom 20% of data was replaced with the smallest untrimmed score and the top 20% of data was replaced with the highest untrimmed score. A bootstrapped regression was then conducted on the winsorized variables. This regression technique uses a random sampling procedure and calculates a mean for each random sample drawn. Modeled after Preacher and Hayes (2008), estimates are based on 5000 bootstrapped samples for each robust regression conducted. Age, language, inhibitory control, false belief, instruction condition, and the specified interaction term were entered to predict each winsorized trap-tube performance.

To demonstrate consistent findings, hierarchical regressions were also conducted for each trap-tube session of interest, although caution should be used for interpretation of these analyses. To assess possible trap-tube performance differences between groups, interaction terms were calculated using instruction group and the centered individual variables of interest (i.e., inhibitory control and false belief). These interaction terms were not entered simultaneously in the regressions because of possible collinearity issues; thus, for teaching session, post-instruction1, and post-instruction2 trap-tube performances, two separate hierarchical regressions were conducted for each performance. For each hierarchical regression, age was entered at Step 1, language was entered at Step 2, inhibitory control was entered at Step 3, false belief was entered at Step 4, instruction condition (0 = correct-only, 1 = incorrect+correct) was entered at Step 5, and the specified interaction term was entered at Step 6.

Trap-tube performance at teaching session measurement. Age, language, inhibitory control, false belief, instruction condition, and Instruction x Inhibitory Control were entered as predictors of teaching session performance (i.e., winsorized teaching performance). Results of the bootstrapped regression indicated that only the Instruction x Inhibitory Control variable had a significant effect on performance during the teaching session (see Table 3-4). Specifically, inhibitory control had a significantly greater influence on trap tube performance for those who received I+C instruction than for those who received C-only instruction. The model overall predicted 30% of the variance in teaching session performance.

A second robust bootstrapped regression was conducted with the same variables listed above, except the interaction term was replaced with Instruction x False Belief. However, the interaction between instruction condition and false belief did not predict trap-tube performance during the teaching session and did not significantly improve the model (see Table 3-4).

Using untransformed variables, two separate hierarchical regressions were conducted to assess the unique effects of age, language, inhibitory control, false belief, and instruction condition on trap-tube performance during the teaching session of measurement. As presented in Table 3-5, age, language, inhibitory control, and false belief did not predict teaching session performance at any steps of analysis. At Step 5, instruction condition significantly improved the model, $\Delta R^2 = .11$, $p < .05$, and had a significant effect on trap-tube performance (see Table 3-5). Specifically, those in the I+C condition had lower performance on the task in this session than those in the C-only condition. However, the Step 5 model did not significantly predict trap-tube performance. The addition of the Instruction x Inhibitory Control interaction term produced the only model to significantly predict teaching session trap-tube performance, $R^2 = .34$, F (6, 36) = 3.11, $p < .05$. The interaction between inhibitory control and instruction condition significantly predicted performance on the task, $\Delta R^2 = .16$, $p < .01$. Consistent with the robust regression results, inhibitory control had a greater influence on trap tube performance for those I+C instruction condition. As illustrated in Figure 1, relative to those in the I+C condition, children with greater inhibitory control performed better on the trap-tube task during the teaching session than those with less inhibitory control. For those in the C-only condition, there was no significant influence of inhibitory control on trap-tube performance. These findings support that inhibitory control influences trap-tube performance when one receives I+C instruction, but false belief did not influence performance during this session for either condition.

Exploratory analyses for the role of false belief on teaching session trials. While false belief was not predictive of teaching session performance overall, the role of false belief on Trials 2 and 4 within the teaching session was examined. As mentioned previously, Trials 2 and 4 were the most crucial trials for highlighting children's initial learning of the task. Arguably, false belief understanding is the most salient for these trials since these trials were the first measures of how children performed the task on their own after receiving instruction. Considering that Trials 2 and 4 are dichotomous dependent variables, logistic regressions and Pearson chi-square tests are reported.

Two separate Pearson chi-square tests were conducted for each instruction condition to test the association between false belief (*low*: at/below median vs. *high*: above median) and Trials 2 and 4 (0=incorrect trial attempt, 1=correct trial attempt) respectively. Expected frequency counts for each analysis were below 5, thus Fisher's exact values are reported. At Trial 2, there was no association between false belief and Trial 2 performance for the C-only condition (p = .350 Fisher's exact), nor the I+C condition (p = .402 Fisher's exact). Specifically, relative to the C-only condition, 80% of those with low false belief and 50% of those with high false belief had correct performance on Trial 2. Similarly, in the I+C condition, 70% of those with low false belief and 46.2% of those with high false belief had correct performance at Trial 2.

Conversely, at Trial 4, there were differences in false belief and performance association between instruction conditions. Again, for the C-only condition, there was no association between false belief and Trial 4 performance (p = 1.00 Fisher's exact). Relative to both false belief groups (i.e., low and high), 90% performed the task successfully at Trial 4. However, for the I+C there was a significant association between false belief and performance (p = .006 Fisher's exact). Specifically, 30% of those with low false belief and 92.3% of those with high false belief successfully performed the task at Trial 4. Thus, majority of children in the C-only condition (regardless of false belief understanding) and majority of children with high false belief in the I+C condition were performing near ceiling by Trial 4. In contrast, those with low false belief in the I+C condition were performing poorly on Trial 4. Figure 2 illustrates the proportion of correct attempts on Trial 4 by false belief group (i.e., low vs. high) for each instruction condition.

To further examine the role of false belief on Trial 4 performance, a hierarchical logistic regression was conducted. Due to the strong relationship between language and false belief understanding, the language variable was included in the analysis. Language was entered at Step 1, false belief was entered at Step 2, instruction condition was entered at Step 3, and Instruction x False Belief was entered at Step 4 to assess the unique contributions of each variable listed. Language made a significant improvement to the null model, $\Delta\chi^2 = 4.41$, $p < .05$. However, as presented in Table 3-6, the effect of language was reduced once false belief and instruction condition were included in the model. The inclusion of instruction condition made the largest improvement to the model, but the estimate was not strong as indicated by the confidence interval. In addition, once the interaction term was included the main effects of false belief and instruction condition decreased, suggesting these effects are qualified by the interaction. The interaction between false belief and instruction condition came close to improving the model, $\Delta\chi^2 = 3.29$, $p < .07$; reflecting the notion that the influence of false belief is relative to instruction condition. Although the finding did not reach significance (see Table 3-6), false belief was more likely to influence performance for those in the I+C condition than the C-only condition. While false belief is not predictive of children's teaching performance, these findings suggest that when exploring the trials most critical for false belief understanding, the role of false belief varies by instruction condition. The implications of these findings are explored further in the discussion.

Trap-tube performance at post-instruction1 measurement. Robust bootstrapped regressions were conducted to further assess the influence of Instruction x Inhibitory Control and Instruction x False Belief on trap-tube performance at post-instruction1. As noted previously, separate robust regressions were conducted to examine the effect of each interaction term with controlling for the four individual variables and instruction condition (see Table 3-7). The Instruction x Inhibitory Control variable had a significant effect on post-instruction1 performance and the model overall explained 21% of the variance in post-instruction1 performance (see Table 3-7). However, the interaction between instruction and false belief was again non-significant for this session of trap-tube performance (see Table 3-7). Relative to the I+C condition, this finding does not support the claim that false belief influences post-instruction performance, but does support that inhibitory control influences post-instruction performance.

Using untransformed variables, two additional hierarchical regressions were conducted to assess the unique effects of age, language, inhibitory control, false belief, and instruction condition on post-instruction1 performance. One regression included all five variables listed and the Instruction x Inhibitory Control interaction term was added at Step 6. A second regression included the same variables for Steps 1-5, but the Instruction x False Belief interaction term was added at Step 6. Unlike the results from the robust regression, age significantly predicted post-instruction1 performance, R^2 = .12, F (1, 41) = 5.49, p < .05 and had a significant effect on post-instruction1 performance (see Table 3-8). Language, inhibitory control, false belief, and instruction condition did not significantly predict post-instruction1 performance after controlling for age. This analysis did not support the expectation that inhibitory control and false belief would influence performance in the I+C condition. Although the results from the hierarchical regression did not coincide with the findings from the robust regression, the robust regression is a more appropriate method of analysis considering the nature of the data as discussed previously. Figure 3 illustrates the slopes for each instruction condition at post-instruction1 measurement.

Trap-tube performance at post-instruction2 measurement. Again, separate robust bootstrapped regressions were conducted to examine the Instruction x Inhibitory Control and Instruction x False Belief interactions. The individual variables and instruction condition variable were entered in the same order as reported for the previous robust regressions (see Table 3-9). There was no significant interaction between instruction condition and inhibitory control. In addition, there was no significant interaction between instruction condition and false belief.

Two final hierarchical regressions were conducted using the untransformed variables to assess the unique effects of age, language, inhibitory control, false belief, and instruction condition on post-instruction2 performance. Consistent with the robust regression analyses, this analysis did not yield any significant models for prediction of post-instruction2 performance, nor did any variables have a significant effect on performance during this session (see Table 3-10). As with the previous regressions, the

Instruction x Inhibitory Control interaction term was added at Step 6 for one regression and Instruction x False Belief interaction term was added at Step 6 for the second regression. Neither of the interaction terms significantly predicted post-instruction2 performance. The expectation that inhibitory control and false belief assist one's ability to benefit from I+C instruction during post-instruction performances was not supported when considering post-instruction2 performance.

In reference to both post-instruction sessions, language was expected to mediate the relationship between false belief understanding and post-instruction performance. However, as indicated by Baron and Kenny's (1986) mediation guidelines, language is not a mediator for the relationship between false belief understanding and post-instruction performances. False belief understanding was not independently related to either of the post-instruction performances; thus, there was not a relationship for language to mediate. Furthermore, language was not independently related to the post-instruction performances.

Inverted trap session. The inverted trap session was used to measure children's use of procedural rules. The use of rules such as, "push the object away from the trap," may have influenced children's performance during the original version of the trap-tube task. Of interest was whether individual factors related to inverted performance and if these relationships varied by instruction condition. However, inverted trap performance was not significantly related to any individual variables for either instruction condition (refer to Table 3-2).

Table 3-1. Descriptive Statistics for Individual Variables and Trap-Tube Session Performance for Instruction Conditions

Instruction Condition	Correct-Only (n = 21)			Incorrect + Correct (n = 23)			Both Conditions (N = 44)		
	M	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
Age in Months	52.86	5.43	52.00	51.61	4.76	51.00	52.20	5.07	52.00
Language (Raw PPVT)	90.48	24.24	89.00	87.83	20.82	86.00	89.09	22.29	88.50
Inhibitory Control	20.62	8.26	20.00	23.04	7.28	26.00	21.89	7.77	23.00
False Belief [a b]	3.20	2.17	3.00	3.52	2.11	4.00	3.37	2.12	4.00
Baseline Session	2.95	2.96	2.00	3.78	2.24	5.00	3.39	2.61	5.00
Teaching Session	8.76	1.41	9.00	7.57	2.54	8.00	8.14	2.14	9.00
Post-instruction1	8.24	2.90	10.00	8.13	2.46	9.00	8.18	2.64	9.50
Post-instruction2	7.81	3.31	9.00	7.61	2.13	8.00	7.70	2.72	9.00
Inverted Trap Session	4.62	2.06	4.00	5.22	2.45	4.00	4.93	2.67	4.00

Note. PPVT = Peabody Picture Vocabulary Test. [a] n = 20 for correct-only condition due to missing false belief task. [b] n = 43 for both conditions due to missing false belief task.

