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Associations among False-belief Understanding, Executive Function, and Social Competence: A Longitudinal Analysis

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Abstract

A growing number of studies demonstrate associations among false-belief understanding (FBU), executive function (EF), and social competence. This study extends previous studies by exploring longitudinal associations among FBU and its correlates within a low-income sample of preschoolers attending Head Start. Sixty-eight children (time 1 mean age = 5 years 2 months) were assessed over their preschool and kindergarten years. Results indicated bidirectional relations between FBU and social competence; FBU in preschool was positively associated with social competence in kindergarten and social competence in preschool was positively associated with FBU in kindergarten. Preschool EF was positively associated with social competence both in preschool and kindergarten and with FBU in preschool. Mediation analyses suggest that the bidirectional longitudinal link between FBU and social competence was independent of EF. These findings extend the FBU literature by examining its development and correlates in early childhood. Implications for future research and practice are discussed.

Keywords

Early childhood; Executive function; False-belief understanding; Social cognition; Social competence

1. Introduction

One aspect of social cognition that has received increased attention in recent years is the development of children's understanding of mind. Within this domain, false-belief understanding (FBU) has been the most often studied theory of mind development. Research suggests that during the preschool years, children acquire an understanding of false-belief; that is, they recognize that others can hold and act on beliefs that are untrue. Once children have acquired false-belief understanding, they are able to mentally represent one's own, as well as another's, mental state (Gopnik & Astington, 1988). Consequently, false-belief understanding serves as a primary indicator of developing theory of mind in young children.

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Given that an understanding of the mind is believed to be a powerful social tool (Moore & Frye, 1991), researchers hypothesized that FBU serves important social functions. As expected, a growing body of research has linked FBU with increased prosocial behavior and decreased problem behavior (for review see Astington, 2003; Hughes & Leekam, 2004). A correlate of FBU and social competence that has received considerable attention in recent years is executive function (EF). EF refers to a collection of cognitive skills that underlie goal-directed behaviors (Welsh, Pennington, & Grossier, 1991). Research supports an association between EF and FBU during early childhood (Carlson, Mandell, & Williams, 2004; Frye, Zelazo, & Palfai, 1995). Moreover, research suggests that EF has implications for children's social competence (Fahie & Symons, 2003; Hughes, Dunn, & White, 1998).

Although a number of studies have shown that FBU and EF are important correlates of social competence, no studies have simultaneously examined the longitudinal associations among these constructs. To clarify the developmental pathways among FBU, EF, and social competence, we focused on the transition from preschool to kindergarten. This timeframe has special significance to both researchers and educators in that FBU and EF each have substantial implications for children's readiness for and adjustment to school, both socially and academically (Astington, 2003; Blair, 2002; Blair & Razza, 2007). Moreover, little is known about FBU and its links with EF and social competence in children from low-income and ethnically heterogeneous backgrounds. Thus, the present study explores these associations in a sample of children enrolled in Head Start, the federal educational daycare program for low SES children. The promotion of school readiness is especially important for such children, as they are at increased risk for school failure (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; McLoyd, 1998).

1.1. The association between false-belief understanding and social competence

By definition, children who demonstrate an understanding of false-belief are able to interpret another person's mental state (Kuhn, 1999). From a theoretical perspective, this ability to interpret the perceptions, desires, and beliefs of other people has important implications for children's social development. Specifically, over the preschool years children become increasingly able to predict and explain associations between mental states and actions (Gopnik & Astington, 1988). During this time, children learn that mental states are related to both emotional and behavioral outcomes (Wimmer & Perner, 1983). Thus, children's knowledge of false-belief, coupled with their understanding of the association between belief and behavior, may influence children's social competence.

Although the concurrent association between FBU and social competence is supported within both normative and clinical samples (see Hughes & Leekam, 2004), the direction of this association remains unclear. One possibility frequently implied in the literature is that FBU promotes social competence. According to this theory, the ability to simultaneously represent multiple and conflicting beliefs may allow children to better coordinate their own thoughts and beliefs with those of others, which would result in more successful interactions (Astington & Jenkins, 1995). Empirical support for this theory comes from studies in which FBU accounts for unique and significant variance in children's social competence (Capage & Watson, 2001; Razza & Blair, 2003). Furthermore, longitudinal studies support FBU as a predictor of peer communication skills and social behavior (see Astington, 2003).

A second possibility is that positive social interaction stimulates the development of FBU. This theory is based on the premise that children's experiences with other people's thoughts and beliefs during pretend play may increase their awareness of the distinction between mental states and reality, which would foster FBU (Flavell, Flavell, & Green, 1987; Youngblade & Dunn, 1995). Empirical support for this theory is found in the literature, albeit via a broad interpretation of social competence. For instance, cooperation with siblings and engagement

in conversation about emotions and the causes of behavior predicted FBU in young children (Dunn, 1995). A third possibility also exists, which is that the association between FBU and social competence is bidirectional, whereby positive social interactions present the opportunity for learning more about the association between thought and behavior, and increased understanding of one's own and other's minds encourages successful social behavior (Moore, Barresi, & Thompson, 1998; Watson, Nixon, Wilson, & Capage, 1999). Moreover, recent reviews of the literature provide support in favor of a reciprocal association (Astington, 2003; Hughes & Leekam, 2004). Unfortunately, however, this model has not been widely tested in single studies. Thus, the first goal of this study is to clarify the direction of the association between FBU and social competence across the preschool and kindergarten years.

