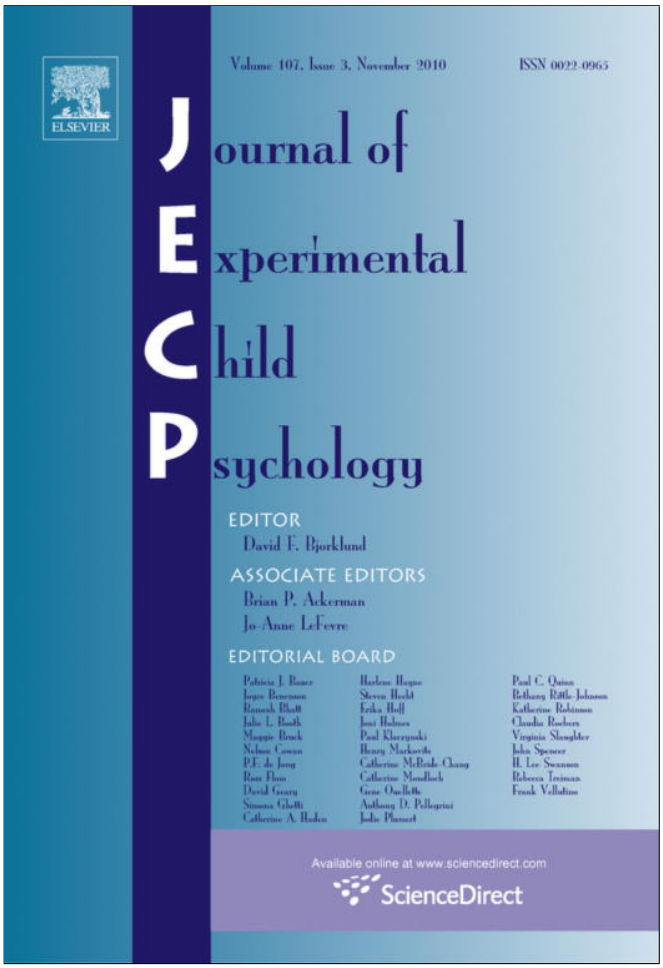

Journal of Experimental Child Psychology 107 (2010) 207–228

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Did she mean to do it? Acquiring a folk theory of intentionality

Melinda S. Mull [a,*], E. Margaret Evans [b]

[a] Department of Psychology, Augustana College, Rock Island, IL 61201, USA
[b] Center for Human Growth and Development, University of Michigan, Ann Arbor, MI 48109, USA

ARTICLE INFO

Article history:
Received 20 August 2008
Revised 29 March 2010
Available online 31 May 2010

Keywords:
Folk theory of intentionality
False belief understanding
Interpretive mind understanding
Theory of mind
Cognitive development
Preschool- and elementary-school aged children

ABSTRACT

The ability to both identify and explain others' intentional acts is fundamental for successful social interaction. In two cross-sectional studies, we investigated 3- to 9-year-olds' ($n = 148$) understanding of the folk concept of intentionality, using three types of intentionality measures. The relationship between this type of reasoning and false belief and interpretive mind understanding was also examined. Judgment of the appropriateness of an explanation was based on adult responses ($n = 20$). Overall, the results indicated that the ability to both identify and appropriately explain a range of intentional acts does not fully emerge until 7 years of age or later. The pattern of explanations revealed the gradual development of a folk concept of intentionality. Preschool- and early school-age children focused on the protagonists' desires and actions, whereas 8- and 9-year-olds and adults were more likely to reference the protagonists' awareness and skills.

Introduction

A clear understanding of the complex network of concepts that constitute a folk theory of intentionality is central to successful social functioning (Malle & Knobe, 1997). An understanding of another person's intentions is required to communicate effectively and interact appropriately (e.g., Dodge, 1980). If one girl hits another, the victim's reaction will depend on whether the act is viewed as intentional or unintentional; that is, did she mean to do it? We use this question to frame two studies on

* Corresponding author.
E-mail address: melindamull@augustana.edu (M.S. Mull).

0022-0965/$ - see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.jecp.2010.04.001

children's ability to both identify and explain intentional acts, with a focus on the transition from preschool age to school age.

Following Malle and Knobe (1997), in this article we use the term *intention* in its everyday sense as a particular mental state or concept that is embedded in a broader folk theory of intentionality. The term *intentionality* is more typically applied to a sequence of actions carried out with a particular goal in mind (Malle, Moses, & Baldwin, 2001). Importantly, one can intend to do something (intention) without ever appropriately carrying out the associated actions (intentionality). In a series of studies, Malle and Knobe (1997) asked adults to explain a variety of intentional acts. After a working definition was provided to half of the participants, adults rated whether a variety of acts should be considered as intentional (e.g., "Anne is sweating," "Anne is infatuated with Ben," "Anne watered her new plants"). There was high agreement among adult participants regardless of whether they received the working definition. In another study, adults were asked the following question: "When you say that somebody performed an action intentionally, what does this mean?" Coding the responses revealed five components that Malle and Knobe described as constituting a folk concept of intentionality: "a desire for an outcome; beliefs about an action that leads to that outcome; an intention to perform the action; skill to perform the action; and awareness of fulfilling the intention while performing the action" (p. 111). For example, if a child kicked a pile of blocks, that action would be considered intentional if the child wanted the blocks knocked over (desire), believed that kicking the blocks would knock them over (belief), tried to kick the blocks (intention), had the ability to kick the blocks (skill), and was aware of kicking the blocks while doing it (awareness). In additional studies, Malle and Knobe manipulated the presence of these components in different scenarios and asked adults to rate the intentionality of the actions. The results suggested that there is a hierarchical arrangement to the folk concept of intentionality. First, desire and belief are required to form an intention. Then, given an intention to act, skill and awareness are also required for an action to be performed with intentionality (see Fig. 1).

Malle and Knobe's (1997) model is based on research with adults, but there has been little equivalent research with children. Past research has focused on the role of desires and beliefs in children's understanding of intention (Astington & Gopnik, 1991; Wellman, 1990), but awareness and skill have not been investigated. Nor have there been developmental studies of the relationship among these components. In the current studies, we use Malle and Knobe's model as a framework for examining how the understanding of more complex aspects of intentionality might emerge.

First, we review extant research on the development of an understanding of intention. In infancy research, the focus has been on whether infants recognize the special status of intention-in-action (Searle, 1983), more often called goal-directed action. What is clear from the research on this topic is that by 12 months of age, infants are skilled at responding to the behavioral concomitants of goal-directed action such as the self-generation of a protagonist's actions and the direction of a protagonist's gaze or limb movements (Tomasello, Carpenter, Call, Behne, & Moll, 2005). What is less clear is the extent to which infants understand the prior intention (Searle, 1983) in pursuit of a goal. Dunphy-Lelii and Wellman (2004) argued that 14- and 18-month-olds understand that looking is referential in the sense that it is directed toward a target, whereas preschoolers also grasp that looking elicits a visual experience. This suggests that although toddlers may possess a rudimentary understanding of intention, perhaps based on behavioral cues, they do not yet have anything approaching a mentalistic theory of intentionality (Malle & Knobe, 1997).

As stated earlier, one can intend to do something without carrying out the associated actions (Feinfield, Lee, Flavell, Green, & Flavell, 1999). To grasp this distinction, children should differentiate among prior intention, the mental representational component, and the goal-directed action (Bartsch

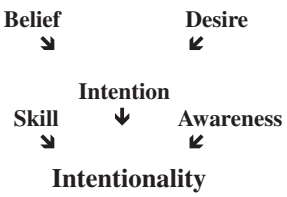

Fig. 1. A model of Malle and Knobe's (1997) folk concept of intentionality.

& Wellman, 1995). To determine when children acquire this differentiated conception, Feinfield and colleagues (1999) presented 3- and 4-year-olds with situations in which the character's intentions, desires, and outcomes differed. The 4-year-olds grasped the concepts of prior intention and intention-in-action, whereas the 3-year-olds performed at below chance levels on the intention-in-action question and only at chance on the prior intention question.

To find out whether preschoolers can infer an agent's intention based on the agent's behavior, Astington and Lee (1991, cited in Feinfield et al., 1999) presented preschoolers with two stories, one intentional and one unintentional, where the outcome was identical. In one story, a girl throws some crumbs on the ground and birds eat them, whereas in the second story, the girl drops some crumbs on the ground and birds eat them. Children were asked, "Which girl meant for the birds to eat the crumbs?" The youngest children (3- and 4-year-olds) performed poorly, whereas 5-year-olds succeeded. In these tasks, both characters were aware of the birds' presence and the outcomes were identical. However, only one character intended to bring about the outcome.