Table 3-2. Spearman's rho Correlations between Individual Variables and Trap-Tube Performances for Each Instruction Group

	1	2	3	4	5	6	7	8	9
Correct-Only (*n* = 21)									
1. Age	–	.65**	.31	.12	.02	.29	.44*	.38	.21
2. Language		–	.33	.57**	-.29	.33	.20	.10	.16
3. Inhibitory Control			–	.17	-.01	.04	-.17	.16	.24
4. False Belief [a]				–	-.55*	.02	.01	-.08	.16
5. Baseline Session					–	.14	.27	.16	.03
6. Teaching Session						–	.30	.20	-.53*
7. Post-Instruction1							–	.73**	-.40
8. Post-Instruction2								–	-.26
9. Inverted Session									–
Incorrect+Correct (*n* = 23)									
1. Age	–	.87**	.42*	.58**	-.22	.07	.26	.13	.18
2. Language		–	.38	.54**	-.28	.09	.32	.22	.11
3. Inhibitory Control			–	.32	.09	.60**	.54**	.52*	.22
4. False Belief				–	-.23	.15	.27	.18	.16
5. Baseline Session					–	-.19	-.15	.15	.35
6. Teaching Session						–	.68**	.69**	-.28
7. Post-Instruction1							–	.89**	-.28
8. Post-Instruction2								–	-.40[b]
9. Inverted Session									–

Note. [a] $n = 20$ due to incomplete false belief task, [b] $p < .06$. * $p < .05$. ** $p < .01$.

Table 3-3. Point Biserial Correlations between Individual Variables and Individual Teaching Trials 2 & 4 for Each Instruction Group

	1	2	3	4	5	6
Correct-Only (*n* = 21)						
1. Age	–	.63**	.27	.14	.04	.48*
2. Language		–	.30	.63**	-.12	.42[b]
3. Inhibitory Control			–	.15	-.20	.09
4. False Belief [a]				–	-.28	-.05
5. Trial 2 Teaching Session					–	-.23
6. Trial 4 Teaching Session						–
Incorrect+Correct (*n* = 23)						
1. Age	–	.83**	.36	.55**	-.32	.33
2. Language		–	.43*	.57**	-.20	.27
3. Inhibitory Control			–	.30	-.08	.39
4. False Belief				–	-.29	.54**
5. Trial 2 Teaching Session					–	.01
6. Trial 4 Teaching Session						–

Note. [a] $n = 20$ due to incomplete false belief task, [b] $p < .06$. * $p < .05$. ** $p < .01$.

Table 3-4. Summary of Robust Bootstrap Regression Analysis for Variables Predicting Teaching Session Trap-Tube Performance (N = 43)

	B	*SE*	*t*
Model 1[a]			
Intercept	8.38	0.20	42.91***
Age	-0.02	0.04	-0.45
Language	0.01	0.01	1.12
InhibCtrl	-0.01	0.03	-0.29
FB	-0.05	0.09	-0.56
Instruction	-0.37	0.27	-1.36
Instruction x InhibCtrl	0.08	0.04	2.10*
Model 2[a]			
Intercept	8.42	0.19	44.38***
Age	-0.04	0.04	-0.96
Language	0.02	0.01	1.60
InhibCtrl	0.03	0.03	1.13
FB	-0.15	0.11	-1.38
Instruction	-0.38	0.26	-1.44
Instruction x FB	0.17	0.15	1.14

Note. R^2 = .30 Model 1; R^2 = .23 Model 2. Age, language, inhibitory control, false belief, and interaction terms centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief. [a] Interaction terms entered in separate regressions.
* p < .05, *** p < .001

Table 3-5. Summary of Hierarchical Regression Analysis for Variables Predicting Teaching Session Trap-Tube Performance (N = 43)

	B	*SE B*	β	*t*
Step 1				
Age	0.04	0.07	0.10	0.65
Step 2				
Age	-0.01	0.09	-0.02	-0.09
Language	0.02	0.02	0.17	0.75
Step 3				
Age	-0.02	0.09	-0.04	-0.17
Language	0.01	0.02	0.09	0.41
InhibCtrl	0.07	0.05	0.25	1.54
Step 4				
Age	-0.02	0.10	-0.05	-0.20
Language	0.01	0.03	0.12	0.45
InhibCtrl	0.07	0.05	0.25	1.52
FB	-0.04	0.20	-0.04	-0.19
Step 5				
Age	-0.04	0.09	-0.10	-0.44
Language	0.01	0.02	0.09	0.34
FB	0.01	0.19	0.01	0.04
Instruction	-1.44	0.66	-0.34	-2.18*
Step 6[a]				
Age	-0.04	0.08	-0.11	-0.53
Language	0.01	0.02	0.09	0.37
InhibCtrl	-0.01	0.05	-0.04	-0.20
FB	-0.03	0.18	-0.03	-0.15
Instruction	-1.44	0.60	-0.34	-2.40*
Instruction x InhibCtrl	0.22	0.08	0.54	2.92**
Step 6[a]				
Age	-0.06	0.10	-0.14	-0.61
Language	0.01	0.03	0.14	0.50
InhibCtrl	0.09	0.05	0.32	1.93
FB	-0.10	0.28	-0.10	-0.38
Instruction	-1.44	0.66	-0.34	-2.17*
Instruction x FB	0.19	0.33	0.13	0.57

Note. R^2= .01, *ns* for Step 1, ΔR^2 = .01, *ns* for Step 2, ΔR^2 = .06, *ns* for Step 3, ΔR^2 = .00, *ns* for Step 4, ΔR^2 = .11, $p < .05$ for Step 5, ΔR^2 = .16, $p < .01$ for Step 6 (Instruction x InhibCtrl), ΔR^2 = .00, *ns* for Step 6 (Instruction x FB). Age, language, inhibitory control, false belief, and interaction term centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief.
[a]Interaction terms entered in separate regressions. [b] $p < .06$. * $p < .05$. ** $p < .01$.

Table 3-6. Summary of Hierarchical Logistic Regression Analysis for Variables Predicting Trial 4 Performance (N = 43)

Variable	*B*	*SE*	95% CI for exp *b* Lower	exp *b*	Upper
Step 1					
Constant	-1.88	1.54	–	–	–
Language	0.04*	0.02	1.00	1.04	1.08
Step 2					
Constant	-1.00	1.89	–	–	–
Language	0.03	0.02	0.98	1.03	1.07
FB	0.18	0.23	0.77	1.20	1.86
Step 3					
Constant	-1.61	2.00	–	–	–
Language	0.03	0.02	0.98	1.03	1.07
FB	0.28	0.25	0.81	1.32	2.14
Instruction	1.92*	0.97	1.02	6.82	45.79
Step 4					
Constant	-2.25	2.22	–	–	–
Language	0.04	0.03	0.99	1.04	1.09
FB	-0.34	0.41	0.32	0.71	1.59
Instruction	1.41	0.95	0.64	4.10	26.21
Instruction x FB	0.85 [a]	0.48	0.91	2.35	6.04

Note. R^2= .10 (Hosmer & Lameshow), .10 (Cox & Snell), .15 (Nagelkerke), Model χ^2 = 4.46, p < .05 for Step 1; R^2= .11 (Hosmer & Lameshow), .11 (Cox & Snell), .17 (Nagelkerke), $\Delta\chi^2$= .65, *ns* for Step 2; R^2 = .21 (Hosmer & Lameshow), .21 (Cox & Snell), .31 (Nagelkerke), $\Delta\chi^2$= 4.82, p < .05 for Step 3; R^2 = .28 (Hosmer & Lameshow), .27 (Cox & Snell), .40 (Nagelkerke) $\Delta\chi^2$= 3.29 *ns* for Step 4. Language, false belief, and interaction term centered. Instruction = instruction condition, FB = false belief,

CI = confidence interval. Dashes indicate no estimate for constant model.

[a] p < .08. * p < .05.

Table 3-7. Summary of Robust Bootstrap Regression Analysis for Variables Predicting Post-Instruction1 Trap-Tube Performance (N = 43)

	B	*SE*	*t*
Model 1 [a]			
Intercept	8.16	0.29	28.38***
Age	0.05	0.05	0.89
Language	0.00	0.02	0.14
InhibCtrl	-0.02	0.04	-0.42
FB	0.01	0.11	0.07
Instruction	-0.19	0.43	-0.45
Instruction x InhibCtrl	0.11	0.05	2.06*
Model 2 [a]			
Intercept	8.23	0.30	27.70***
Age	0.04	0.06	0.68
Language	0.00	0.02	0.14
InhibCtrl	0.03	0.03	0.90
FB	0.02	0.17	0.13
Instruction	-0.18	0.44	-0.41
Instruction x FB	0.01	0.25	0.05

Note. R^2 = .21, Model 1; R^2 = .12, Model 2. Age, language, inhibitory control, false belief, and interaction term centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief. [a] Interaction terms entered in separate regressions. * p < .05. *** p < .001.

Table 3-8. Summary of Hierarchical Regression Analysis for Variables Predicting Post-Instruction1 Trap-Tube Performance (N = 43)

	B	*SE B*	β	*t*
Step 1				
Age	0.18	0.08	0.34	2.34*
Step 2				
Age	0.12	0.11	0.24	1.11
Language	0.02	0.03	0.15	0.71
Step 3				
Age	0.12	0.11	0.23	1.07
Language	0.01	0.03	0.13	0.57
InhibCtrl	0.03	0.05	0.09	0.54
Step 4				
Age	0.12	0.11	0.24	1.08
Language	0.01	0.03	0.10	0.37
InhibCtrl	0.03	0.05	0.08	0.52
FB	0.05	0.24	0.04	0.21
Step 5				
Age	0.12	0.12	0.24	1.07
Language	0.01	0.03	0.10	0.37
InhibCtrl	0.03	0.06	0.08	0.49
FB	0.05	0.24	0.04	0.19
Instruction	0.08	0.83	0.02	0.10
Step 6 [a]				
Age	0.12	0.11	0.23	1.07
Language	0.01	0.03	0.10	0.37
InhibCtrl	-0.05	0.07	-0.15	-0.69
FB	0.02	0.24	0.02	0.09
Instruction	0.08	0.81	0.01	0.10
Instruction x InhibCtrl	0.17	0.10	0.34	1.67
Step 6 [a]				
Age	0.14	0.13	0.27	1.10
Language	0.01	0.03	0.07	0.24
InhibCtrl	0.03	0.06	0.09	0.50
FB	0.13	0.35	0.10	0.36
Instruction	0.08	0.84	0.02	0.10
Instruction x FB	-0.13	0.42	-0.08	-0.32

Note. R^2= .12, p < .05 for Step 1, ΔR^2 = .01, *ns* for Step 2, ΔR^2 = .01, *ns* for Step 3, ΔR^2 = .00, *ns* for Step 4, ΔR^2 = .00, *ns* for Step 5, ΔR^2 = .06, *ns* for Step 6 (Instruction x InhibCtrl), ΔR^2 =.00, *ns* for Step 6 (Instruction x FB). Age, language, inhibitory control, false belief, and interaction term centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief. [a] Interaction terms entered in separate regressions. * p < .05.