1.2. The association between false-belief understanding and executive function

EF refers generally to cognitive processes that support goal-oriented behavior. More specifically, EF refers to inhibitory control, attentional flexibility, and working memory processes that are understood to be central to engagement in and successful completion of relational reasoning and planning and problem solving tasks (Diamond, 2002; Welsh et al., 1991). The extant literature supports EF as an important correlate of FBU during the preschool years (Carlson & Moses, 2001; Hughes, 1998a, 1998b). Specifically, concurrent associations have been found between FBU and EF components, including attentional flexibility (Frye et al., 1995), inhibitory control (Carlson & Moses, 2001), and working memory (Hughes, 1998a).

A growing body of research supports the hypothesis that EF precedes and is necessary for the acquisition of FBU. This argument is consistent with the *emergence* account of false-belief development, which asserts that a certain level of executive ability is required for the construction of mental concepts. In other words, the ability to consider multiple mental representations is not possible without some executive skill (see Moses, 2001). Consistent with this hypothesis, cross-sectional research suggests that EF accounts for unique and significant variance in children's FBU (Carlson, Moses, & Breton, 2002; Hughes, 1998a). Moreover, longitudinal research suggests that EF, specifically inhibitory control, contributes to FBU, but not vice versa (Carlson et al., 2004; Hughes, 1998b). Despite these findings, the developmental ordering of EF and FBU remains unclear. For example, once initial FBU scores were considered in a model predicting later FBU from initial EF, only one of four EF tasks was an independent predictor of later FBU (Hughes, 1998b). Moreover, when EF was an independent predictor of FBU, FBU scores were not correlated across the two time points (Carlson et al., 2004). Given that EF may influence later FBU primarily through its concurrent association with FBU, we examined FBU at T1 as a mediator of the link between EF at T1 and FBU at T2 (see Figure 1).

Although the directional association between EF and FBU has important implications for understanding cognitive development, this association may also reveal specific links between cognitive and social development. EF has been linked with self-regulation (Cole, Usher, & Cargo, 1993), and impairments in EF have been consistently reported for childhood disorders including autism and ADHD (for review, see Pennington & Ozonoff, 1996). Given the associations among EF and social competence (Hughes et al., 1998; Shultz, Izard, Ackerman, & Youngstrom, 2001), EF and FBU (Carlson et al., 2004; Hughes, 1998b), and FBU and social competence (for review, see Astington, 2003; Hughes & Leekam, 2004), it has been proposed that EF may impact social competence both directly and indirectly (Hughes et al., 1998). Thus, it is possible that FBU partially mediates the association between EF and social competence. Interestingly, the results from previous correlational studies that indirectly examined a mediator model are conflicting. Specifically, while some research supports FBU as an independent predictor of behavioral problems (Hughes & Ensor, 2006), other studies fail to

find a significant link between FBU and social problems once EF is partialled out (Fahie & Symons, 2003). Given that this model has not been tested with longitudinal data, we examined FBU at T1 as a mediator of the link between EF at T1 and social competence at T2 (see Figure 2).

1.3. Low-income sample

Despite the fact that interest in the development of FBU has grown over the last two decades, the majority of the research has been conducted with a select population. Specifically, we know about FBU and its correlates primarily through work with Caucasian, middle and upper-income samples. This trend has begun to change in recent years, however, as the field has extended to include low SES samples. In the first study to examine FBU in a low SES sample, children exhibited only moderate consistency across a variety of false-belief tasks (Holmes, Black, & Miller, 1996) and their performance fell below that typically reported for more advantaged populations (see Wellman, Cross, & Watson, 2001). While subsequent studies of FBU within low SES samples support reduced consistency across tasks (Curenton, 2003; Garner, Curenton, & Taylor, 2005; Razza & Blair, 2003), findings regarding overall performance level have been mixed. Specifically, some researchers continue to report lower levels of FBU for children from low SES backgrounds (Cutting & Dunn, 1999; Shatz, Diesendruck, Martinez-Beck, & Akar, 2003), while others fail to find a link between SES and FBU (Garner et al., 2005; Lucariello, Durand, & Yarnell, 2007; Weimer & Guajardo, 2005).

Given that the above studies have focused predominantly on the impact of SES on children's performance on false-belief tasks, we still know little about whether the associations between FBU and its correlates are consistent across income-levels. For example, research on the association between FBU and EF within low SES samples has been supportive, but rare (Blair & Razza, 2007; Hughes, 1998b). Although some studies suggest that FBU is associated with social behavior for low SES children (Razza & Blair, 2003; Hughes, 1998b), others have failed to find an independent association between FBU and social competence (Garner et al., 2005; Weimer & Guajardo, 2005). Thus, this study seeks to further explore the associations among FBU, EF, and social competence within low SES children.

1.4. Research aims

The primary purpose of this study was to increase our understanding of FBU and its correlates within disadvantaged children over the transition from preschool to kindergarten. The first aim was to examine the longitudinal association between FBU and social competence. The second aim was to investigate associations among EF, FBU, and social competence using mediation analyses. Finally, a strong interest for us in this study was the opportunity to examine FBU within low-income children. Given that all children in this sample were low-income, it was not the intent, or within the ability, of this study to make direct comparisons of children's FBU across SES levels.

2. Method

2.1. Participants

Participants were recruited from two Head Start programs, which were comprised of 15 classrooms spanning three rural counties in central Pennsylvania. Participants were part of a larger longitudinal study ($N = 170$) targeting school readiness among Head Start preschool children. The study included 88 of the 170 children from the larger sample who were included in previously published research (Blair, Granger, & Razza, 2005; Blair, Peters, & Granger, 2004; Blair & Razza, 2007). Children who were between 3.5 and 6 years of age at the first wave of data collection and entered kindergarten the following school year were eligible for the present study. Eighty-eight children met these requirements and were included in the Time

1 (T1) sample. Head Start personnel obtained parental consent for the T1 data collection during a routine home visit. Parental consent for the kindergarten year, or Time 2 (T2), was collected via mail or was provided at the time of the child interview. At T2, children were enrolled in 36 kindergarten classrooms in 26 schools in central Pennsylvania. Children provided verbal assent at both time points. Of the 88 families at T1, 5 children were excluded from analyses (3 identified as having developmental problems, 1 moved, 1 received a score greater than 2.5 standard deviations from the sample mean on the social competence measure). The final number of families available at T1 was 83.