In studies of 3- to 7-year-olds' ability to make the distinction between intentions and desires, Schult (2002) found that only 5- and 7-year-olds consistently made this distinction. Schult suggested that 3- and 4-year-olds' difficulty might be due to a lack of understanding of the causal relation between beliefs/intentions and actions. For example, if a child wanted to knock over some blocks and then kicked the blocks, one could infer that the child's kicking was intentional. However, if instead the child tripped and knocked the blocks over, one should not infer that the fall was intentional even though the goal was achieved. According to Searle (1983), an action needs to be carried out in the right way for the intention to be satisfied. Such distinctions could not be made with a simple desire–outcome matching strategy. Furthermore, to make this distinction, children should realize that the action is causally linked to the beliefs/intentions of the actor. This suggests that a representational understanding of mind, in which children understand, for example, that beliefs are mental representations that may or may not reflect reality, is necessary for reasoning about the intentionality of the act.

Joseph and Tager-Flusberg (1999) tested 3- to 5-year-olds' ability to distinguish between intended and unintended actions on the basis of the agent's desire and knowledge (having vs. not having the relevant knowledge to intend to bring about the outcome). All age groups had little difficulty in imputing intention on the basis of desire, whereas only the 5-year-olds accurately imputed intention based on knowledge. False belief tasks assessing children's representational understanding of mind were also administered. All age groups performed better on the false belief tasks than on the knowledge intention task. Joseph and Tager-Flusberg also assessed children's explanations of intention. By 5 years of age, appropriate explanations, referring to the character's knowledge, were produced 66% of the time. Before this age, appropriate explanations were given at levels below chance. Such research indicates that intentions inferred from desires are understood before the attainment of false belief understanding and that intentions inferred from knowledge are understood after the attainment of false belief understanding.

During middle and late childhood, children begin to understand the mind as interpretive, which some researchers argue is qualitatively different from a representational understanding of mind (e.g., Carpendale & Chandler, 1996). Viewing the mind in this way involves the realization that different minds can interpret the same events differently and, more important, that both of the interpretations may be valid. Although it is often believed that passing the false belief task requires this type of understanding (e.g., Ruffman, Olson, & Astington, 1991), Carpendale and Chandler (1996) demonstrated that children do not recognize the mind as interpretive until around 7 or 8 years of age. In a series of experiments, 5- to 8-year-olds were tested on a number of interpretive mind and false belief tasks. All participants passed the false belief tasks, whereas only the 7- and 8-year-olds were successful on the interpretive mind tasks.

Overall, this research indicates that although 2-year-olds may respond appropriately to goal-directed actions, it is not until the preschool years that children reliably distinguish between the prior intent and the goal-directed action. Furthermore, as this review indicates, intentions based on desires are understood earlier than intentions based on beliefs (see also Bartsch & Wellman, 1995; Moses, 1993; Wellman & Liu, 2004; Wellman & Woolley, 1990).

What are the implications of this progression? Although it could be argued that infants have a rudimentary understanding of intention (e.g., Brandone & Wellman, 2009), they are not yet able to judge

prior intent. Over the preschool and elementary school years, children gradually acquire a mentalistic understanding of intention, but little is known about their understanding of intentionality. In Malle and Knobe's (1997) framework, the components of intentionality are arranged hierarchically; whereas belief and desire underlie an understanding of intention, skill and awareness are also necessary to judge the full intentionality of an act (see Fig. 1). Plausibly, the developmental acquisition of these components might reflect this framework, with skill and awareness appearing later in the developmental trajectory. Furthermore, as this review indicates, given that the acquisition of a representational theory of mind is associated with children's grasp of intention based on beliefs, it seems plausible that the acquisition of an interpretive theory of mind might be associated with the emergence of more complex concepts.

The goal of the current investigation was to chart age-related changes in children's understanding of the components of intentionality and to explore how this understanding might be related to other aspects of an understanding of mind. Based on Malle and Knobe's (1997) framework and the above research, we assessed whether the two foundational components of a folk theory of intentionality, namely desire and belief, were understood prior to the other components, namely intention, skill, and awareness. In addition, we examined whether false belief and interpretive mind understanding were related to the developmental sequence. The focus of the first study was the reasoning of 5- to 9-year-olds, and preschoolers and adults were also included in the second study. In both studies, we incorporated three measures of intentionality. Two measures were adapted from previous research, and the third measure was created for the current research. To improve the reliability of the measures, we included three tasks for each measure. Furthermore, and in contrast to much of the previous research, for each task identification questions (e.g., "Who meant to do it?") and explanation questions (e.g., "Why?"/"Why not?") were included.

The first measure, the behavior–intentionality measure, was based on tasks (described earlier) used by Astington and Lee (1991, cited in Feinfield et al., 1999) where children were asked to infer an agent's intention based on the agent's behavior (e.g., throwing vs. dropping). An inference of intentionality in these tasks required participants to focus on the physical actions of the protagonists and/or the language describing the action. If children performed well on this measure but poorly on other measures that require mental states to infer intention, this might suggest that children rely more heavily on a behavioristic model to reason about intentionality.

The second measure, the skill–intentionality measure, was created for the current study. These tasks required children to infer the likely intentionality of the action based on the character's level of skill that was inferred from the character's age. According to Malle and Knobe (1997), a protagonist must have the skill to perform an act if the act is to be considered intentional. For example, suppose that a toddler wished to type his or her name on a keyboard, but due to a lack of skill, the toddler could not perform this act intentionally. If the child happened to be successful (e.g., due to luck), we would not conclude that the child had typed the name intentionally.

The third measure, the awareness–intentionality measure, was derived from Joseph and Tager-Flusberg's (1999) research described earlier. This measure assessed whether children recognized that for an action to be considered as intentional, protagonists must be aware that they are performing an action (Malle & Knobe, 1997). The tasks involved two characters carrying out an action, but only one of them was aware that he or she was doing so. Awareness was manipulated via visual access. Joseph and Tager-Flusberg (1999) referred to this task as knowledge intention, but because their use of this term resembles Malle and Knobe's (1997) use of the term *awareness,* the latter was used in these studies.

Study 1

The first goal of Study 1 was to chart the development of early school-age children's ability to reason about the different components of intentionality, focusing on awareness and skill. The second goal was to compare the results with the age-related changes in children's understanding of the mind as representational and interpretive. Children between 5 and 9 years of age completed measures of false belief and interpretive mind understanding and the three intentionality measures. In keeping with Carpendale and Chandler's (1996) research, false-belief understanding was assessed even though,

given the age of the sample, it was expected that most children would do well. The interpretive theory of mind measure was adopted from Carpendale and Chandler. Based on prior research, we hypothesized that children would be able to identify an intentional act based on behavioral indicators but that appropriate explanations of an intentional act would require a grasp of the mentalistic components, a folk theory of intentionality, that comprise the plan of action. Therefore, we predicted that all children would perform well on the identification questions but that only older children would provide appropriate explanations referencing awareness and skill.

Method

Participants

Participants were 86 children (41 boys and 45 girls). There were 19 5-year-olds (range = 5 years 0 months to 5 years 11 months, *M* = 5 years 5 months), 18 6-year-olds (range = 6 years 0 months to 6 years 11 months, *M* = 6 years 5 months), 16 7-year-olds (range = 7 years 1 month to 7 years 11 months, *M* = 7 years 6 months), 16 8-year-olds (range = 8 years 0 months to 8 years 9 months, *M* = 8 years 5 months), and 17 9-year-olds (range = 9 years 0 months to 9 years 11 months, *M* = 9 years 5 months). Children's names were obtained from a database of collected birth records in a midwestern U.S. city, and parents were recruited by letter and telephone. Of the 86 participants, 80 (93%) were Caucasian and 6 (7%) were from minority groups. Parents' education level was measured using a 6-point scale (1 = *some high school*, 2 = *high school*, 3 = *some college*, 4 = *2-year college*, 5 = *4-year college*, 6 = *graduate school*). The mean education level for mothers was 4.4 (range = 1–5), and the mean for fathers was also 4.4 (range = 1–5); these means did not differ among the five age groups.

Procedure

Children completed four false belief tasks, three interpretive mind tasks, and nine intentionality tasks. There were three types of intentionality measures, with three versions of each type. The three types were behavior–intentionality, skill–intentionality, and awareness–intentionality. The false belief tasks were expected to be easy, so they also served as warm-up tasks. The interpretive mind and intentionality tasks were presented in random order as stories in a picture book format, with photographs of adults acting out each scene. The experimenter drew children's attention to the appropriate incident by pointing to the relevant photo during the narration. The experimenter asked the test questions and recorded children's responses. Each session was also audio-recorded to allow responses to be verified later if necessary. Children were tested individually in a laboratory setting, and the average length of each session was 18 min.

Measures

False belief measure. The false belief measure included adult actors in real-life scenarios who depicted the four false belief tasks on video, in one of two fixed random orders, while a narrator described the actors' actions. Two of the tasks were simple versions of the standard change in location paradigm (Wimmer & Perner, 1983). The other two were versions of the standard unexpected content paradigm (Perner, Leekham, & Wimmer, 1987).