Table 3-9. Summary of Robust Bootstrap Regression Analysis for Variables Predicting Post-Instruction2 Trap-Tube Performance (N = 43)

	B	*SE*	*t*
Model 1 [a]			
Intercept	7.79	0.41	18.99***
Age	0.07	0.07	1.00
Language	0.00	0.02	-0.16
InhibCtrl	0.03	0.05	0.62
FB	-0.07	0.16	-0.44
Instruction	-0.52	0.56	-0.92
Instruction x InhibCtrl	0.07	0.08	0.95
Model 2 [a]			
Intercept	7.82	0.40	19.38***
Age	0.04	0.08	0.46
Language	0.00	0.02	0.15
InhibCtrl	0.06	0.04	1.68
FB	-0.24	0.22	-1.08
Instruction	-0.50	0.54	-0.93
Instruction x FB	0.33	0.31	1.07

Note. R^2 = .18, Model 1; R^2 = .18, Model 2. Age, language, inhibitory control, false belief, and interaction term centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief. [a] Interaction terms entered in separate regressions. *** $p < .001$.

Table 3-10. Summary of Hierarchical Regression Analysis for Variables Predicting Post-Instruction2 Trap-Tube Performance (N = 43)

	B	*SE B*	β	*t*
Step 1				
Age	0.13	0.08	0.25	1.67
Step 2				
Age	0.15	0.12	0.29	1.30
Language	-0.01	0.03	-0.05	-0.21
Step 3				
Age	0.15	0.12	0.28	1.25
Language	-0.01	0.03	-0.10	-0.43
InhibCtrl	0.06	0.06	0.17	1.04
Step 4				
Age	0.15	0.12	0.28	1.21
Language	-0.01	0.03	-0.10	-0.37
InhibCtrl	0.06	0.06	0.17	1.02
FB	0.00	0.25	0.00	0.01
Step 5				
Age	0.15	0.12	0.27	1.18
Language	-0.01	0.03	-0.10	-0.37
InhibCtrl	0.06	0.06	0.17	1.01
FB	0.01	0.26	0.00	0.02
Instruction	-0.09	0.88	-0.02	-0.11
Step 6 [a]				
Age	0.14	0.12	0.27	1.17
Language	-0.01	0.03	-0.10	-0.37
InhibCtrl	0.01	0.08	0.02	0.09
FB	-0.01	0.26	-0.01	-0.05
Instruction	-0.09	0.88	-0.02	-0.11
Instruction x InhibCtrl	0.12	0.11	0.23	1.06
Step 6 [a]				
Age	0.13	0.13	0.24	0.97
Language	-0.01	0.04	-0.07	-0.23
InhibCtrl	0.06	0.06	0.17	0.97
FB	-0.09	0.37	-0.07	-0.24
Instruction	-0.09	0.89	-0.02	-0.11
Instruction x FB	0.16	0.44	0.09	0.35

Note. R^2= .06, *ns* for Step 1, ΔR^2 = .00, *ns* for Step 2, ΔR^2 = .03, *ns* for Step 3, ΔR^2 = .00, *ns* for Step 4, ΔR^2 = .00, *ns* for Step 5, ΔR^2 = .03, *ns* for Step 6 (Instruction x InhibCtrl), ΔR^2 = .00, *ns* for Step 6 (Instruction x FB). Age, language, inhibitory control, false belief, and interaction term centered. Instruction = instruction condition, InhibCtrl = inhibitory control, FB = false belief. [a] Interaction terms entered in separate regressions. All *p*-values *ns.*

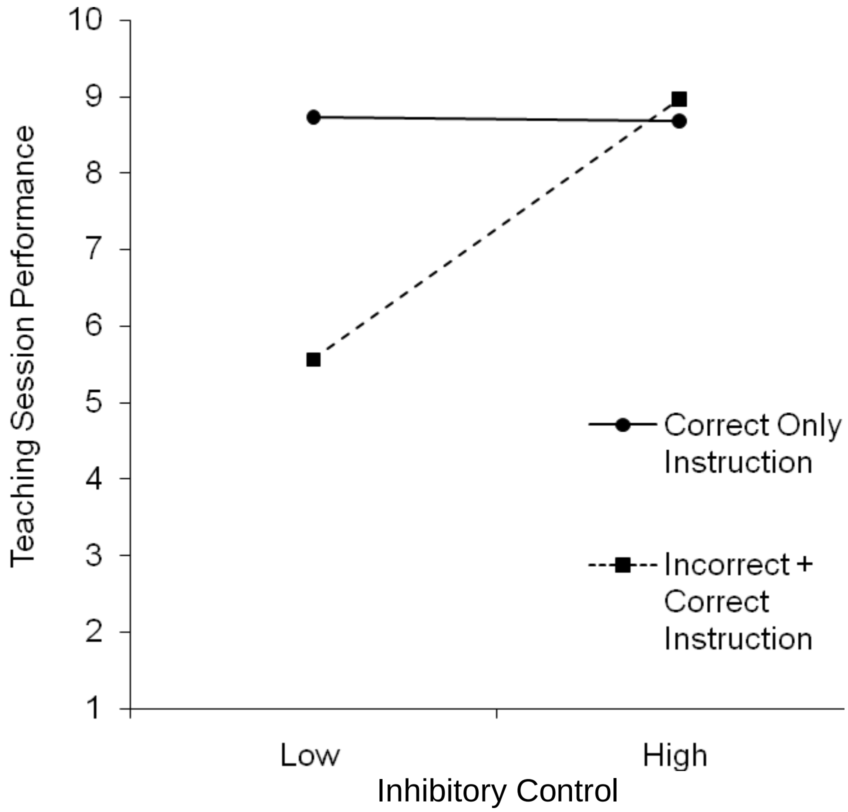


Figure 3-1. Instruction condition by inhibitory control interaction predicting trap-tube performance at teaching session.

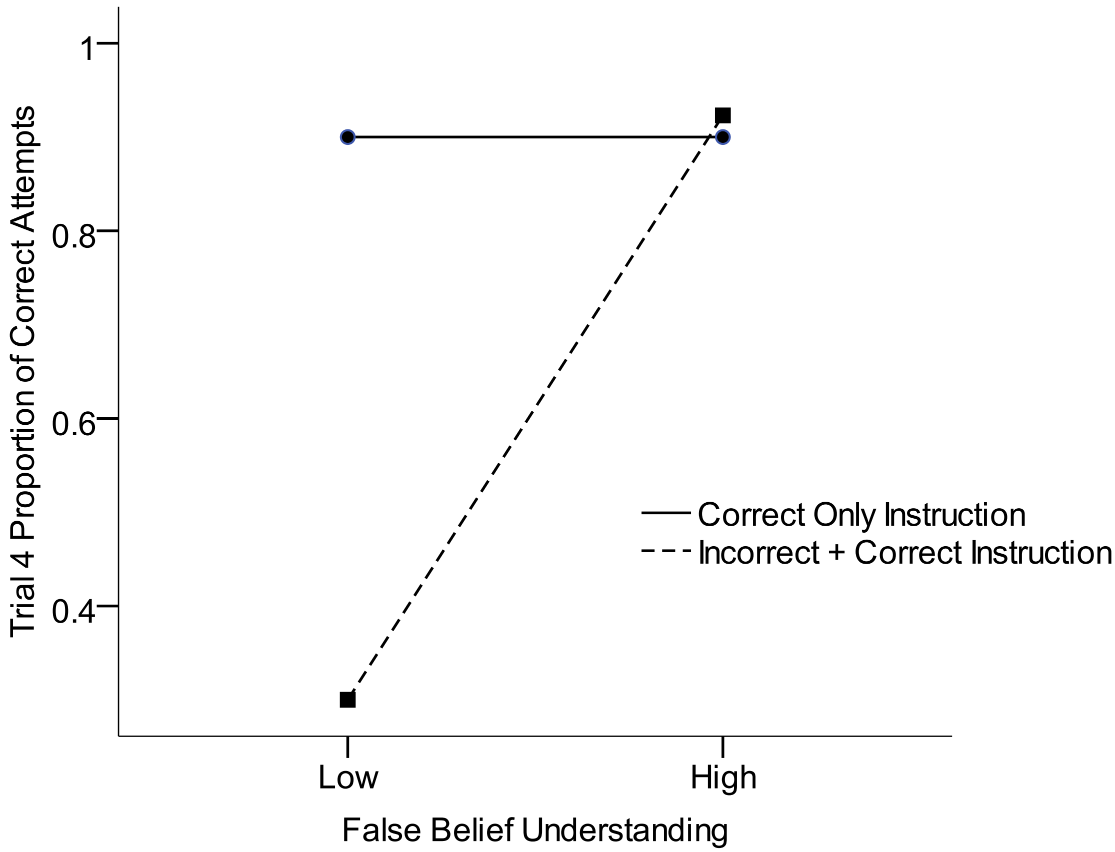


Figure 3-2. Teaching session Trial 4 proportion of correct attempts by false belief performance and instruction condition.

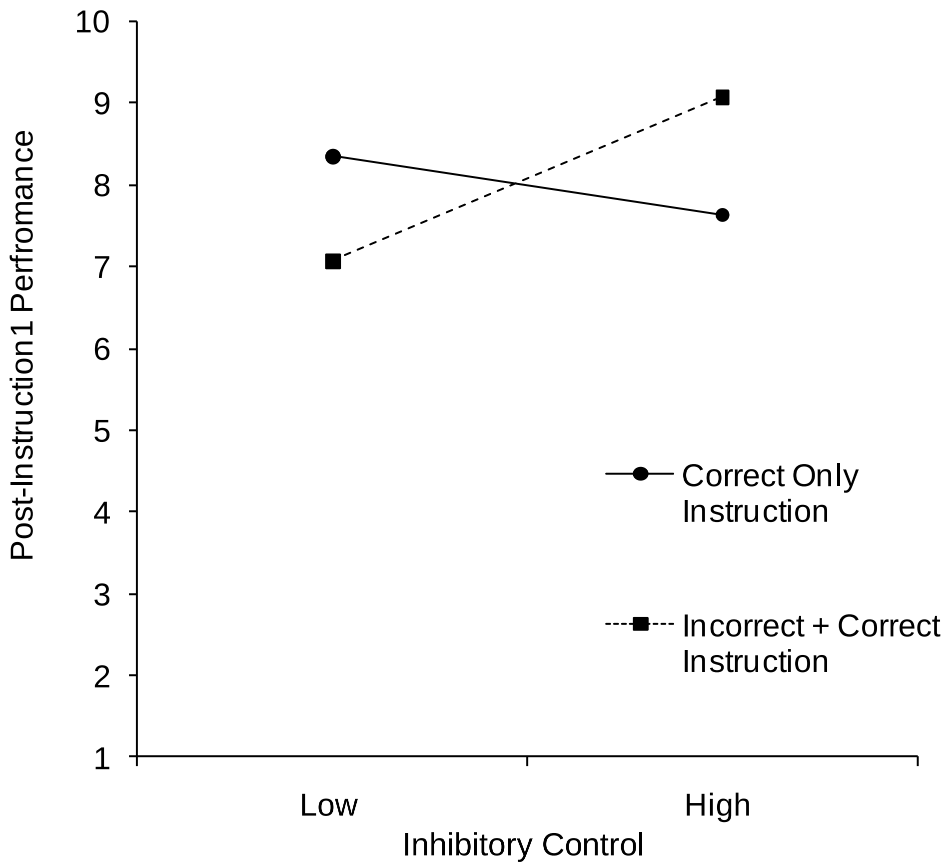


Figure 3-3. Instruction condition by inhibitory control interaction predicting trap-tube performance at post-instruction1 session.