At T1, the mean age of the primary caregiver was 31 years (range = 21 - 57 years). The majority of primary caregivers were mothers (88%), had either a high school degree or GED (58%), and were employed (54%). For those who reported their earnings (88%), the mean monthly income was \$1,720 (range = \$279 to \$6500). The majority of households were comprised of two adults (69%), the mean number of children per household was 2.4, and the mean number of moves per year was 1. The majority of children were over 5 years of age (69%), female (59%), and Caucasian (87%).

Parental consent for T2 was received from 72 families. Three of these families were living out of state, and child and teacher assessments were not collected. The retention rate was 83%, which is notable given the high mobility of many Head Start families. With two exceptions, attrition was due to the inability to contact a family due to relocation rather than to refusal to participate. One child was missing all child assessment data across both T1 and T2 and was dropped from the sample. Sixty-eight children were included in the longitudinal sample. The mean chronological age of these children at T1 was 5 years 2 months (range = 4 years 7 months to 5 years 7 months). Results of independent *t*-tests revealed that the returning participants ($n = 68$) and the missing participants ($n = 15$) did not differ significantly on the primary variables of interest. Similarly, these groups did not differ on demographic variables, with the exception of employment status; participants lost to attrition were more likely to have unemployed primary caregivers than returning participants, $\chi^2(1, N = 83) = 4.46, p \leq .05$.

2.2. Measures

Table 1 provides information on the study design and the measures for each construct at each time.

2.2.1 False-belief understanding tasks—Four false-belief tasks commonly used in research with preschoolers were included in the false-belief battery. These tasks were the unexpected contents task, two sub-tasks of an unexpected identity task, and the changed locations task. With the exception of the unexpected contents task, the materials were identical at T1 and T2. Tasks were administered in a standard order. Similar studies employ a fixed order rather than counterbalancing (e.g., Shatz et al., 2003; Weimer & Guajardo, 2005), as order effects are typically not found for false-belief tasks (Fahie & Symons, 2003; Wellman & Lui, 2004). Children were successful if they responded correctly to both the test and control questions. Each task was scored as pass (1) or fail (0).

Although the reliability of false-belief tasks has not been formally established, there is evidence of strong test-retest reliability, $r(46) = .77$, as well as substantial internal consistency, $\alpha = .76$ and $.82$ at times 1 and 2, for a battery of standard tasks (Hughes, Adlam, Happe, Jackson, Taylor, & Caspi, 2000). Moreover, the results of a recent meta-analysis suggest that children perform similarly across false-belief tasks with a similar conceptual content (Wellman & Lui, 2004).

2.2.1.1. Unexpected contents task: This task is a descendent of Perner, Leekam, and Wimmer's (1987) "smarties" task. The version used in this study is similar to

Hughes' (1998b) adaptation of the original task. At T1, an egg carton was placed in front of the child and the child was asked, "What do you think is inside this carton?" Children were required to answer this pretest question correctly (i.e., "eggs") to continue, but this question was not scored. The egg carton was then opened and the child was shown that the carton really contained crayons. The carton was shut and the child was asked the test question, "What did you think was inside the carton, before we opened it?" followed by the control question, "What is in the carton really?" If the child did not respond, a forced-choice prompt was provided (i.e., "eggs or crayons"). A similar procedure was followed at T2, but a crayon box containing gum was used as the prop.

2.2.1.2. Unexpected identity - subtask 1: In subtask 1, children's understanding of their own false-belief was assessed via a storybook task modeled after Slaughter and Gopnik's (1996) "Ears book". Each page of the book contained a clear window, through which the child could see part of the picture from the subsequent page. For the first three pages, the picture appeared to be ears of different animals. Before turning to the final page, the child was asked, "What do you think these are?" This pretest question was not scored, but it had to be answered correctly (i.e., "ears") in order to administer the task. Next, the page was turned, revealing that the ears were really petals on a flower. The book was then turned back to the prior page and the child was asked the test question, "Before we turned the page, what did you think these would be, ears or petals?" and a control question, "What are these really, ears or petals?"

2.2.1.3. Unexpected identity - subtask 2: The second subtask assessed children's understanding of another person's false-belief. For subtask 2, the book was closed and the child was shown a cat cut-out, who was introduced as follows: "Look, this is Charlie. Charlie has never seen this book before. If he comes over and looks through this window, what will he think these are, ears or petals?" This test question was followed by a control question, "What are they really, ears or petals?"

2.2.1.4. Changed locations task: This task was modeled after the original Wimmer and Perner (1983) Maxi task. Children were told a story where the location of an object was changed by Character A while Character B was out of sight and were then asked to predict where Character B would look for the object upon his/her return. Figurines of two familiar characters, Big Bird and Elmo, were used to act out this scenario. The protocol was identical to scenario 1 of the location trial for the standard condition (i.e., non-deceptive condition) presented by Holmes et al. (1996). Specifically, Elmo put a chocolate bar in a drawer and went out to play. While he was gone, Big Bird moved the chocolate from the drawer to the refrigerator. Elmo returned home and wanted some chocolate. Children were asked, "Do you remember where Elmo put the chocolate in the beginning?" If the child could not remember, he/she was reminded of the original location. This memory question was not scored. Next, children were asked the control question, "Do you remember where the chocolate is now?" If the child could not remember, he/she was shown the correct location. This question was followed by the test question, "Where will Elmo look for the chocolate?"