Each false belief task was followed by four questions. The first two were control questions that verified whether children understood the sequence of events (e.g., "Where did Bob put the cookies before he left the room?"). These were answered correctly by all but two children, who were excluded from analyses using the false belief measure. Following the control questions, two test questions were asked (e.g., "Where will Bob think the cookies are?" and "Where will Bob look for the cookies?"). For each task, correct answers on both test questions were required to receive a passing score of 1; if one or both of the test questions were answered incorrectly, the score was 0 (range = 0–4).

Interpretive mind measure. Each of the three interpretive mind tasks involved objects that were interpreted in different ways by two characters (Carpendale & Chandler, 1996). For example, one task depicted two characters looking at three cards. Participants were told the following: "This is Mike and this is Mary. Mike is sitting at a table looking at some cards. On the back of the cards there is a green star, a green square, and an orange circle. Over here, Mary is sitting at a table looking at the same

cards. Somebody tells them that there is a penny hidden under the card with the green shape. So Mike chooses the card with the green star and Mary chooses the card with the green square."

Three explanation questions were asked: "Does it make sense for Mike to choose the green star?," "Does it make sense for Mary to choose the green square?," and "Why does/doesn't it make sense?" Participants needed to indicate that both of the characters' choices were sensible by responding "yes" to the first two questions and also refer to the ambiguous nature of the task in the third question to receive 1 point. The total range of scores was 0–3. Even though the first two questions are answered with a simple yes/no response, they are still considered as explanation questions because without the recognition of the ambiguous nature of the task, the response to the third question is meaningless. Following the explanation questions, a prediction question was asked: "If we showed these cards to someone else, which card would they choose?" Children were scored as failing (0 points) if they made a specific prediction on behalf of a third person or failed to make a prediction but could not explain why. Children were scored as passing (1 point) if they refused to make a prediction and explained why it would be difficult to do so (e.g., "They could choose either green shape"). The total range of scores was 0–3. The scoring method for both the explanation and prediction questions was adopted from Carpendale and Chandler (1996). Finally, the explanation score (range = 0–3) and the prediction score (range = 0–3) from all three tasks were summed to create the interpretive mind score (range = 0–6).

Intentionality measures

1. Behavior–intentionality measure:

The three behavior–intentionality tasks were based on Astington and Lee (1991, cited in Feinfield et al., 1999). For each task, two protagonists were depicted as behaving in similar ways with identical outcomes (see Appendix A). Only one protagonist intended to bring about the outcome and directed his or her actions toward the target. For example, in one task, there was a series of pictures depicting a boy, "Brian," and a girl, "Judy." Each carried some food outside, where each saw a dog. In the intentional incident, Judy throws the food on the ground and the dog eats the food; in the unintentional incident, Brian drops the food on the ground and the dog eats the food. Following the task, three questions were asked: "Who meant to feed the dog, Judy or Brian?" (identification), "Why do you think it was Judy/Brian?" (Explanation A), and "Why don't you think it was Brian/Judy?" (Explanation B). It should be noted that the explanation questions elicited explanations of the participants' own reasoning rather than explanations of why the protagonists acted as they did.

2. Skill–intentionality measure:

The second type of intentionality measure assessed an understanding of intention based on the skill of the protagonists that was inferred from their age (see Appendix B). For example, one picture depicted a toddler cutting a piece of paper, and the other depicted the toddler's mother cutting a piece of paper. Each protagonist used the same scissors, paper, and hand actions. Participants were told that "Sam" was only 2 years old and that "Sally" was his mom and that they were cutting some orange paper. The final picture showed only a perfectly cut orange paper star; no people were present. Therefore, to answer the identification question correctly, one must recognize that skill is necessary to perform the action and the skill can be inferred from the age of the protagonist. Following the task, three questions were asked: "Who meant to cut out the orange star, Sally or Sam?" (identification), "Why do you think it was Sam/Sally?" (Explanation A), and "Why don't you think it was Sally/Sam?" (Explanation B).

3. Awareness–intentionality measure:

The three awareness–intentionality tasks were based on Joseph and Tager-Flusberg (1999). In all tasks, the narrator drew participants' attention to the direction of the protagonist's gaze. Only the protagonist who was looking at the target while acting had the requisite awareness to perform the act intentionally even though the outcome was identical in the intentional and unintentional incidents (see Appendix C). For example, in one task, there was a series of pictures with a male protagonist, "Steve," and a female protagonist, "Jenny." Both were walking into a room that had a stack of blocks on the floor. Participants were then told a story in which it was made clear that only Steve had seen the blocks before walking into them and knocking them over. The next set of pictures showed the fallen blocks, with Steve looking at the blocks in the intentional incident and Jenny looking away from the blocks in the unintentional incident. Following the story, three questions were asked: "Who meant to

knock over the blocks, Steve or Jenny?" (identification), "Why do you think it was Steve/Jenny?" (Explanation A), and "Why don't you think it was Jenny/Steve?" (Explanation B).

In the behavior–intentionality and awareness–intentionality measures, male and female characters were randomly assigned to the intentional and unintentional incidents, and in all intentionality measures each type of incident (intentional vs. unintentional) was randomly assigned to the first or second position in the narrated story.

4. Intentionality measures scoring and coding:

Regarding identification questions, for each intentionality task, the identification question ("Who meant to do X?") was given 1 point for a correct answer and 0 points for an incorrect answer. For each intentionality measure, the range of scores was 0–3.

Regarding explanation questions, a coding scheme based on Malle and Knobe's (1997) categories was created to code responses to the explanation questions ("Why do you think it was X?") regardless of whether the response to the identification question was correct (see Appendix D for the complete coding scheme). Additional categories beyond those of Malle and Knobe that reflected the tasks used in this research were also added. For the initial coding by two raters (one unaware of the hypotheses and both unaware of children's ages), overall interrater agreement collapsed across all explanations was 94% ($N = 86$). Following this, all responses were coded to 100% agreement. Based on the pattern of adult responses (reported in detail in Study 2, Table 2), explanations that were used by adults at least 10% of the time were considered as appropriate for each of the three intentionality measures. For both the behavior–intentionality and awareness–intentionality measures, awareness, action, and intention all were considered as appropriate explanations. For the skill–intentionality measure, skill and age were considered as appropriate. For each question, an explanation was coded as present only once even if the same explanation was repeated for that question. It was possible for participants to provide more than one explanation for a single question. For example, if a participant provided two desire explanations and one action explanation for the same question, both desire and action were coded only once. Therefore, repetitions were not included in the total number of explanations.

An explanation score was created for each intentionality measure and consisted of the number of appropriate explanations for that measure summed across the six explanation questions (two per task). The number of appropriate explanations was then divided by the total number of explanations given by each participant for that measure. This created an adjusted explanation score. Therefore, if two participants both provided six appropriate responses, but one of them also gave six other inappropriate responses, their adjusted scores would differ. The more talkative participant would receive an adjusted score of .5, and the other participant would receive a score of 1.0 (range = 0–1). A child who provides inappropriate explanations along with appropriate explanations might not possess the same understanding as a child who offers only appropriate explanations. The adjusted explanation score allows this distinction to be made, whereas simply noting the presence or absence of appropriate explanations would not do so.

Results

False belief measure

A one-way analysis of variance (ANOVA) indicated that there were no significant age effects for false belief ($p = .58$).[1] Because they all scored at ceiling, the 9-year-olds were not included in this analysis. As anticipated, all age groups performed significantly above chance: 5-year-olds ($M = 3.16$, $SD = 1.34$), $t(18) = 3.76$, $p = .002$; 6-year-olds ($M = 3.44$, $SD = 1.04$), $t(17) = 4.93$, $p = .0001$; 7-year-olds ($M = 3.38$, $SD = 1.15$), $t(15) = 4.79$, $p = .0002$; 8-year-olds ($M = 3.69$, $SD = 0.87$), $t(15) = 7.73$, $p < .0001$; 9-year-olds ($M = 4.00$, $SD = 0.00$) (range = 0–4).

Interpretive mind measure

A one-way ANOVA on the interpretive mind measure revealed significant age differences, $F(3, 63) = 3.87$, $p = .013$. Because they scored so close to floor, the 5-year-olds were not included in this

[1] Gender was included as an independent variable in all ANOVAs for Study 1. There were no significant main effects or interactions.

analysis. Post hoc comparisons revealed that the scores of the 8- and 9-year-olds were higher than those of the 6-year-olds (*p*s < .01). However, not even the oldest age group scored well on this measure: 5-year-olds $M = 0.05$, $SD = 0.23$; 6-year-olds $M = 0.61$, $SD = 1.38$; 7-year-olds $M = 1.25$, $SD = 1.53$; 8-year-olds $M = 2.38$, $SD = 2.16$; 9-year-olds $M = 2.29$, $SD = 2.02$ (range = 0–6).