.

CHAPTER 4
DISCUSSION

The current study aimed to explore developmental differences in preschoolers' ability to learn from another's instruction. Using cultural learning theory as a framework, the influences of language, social cognition, and executive function on children's learning ability were examined. It was expected that children would benefit more from observing another's mistake and correct instruction (i.e., I+C instruction) considering more information about the task was provided to children in this condition. In addition, inhibitory control and false belief were expected to moderate the relationship between instruction condition and trap-tube performances. Specifically, it was expected that those who were more advanced in these skills would benefit more from the I+C condition than those who were less advanced in these cognitive skills.

Instruction Condition Differences

Children's average performance on the trap-tube task could not be assessed in relation to statistical chance due to violations of normality, thus median comparisons were conducted. Relative to both instruction conditions, performance was not significantly above chance at baseline measurement (i.e., when no instruction was provided). This finding is as suspected given the medians listed in Table 3-1. Once children received instruction for the task (i.e., at teaching session), median performance significantly increased to above chance level for the C-only condition, but not for the I+C condition. This finding contrasts with the findings from the Horner and Whiten (2007) study, which indicated no significant condition differences in median performance relative to chance. One reason for this discrepancy is that children in the current study received instructions in both verbal and demonstration form. Horner and Whiten (2007) provided demonstration-only instruction with very limited verbal information. The experimenter in their study simply said, “yay” and “uhh ooh” after completing “correct” and “mistake” actions respectively. The current findings suggest that receiving both explicit verbal instruction and demonstration further assist children’s ability to benefit from C-only instruction. Considering that performance in the I+C condition was not significantly above chance, receiving both forms of instruction was not necessarily more beneficial for those in the I+C condition.

These findings regarding condition performance differences also contrast with the findings of Want and Harris (2001). Unlike the findings from Want and Harris (2001), children in the current study did not benefit more from observing another’s mistake (i.e., I+C instruction). As mentioned previously, the tube was rotated after each trial in the Want and Harris (2001) procedure. As Horner and Whiten (2007) propose, this type of procedure may have provided a perceptual cue, which may have biased children’s tool insertion (i.e., children may have used an “alternating” rule). The procedure in the current study removed the possibility of eliciting a bias in children’s responses. In addition, the presentation of the mistake action was fundamentally different in the Want and Harris (2001) study. The current study presented the mistake in conflicting ways, similar to Horner and Whiten (2007). The same action was presented as a “mistake” in one situation and as “correct” in another situation. In the Want and Harris (2001) study, the mistake action was never presented in this conflicting manner, children only observed one demonstration of the mistake action. Due to the nature of how the mistake was presented, the cognitive demands were not as great in the Want and Harris (2001) study.

Despite how the mistake action was presented, children were expected to benefit more from another's mistake. Initially it was expected that children would receive more information about the task when provided with both the mistake and correct solution. This "extra" information was expected to assist children in their task performance. The current findings did not support this notion; children did not benefit more from observing another's mistake. In contrast, when considering performance relative to statistical chance, the *C-only* instruction was more beneficial than the I+C instruction during initial exposure to instruction (i.e., at teaching session). However, these group differences in "above chance" performance disappeared by post-instruction1 and post-instruction2. In hindsight it is not surprising that children did not benefit more from the I+C condition considering the cognitive demands presented in this condition. As discussed further below, the current study found developmental differences in children's ability to learn from the I+C instruction, suggesting that not all children were capable of benefiting from this form of instruction. It is clear however, that children benefited from instruction regardless of the form considering that both conditions significantly improved from baseline performance. In addition, there were no significant condition differences in mean performance at any occasion of measurement.

Cognitive Influences on Performance

However, the current study was not primarily concerned with these differences in performance between instruction conditions, rather the study focused on examining cognitive factors that relate to children's ability to engage in social learning. Specifically, social cognition, executive function, and language were expected to influence differences in children's ability to learn from others. Although there were no significant differences in the trap-tube mean *performance* between instruction conditions, the cognitive factors that predicted children’s performance during the trap-tube sessions differed between instruction conditions. In understanding these differences, it is important to consider the cognitive demands that each instruction condition required in relation to the task demands. The nature of the trap-tube task requires learners to consider the location of the object in relation to the trap in order to succeed on the task. In addition to these task demands, each instruction condition presented additional challenges.

C-Only Instruction

The correct-only instruction condition provided children with the correct solution to the task; thus, there was only one solution for children to process. Children in this instruction condition only observed an action that lead to achievement of the experimenter’s final goal. In the C-only condition, the experimenter’s behavior was *use a tool to push the object away from the trap*; the goal was *get the object out of the tube.* Considering the literature on imitation, children in this condition could succeed on the task by engaging in imitative learning.

Research has found that young infants can interpret an intentional action (Carpenter et al., 1998a) and selectively attend to information directly related to one’s goal (Carpenter et al., 2005). Considering the age group of the children in the current study, they were developmentally prepared to understand the experimenter’s intention and were capable of attending to the experimenter’s actions. In addition, 3-year-olds have been found to imitate a model’s actions more often when the model successfully achieves their goal (Williamson, Meltzoff, & Markman, 2008). In the C-only condition, the experimenter always achieved their goal, thus, making it more likely for children to imitate the experimenter. Imitation of the C-only instruction was a sufficient learning method for success on the task. Children's inhibitory control and false belief were not necessarily expected to influence children's learning in this condition because these skills are not required for imitative learning. As discussed below, the current findings relative to the correct-only condition support this notion.

Role of inhibitory control

In the correct-only condition, children's level of inhibitory control did not influence their performance on the task. Although children had to regulate their behavior in order to act in accordance with the instruction provided, they did not have to inhibit between two conflicting behaviors (as the I+C condition required). As mentioned, research has demonstrated that infants are capable of producing another's intended goal, essentially regulating their behavior in order to achieve the model's goal (Carpenter, et al. 1998a; Carpenter et al., 2002). Thus, relative to the current study, it is not surprising that children's level of inhibitory control was not considerably influential for children's task performance.

Role of false belief understanding

In addition, children's level of false belief understanding did not influence task performance for the correct-only condition. This is not unexpected considering the infant imitation literature. Studies have found that joint attention, one of the most primary social skills, is influential for one's ability to engage in imitation (Carpenter et al., 1998b). Thus, the more advanced understanding of another's thoughts and beliefs is not a necessary cognitive skill for one to engage in imitative learning and consequently was not necessary for interpreting the correct-only instruction.

Inhibitory control and false belief understanding did not relate to or influence performance during the teaching session, post-instruction1, or post-instruction2 sessions because these skills were not required to understand the instruction or to perform the task. Thus, the task in relation to the correct-only instruction was not sufficient to parcel out possible differences in how children processed the instruction. While there were differences in children's levels of inhibitory control and false belief, the importance of these skills for children's internalization of instruction did not emerge in this condition. In addition, language was not related to performance either. Age was the only individual factor that related to post-instruction performance, but this factor did not significantly predict children's post-instruction performances. The task relative to the instruction provided did not require the same complex cognitive demands that the I+C instruction condition required and consequently differences in the cognitive factors that influenced children's ability to learn emerged between the conditions.

I+C Instruction

Observing the I+C instruction required one to differentiate between the mistake or "incorrect" solution and the "correct" solution in order to succeed on the task. Children were required to coordinate between these conflicting representations and regulate their behavior to act in accordance with the correct solution, but not the incorrect solution. It was proposed that children would also be required to coordinate between the experimenter's understanding of the task and their own understanding of the task. Specifically, it was expected that false belief and inhibitory control would be more influential for children's performance in the I+C condition. Unlike the C-only condition, the nature of the task in relation to the I+C instruction was expected to parcel out differences in children's ability to process the instruction.

Role of false belief understanding

False belief understanding was the primary cognitive factor that was expected to influence children's performance in the I+C condition. However, this expectation was not supported. False belief was not related to and did not predict *overall* task performance at the teaching session, post-instruction1, or post-instruction2 sessions. It is not clear that the current task relative to instruction was sufficient to parcel out the role of false belief in children's ability to learn.

Initially it was expected that the I+C condition would require children to coordinate between their own perspective and the experimenter's perspective to succeed on the task. Upon further examination, children's understanding of another's perspective per se did not seem relevant for children to succeed on the task *overall.* From a cultural learning perspective, it is not problematic that false belief was not critical for *overall performance*, but false belief was expected to be critical for processing the I+C instruction considering the conflicting representations associated with this instruction. As discussed in more detail below, the exploratory analyses suggest false belief did play a role in children's ability to learn from the I+C instruction.

While false belief understanding may not have been "required" for *overall* task performance, it seems false belief still played a role in children's initial processing of the I+C instruction. To support this notion, we selectively examined children's individual trial performance during the teaching session. Trials 2 and 4 were considered to highlight children's initial understanding of the instruction and . may require false belief understanding. At Trial 1, children had only received instruction for one situation (i.e., location of object to left of the trap). At Trial 2, children were presented with an opposite situation (i.e., location of object to right of the trap). Trial 2 represents children's initial application of the instruction provided. At this point, there was no association between false belief on children’s application of instruction for either instruction condition. At Trial 4 children had received all the instructions necessary for the task (i.e., instruction for both situations of object location). Thus, at this point, children had to demonstrate their understanding of the instruction in relation to the task.

Relative to the I+C condition, false belief was associated with Trial 4 performance. Trial 4 presented a unique situation which required children to coordinate between multiple pieces of conflicting information prior to the influence of practice. At this point, the experimenter had presented the child with two conflicting demonstrations, the action presented as a “mistake” in the teaching of Trial 1 was later presented as “correct” in the teaching of Trial 3. Thus at Trial 4, children had to integrate the conflicting pieces of information, the principle behind false belief understanding. Children had to consider why an action was a mistake in one situation, but later this same action was correct. Children with low false belief understanding had difficulty understanding the instructions for the task because they were not capable of resolving the conflicting representations.

It is important to emphasize that false belief was not associated with Trial 4 performance for the correct-only condition. Although children in the correct-only condition observed the experimenter use two different actions to obtain their goal, the actions were not presented in a conflicting manner. The experimenter did not present identical actions as a mistake in one situation and correct in another. Rather the experimenter’s actions were always presented as the correct way to achieve the experimenter’s goal. The C-only instruction did not require children to consider conflicting representations of the solutions. The C-only condition required children to think about the experimenter's goal and the experimenter's behavior to achieve that goal as mentioned previously.