2.2.2. Language ability task—Language ability was assessed using the Peabody Picture Vocabulary Test (PPVT-III; Dunn & Dunn, 1997), a norm-referenced measure of receptive vocabulary. In this task, children were presented with a series of plates, each containing four pictures, and were asked to point to single picture that corresponded to the word spoken by the interviewer (e.g., "Point to dog"). Children's raw scores were converted to age-based standardized scores based on a mean of 100 and a standard deviation of 15. The PPVT has high internal reliability, $\alpha = .94$, for children ages 3 to 6 years, as well as strong validity (Williams & Wang, 1997). The extant literature supports an association between language ability and FBU (for a review, see Milligan, Astington, & Dack, 2007). Thus, it is critical and common

practice to control for language ability when assessing the associations among FBU and its correlates.

2.2.3. Executive function tasks—The executive function battery consisted of two tasks that assessed inhibitory control and working memory (peg tapping) and set shifting or mental flexibility (flexible item selection task; FIST). Although the psychometrics of these tasks have not been formally established, both tasks were derived from standard neuropsychological tests used with adults, which are reliable and valid tests of prefrontal functions (Hughes, 1998a; Zelazo & Jacques, 1996).

2.2.3.1. Peg-tapping task (PEG): The peg-tapping task (Diamond & Taylor, 1996; Luria, 1966) requires children to inhibit a natural response to imitate the interviewer's tapping pattern, and thus it is primarily a measure of children's inhibitory control. Given that participants must also hold two rules in memory to succeed, working memory is inherent in the task. For this task, children were presented with a wooden peg and instructed to tap twice on the table when the interviewer tapped once (Rule 1), and to tap once when the interviewer tapped twice (Rule 2). Children who demonstrated an understanding of both rules during practice trials were administered a series of 16 test trials presented in a fixed order. Coefficient α for the 16 trials in these data was .84. The child's total score was the proportion of correct responses on 16 trials (Blair & Razza, 2007; Diamond & Taylor, 1996).

2.2.3.1. Flexible item selection task (FIST): The FIST (Jacques & Zelazo, 2001) assesses attention shifting. Each page of a booklet contained three pictures that varied in two out of three possible dimensions (e.g., size, shape, and color). Children selected two out of three pictures that matched on one dimension first (e.g., color), and then select a different pair of pictures that match on another dimension (e.g., size). Children who correctly identified both matches on at least one of the two practice pages qualified for the testing session, which consisted of 15 trials. Coefficient α for the 15 trials was .77. The child's total score was the proportion of correct responses on 15 trials (Blair & Razza, 2007; Jacques & Zelazo, 2001).

2.2.4. Social competence task—Social competence was measured using the Preschool and Kindergarten Behavior Scales (PKBS; Merrell, 1994). The PKBS is a standardized instrument for assessing typical problem behaviors and social skills in preschool- and kindergarten-aged children. The Social Skills scale (Scale A) was included in the present study. Teachers rated children on 34 items assessing typical classroom behaviors using a Likert scale (0 = "Never," 1 = "Rarely," 2 = "Sometimes," 3 = "Often"). Scale A taps three sub-domains of social skills, which include social cooperation (e.g., *shows self control*), social interaction (e.g., *tries to understand another child's behavior*), and social independence (e.g., *is confident in social situations*). Scores were summed across these subscales to create an overall social skills score. Typical mean values for overall social skills derived from sub-samples of a national normative group range between 81 and 83 (e.g., Holland & Merrell, 1998).

2.3. Procedure

Children were seen individually on two separate occasions in the spring of their Head Start year and then again on one occasion in the spring of their kindergarten year. A team of trained child interviewers consisting of two graduate students and two hired research staff, all of whom had previous experience working with children, administered the interviews. All Head Start interviews were conducted in a quiet area down the hall from the child's classroom. A member of the Head Start staff, who remained in the room throughout both interviews, accompanied children at T1. Given the length of the T1 battery, the preschool interview was conducted over two 45-minute sessions (Sessions A and B), approximately two weeks apart. During Session A, children completed the PPVT and the FIST measure of EF. Over the course of this interview,

children's heart rates were recorded and saliva samples were collected as part of the larger study. During Session B, children performed the PEG measure of EF and four FBU tasks. All measures were administered in a standard order within each session, as there was no reason to expect order effects. Due to scheduling issues and child absences, approximately two-thirds of the children were administered Session A first. Teachers received questionnaires assessing children's social competence, behavior, and temperament. Teachers were paid \$10 for each child that they assessed and were provided with a self-addressed stamped envelope.

Kindergarten interviews were conducted in either an unoccupied room of a centrally located Head Start center or in a university child research laboratory. A primary caregiver or guardian who remained in the room throughout the interview accompanied children at T2. Due to transportation or employment issues, a few kindergarten interviews were conducted in the family's home. In these cases, a primary caregiver as well as a second child interviewer was present. Due to variation in children's kindergarten schedules, some children were seen before or after their school day and others were seen on their day off. During the visit, children performed the same four false-belief tasks, again in a fixed order. Over the course of this interview, children also completed additional measures of executive function, fluid intelligence, and academic competence that were collected as part of the larger study. Each interview lasted approximately 45 minutes and children were rewarded with stickers, regardless of their performance. Families were paid \$50 at both T1 and T2 for their participation. Teachers received questionnaires tapping children's social competence, behavior, and temperament. Teachers were paid \$10 for each child that they assessed and were provided with a self-addressed stamped envelope.