Intentionality identification questions

An Age (5, 6, 7, 8, or 9 years) × Intentionality Measure (behavior, skill, or awareness) repeated measures ANOVA on the identification score revealed significant main effects for age, $F(4, 81) = 7.50$, $p < .0001$, and intentionality measure, $F(2, 162) = 23.56$, $p < .0001$, and a significant Age × Intentionality Measure interaction, $F(8, 162) = 2.99$, $p = .004$. To explore the Age × Intentionality Measure interaction, each of the intentionality measures was analyzed individually using one-way ANOVAs (see Fig. 2A–C for means and standard errors). Significant effects were then explored using Bonferroni–Dunn post hoc comparisons.

For the behavior–intentionality measure, no significant age differences were found on the identification question, $F(4, 81) = 2.27$, $p = .07$ (see Fig. 2A). Because they scored at ceiling, the 8- and 9-year-olds were not included in the analysis. All age groups performed significantly above chance: 5-year-olds ($M = 2.68$, $SD = 0.58$), $t(18) = 8.86$, $p < .0001$; 6-year-olds ($M = 2.83$, $SD = 0.51$), $t(17) = 10.99$, $p < .0001$; 7-year-olds ($M = 2.94$, $SD = 0.25$), $t(15) = 23.00$, $p < .0001$ (range = 0–3). Similar findings were reported by Astington and Lee (1991, cited in Feinfield et al., 1999).

For the skill–intentionality measure, no significant age differences were found on the identification question, $F(4, 81) = 2.47$, $p = .06$ (see Fig. 2B). All age groups scored significantly higher than chance levels: 5-year-olds ($M = 2.32$, $SD = 0.82$), $t(18) = 4.34$, $p = .0004$; 6-year-olds ($M = 2.61$, $SD = 0.78$), $t(17) = 6.06$, $p < .0001$; 7-year-olds ($M = 2.88$, $SD = 0.34$), $t(15) = 16.10$, $p < .0001$; 8-year-olds ($M = 2.75$, $SD = 0.45$), $t(15) = 11.18$, $p < .0001$; 9-year-olds ($M = 2.82$, $SD = 0.39$), $t(16) = 13.89$, $p < .0001$ (range = 0–3).

For the awareness–intentionality measure, there was a significant effect for age on the identification question, $F(4, 81) = 5.73$, $p = .0004$ (see Fig. 2C). The 5- and 6-year-olds performed at lower levels than the 8- and 9-year-olds (*p*s < .005). Furthermore, the 5- and 6-year-olds' rate of responding did not differ from chance levels, whereas the 7-, 8-, and 9-year-olds' scores were significantly higher than chance: 7-year-olds ($M = 2.25$, $SD = 1.13$), $t(15) = 2.67$, $p = .0176$; 8-year-olds ($M = 2.75$, $SD = 0.78$), $t(15) = 6.46$, $p < .0001$; 9-year-olds ($M = 2.77$, $SD = 0.75$), $t(16) = 6.93$, $p < .0001$ (range = 0–3).

Explanation of intentionality questions

An Age (5, 6, 7, 8, or 9 years) × Intentionality Measure (behavior, skill, or awareness) repeated measures ANOVA on the adjusted explanation score revealed significant main effects for age, $F(4, 77) = 6.58$, $p < .0001$, and intentionality measure, $F(2, 154) = 4.62$, $p = .011$. However, there was no significant Age × Intentionality Measure interaction, $F(8, 154) = 1.51$, $p = .16$. Post hoc comparisons on the main effect of age revealed that the 5- and 6-year-olds provided fewer appropriate explanations than the 8- and 9-year-olds (*p*s < .005). In addition, post hoc comparisons on the main effect of intentionality measure revealed that overall the children offered more appropriate explanations for the behavior–intentionality measure than for the awareness–intentionality measure ($p = .003$) (see Fig. 3A–C for means and standard errors).

Although the adjusted explanation score was the primary measure and was used for the above analysis, descriptive information about the types of explanations children in each age group provided (as percentages of the total) is provided in Table 1. To explore this pattern of explanations, one-way ANOVAs were performed on key explanation types within each measure. Significant effects were then examined using Bonferroni–Dunn post hoc comparisons. The dependent variables were the number of times each explanation type was articulated across the six questions (range = 0–6) divided by the total number of explanations given by that child and expressed as a percentage.

For the behavior–intentionality measure, there was a significant effect for age on the percentage of action explanations provided, $F(4, 79) = 3.46$, $p < .05$. The 5- and 6-year-olds provided fewer action explanations than the 9-year-olds (*p*s < .005). For the skill–intentionality measure, there was a significant effect for age on the percentage of skill explanations, $F(4, 78) = 3.71$, $p < .01$. The 5-year-olds offered fewer skill explanations than the 7- and 8-year-olds (*p*s < .005). Finally, for the awareness–

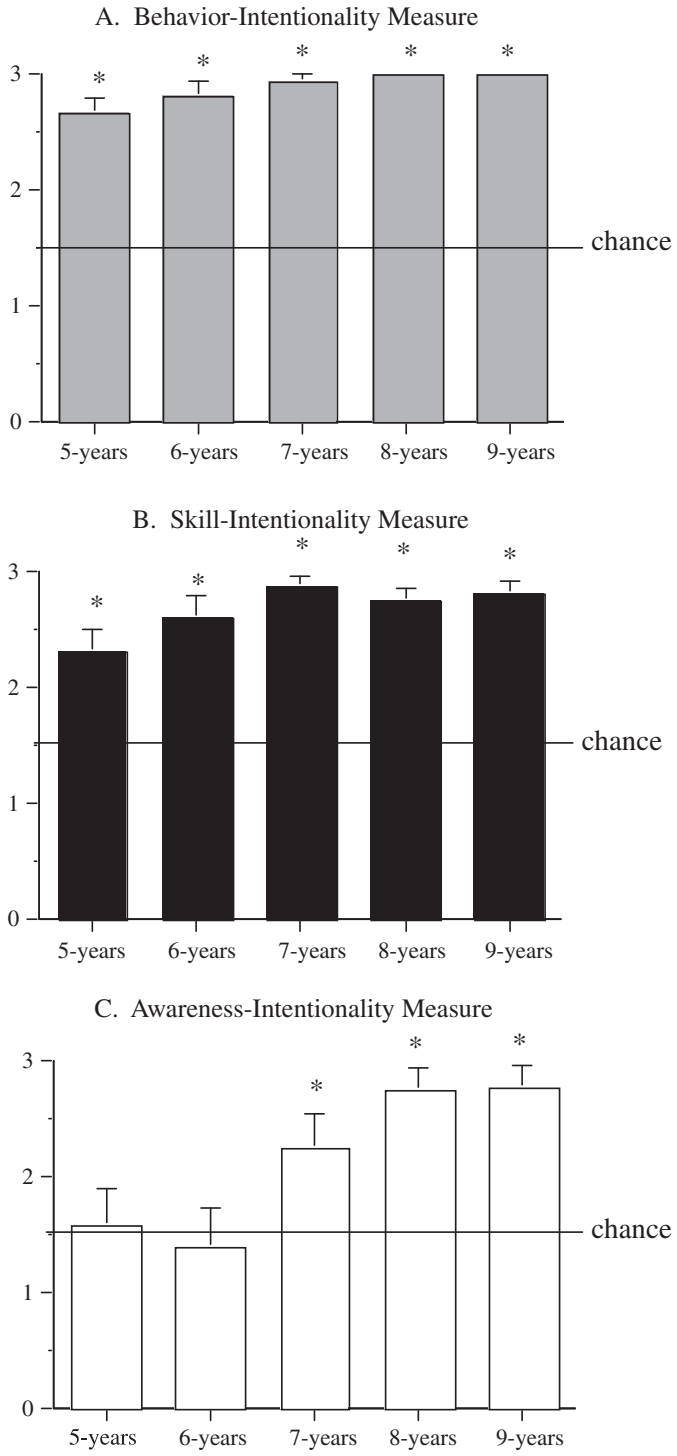

Fig. 2. Participants' mean identification scores on the three intentionality measures in Study 1. ∗Indicates that the mean score differed significantly from chance.

intentionality measure, there was a significant effect for age on the percentage of awareness explanations, $F(4, 80) = 5.17$, $p < .001$. The 5- and 6-year-olds offered fewer awareness explanations than the 8- and 9-year-olds ($ps < .005$).