Although false belief was associated with performance on this crucial trial for the I+C condition, false belief understanding was not related to nor predictive of children's *overall* performance. This finding may be related to the amount of exposure children had with the task. Children performed the task multiple times and observed the instructions over numerous occasions. This repeated exposure may have contributed to children's ability to increase their overall performance simply because of increased experience with the task. In addition, the repeated *explanation* of the mistake may have reduced children's need to rely on false belief understanding in order to interpret the instruction throughout the entire teaching session. Recall that the experimenter produced the mistake then explained why the incorrect method did not yield a successful attempt. A study by Sobel and Sommerville (2009) found that children's causal learning was more accurate when a model provided a relevant explanation for the action produced. They also found children's casual reasoning was reduced when a model provided no explanation for an action (Sobel & Sommerville, 2009). Relative to the current study, children were provided with an accurate explanation for why the "incorrect" solution was not sufficient on four separate occasions of instruction. Consequently, the experimenter's repetition of the rationale for the "mistake action" may have increased children's ability to reason about the *task* and reduced the need for children to understand the conflicting instruction (i.e., mistake and correct) in order to increase their overall performance. Children's repeated exposure to the task and the experimenter's explanation of the mistake action may have increased children's knowledge about the task allowing for higher *overall* performance. However, the analysis relative to Trial 4 does suggest that children are relying to some extent on their social cognitive understanding to process the I+C instruction.

Role of inhibitory control

While children may not have been *required* to understand conflicting representations to increase their *overall* performance, they were required to regulate their behavior to act in accordance with the experimenter's correct solutions. The findings support that when children witnessed another's instruction in the form of a "mistake" and "correct" solution; their level of inhibitory control influenced their performance. For children in the I+C condition, those with higher inhibitory control had higher *overall* teaching session performance on the trap-tube task. This demonstrates that children with better self-regulation skills, as measured by inhibitory control, were able to regulate their behavior with the correct action while inhibiting the incorrect action in order to succeed on the task.

While it may be argued that children ignored the incorrect solution and only attended to the correct solution in this condition, it is unlikely. Considering the findings relative to the C-only condition, in which children had no choice but to attend to the correct solution, inhibitory control did not influence performance on the task, thus it is clear that advanced inhibitory control is not required to complete the task. Relative to the I+C condition, if children were only attending to the correct solution, it is reasonable to expect that inhibitory control would not have influenced performance considering the C-only results. However, the results indicate that inhibitory control did influence performance for the I+C condition only. It is reasonable to expect that this condition difference emerged due to the demands of the I+C instruction relative to the task. It is clear that children were attending to more than just the correct solution in the I+C condition based on the finding that the influence of inhibitory control is relative to instruction condition. Essentially, children with low inhibitory control had a more difficult time learning from the I+C instruction because this instruction in relation to the task placed greater cognitive (i.e., executive function) demands on the children than the C-only condition.

This is not to suggest that those with low inhibitory control were unable to recognize the incorrect action as a “mistake.” Infants are capable of distinguishing between a model’s accidental and successful attempts at a task (Carpenter, Akhtar, & Tomasello, 1998a). Thus, the preschoolers in the current study were cognitively prepared to understand the experimenter’s incorrect actions as a *mistake* or as *accidental*. However, understanding one’s unsuccessful actions and regulating one’s behavior to inhibit another’s unsuccessful actions are two different (although related) skills. Inhibitory control influenced children’s performance because of the way the mistake was presented. As mentioned previously, children in this condition observed the experimenter identify identical actions as a “mistake” in some trials and as correct in other trials. The “mistake” actions in the current study were relative to the task demands (i.e., location of object in relation to the trap), making the cognitive demands in this study much more challenging.

Infants will imitate a model’s successful actions more often than a model’s accidental actions (Carpenter et al., 1998a). However, in the current study, the actions considered “successful” were relative to the task demands. The experimenter did not identify one successful or accidental action, the “success” or “mistake” actions were relative to the object placement. Considering that children are more inclined to imitate one’s successful actions over accidental actions, the I+C condition presented a unique challenge. Children had to rely on inhibitory control more because behaviors presented by the experimenter conflicted. If children relied on imitation of the correct actions, their performance success would be dependent upon which “correct” action they were imitating. Children had to inhibit imitating actions that were presented as correct when the situation required them to use the action displayed as “incorrect” and vice versa. Children with low self-regulation were not developmentally prepared to process the I+C instruction because this condition required them to have a more sophisticated ability to regulate their behavior relative to the task demands and the experimenter’s instruction. Thus, benefiting from another’s mistake is relative to both the task one is learning and one’s cognitive development.

Although inhibitory control was predictive of overall teaching session performance, it was not significantly related to performance on Trial 4. However, considering the size of the correlation coefficient, clearly there is a moderate relationship between inhibitory control and performance on this trial which did not reach significance due to small sample size. From a cultural learning perspective, both false belief and self-regulation are important for changes in the way children learn from others. Relative to the I+C condition, this notion is supported to some extent given that false belief had a strong relationship with performance on Trial 4 and inhibitory control was moderately related to performance on the trial. Recall that Trial 4 was a crucial trial for assessing children’s first understanding of the instruction without practice effects.

Children with greater false belief understanding were able to coordinate between the conflicting solution representations in order to choose the appropriate method for success at this trial. Cultural learning theory proposes that changes in social cognition (i.e., false belief understanding), allow one to internalize instruction and one's self-regulation serves as evidence for this (Tomasello, et al., 1993). As children performed more trials during the teaching session, the influence of false belief disappeared and the influence of self-regulation became stronger. Conceptually, one's self-regulation was more critical for acting in accordance with the instruction throughout the session and this is reflected in the finding that inhibitory control predicted *overall* teaching session performance. However, the extent to which inhibitory control influences one's ability to learn from instruction may be altered as task practice increases. Relative to the I+C condition, while inhibitory control predicted performance on the task during the teaching session, the influence of inhibitory control on post-instruction performances changed with experience. At post-instruction1 the interaction between inhibitory control and instruction condition still significantly predicted performance on the trap-tube task as indicated by the robust regression, however the magnitude of this effect was reduced. This effect of inhibitory control on performance disappeared by the post-instruction2 session.

One reason for the reduction in influence at the post-instruction sessions may be due to the amount of exposure children had with the task prior to these sessions. The findings from Williamson et al. (2008) suggested that children differentially imitate. Specifically the authors proposed that children integrate information received from instruction with information received from their own experience (Williamson et al., 2008).

Prior to post-instruction1, children had completed 20 attempts on the task (i.e., baseline and teaching session: 10 trials each) and 30 attempts on the task prior to post-instruction2 session (i.e., baseline, teaching session, and post-instruction1: 10 trials each). Independent of instruction, children had the opportunity to gain information about the task through repeated exposure. In other words, children combined the information they received from instruction with their own experience to guide their performance. Thus, while certain developments in cognition are important for processing the instruction initially, the influence of these factors may become overshadowed once the learner gains more exposure to the task and instruction as well.

Role of Language Across Instruction Conditions

Children's language did not relate to or predict trap-tube performance at any session for either instruction condition. While research has demonstrated that language is related to children's false belief and self-regulation, the current study demonstrates that children's self-regulation uniquely contributes to their ability to engage in learning. In addition, the findings lean towards the notion that false belief may also uniquely contribute to the process of children's learning during critical teaching trials, but as mentioned this relationship remains unclear. It is clear however, that language is not a sole contributor to differences in children's ability to learn from another's instruction. This is not to suggest that language is unimportant. Language is a fundamental skill for the development of other cognitive skills, such as false belief understanding (Jenkins & Astington, 1996), and private speech specifically plays an important role in children's problem-solving (Duncan & Pratt, 1997). As cultural learning theory highlights, the development of language is key for transitions in children's cognitive development and in turn, these advances in cognition are crucial for advances in children's learning ability. It is also important to note that the current study only measured children's receptive language *ability*. This limits the understanding of how language relates to developments in children's learning ability. Children's *use* of language, specifically *during* social interactions, may be more influential for their ability to benefit from instruction. Future research may consider how children's use of language (e.g., private speech) influences their ability to engage in social learning. This notion is discussed in more detail further below.

General Discussion

Considering that the trap-tube task is a problem-solving task and by default requires executive function skills, advanced inhibitory control was not necessarily required to succeed on the task considering the lack of influence on performance in the C-only condition. Williamson, et al. (2008) proposed, inhibition and memory were necessary for children to engage in imitation. The authors proposed that these skills allow children to override their original method to solve a given problem in order to comply with a model's method to solve the same problem (Williamson, et al. 2008). However, their study did not include any measures of children's inhibition or memory, thus it was unclear the extent to which inhibition and memory influenced children's ability to engage in imitation.

The current findings offer some insight regarding the role of inhibition and the potential influence of false belief in children's learning. Children's inhibitory control does not independently influence how they learn from instruction. Rather, advanced inhibitory control *relative to* the type of instruction provided influences how children learn. However, the full influence of inhibition in children's learning ability remains incomplete considering only conflict inhibitory control was assessed in the current study. The extent to which false belief understanding influences children's ability to learn also remains unclear. The finding for Trial 4 suggests that false belief influences children's ability to learn from the I+C instruction. However, caution should be used when considering the implications of this finding given that this finding only emerged through the examination of one trial.

In addition, the extent to which cognitive developmental differences influence performance is somewhat unclear considering the amount of exposure and repetition in the current study. As mentioned, when learning a novel task, children will integrate their experience with the information received from instruction (Williamson, et al., 2008). In addition to children's actual experience with the task, children's causal understanding likely influenced performance results as well. In the baseline condition, although some children required prompting to use the tool, no instruction was provided regarding how to use the tool –the experimenter simply said, *"You can use that stick to help you."* Children followed the prompt by inserting the tool into the tube, suggesting that children were relying on prior knowledge of tool use in general. Previous research has demonstrated that children as young as 2-years have some understanding of causation even though this understanding may be subconscious (Gopnik, Sobel, Glymour, Schulz, Kushnir, & Danks, 2004). In the current study, children had some prior understanding of causation considering they used the tool in order to act on the object. Relative to social learning, certain aspects of cognition may be important for children's ability to learn, but performance may be a product of learning ability, causal knowledge, as well as individual differences in prior experiences with causal events.

Future research should expand on the current findings by considering how children's initial strategies influence their ability to benefit from instruction. Arguably, these strategies may be related to children's initial causal knowledge. In the current study, children varied in their strategy use at baseline measurement, specifically in the tendency to alter the side of tool insertion. Differences in children's ability to benefit from particular forms of instruction may emerge depending on one's initial strategy choices. Exploring factors that influence children's initial approaches to novel tasks may highlight why certain cognitive factors relate to children's processing of instruction for the task.

While research has demonstrated that developmental differences in children's ability to learn from various forms of instruction exist (Horner & Whiten, 2007; Want & Harris, 2001), there is limited information regarding why these differences occur. Within the context of cultural learning theory, the current study provides support for the notion that fundamental cognitive changes influence how children are prepared to engage in learning. This study demonstrated that changes in cognitive development *expand* one's ability to engage in social learning, but these advancements may not modify one's learning method altogether.