2.4. Missing data

For the longitudinal sample of 68 participants, the following data were missing. At T1, FBU data were missing for 5 children, FIST data were missing for 13 children, and PEG data were missing for 5 children. The primary reason for missing data was child refusal to participate in the particular assessment. The high rate of refusals on the FIST was believed to be due to fatigue on the part of the child, as this was the final task in the session and children were often eager to get back to their classroom for an activity or get ready for departure. In addition, due to teacher nonresponse, 6 children were missing PKBS data at T2. In sum, 91% of the children had complete data or were missing only one measure across both time points. The remaining 9% of children were missing no more than four measures.

Missing data patterns for the primary variables of interest were assessed using SPSS version 11.5 Missing Value Analysis module (SPSS, 2001). Little's (1988) MCAR test failed to reach significance, $\chi^2(1, N = 68) = 8.31$, which suggests that the variables in the data set as a whole exhibit a pattern of values that are missing at random. To maximize statistical power, missing data were imputed using the EM estimation method from the SPSS Missing Value Analysis module. The EM method uses an iterative process to replace missing values with imputed values.

3. Results

3.1. Preliminary analyses

Analyses were based on data from 68 participants. Although children's success rates varied across false-belief tasks, their pattern of success was consistent over time. At T1, 50 children (74%) passed the changed locations task, 37 (54%) passed the unexpected contents task, 21 (31%) passed the "own" question for unexpected identity, and 20 (29%) passed the "other" question for unexpected identity. Similarly, at T2, 61 children (90%) passed changed locations, 54 (79%) passed unexpected contents, 51 (75%) passed the "own" question for unexpected

identity, and 35 (52%) passed the “other” question for unexpected identity. One sex difference in performance was reported; girls outperformed boys on changed locations at T1, $t(66) = 2.81$, $p \leq .05$.

Coherence across false-belief tasks was assessed using the phi contingency statistic (see Table 2), which is a measure of association between dichotomous variables, similar to a Pearson correlation among continuous variables (Hays, 1988). Overall, findings indicate coherence among the tasks and support the use of an aggregate measure. Given the low success rate of the “other” question at T2 and the lack of consistency between the “other” and “own” questions across both time points, however, we excluded the “other” subtask from the aggregate. Thus, the FBU aggregate represents performance across 3 tasks (i.e., contents, location, and “own” subtask of identity) and ranged from 0 to 3. In addition to providing a robust indicator of FBU, an aggregate variable has distributional properties that are superior to those of any one task and improves the reliability with which children's theory of mind can be measured (Rushton, Brainerd, & Pressley, 1983). Children's performance across EF measures was also examined for coherence. The PEG and FIST were not significantly related at T1, $r(68) = .19$, and were entered as separate variables in analyses.

Table 3 presents the means and standard deviations for the primary variables as well as partial correlations controlling for language ability ($M = 97.89$, $SD = 8.90$). There were no significant performance differences between boys and girls across these measures, with one exception at T1: girls received higher social competence scores than boys, $t(66) = 2.19$, $p \geq .05$. Age was not included as a control, as it was significantly correlated only with social competence at T2, $r(66) = .24$, $p \leq .05$. Results supported longitudinal stability for FBU and social competence. Furthermore, results from paired samples t -tests indicated that FBU increased significantly between T1 and T2, $t(67) = 6.67$, $p \leq .001$, suggesting that children experienced significant developments in their FBU skills during early childhood. In contrast, change in social competence across that time was not significant, $t(67) = -1.50$, ns , which is not entirely unexpected, as the development of social competence is a gradual process.

As expected, FBU was positively correlated with social competence both at T1 and T2, although this association was stronger at T1. Longitudinal associations between FBU and social competence were also supported, such that FBU at T1 was linked with social competence at T2, and vice versa. The hypothesized positive link between EF and FBU at T1 was also supported for the peg-tapping task. After controlling for language ability, the FIST was not associated with any of the primary variables and thus was excluded from further analyses. Based on the correlations, a series of step-wise hierarchical regressions and mediation analyses were conducted to determine directions of associations among FBU, EF, and social competence.

3.2. Association between false-belief understanding and social competence

The first regression analysis addressed the hypothesis that FBU in preschool (T1) would predict social competence in kindergarten (T2). Given that social competence did not increase over time and the preschool score was included as a control, this model does not predict change in children's social competence, but rather models social competence as a more stable characteristic of the child. The final model is presented in Table 4. In Step 1, language ability and social competence at T1 were entered and accounted for 16% of the variance in T2 social competence, $F(2, 65) = 7.41$, $p \leq .001$. In Step 2, FBU at T1 was significant and accounted for an additional 7% of the variance in social competence at T2, $F(3, 64) = 7.69$, $p \leq .001$. Thus, FBU in preschool independently predicted social competence in kindergarten.

A second regression analysis addressed the hypothesis that social competence in preschool (T1) would predict FBU in kindergarten (T2). The final model is displayed in Table 5. In Step

1, language ability and FBU at T1 were entered and accounted for 20% of the variance in FBU at T2, $F(2, 65) = 9.36, p \leq .001$. In Step 2, social competence at T1 was significant and accounted for an additional 10% of the variance in FBU at T2, $F(3, 64) = 10.50, p \leq .001$. Thus, social competence in preschool (T1) independently predicted FBU in kindergarten (T2).