Discussion

Overall, the results of Study 1 suggest that early school-age children correctly identify a behavior as intentional but that their ability to explain the intentionality of the act continues to develop beyond

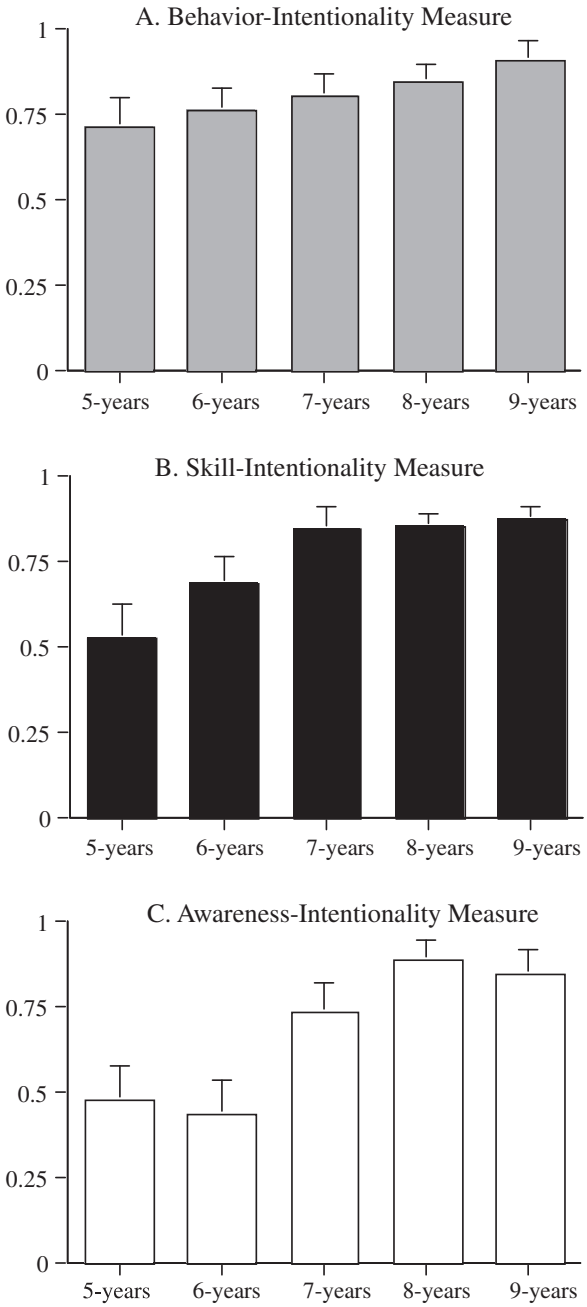

Fig. 3. Participants' mean adjusted explanation scores on the three intentionality measures in Study 1.

the early school-age years. Only on the awareness–intentionality measure did children's identification of the intentional agent improve much beyond 5 years. In the other two measures, there were no age-related differences, with all age groups performing well. The behavior–intentionality measure was the easiest for all age groups. In contrast, when explaining why they thought a particular action was intentional, children did not consistently provide appropriate explanations until at least 7 years of age on the skill–intentionality and awareness–intentionality measures.

All children scored well on the false belief measure. However, even though the 5- and 6-year-olds possessed this understanding, they did not provide appropriate explanations on the awareness–intentionality and skill–intentionality measures. This suggests that a representational understanding of mind may be necessary, but not sufficient, for the development of a complete understanding of intentionality. The interpretive mind measure, however, proved to be particularly difficult even for the oldest children, although there were significant age-related improvements. These findings partially

Table 1
Study 1: For each intentionality measure, group mean percentage scores for each type of explanation for each age group.

Age (years)	Belief	Skill	Awareness	Desire	Intention	Action	Age	Other	Don't know
Behavior–intentionality measure									
5	0	0	32	4	0	39	0	14	11
6	0	0	36	4	4	37	0	14	5
7	0	0	18	9	5	58	0	10	0
8	1	0	17	5	9	59	0	9	0
9	0	0	19	0	7	65	0	8	1
Skill–intentionality measure									
5	0	23	12	1	0	7	30	11	16
6	0	41	8	1	0	9	28	8	5
7	0	47	2	3	0	4	39	4	1
8	0	50	0	1	2	2	35	9	1
9	0	39	0	0	1	5	49	5	1

Age (years)	Belief	Skill	Awareness	Illogical	Desire	Intention	Action	Age	Other	Don't know
Awareness–intentionality measure										
5	1	0	46	29	1	1	1	0	9	12
6	0	0	43	47	1	1	0	0	5	3
7	1	0	67	17	1	5	2	0	6	1
8	0	0	87	7	3	2	0	0	1	0
9	1	0	83	8	4	1	1	0	1	1

Table 2
Study 2: For each intentionality measure, group mean percentage scores for each type of explanation for each age group.

Age (years)	Belief	Skill	Awareness	Desire	Intention	Action	Age	Other	Don't know
Behavior intention measure									
3–4	3	0	10	13	2	22	0	33	17
5–6	1	0	26	5	4	41	1	16	6
8–9	1	0	19	0	14	58	0	8	0
Adults	0	0	10	0	33	56	0	1	0
Skill intention measure									
3–4	0	6	15	14	0	4	7	33	21
5–6	2	20	6	7	1	8	31	13	12
8–9	2	48	5	0	2	8	28	5	2
Adults	4	41	3	4	4	6	33	5	0

Age (years)	Belief	Skill	Awareness	Illogical	Desire	Intention	Action	Age	Other	Don't know
Awareness intention measure										
3–4	0	0	6	38	12	1	5	0	27	11
5–6	1	0	41	44	1	1	2	0	2	8
8–9	0	0	81	13	0	5	1	0	0	0
Adults	6	0	70	0	0	10	14	0	0	0

replicate those of Carpendale and Chandler (1996); however, their 8-year-olds performed at higher levels. The difference in performance may have been due to the mode of presentation; Carpendale and Chandler used puppets, whereas a storybook format was used in the current study. Because even the oldest children performed poorly on this measure yet were successful on the intentionality measures, there is no support for the idea that there might be a relationship between an interpretive theory of mind and reasoning about the more complex components of intentionality.

Study 2

In Study 2, the relationship between false belief understanding and an overall understanding of intentionality was examined using the same intentionality measures. Preschoolers were included to

attain greater variability in the false belief measure, and adults were included to chart a more complete developmental progression. In addition, as stated earlier, the adults' responses provided the basis for the coding of the explanations. With the addition of younger children and adults, a closer examination of the age-related predictions in the acquisition of the components of a folk theory of intentionality could be made. The following predicted order of acquisition of these components was based on results from the first study, prior research, and the hierarchical nature of Malle and Knobe's (1997) model: desire, belief, intention, skill, and awareness. The interpretive mind measure was excluded because it did not seem to be related to performance on the intentionality measures in Study 1. Therefore, the goals of Study 2 were to replicate and extend the findings from Study 1.

Method

Participants

Participants were 62 3- to 9-year-olds (27 boys and 35 girls) and 20 adults (7 men and 13 women). (An additional 2 children were excluded for failure to complete all tasks.) There were 22 3- and 4-year-olds (range = 3 years 2 months to 4 years 10 months, M = 4 years 1 month), 23 5- and 6-year-olds (range = 5 years 2 months to 6 years 11 months, M = 5 years 11 months), 17 8- and 9-year-olds (range = 8 - years 2 months to 9 years 11 months, M = 9 years 2 months), and 20 adults (range = 18 years 10 months to 21 years 4 months, M = 19 years 8 months). As in the first study, children's names were obtained from a database of collected birth records, and parents were recruited by letter and telephone. Adult participants were recruited through introductory psychology courses and received course credit. Of the 62 children, 58 (94%) were Caucasian and 4 (6%) were multiracial. Education level of the parents was measured using the same scale as in Study 1 and did not differ among the age groups. The mean education level for mothers was 4.2 (range = 2–6) and for fathers was 4.1 (range = 2–6).

Materials and procedure

As in the first study, children viewed the same series of false belief tasks presented on video and the same nine randomly ordered intentionality tasks. Adults did not complete the false belief measure but did complete all intentionality tasks. The scoring procedures for the false belief and intentionality measures were identical to those used in Study 1. The same coding scheme was also used for the explanations. Two raters (one unaware of the hypotheses and both unaware of the age of participants) achieved an overall interrater agreement of 92% collapsed across all types of explanations (N = 82). Subsequently, all responses were coded to 100% agreement. The children were tested individually in a laboratory setting, and the average length of each session was 28 min.

Results

False belief measure

A one-way ANOVA revealed a significant effect for age on the false belief measure, $F(2, 59) = 37.87$, $p < .0001$.[2] The 3- and 4-year-olds (M = 0.86, SD = 1.13) performed at a significantly lower level than the 5- and 6-year-olds (M = 2.96, SD = 1.26) and the 8- and 9-year-olds (M = 3.77, SD = 0.75), $ps < .0001$. Furthermore, the 3- and 4-year-olds performed significantly below chance, $t(21) = -4.74$, $p < .0001$, whereas the 5- and 6-year-olds, $t(22) = 3.64$, $p = .001$, and the 8- and 9-year-olds, $t(16) = 9.67$, $p < .0001$, performed significantly above chance (range = 0–4).