Future Directions

In relation to the cognitive advancements that influence children's ability to learn from instruction, recent research has documented similar cognitive influences on preschoolers' ability to *instruct* others. Studies have found that social cognitive advances are related to developmental differences in how children teach others and how children *understand* the act of teaching in general. Research has demonstrated that false belief understanding is related to children's use of more advanced teaching strategies (Davis-Unger & Carlson, 2008; Strauss, Ziv, & Stein, 2002), as well as children's understanding of one's intentions to teach and that beliefs will guide one's teaching behaviors (Strauss et al., 2002; Ziv & Frye, 2004; Ziv, Solomon, & Frye, 2008). The recent research on children's teaching knowledge and ability suggests that children's *understanding* of teaching coincides with the changes observed in children's *ability to engage* in teaching another.

Considering the current findings relative to teaching, it is possible a similar pattern may emerge relative to learning. There is limited research examining children's understanding of learning, specifically children's judgments about whether or not learning has occurred. (Sobel, Li, & Corriveau, 2007). Initially children base their understanding of learning on the learner's desires and eventually come to understand learning by integrating knowledge of the learner's desire, intention, beliefs, and effort (Sobel et al., 2007). It is unknown how advancements in children's understanding of learning relate to children's learning ability. It is suggested that the *changes* in one's ability to understand learning and engage in learning may be related to similar advancements in cognition. Following the line of research relative to children's teaching, future studies should examine how children's ability to engage in learning relates to their understanding of learning as this would be a fundamental step to understanding developmental differences in children's approaches to learning.

Future research should also assess multiple aspects of learning beyond behavioral performance. In the current study, children's understanding was assessed by their ability to perform the task after instruction. However, our study did not consider other benefits children may have gained from instruction. Learning is an abstract construct and the nature of learning may not be completely reflected in one's performance alone. For example, it is unknown which forms of instruction are the most beneficial for children's future teaching strategies. There are developmental differences in the teaching strategies children use for teaching others (Strauss et al., 2002). When required to teach another a novel task, it is unknown how the initial instruction one receives influences one's ability to teach another the novel task. Observing another's mistake may enhance one's ability to explain or teach the task to another novice. The "extra" information received from observing another's mistake may not be more beneficial for one's own task performance, but this "extra" information may have substantial benefits for the learner in related situations.

In addition to exploring multiple aspects of learning, future research should use larger samples to explore multiple aspects of self-regulation and social cognition as well. The current study had a very small sample size considering the numerous independent variables and was limited in the assessment of self-regulation. Inhibitory control is only one aspect of self-regulation. Vygotsky noted self-directed speech (i.e., private speech) is a skill that assists in self-regulation (Rowe & Wertsch, 2002). Private speech is intended for communication with the self rather than with another. Children use private speech as a method for planning (Duncan & Pratt, 1997) and children become more sophisticated in their use of private speech during the preschool years. Around the age of 4 years, children begin to coordinate their behavior with their private speech (Luria 1961, as cited in Tomasello et al., 1993). Future studies should consider how advances in children's use of private speech correspond to advances in children's ability to learn. Children's ability to coordinate their behavior with private speech may relate to changes in children's ability to coordinate their behavior with another's instruction. Researchers examining children's teaching abilities may also consider how advances in one's use of private speech relate to advances in one's teaching strategies. Finally, future studies should also consider learning using a variety of problem-solving tasks considering the use of private speech tends to increase with task difficulty (Goodman, 1981).

Conclusions

It has long been suggested that there are distinct changes in children's ability to engage in learning (Tomasello et al., 1993; Flynn & Whiten, 2008) and more recently research has described distinct changes in how children *understand* the process of learning (Sobel et al., 2007). The current study provides insight concerning the cognitive advancements that influence developmental differences in children's ability to engage in learning from others. However, examination of cognitive developments related to changes in learning ability and the importance of these changes remains incomplete. Although it is valuable to continue improving teaching methods and instruction techniques to assist children in learning, it is also important to highlight the young child's learning development and abilities that complete these social interactions.

APPENDIX A
STUDY DESCRIPTION AND INFORMED CONSENT FORM

UF UNIVERSITY of FLORIDA
College of Liberal Arts & Sciences
Department of Psychology

114 Psychology Building
PO Box 112250
Gainesville, FL 32611-2250
352-273-2118
352-392-7985 Fax

Description: Study of Instruction, Problem Solving, and False Beliefs in Preschool Children

Dear Parent/Guardian,

I am a graduate student in the Psychology Department at the University of Florida, conducting research on preschool children's ability to learn from others under the supervision of Dr. M. Jeffrey Farrar.

What is this study about? We are interested in learning the effects of instruction, language, and false belief understanding on children's ability to learn from others during problem solving tasks. False belief understanding refers to one's understanding that others may have beliefs that are false. For example, if John puts a toy in his bag and does not see his friend has removed the toy, John may falsely believe his toy is still in his bag. This type of understanding is important for social interactions and could be beneficial during tasks that require instruction.

How will my child be tested? If you agree to allow your child to participate in this study, testing will take place at your childcare center. Two research assistants from the University of Florida will conduct the testing sessions. Your child will receive two testing sessions, one session a day. The testing sessions will last roughly 20-30 minutes. Your child will be given a new problem-solving task, which requires them to retrieve a toy from a container. In addition, children will receive a card sorting task. With your permission, your child will be videotaped while performing the problem-solving task and card sorting task. The video will be accessible only to the research team for data verification purposes. In addition, your child's false belief understanding will be assessed by a series of short stories and puppet games. The stories involve characters hiding and looking for objects and the puppet games involve puppets thinking about the content of objects. During these stories and games, your child will be asked about his/her thoughts regarding the objects and the story character/puppets' beliefs about the objects. Your child's language development will also be assessed by using a picture vocabulary test. After each testing session is complete, your child will be offered stickers for their participation.

What is required of me? You will be asked to complete and return a 13-item questionnaire regarding demographic information. However, you do not have to answer any question you do not wish to answer.

Participant Privacy and Confidentiality of Records. Participation in this study is voluntary. There is no direct compensation, benefits, or risks associated with this study. You and your child may withdraw consent for your child's participation in this study without consequence. All answers to your questionnaire, your child's participation, and your child's performance in this study are confidential. Both your name and your child's name will be kept confidential to the fullest extent provided by the law and will not be used in any scientific or news publications. Once the study is completed, we will provide you with a summary of results as they become available. This summary will review the *general* pattern of our findings and will not indicate individual child performances nor the demographic information associated with each child.

Consent and Contact. If you would like for your child to participate in this study, please read and sign the attached consent form. If you have questions regarding this study, please do not hesitate to ask. We can be reached at the numbers listed below any time. If you have questions or concerns about your rights as a research participant, you may contact the University of Florida Institutional Review Board (IRB-02), P.O. Box 112250, University of Florida, Gainesville, FL 32611-2250, (352) 392-0433.

Sincerely,

Jennifer Tamargo, Graduate Student
(352) 273-2118

M. Jeffrey Farrar, PhD, Associate Professor
(352) 273-2140

The Foundation for The Gator Nation
An Equal Opportunity Institution

Study of Instruction, Problem-Solving, and False Beliefs in Preschool Children
Jennifer Tamargo and M. Jeffrey Farrar, PhD

Directions to participate in this study:
1.) Complete and sign this consent and the questionnaire attached (1 page front & back)
*2.) **Return Consent & Questionnaire Attached** to your childcare center.*
Keep the description of the study.

"I have read the description of the said study and have kept a copy of the description for my records. By completing this consent, I voluntarily agree to allow my child to participate in the said study and to return the parent questionnaire."

Child's Name ____

Child's Date of Birth ____

Child's Sex (check one) ____*Male* ____*Female* *Child's Race* ___________________

Parent Name (PRINTED) ________________________________

Parent Signature ______________________________________ ***Date*** ____________

2nd Parent / Witness ______________________________________

Parent Contact Information

****Contact information requested in order to send you information regarding the general results of this study.***

Parent Mailing Address ____

____

Daytime Contact Number (______)_______–____________extension_________

Parent e-mail address ____

Childcare Center Name

Research Representative Only

#

APPENDIX B
PARENT QUESTIONNAIRE

Study of Instruction, Problem-Solving, and False Beliefs in Preschool Children
Jennifer Tamargo and M. Jeffrey Farrar, PhD

There are 13 questions on this questionnaire.

You do not have to answer any question you do not wish to answer.

1. What is your age? (Please write in) ________________

2. What is your sex? (Please circle one)
   a.) Female   b.) Male

3. What is your race? (Please write in) ________________________

4. What is your *highest* level of education (*Please circle one and write in if applicable*)
   a.) High School Diploma
   b.) GED
   c.) Some college
   d.) Associate's Degree
   e.) Bachelor's Degree
   f.) Master's Degree
   g.) Doctorate Degree
   h.) Other **Please indicate*: ______________________________________

5. What is your current employment?(Please write in job title – No company names)

   ____

6. What is your TOTAL HOUSEHOLD income?

(Please circle the one CLOSEST to your TOTAL income)

a.) 0 – 10,000	b.) 11,000 – 20,000	c.) 21,000 – 30,000
d.) 31,000 – 40,000	e.) 41,000 – 50,000	f.) 51,000 – 60,000
g.) 61,000 – 70,000	h.) 71,000 – 80,000	i.) 81,000 – 90,000
j.) 91,000 – 100,000	k.) 100,000 and up	

7. How many persons live in your home? ***This includes anyone currently living in your home: related and non-related.*** (*Please write number below*)

   ____

Turn Over to Continue →

8. How many *children* are in your household? (*Please write number below*)

____

9. What are the ages of the children in your household? *(Please list all ages below)*

____

THE QUESTIONS BELOW ARE IN RELATION TO THE CHILD PARTICIPATING IN THIS STUDY ONLY:

10. What is your relationship with this child's teacher?

(Please circle one)

a.) **Strained** (*feel uncomfortable speaking with my child's teacher regarding my child*)

b.) **Limited** (*feel somewhat comfortable to speak with my child's teacher, but rarely speak with my child's teacher*)

c.) **Average** (*speak with my child's teacher regarding my child on occasions*)

d.) **Strong** (*speak with my child's teacher regarding my child daily*)

11. ***How long*** has this child been ***enrolled in childcare TOTAL***?

(*Please write in number where **most** applicable – for example: __3__ years)*

____ day(s) _____ week(s) _____month(s) ____year(s)

12. ***How many*** childcare centers has this child been ***enrolled in TOTAL***?

(Please write in ***total number of centers*** this child has attended, **including the current center**)

____

13. ***How long*** has this child been ***enrolled in the CURRENT childcare center***?

(*Please write in number where **most** applicable– for example: __3__ week(s)*)

____ day(s) _____ week(s) _____month(s) ____year(s)

End of Questionnaire
Please return with the signed consent form

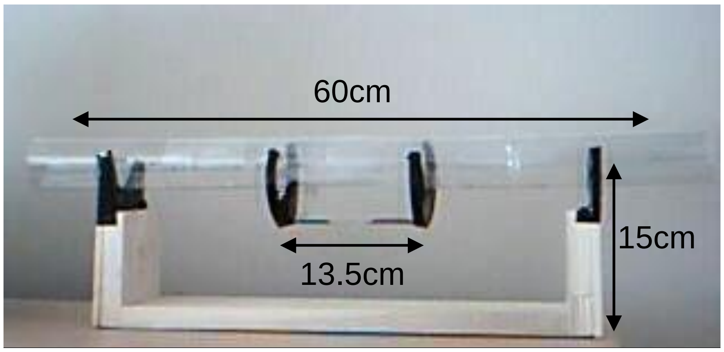
THANK YOU!