3.3. Association between false-belief understanding and executive function

Next, we addressed the hypothesis that FBU in preschool (T1) would mediate the association between EF in preschool (T1) and FBU in kindergarten (T2), which is presented in Figure 1. Formal mediation tests were conducted in STATA using *sgmediation*, which uses bootstrap analyses to estimate the indirect effect of the predictor variable on the dependent variable through the mediator variable. Bootstrap analysis involves drawing a large number of samples (with replacement) from a data set, computing the indirect effect for each sample, and then generating an average indirect effect across all samples. This procedure is especially useful for small samples as it estimates standard errors more appropriately and thus increases statistical power (Dearing & Hamilton, 2006).

Results of this mediation analysis, which included a series of three distinct regression models, are displayed in Table 6. Language ability at T1 was included as a control. In Step 1, EF at T1 predicted FBU at T2 (path c). In Step 2, EF at T1 predicted FBU at T1 (path a). In Step 3, EF at T1 was no longer a significant predictor of FBU at T2 (path c'), once the link between FBU at T1 and FBU at T2 (path b) was accounted for in the model. These results suggest that there is no independent association of EF at T1 with FBU at T2, but rather this association is fully mediated by FBU at T1. Thus, EF in preschool does not predict FBU in kindergarten directly, but likely affects it indirectly through its concurrent association with FBU.

3.4. Associations among false-belief understanding, executive function, and social competence

A similar mediation analyses was conducted in STATA to test the hypothesis that FBU in preschool (T1) partially mediates the association between EF in preschool (T1) and social competence in kindergarten (T2), which is presented in Figure 2.

Results are displayed in Table 7. Language ability and social competence at T1 were included as controls. Although EF at T1 and social competence at T2 were moderately correlated ($r = .22, p \leq .10$), results from Step 1 indicate that this link was not significant once social competence at T1 was considered (path c). Although the proposed mediation model was not supported given the failure of EF to predict social competence in Step 1, we continued the analyses to learn more about how these variables are associated over time. In Step 2, EF at T1 predicted FBU at T1 (path a). In Step 3, the nonsignificant link between EF at T1 and social competence at T2 (path c) was further reduced (path c') once the significant link between FBU at T1 and social competence at T2 (path b) was accounted for in the model. Thus, the longitudinal association between FBU in preschool and social competence in kindergarten is independent of early language ability, social competence, and EF.

4. Discussion

This longitudinal study made three important contributions to the false-belief literature. First, this study increased our understanding of the reciprocal association between FBU and social competence. Specifically, FBU in preschool accounted for unique and significant variance in social competence in kindergarten. Similarly, early social competence accounted for unique and significant variance in later FBU. Second, this study furthered our knowledge of the associations among FBU, EF, and social competence. Specifically, results support EF in preschool as a predictor of FBU in kindergarten, although this association was mediated by

FBU in preschool and was only examined for the inhibitory control aspect of EF. In addition, FBU was supported as an independent predictor of social competence, even after accounting for EF, and was identified as a possible mechanism through which early EF may affect later social competence. Third, this study extended the investigation of FBU and its correlates to low-income children. Results suggest that the proposed associations between FBU and its correlates do not appear to be specific to children from advantaged backgrounds, but generalize to low-income samples.

Overall, the associations supported in this study identify FBU as an important component for future interventions or curricula designed to promote children's social competence or correct problem behavior. Extant literature suggests that disruptive behavior disorders may begin as early as preschool and are relatively stable throughout childhood (Rose, Rose, & Feldman, 1989; Wehby, Dodge, Valente, et al., 1993). Furthermore, recent research suggests that children's social competence in preschool has a lasting effect on peer acceptance, regardless of subsequent modifications in their social conduct (see review, Johnson, Ironsmith, Snow, & Poteat, 2000). The implications of our research for such efforts are highlighted below.

The first aim of this study was to determine the direction of the association between FBU and social competence over the transition from preschool to kindergarten. Results indicated that early FBU accounted for significant variance in later social competence. This finding supports the theory that the ability to simultaneously consider counterfactual and conflicting beliefs stimulates positive social interaction (Astington & Jenkins, 1995; Capage & Watson, 2001). There was also support for the opposite association, in which social competence in preschool accounted for unique variance in FBU in kindergarten. This finding supports the theory that positive social interaction motivates the acquisition of FBU (Flavell et al., 1987; Youngblade & Dunn, 1995). Taken together, these results indicate a reciprocal association between FBU and social competence, which is consistent with the notion that the ability to understand one's own and other's minds promotes favorable social interaction, and that constructive social interactions present the opportunity for learning more about mental states (Astington, 2003; Hughes & Leekam, 2004). These results have implications for efforts to enhance FBU and social competence, as they highlight the closely intertwined nature of these constructs during early childhood and support the need for training studies of FBU to further specify the mechanisms underling this association.

The second aim of this study was to examine the longitudinal association between FBU and EF, as well as to investigate how these constructs fit into a mediation model predicting social competence. Results indicated that early EF, particularly inhibitory control, was related to later FBU, but that the association was a result of the concurrent EF-FBU link in preschool. Thus, although a direct association between early EF and later FBU was not supported in the present study, analyses did support an indirect association between these variables, via initial FBU. This finding is consistent with previous research reporting EF as predictor of FB (Carlson et al., 2004; Hughes, 1998b) and suggests the need for further research into the basis of this association.

Associations among EF, FBU, and social competence were also examined within a mediation framework. Although the results of previous studies have implied mediation models (e.g., Hughes et al., 1998), this study is the first to specify and test such a model using longitudinal data. Specifically, it was hypothesized that FBU would partially mediate the association between early EF and later social competence. Although the proposed model was not supported, the results of the analyses are interesting and offer insight into the longitudinal associations among these constructs. First, the results from Step 2 (FBU at T1 regressed on EF at T1) are consistent with literature reporting a concurrent association between FBU and EF, particularly inhibitory control, in preschool (Carlson & Moses, 2001). Second, the results from

Step 3 (social competence at T2 regressed simultaneously on EF at T1 and FBU at T1) identify FBU in preschool as a unique predictor of social competence in kindergarten, even after accounting for early inhibitory control. In sum, this study highlights the early EF-FBU link as an important contributor to the development of children's social competence. While there is evidence that training can promote children's EF (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005) and FBU (Clements, Rustin, & McCallum, 2000), the implications of these enhancements for children's social competence are unknown. Thus, incorporating EF and FBU skills in early curricula may enhance development across both cognitive and social domains.