Intentionality identification questions

An Age (3–4, 5–6, or 8–9 years) × Intentionality Measure (behavior, skill, or awareness) repeated measures ANOVA on the identification score was performed. Adults were not included in the analysis because they scored at or near ceiling on the measures. The ANOVA revealed significant main effects for age, $F(2, 59) = 27.73$, $p < .0001$, and intentionality measure, $F(2, 118) = 25.19$, $p < .0001$, and a significant Age × Intentionality Measure interaction, $F(4, 118) = 3.71$, $p = .007$. To explore the

[2] As in Study 1, gender was included as an independent variable in all ANOVAs for Study 2. There were no significant main effects or interactions.

Age × Intentionality Measure interaction, each of the intentionality measures was analyzed individually using one-way ANOVAs (see Fig. 4A–C for means and standard errors). Significant effects were then explored using Bonferroni–Dunn post hoc comparisons.

For the behavior–intentionality measure, a significant effect for age was found on the identification question, $F(2, 59) = 6.99$, $p = .002$ (see Fig. 4A). The 3- and 4-year-olds performed at a lower level than the 5- and 6-year-olds ($p = .008$) and the 8- and 9-year-olds ($p = .0008$). However, all age groups performed significantly above chance: 3- and 4-year-olds ($M = 2.05$, $SD = 0.95$), $t(21) = 2.69$, $p < .0001$; 5- and 6-year-olds ($M = 2.65$, $SD = 0.71$), $t(22) = 7.74$, $p < .0001$; 8- and 9-year-olds ($M = 2.88$, $SD = 0.33$), $t(16) = 17.16$, $p < .0001$ (range = 0–3).

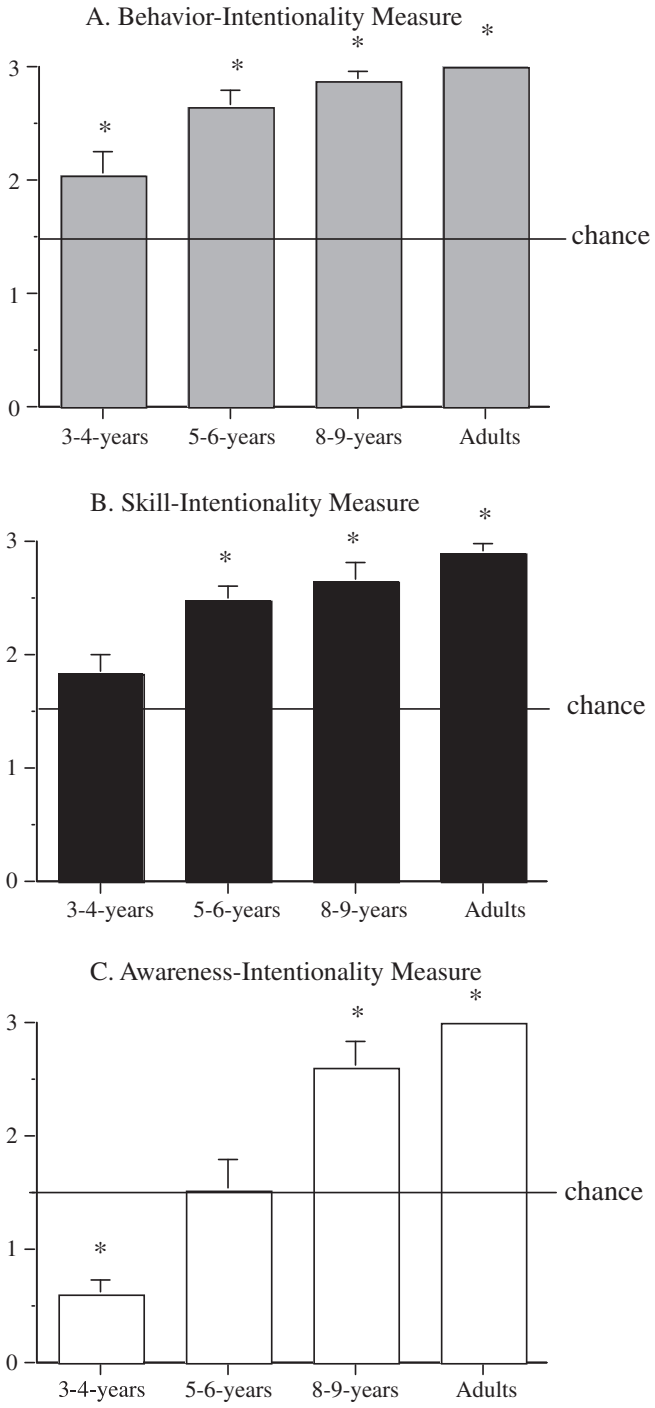

Fig. 4. Participants' mean identification scores on the three intentionality measures in Study 2. ∗Indicates that the mean score differed significantly from chance.

For the skill–intentionality measure, a significant effect for age was found on the identification question, $F(2, 59) = 8.05$, $p = .001$ (see Fig. 4B). The 3- and 4-year-olds performed at a lower level than the 5- and 6-year-olds ($p = .003$) and the 8- and 9-year-olds ($p = .001$). Furthermore, the 3- and 4-year-olds' performance did not differ from chance levels ($M = 1.82$, $SD = 0.85$), $t(21) = 1.75$, $p = .095$, whereas the two older age groups performed above chance: 5- and 6-year-olds ($M = 2.48$, $SD = 0.59$), $t(22) = 7.91$, $p < .0001$; and 8- and 9-year-olds ($M = 2.65$, $SD = 0.61$), $t(16) = 7.80$, $p < .0001$ (range = 0–3).

For the awareness–intentionality measure, a significant effect for age was found on the identification question, $F(2, 59) = 19.10$, $p < .0001$ (see Fig. 4C). The 3- and 4-year-olds performed at a lower level than the 5- and 6-year-olds ($p = .003$), who in turn performed at a lower level than the 8- and 9-year-olds ($p = .002$). Furthermore, the 3- and 4-year-olds performed at below chance levels ($M = 0.59$, $SD = 0.59$), $t(21) = -7.22$, $p < .0001$, the 5- and 6-year-olds' performance did not differ from chance ($M = 1.52$, $SD = 1.28$), $t(22) = 0.08$, $p = .935$, and the 8- and 9-year-olds performed above chance ($M = 2.59$, $SD = 1.00$), $t(16) = 7.80$, $p < .0001$ (range = 0–3).

Explanation of intentionality questions

Adults were included in the analyses of appropriate explanations because there was no identified correct answer and there was variance in their responses. An Age (3–4, 5–6, or 8–9 years or adult) × Intentionality Measure (behavior, skill, or awareness) repeated measures ANOVA on the adjusted explanation score revealed significant main effects for age, $F(3, 71) = 59.70$, $p < .0001$, and intentionality measure, $F(2, 142) = 13.26$, $p < .0001$. However, there was no significant Age × Intentionality Measure interaction, $F(6, 142) = 1.82$, $p = .10$ (see Fig. 5A–C for means and standard errors). Post hoc comparisons on the main effect of age revealed that the 3- and 4-year-olds provided fewer appropriate explanations than all other age groups ($ps < .0001$) and that the 5- and 6-year-olds provided fewer appropriate explanations than the 8- and 9-year-olds and adults ($ps < .0001$). In addition, post hoc comparisons on the main effect of measure revealed that overall participants offered more appropriate explanations for the behavior–intentionality measure than for the skill–intentionality measure ($p < .0001$) and the awareness–intentionality measure ($p = .0003$).

Although the adjusted explanation score was the primary measure and was used for the above analysis, descriptive information about the types of explanations participants in each age group generated is provided in Table 2. To explore this pattern of explanations, one-way ANOVAs were performed on key explanation types within each measure as in Study 1. Significant effects were then examined using Bonferroni–Dunn post hoc comparisons. The dependent variables were the number of times each explanation type was articulated across the six questions (range = 0–6) divided by the total number of explanations given by that child and were expressed as percentages.

For the behavior–intentionality measure, there was a significant effect for age on the percentage of action explanations, $F(3, 71) = 9.43$, $p < .0001$. The 3- and 4-year-olds provided fewer action explanations than the 8- and 9-year-olds and adults ($ps < .0001$). For the skill–intentionality measure, there was a significant effect for age on the percentage of skill explanations, $F(3, 72) = 18.44$, $p < .0001$. The 3- and 4-year-olds and 5- and 6-year-olds offered fewer skill explanations than the 8- and 9-year-olds and adults (all $ps < .0001$). Finally, for the awareness–intentionality measure, there was a significant effect for age on the percentage of awareness explanations, $F(3, 72) = 21.73$, $p < .0001$. The 3- and 4-year-olds and 5- and 6-year-olds offered fewer awareness explanations than the 8- and 9-year-olds and adults (all $ps < .004$).

Relationships between the measures

Zero-order correlations among age (as a continuous variable), false belief score, the identification score for each intentionality measure, and the adjusted explanation score for each intentionality measure were calculated (see Table 3). (Only the two youngest age groups were included in this analysis because the other groups were at ceiling on false belief.) False belief score correlated significantly with all intentionality measures ($rs = .33–.45$, $ps < .04$). However, a series of regressions with both age and false belief score on the identification and explanation score for each intentionality measure revealed that false belief did not account for any significant variance beyond the effects of age on any of the dependent measures.