Research Representative Only

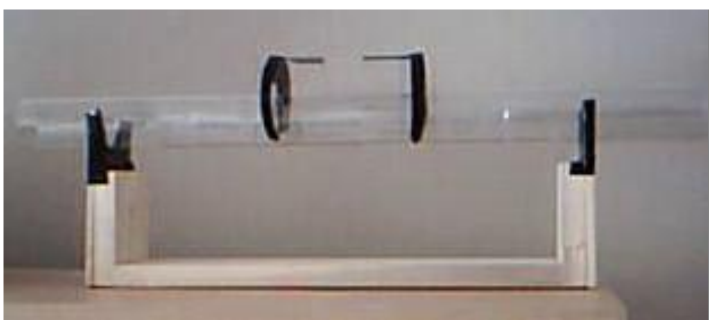
#

APPENDIX C
TRAP-TUBE APPARATUS

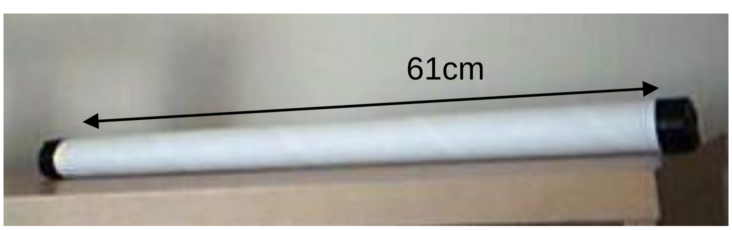
Original Trap-Tube



Inverted Trap-Tube



Tool



APPENDIX D
FALSE BELIEF TASKS

Format: PICTURE BOOK
Scene: Emma & Truck

Take out Emma's Story.
Say "Ok [child's name], I would like to tell you a story. Let's see what happens in this story."
Read each sentence while showing child the corresponding page.

Page 1: This is Emma. She loves to play with her toy truck.
Page 2: Emma wanted a snack.
Page 3: So Emma put her truck under a hat.
Page 4: Then she left.
Page 5: Emma's grandma walked in.
Page 6: She thought that the truck would roll off the table and be broken.
Page 7: So she took the truck from under the hat and put it in a bag.
Page 8: Then she left the room.
Page 9: Emma came back to play with her toy truck.

[Immediately ask questions listed below while page 9 is still visible to the child.]

Q1: Where will Emma look for her toy truck?
Response: ____

→ ***IF NO RESPONSE – ASK…<u>under the hat</u> or in the bag?***
Response: ____

Q2: Why will she look there?
Response: ____

Q3: Where did Emma leave her toy truck?
Response: ____

→ ***IF NO RESPONSE – ASK… <u>under the hat</u> or in the bag?***
Response: ____

Q4: Where is the toy truck now?
Response: ____

→ ***IF NO RESPONSE – ASK… under the hat or <u>in the bag</u>?***
Response: ____

Format: PICTURE BOOK
Scene: John & Book

Take out John's Story Picture Book.
Say "Ok [child's name], I would like to tell you another story. Let's see what happens in this story."
Read each sentence while showing child the corresponding page.

Page 1: This is John. He loves his book.
Page 2: John wanted to eat ice cream.
Page 3: So John put his book under his bed.
Page 4: Then he went to the kitchen.
Page 5: John's mom went to his room.
Page 6: She thought that the pages would be torn if the book were left under the bed.
Page 7: So she took the book and put it in a drawer.
Page 8: Then she left the room.
Page 9: John came back to read his book.

[Immediately ask questions listed below while page 9 is still visible to the child.]

Q1: Where will John look for his book?
Response: ____

→ ***IF NO RESPONSE – ASK…<u>under his bed</u> or in the drawer?***
Response: ____

Q2: Why will he look there?
Response: ____

Q3: Where did John leave his book?
Response: ____

→ ***IF NO RESPONSE – ASK… <u>under his bed</u> or in the drawer?***
Response: ____

Q4: Where is his book now?
Response: ____

→ ***IF NO RESPONSE – ASK… under his bed or <u>in the drawer</u>?***
Response: ____

Format: GAME/PUPPETS
Materials: Toy Doll & Crayon Box filled with ribbons
Complete actions and questions in the sequence indicated below.

Show child Crayon Box:

Q1: What do you think is inside this box?

Response: ____

Open Crayon Box:

Q2: What is inside this box?

Response:____

Close Crayon Box:

Q3: When you first saw this box all closed up, what did you think was inside the box?

Response:____

→ ***IF NO RESPONSE – ASK…Did you think there were <u>crayons</u> or ribbons?***
Response: ____

Q4: Can you remember what was inside the box?

Response: ____

→ ***IF NO RESPONSE – ASK…Were there crayons or <u>ribbons</u>?***
Response: ____

Take out toy doll – make toy doll look at closed crayon box and read below:

Q5: This is Dolly, she has never seen inside this box. What does Dolly think is inside?

Response: ____

→ ***IF NO RESPONSE – ASK…Does she think there are <u>crayons</u> or ribbons?***
Response: ____

Q6: Why does Dolly think that?

Response: ____

Format: GAME/PUPPETS
Materials: Stuffed Bear & Band-Aid Box containing a small ball
Complete actions and questions in the sequence indicated below.

Show Child closed Band-Aid Box:

Q1: What do you think is inside this box?

Response: ____

Open Band-Aid Box:

Q2: What is inside this box?

Response:____

Close Band-Aid Box:

Q3: When you first saw this box all closed up, what did you think was inside the box?

Response:____

→ ***IF NO RESPONSE – ASK…Did you think there were Band-Aids or a ball?***
Response: ____

Q4: Can you remember what was inside the box?

Response: ____

→ ***IF NO RESPONSE – ASK…Were there Band-Aids or was there a ball?***
Response: ____

Take out stuffed bear – make stuffed bear look at closed Band-Aid Box and read below:

Q5: This is Bear, he has never seen inside this box. What does Bear think is inside?

Response: ____

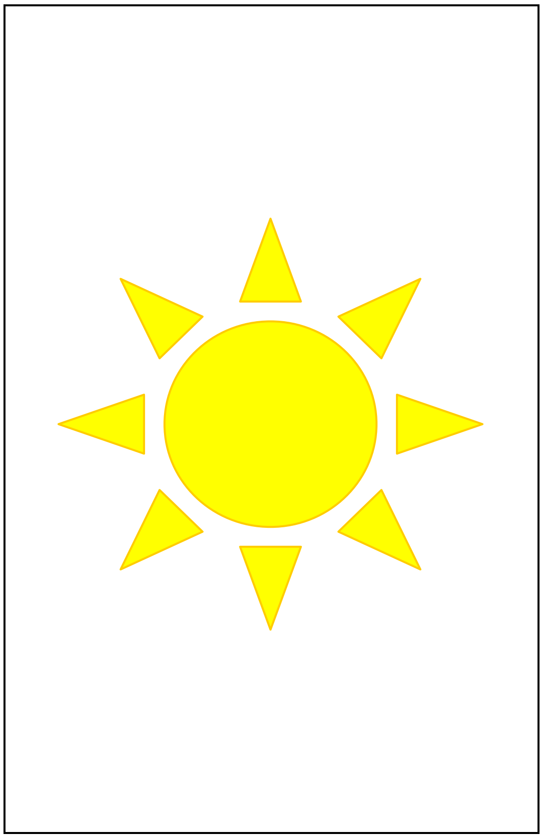
→ ***IF NO RESPONSE – ASK…Does he think there are Band-Aids or a ball?***
Response: ____

Q6: Why does Bear think that?

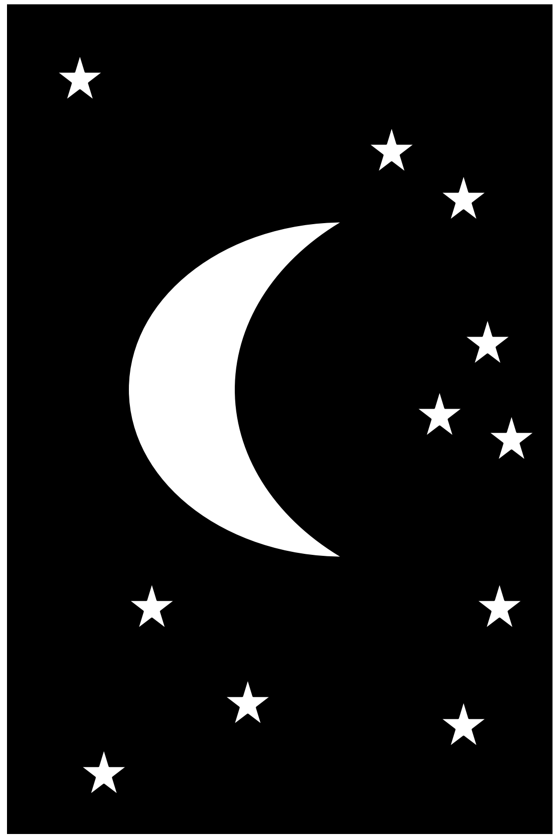
Response: ____

APPENDIX E
INHIBITORY CONTROL TASK: DAY/NIGHT STROOP-LIKE TASK

Day Card



Night Card



Experimenter Script - Training Session

---Child shown the “night” card
When you see this night card, I want you to say ‘day’ Can you say day?

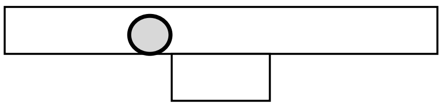
---Child shown the “day” card:
When you see this day card, I want you to say ‘night’ Can you say night?