The third aim of this study was to learn more about the associations between FBU and its correlates among low-income children. Research has only recently begun to extend the study of FBU to low SES samples. Although the study was not designed to make direct comparisons of FBU across income levels, several remarks can be made with respect to the performance of these children relative to previous studies. The rates of success on the unexpected locations and unexpected contents tasks at T1 for the children in this study were almost identical to those reported for a sample of Head Start preschoolers of a similar age (Holmes et al., 1996), but fall below the 55% and higher rates typically reported for higher SES children (Wellman et al., 2001). The children in this sample also demonstrated difficulty with EF. The mean percent correct for the peg-tapping task was 59% at T1, compared with 80% and above in higher SES samples of children the same age (Diamond & Taylor, 1996).

It is important to note that FBU and EF performance may differ across income levels due to a number of factors, such as familiarity with the format of the tasks or comfort level with the interview process. Moreover, the assumed norms for the FBU and EF tasks were derived from studies with nonrepresentative samples. Thus, it is possible that if FBU tasks were administered nationally, the norms might lag behind the assumed norms based on studies with more advantaged children. Therefore, we urge caution in concluding that these variations in performance reflect fundamental differences in the acquisition of FBU or EF.

The children in this study demonstrated levels of language ability and social competence that approximated national averages. Specifically, the mean PPVT score for this sample was almost equivalent to age-based standard mean score of 100. Similarly, the mean PKBS scores for the present sample were within or slightly above the normative range of 81 to 83. Thus, despite their low-income backgrounds, children in this sample did not demonstrate deficits in receptive vocabulary or social competence. Given that assessments occurred at the end of the preschool year, and that Head Start has been especially successful in promoting children's vocabulary and social skills (Administration for Children and Families, 2003), it is possible that children entered preschool at a disadvantage in terms of these skills and benefited from the program. Future research should explore whether similar benefits can be achieved for FBU and EF.

As expected, the results of the present study suggest that the targeted associations previously reported for higher-income samples are also relevant for low SES samples. Moreover, the magnitudes of these associations closely resemble those reported for advantaged samples. For example, in the present study, after controlling for its correlates, FBU in preschool accounted for 7% of unique variance in social competence in kindergarten, which approximates the 8 to 14% range reported for higher income samples (see Astington, 2003; Watson et al., 1999). Likewise, the strength of the correlations between FBU and EF coincided with the .30 to .60 range typically reported in the literature (Carlson & Moses, 2001; Frye et al., 1995). These results suggest consistency for the associations between FBU and its correlates across SES levels. Thus, the above-mentioned intervention applications might benefit children from different SES levels in similar ways, although given the assumed deficit of low SES children, differences in the magnitude of the effects would be interesting to examine.

Although this study provides important information in an area largely unaddressed by previous research, it is not without limitations. First, findings indicate potential methodological limitations. For example, the correlation between FBU and social competence in kindergarten was moderate and in the expected direction, but failed to reach the level of significance, which is surprising and inconsistent with previous research (e.g., Astington & Jenkins, 1995; Razza & Blair, 2003; Watson et al., 1999). Teacher-bias in preschool and a ceiling effect in kindergarten may have resulted in reduced variance on the social competence measure at T1 and the FBU measures at T2, respectively. Thus, future research should include observational measures of social competence and FBU batteries that vary with age in the interest of detecting meaningful associations. In addition, children's above-average performance on the FIST may have contributed to the lack of findings with this measure in our study. Specifically, the mean score of children in this sample was 73%, which is substantially higher than the mean score of similar-aged children, which approximates 50% (Jacques and Zelazo, 2001). Thus, the lack of an association between the FIST and FBU might be due to the low variance resulting from high scores on the FIST paired with floor effects on FBU at T1 and ceiling effects at T2.

Second, the present study examined associations between FBU and its correlates over one year in early childhood. Consequently, the results are specific to the period across preschool and kindergarten. Given that FBU is typically acquired by 5 years of age (Wellman et al., 2001), it is possible that the associations among constructs may differ with age. For example, the longitudinal association between EF and FBU may be stronger, or only exist, across earlier ages. Furthermore, the present study can only identify the immediate implications of FBU for children's social competence. Thus, the question of whether early FBU has long-term implications for children's social competence remains unanswered. Future research should address these related issues by altering the timeframe of the study. Specifically, to learn more about the directional association between FBU and EF, future studies should examine these constructs across earlier periods in childhood and continue to assess children's social competence across the elementary school years.

Given that majority (87%) of children in the present study were Caucasian, a third limitation is the homogeneity of the sample. According to the Head Start Bureau (2006), in the fiscal year 2005, the national Head Start racial composition was dominated by the following three groups: Hispanic (31.2%), Black (31.1%), and White (26.9%). Although Hispanic and Black children embody a substantial proportion of the Head Start population, these two groups were largely underrepresented in the present study. Therefore, it is unclear whether the current findings would generalize to low-income children from these or other ethnic backgrounds. Future research should examine the proposed associations in more ethnically diverse samples.

In sum, our study highlights significant associations among FBU, EF, and social competence during early childhood and supports their relevance for low-income children. Results identify FBU as an important component for the promotion of children's social competence and suggest avenues for future research in this area.