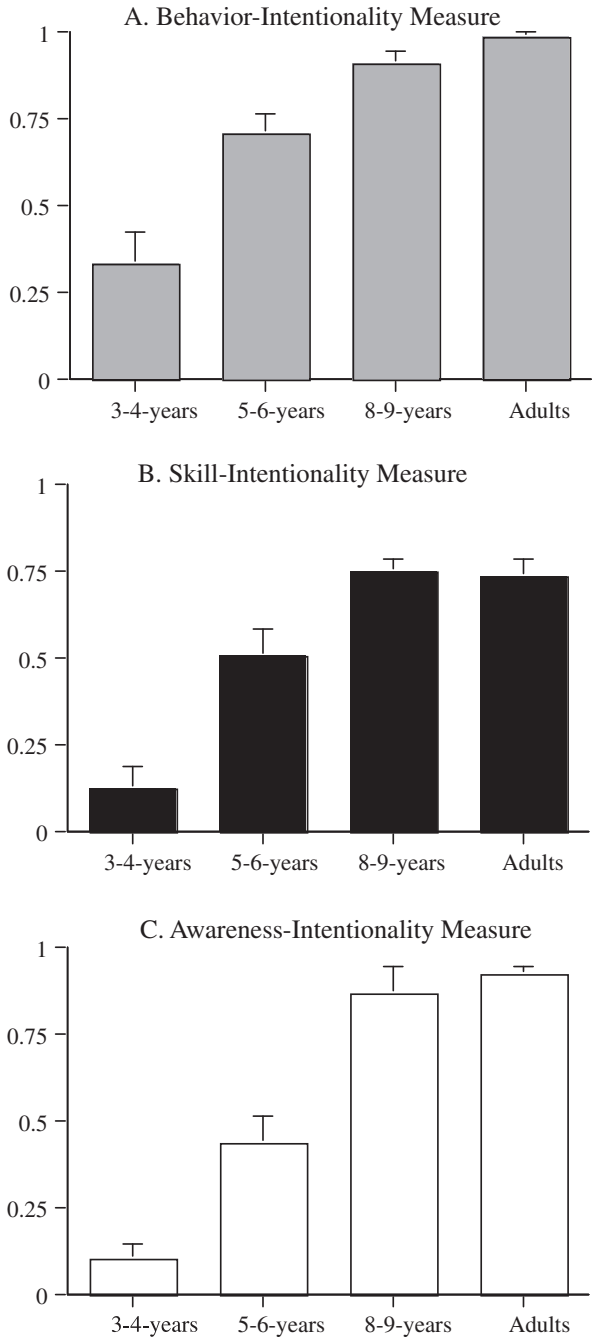

Fig. 5. Participants' mean adjusted explanation scores on the three intentionality measures in Study 2.

In addition, the correlations revealed that the identification scores for the behavior–intentionality and skill–intentionality measures were correlated ($r = .43$, $p = .006$), although neither correlated significantly with the identification score on the awareness–intentionality measure. This suggests that the awareness–intentionality measure assesses a qualitatively different aspect of intentionality understanding from the other two measures. Finally, the adjusted explanation scores for each of the intentionality measures correlated significantly with each other ($rs = .37–.51$, $ps < .03$).

Discussion

The developmental trends found in Study 1 were replicated in Study 2, with the inclusion of preschoolers and adults providing a more complete picture. Overall, several clear findings emerged. Iden-

Table 3
Study 2: Intercorrelations among age, false belief score, identification question scores, and adjusted explanation scores.

Measure	1	2	3	4	5	6	7	8
1. Age								
2. False belief score	.60***							
3. Behavior–intentionality identification score	.46**	.42**						
4. Skill–intentionality identification score	.52**	.35*	.43**					
5. Awareness–intentionality identification score	.58***	.33*	.21	.23				
6. Behavior–intentionality adjusted explanation score	.47**	.34*	.47**	.42**	.05			
7. Skill–intentionality adjusted explanation score	.58***	.45**	.39*	.64***	.26	.51**		
8. Awareness–intentionality adjusted explanation score	.61***	.35*	.43**	.28	.84***	.37*	.41**	

Note. Includes only the 3- and 4-year-olds and 5- and 6-year-olds.
* $p < .05$.
** $p < .01$.
*** $p < .0001$.

tification of the protagonist in an intentional act is accomplished at an earlier age than the appropriate explanation of this choice, although the timetable varies depending on the type of intentionality measure. There is marked improvement from the preschool- to early school-age years in the ability to identify an intentional agent, and this capacity continues to develop until children can both identify and explain a range of intentional actions, which the current research suggests might not occur until 8 or 9 years of age.

Preschoolers were above chance in their identification of the correct protagonist in the behavior–intentionality measure, indicating that they understood the question. However, they performed below chance on the false belief measure. Although this suggests that a representational understanding of mind is not necessary to identify an intentional agent, it was not until after this understanding of mind is acquired (5–6 years of age) that children began to consistently provide appropriate explanations on the behavior–intentionality measure. Because false belief understanding is acquired prior to the skill and awareness components of a folk model of intentionality, the indications are that understanding the mind as representational may be a stepping-stone to a fully developed theory of intentionality. However, false belief understanding was not significantly related to the intentionality measures independent of the effects of age, suggesting that although it may be a necessary condition, it is certainly not sufficient.

There were age-related differences among the various measures of intentionality understanding, with the same developmental pattern being observed across both studies, first for the identification questions and second for the explanation questions (see Figs. 2–5). The behavior–intentionality measure was mastered at an earlier age than the skill–intentionality measure, which in turn was mastered earlier than the awareness–intentionality measure. Differences among the measures are addressed in more detail in the General discussion, but one obvious explanation was the scarcity of behavioral cues in the awareness–intentionality measure; only one cue, the act of looking, clearly differentiated the unintentional action from the intentional action. Younger children's misuse of this cue, called illogical awareness (see coding scheme in Appendix D), might have arisen because the narrator emphasized looking in the description of the task. Children were sensitive enough to pick up on the importance of this information, but they seemed to be unaware of the significance of the relationship between looking and intentional action. In contrast, for the behavior–intentionality measure, there were several cues; visual (looking) and body cues (the different hand positions) were apparent in the photograph, and they portrayed the intentional (e.g., throws) and unintentional (e.g., drops) hand actions that were also described in the narrative.

General discussion

The findings across both studies illustrate interesting and internally consistent developmental changes in preschool- and early school-age children's acquisition of the components of a folk theory of intentionality. Malle and Knobe's (1997) model of these folk concepts begins with the recognition

that desires and beliefs are important when reasoning about intentions. Building on this base is the recognition that for a person to perform an act intentionally, that person needs to have the intention to do so, the skill to carry out the act, and awareness that the action is performed. Malle and Knobe speculated that the recognition of the role of skill and awareness probably develops later during childhood and perhaps not until adolescence. Our data support their suggestion. We found that the skill–intentionality and awareness–intentionality measures were significantly more difficult than the behavior–intentionality measure, with only the 8- and 9-year-olds performing well on the awareness–intentionality measure.

Differences among the measures of intentionality

Based on the current and previous research findings, it is apparent that the information used to determine whether or not an action is intentional varies with age. Moreover, most acts provide multiple cues as to their intentionality, beginning with the characteristic goal-directed movement recognizable to infants and nonhuman primates alike. Infants, toddlers, and nonhuman primates can use behavioral cues to interpret the actions of others (e.g., Penn & Povinelli, 2007; Tomasello et al., 2005). In fact, all age groups reference these behaviors, but for older participants goal-directed actions are embedded in a more complex network of mentalistic concepts. A behavioristic model may also help to explain why in the current research the behavior–intentionality measure was easier than the other two intentionality measures for the younger participants. It was the only measure on which the preschoolers performed at above chance levels on the identification question. This measure simply requires participants to recognize, for example, the difference between the hand movements of the two protagonists as they engaged in intentional versus unintentional acts. Moreover, both preschoolers and 5- and 6-year-olds noted these actions in their explanations, providing further evidence of the importance of this cue. (Preschoolers also mentioned desire.) In future research, an interesting way to assess whether children were using behavioral information only to judge intentionality would be to simply show participants the pictures without the accompanying narration.