--- Experimenter then shows the child each card once while asking the child “*What do you say for this one?*”
* If child answers incorrectly or does not respond, the training session is repeated

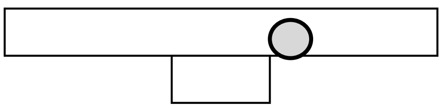
Experimenter Script – Trial Block (3 blocks of 10 trials)
- Experimenter says the below rules to the child prior to trials 1 and 6 for each block (i.e., every 5 cards)
When you see the ‘day’ card, I want you to say ‘night’
When you see the ‘night’ card, I want you to say ‘day’

APPENDIX F
TRAP-TUBE TASK: TEACHING SESSION

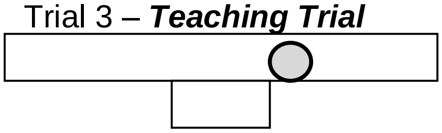
Trial 1 – ***Teaching Trial***



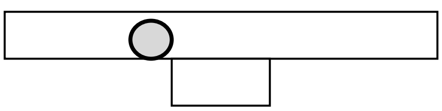
Trial 2



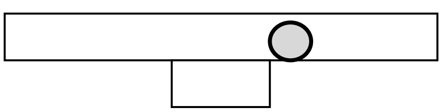
Trial 3 – ***Teaching Trial***



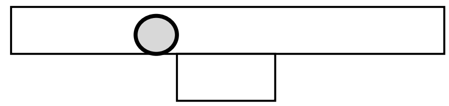
Trial 4



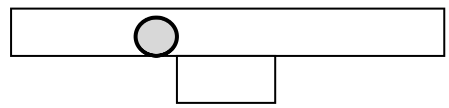
Trial 5



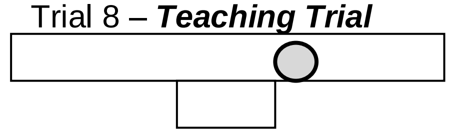
Trial 6 – ***Teaching Trial***



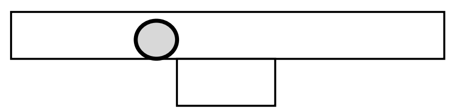
Trial 7



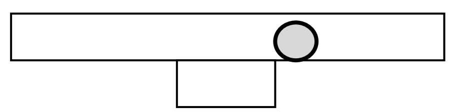
Trial 8 – ***Teaching Trial***



Trial 9



Trial 10



APPENDIX G
TRAP-TUBE TASK: EXPERIMENTER SCRIPT

Session 1 – Order Fixed

1. Baseline session - Experimenter verbally states goal of task. If no attempt after 2 minutes, child's attention drawn to the tool. Set up for 10 trials.

Hi [child's name]. Today we have a game to play. To play the game, we have to get the mouse out of the tube. It's your turn first.

---

2. Teaching session - Set up for 10 trials. Instruction will occur before child attempts trials 1, 3, 6, and 8. After each instruction trial, experimenter reminds child of the goal of the task, but provides no further instruction.

> a.) Correct Only Instruction (C-only Condition): *Ok now I will help you. Let us look at the tube. There is a trap right next to the mouse* (experimenter points to object, then points to trap). *We do not want the mouse to fall into the trap. First, we need to pick up the stick* (experimenter then picks up tool). *We have to put the stick in over here so we can push the mouse out of the tube* (puts in the tool and retrieves the object). [Experimenter2 resets apparatus for child's trial.] *You try now. We want to get the mouse out of the tube.*

………

> b.) Incorrect + Correct Condition (I+C Condition): *Ok now I will help you. Let us look at the tube. There is a trap right next to the mouse* (experimenter points to object, then points to trap). *We do not want the mouse to fall into the trap. First, we need to pick up the stick* (experimenter then picks up tool). *We have to put the stick in so we can push the mouse out of the tube* (experimenter puts in the tool, object falls inside trap).*Oops! That will not work because the mouse will fall in the trap.* [Experimenter2 sets object in tube]. *We have to put the stick in over here so we can push the mouse out of the tube (points to the correct end of tube then puts in the tool and retrieves the object).* [Experimenter 2 resets apparatus for child's trail] *You try now. We want to get the mouse out of the tube.*

---

3. Post-instruction1 - Experimenter verbally states goal of task. Set up for 10 trials, stop after 2 minutes if no attempts made by child.

Let us try the tube game again. To play the game, we have to get the mouse out of the tube.

Session 2 - Order of Post-instruction2 and Inverted Session counterbalanced

Post-Instruction2 - Experimenter verbally states goal of the task. Set up for 10 trials, stop after 2 minutes if no attempts made by child.

Hi [child's name]. Let us play this game. To play this game, we have to get the mouse out of the tube.

Inverted Session - Experimenter verbally states goal of the task. Set up for 10 trials, stop after 2 minutes if no attempts made by child.

Hi [child's name]. Let us play this game. To play this game, we have to get the mouse out of the tube.

REFERENCE LIST

Bandura, A. (1977). *Social learning theory*. Oxford, England: Prentice-Hall.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*. *51*(6), 1173-1182.

Bronfenbrenner, U. (2005). The bioecological theory of human development. In U. Bronfenbrenner (Ed), *Making human beings human: Bioecological perspectives on human development.* (pp. 3-15). Thousand Oaks, CA: Sage.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032–1053.

Carpenter, M., Akhtar, N., & Tomasello, M. (1998a). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior & Development, 21*(2), 315-330.

Carpenter, M., Call, J., & Tomasello, M. (2002). Understanding "prior intentions" enables two- year-olds to imitatively learn a complex task. *Child Development, 73,* 1431–1441.

Carpenter, M., Call, J., & Tomasello, M. (2005). Twelve and 18-month-olds copy actions in terms of goals. *Developmental Science, 8*(1), F12-F22.

Carpenter, M., Nagell, K., & Tomasello, M. (1998b). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, *63*, 176.

Davis-Unger, A. C., & Carlson, S. M. (2008). Development of teaching skills and relations to theory of mind in preschoolers. *Journal of Cognition and Development, 9*, 26-45.

Duncan, R. M., & Pratt, M. W. (1997). Microgenetic change in the quantity and quality of preschoolers' private speech. *International Journal of Behavioral Development, 20*(2), 367-383.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test* (4th ed.). Circle Pines, MN: American Guidance Service.

Erceg-Hurn, D. M., & Mirosevich, V. M. (2008). Modern robust statistical methods: an easy way to maximize the accuracy and power of your research. *American Psychologist, 63(*7), 591-601.

Erikson, E. H. (1950). *Childhood and society*. New York: Norton.

Flynn, E., (2007). The role of inhibitory control in false belief understanding. *Infant and Child Development, 16,* 53-69.

Flynn, E., & Whiten, A. (2008). Cultural transmission of tool use in young children: A diffusion chain study. *Social Development*. *17*(3), 699-718.

Freud, S. (1942). Psycho-analysis. *International Journal of Psycho-Analysis, 23*, 97-105.

Frye, D., Zelazo, P., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development, 10*, 483–527.

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3½ -7 years old on a stroop-like day-night test. *Cognition, 53*(2), 129-153.

Goodman, S. H. (1981). The integration of verbal and motor behavior in preschool children *Child Development, 52,* 280-289.

Gopnik, A., & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development, 59,* 26-37.

Gopnik, A. Glymour, C., Sobel, D., Schulz, L., Kushnir, T., & Danks, D. (2004). A theory of causal learning in children: Causal maps and Bayes nets. *Psychological Review, 111*(1), 3-32.

Horner, V., & Whiten, A. (2007). Learning from others' mistakes? Limits on understanding a trap-tube task by young chimpanzees (pan troglodytes) and children (homo sapiens). *Journal of Comparative Psychology, 121*(1), 12-21.

Jaccard, J., Wan, C. K., & Turrisi, R. (1990). The detection and interpretation of interaction effects between continuous variables in multiple regression. *Multivariate Behavioral Research, 25*(4), 467-478.

Jenkins, J. M., & Astington, J. W. (1996). Cognitive factors and family structure associated with theory of mind development in young children. *Developmental Psychology, 32*(1), 70-78.

Keselman, H. J., Algina, J., Lix, L. M., Wilcox, R. R., & Deering, K. N. (2008). A generally robust approach for testing hypotheses and setting confidence intervals for effect sizes. *Psychological Methods, 13*(2), 110–129.

Nagell K., Olguin, R., & Tomasello, M. (1993). Processes of social learning in the tool use of chimpanzees (Pan troglodytes) and human children (Homo sapiens). *Journal of Comparative Psychology, 107,* 174–186.

Nielsen, M. (2006). Copying actions and copying outcomes: Social learning through the second year. *Developmental Psychology, 42,* 555–565.

Perner, J., & Wimmer, H. (1985). “John thinks that Mary thinks that…” attribution of second-order beliefs by 5- to 10-year-old children. *Journal of Experimental Child Psychology, 39*, 437-471.

Piaget, J. (1930). *The child’s perception of the world*. New York: Harcourt, Brace & World. (Original work published in 1926).

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879-891.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences, 1,* 515-526.

Rowe, S. M., & Wertsch, J. V. (2002). Vygotsky's model of cognitive development. In U. Goswami (Ed). *Blackwell handbook of childhood cognitive development*. (Vol. 13, pp. 538-554). Blackwell handbooks of developmental psychology. Malden, MA, US: Blackwell.

Sobel, D., Li, J., & Corriveau, K. (2007). “They danced around in my head and I knew them”: Children’s developing conceptions of learning. *Journal of Cognition and Development, 8*(3), 345-369.

Sobel, D., & Sommerville, J. (2009). Rationales in children’s causal learning from other’s actions. *Cognitive Development, 24*, 70-79.

Strauss, S., Ziv, M., & Stein, A. (2002). Teaching as a natural cognition and its relation to preschoolers’ developing theory of mind. *Child Development, 17*, 1473-1787.

Tomasello, M. (1995). Joint attention as social cognition. In C. Moore & P. Dunham (Eds.), *Joint attention: Its origins and role in development*. (pp. 103-130). Hillsdale, NJ: Erlbaum.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.

Tomasello, M., Kruger, A. C., & Ratner, H. H. (1993). Cultural learning. *Behavioral and Brain Sciences, 16,* 495-552.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Want S. C., & Harris, P. L. (2001). Learning from other people’s mistakes: causal understanding in learning to use a tool. *Child Development*, *72*, 431–443.

Welch-Ross, M. K. (1997). Mother-child participation in conversation about the past: Relationships to preschoolers' theory of mind. *Developmental Psychology, 33*(4), 618-629.

Wilcox, R. R. (1998) How many discoveries have been lost by ignoring modern statistical methods? *American Psychologist, 53*(3), 300-314.

Williamson, R. A., Meltzoff, A. N., & Markman, E. M. (2008). Prior experiences and perceived efficacy in 3-year-olds' imitation. *Developmental Psychology, 44*(1), 275-285.

Ziv, M., & Frye, D. (2004). Children's understanding of teaching: The role of knowledge and belief. *Cognitive Development, 19,* 457-477.

Ziv, M., Solomon, A., & Frye, D. (2008). Young children's recognition of the intentionality of teaching. *Child Development, 79*(5), 1237-1256.

BIOGRAPHICAL SKETCH

Jennifer Tamargo was born and raised in Jacksonville, Florida. She graduated from Bishop Kenny High School in 2000. In 2004, she received her Bachelor of Arts in psychology (minor social welfare) from the University of North Florida.

As an undergraduate, she held internships with the Clay County Head Start Program and the Jacksonville Children's Commission (JCC). Upon graduation, the JCC offered Jennifer a position as the developmental screener for the Healthy School Readiness Project (HSRP), a pilot project funded by the Early Learning Coalition of Duval County. HSRP was collaborative project involving the JCC, Duval County Health Department, UF College of Medicine-Jacksonville Department of Pediatrics, Vision Is Priceless Council, and Speech & Hearing Inc. Jennifer primarily served as the developmental screener, but also served as a liaison to the mentioned agencies, which provided additional services to the HSRP children and childcare providers. Elements of the project were implemented to restructure the JCC developmental screening process and JCC's coordination of services to their childcare providers.

In August 2007, Jennifer began the developmental psychology doctorate program at the University of Florida. Primarily, she is interested in social cognition, executive function, and preschoolers' learning development. She completed her master's degree in the fall of 2009. Currently, she is continuing her graduate work and is expected to complete her doctorate in 2012.