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Figure 1.

False-belief understanding in preschool as a mediator of the association between executive function in preschool and false-belief understanding in kindergarten

Note. Path a represents the effect of the predictor on the mediator. Path b represents the effect of the mediator on the outcome, controlling for the predictor. Path c (not shown) represents the effect of the predictor on the outcome. Path c' represents the indirect effect of the predictor on the outcome, after including the mediator in the model.

Figure 2.

False-belief understanding in preschool as a mediator of the association between executive function in preschool and social competence in kindergarten

Note. Path a represents the effect of the predictor on the mediator. Path b represents the effect of the mediator on the outcome, controlling for the predictor. Path c (not shown) represents the effect of the predictor on the outcome. Path c' represents the indirect effect of the predictor on the outcome, after including the mediator in the model.

Table 1

List of constructs, measures, and time points of assessment for the study

Construct	Measure/battery	Assessment Time points
False-belief understanding	Unexpected contents task	T1 and T2
	Unexpected identity - subtask 1	
	Unexpected identity - subtask 2	
	Changed locations task	
Language ability	Peabody Picture Vocabulary Test	T1
Executive function	Peg-tapping task	T1
	Flexible-item selection task	
Social competence	Preschool and Kindergarten Behavior Scales	T1 and T2

Note. T1 = Time 1, T2 = Time 2.

Table 2

Phi contingency coefficients for false-belief tasks (N = 68)

Tasks	T1	T2
BOX - OWN	.23 ⁺	.63 ^{**}
BOX - OTHER	.27 [*]	.23 [*]
BOX - LOC	.32 ^{**}	.31 ^{**}
OWN - OTHER	.20 ⁺	.39 ^{**}
OWN - LOC	.19	.25 ⁺
OTHER - LOC	.10	.16

Note. BOX = unexpected contents task, OWN = subtask 1 of unexpected identity task, OTHER = subtask 2 of unexpected identity task, LOC = changed locations task, T1 = Time 1, T2 = Time 2.

⁺
 $p \leq .10$.

^{*}
 $p \leq .05$.

^{**}
 $p \leq .01$.

Table 3

Partial correlations among primary variables at times 1 and 2 ($N = 68$)

	FBU T1	PEG T1	FIST T1	PKBS T1	FBU T2	PKBS T2	M	SD
FBUT1	--	.31**	.18	.24*	.31**	.37**	1.59	1.00
PEGT1			.05	.39***	.24*	.22+	0.59	0.37
FIST T1				.16	.00	.07	0.73	0.15
PKBS T1					.42***	.39*	85.40	11.80
FBUT2						.20+	2.44	0.90
PKBS T2							82.84	13.30

Note. Partial correlations controlled for language ability at T1. FBU = false-belief understanding aggregate, PEG = peg-tapping task, FIST = flexible item selection task, PKBS = Preschool and Kindergarten Behavior Scales - Social Skills Scale; T1 = Time 1, T2 = Time 2.

+ $p \leq .10$.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 4Summary of hierarchical regression analysis of T2 social competence on false-belief understanding ($N = 68$)

Variable	B	SE B	β	R^2 or ΔR^2
Step 1				.16***
Language ability, T1	.30	.17	.20 ⁺	
Social competence, T1	.43	.13	.38***	
Step 2				.07***
Language ability, T1	.17	.17	.11	
Social competence, T1	.36	.12	.32**	
False-belief understanding, T1	4.05	1.54	.30*	

Note. Dependent variable = social competence at Time 2. T1 = Time 1.

⁺ $p \leq .10$.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 5Summary of hierarchical regression of T2 false-belief understanding on social competence ($N = 68$)

Variable	B	SE B	β	R^2 or ΔR^2
Step 1				.20***
Language ability, T1	.03	.01	.28*	
False-belief understanding, T1	.28	.10	.30**	
Step 2				.10***
Language ability, T1	.03	.01	.31**	
False-belief understanding, T1	.20	.10	.22*	
Social competence, T1	.03	.01	.36**	

Note. Dependent variable = false-belief understanding at Time 2. T1 = Time 1.

*
 $p \leq .05$.

**
 $p \leq .01$.

 $p \leq .001$.

Table 6Mediation analysis examining executive function and false-belief understanding ($N = 68$)

Variable	B	SE B	β	R ²
Step 1 ^a (Path c)				.16***
Executive function, T1	.58	.30	.24*	
Step 2 ^b (Path a)				.15**
Executive function, T1	.88	.33	.33**	
Step 3 ^a (Paths b and c')				.21***
Executive function, T1 (Path c')	.37	.31	.15	
False-belief understanding, T1 (Path b)	.23	.11	.26*	

Note. Language ability at T1 was a control in these analyses.

^aDependent variable = T2 false-belief understanding

^bDependent variable = T1 false-belief understanding.

*
 $p \leq .05$.

**
 $p \leq .01$.

 $p \leq .001$.

Table 7

Mediation analyses examining associations among false-belief understanding, executive function, and social competence ($N = 68$)

Variable	B	SE B	β	R ²
Step 1 ^a (Path c)				.15**
Executive function, T1	2.97	4.78	.08	
Step 2 ^b (Path a)				.15**
Executive function, T1	.74	.36	.28*	
Step 3 ^a (Paths b and c')				.22***
Executive function, T1	.00	4.74	.00	
False-belief understanding, T1	4.05	1.60	.30*	

Note. Language ability and social competence at Time 1 (T1) were controls in these analyses.

^aDependent variable = social competence at T2

^bdependent variable = false-belief understanding at T1.

*
 $p \leq .05$.

**
 $p \leq .01$.

 $p \leq .001$.