As children's understanding of complex mental states increases, they seem to shift from an implicit grasp of goal-directed actions to a more explicit model of the underlying mentalistic components. The skill–intentionality measure involved a variety of cues, both behavioristic and mentalistic. Participants could have identified the correct protagonist by simply associating adults with the relevant skills, a behavioristic model, or by going one step further and inferring that only adults would have the relevant knowledge or skill, a mentalistic model. It is plausible that 5- and 6-year-olds had heard the phrase "you're not old enough" enough times to make that association. This may explain why their overall performance on this measure fell in-between the other measures. Again, there was an interesting developmental trend in the kinds of explanations given. Not until 5 or 6 years of age did children mention age, and not until 7–9 years of age did they mention skill in approximately half of their responses. It should be noted that the skill–intentionality measure required participants to make an additional inference. That is, they needed to realize that only someone with particular skills could perform the action and, furthermore, that only certain individuals would possess these skills. Recent research indicates that preschoolers are sensitive to the fact that there are individuals who possess more reliable or different kinds of knowledge than others (e.g., Harris, 2007; Lutz & Keil, 2002), but tying this insight to their interpretation of the intentionality of an individual's action clearly requires an additional step. Future research should delineate these components of intentionality.

The awareness–intentionality measure was the most difficult of the three, and children did not perform at a consistently high level until 7 years of age. There was only one clear cue: The correct protagonist looked at the fallen blocks. At 5 or 6 years of age, children began to reference cues such as awareness to explain the protagonist's intention; however, they often did so illogically (e.g., "Jenny wasn't looking at the blocks, so she meant to knock them over"). It is not surprising that preschoolers who do not yet have a fully developed representational understanding of mind had difficulty on this task. The measure required participants to understand that awareness (visual access) leads to knowledge/beliefs and then apply that knowledge to the task at hand. Interestingly,

even the 5- and 6-year-olds who performed well on the false belief measure were at chance on the identification question. This suggests that although children may understand that visual access leads to certain knowledge, it may still be difficult for them to apply this knowledge when reasoning about intentionality. In addition, as Searle (1983) discussed, awareness is self-referential ("I am aware that I am acting in accordance with my intention"). This may also make this component difficult for younger children to reason about when considering the potential intentionality of an action.

Acquiring a folk theory of intentionality

Overall, this analysis provides a developmental framework that maps fairly closely onto Malle and Knobe's (1997) hierarchical model of the folk concept of intentionality. The identification of an intentional act preceded children's ability to explain the intentional actions. Preschoolers performed better on the identification question than on the explanation questions, but they did not do well on either. The 5- and 6-year-olds performed at above chance levels on the behavior–intentionality and skill–intentionality identification questions but not on the awareness–intentionality identification questions. This pattern was replicated in their performance on the explanation questions. The oldest age groups performed similarly, and at high levels, on all measures. Overall, in the explanations for intentional acts, there was an age-related shift from desire- to belief-based concepts that was associated with an increase in false belief reasoning from the early preschool- to school-age years (see also Astington, 2001; Wellman & Liu, 2004). This was followed by awareness- and skill-based concepts at 7–9 years of age to explicit references to the overall intentionality of an act among adults who were more likely to use phrases such as "on purpose."

These studies uniquely link components of Malle and Knobe's (1997) folk theory of intentionality into a developmental framework. Furthermore, they provide evidence that an understanding of the role that skill and awareness play in an inference of intentionality is late developing. Overall, this trajectory parallels that found in the extant literature on children's understanding of mental functions. Not until 7–10 years of age do children appear to grasp the mental processes that underlie everyday reasoning (Amsterlaw, 2006), consciousness and thinking (Flavell, Green, Flavell, & Lin, 1999), and emotion understanding (Lagattuta, 2005).

This research suggests that a key issue separating a rudimentary understanding from a more sophisticated understanding of intentionality is the creation of causal links (Gopnik & Schulz, 2007) between a multiplicity of cues. Young children seem more sensitive to the proximal or immediate causes of an act (Evans, 2001) such as the physical action (e.g., a hand movement). Over time, more distal causes, such as the reasons that might underlie the physical action (Dunphy-Lelii & Wellman, 2004), are integrated into a comprehensive judgment of intentionality. This uses the whole causal chain in a causal history linking proximal and distal causes, from behavioral cues to nonobvious mental states (Schult, 2002). For example, although preschoolers may realize that adults are more skilled than toddlers (e.g., Lutz & Keil, 2002), an inference of intentionality based on this cue requires that children make an explicit causal link between the knowledge state of the adult and the intentional action. Children's explanations of the skill–intentionality measure indicates that this does not occur until 7 years of age or older.

Mastering the causal history of an action might not be the only way in which a more complex understanding of intentionality emerges. In recent work, Wellman and his colleagues (e.g., Wellman & Liu, 2004) have constructed a developmental scale that assesses five core constructs underlying preschoolers' theory of mind. Moreover, they demonstrate that these constructs are acquired in a sequential manner. They suggest that the later acquired constructs are neither substitutions for nor additions to earlier ones; instead, the later acquired constructs may represent a process of modification, that is, a broadening of the earlier constructs. Following this logic, it is plausible that children's earliest understanding of intentionality, based on belief and desire, yields an understanding of intentionality based on awareness. The former provides the foundation for a more differentiated construct, such as awareness, which has a self-reflective component not found in the earlier constructs.

The current research did not allow us to assess the factors influencing these changes in children's theory of intentionality, although false belief understanding may play a necessary, but not sufficient, role. Possible contributors include the development of more complex cognitive abilities (e.g., mutual perspective taking), memory development, the acquisition of more complex language skills, and more experience in interacting with others. There is ample evidence, for example, to suggest that discourse about mental states facilitates children's acquisition of false belief understanding (Carpendale & Lewis, 2004). Similarly, perhaps increased peer interaction, as the result of entrance into school, provides children with more opportunities to interpret others' behaviors and engage in perspective taking. These experiences and new abilities may give children the tools to understand and explain intention in new ways.

Perceiving the acts of others as intentional brings order and meaning to otherwise unrelated behaviors. Most of the time, the process of inferring intentionality is implicit. However, situations do arise where this process is more difficult, requiring conscious thought and the ability to relate the intentionality of an act to responsibility and culpability. If cues are absent or ambiguous, it may be difficult to infer the intentions of others. In situations like these, the possession of a mentalistic model of intentionality helps to both identify and explain the observed behaviors. Not until the middle elementary school years do children easily access a folk theory of intentionality, albeit not a fully fledged theory but still a reasonable approximation.

Appendix A. Descriptions of the three behavior–intentionality tasks

Task 1	Task 2	Task 3
Introducing characters This is Judy and this is Brian.	*Introducing characters* This is Brian and this is Judy.	*Introducing characters* This is Brian and this is Judy.
Scenario 1 Over here, Judy walks outside and sees a dog.	*Scenario 1* Over here, Brian walks into a room holding a glass of water and sees a plant.	*Scenario 1* Over here, Brian walks into the kitchen and sees that the cabinet door is open.
Scenario 2 Over here, Brian walks outside and sees a dog.	*Scenario 2* Over here, Judy walks into a room holding a glass of water and sees a plant.	*Scenario 2* Over here, Judy walks into the kitchen and sees that the cabinet door is open.
Event 1 Over here, Judy throws the food onto the ground and the dog eats the food.	*Event 1* Over here, Brian pours some water into the plant and waters the plant.	*Event 1* Over here, Brian bumps into the cabinet door as he is walking by and the door closes.
Event 2 Over here, Brian happens to drop the food on the ground as he is walking by and the dog eats the food.	*Event 2* Over here, Judy happens to spill some water into the plant as she is walking by and waters the plant.	*Event 2* Over here, Judy pushes the cabinet door and the door closes.
Questions *Intention:* Who meant to feed the dog, Judy or Brian? *Justification A:* Why do you think it was Judy/Brian? *Justification B:* Why don't you think it was Brian/Judy?	**Questions** *Intention:* Who meant to water the plant, Brian or Judy? *Justification A:* Why do you think it was Brian/Judy? *Justification B:* Why don't you think it was Judy/Brian?	**Questions** *Intention:* Who meant to close the cabinet, Brian or Judy? *Justification A:* Why do you think it was Judy/Brian? *Justification B:* Why don't you think it was Brian/Judy?

Appendix B. Descriptions of the three skill–intentionality tasks

Task 1	Task 2	Task 3
Introducing characters This is Sally and this is Sam.	*Introducing characters* This is Sam and this is Sally.	*Introducing characters* This is Sally and this is Sam.
Describing age Sam is only 2 years old and Sally is his mom.	*Describing age* Sam is only 2 years old and Sally is his mom.	*Describing age* Sam is only 2 years old and Sally is his mom.
Scenario 1 Over here, Sally is outside and she's holding a glass.	*Scenario 1* Over here, Sam is sitting at the computer and he's pressing on the keyboard.	*Scenario 1* Over here, Sally is sitting at the table and she's cutting some orange paper.
Scenario 2 Over here, Sam is outside and he's holding a glass.	*Scenario 2* Over here, Sally is sitting at the computer and she's pressing on the keyboard.	*Scenario 2* Over here, Sam is sitting at the table and he's cutting some orange paper.
Event Look, there's a broken glass!	*Event* Look, some words were typed and came up on the computer screen!	*Event* Look, there's an orange star!
Questions	**Questions**	**Questions**
Intention: Who meant to break the glass, Sally or Sam?	*Intention:* Who meant to type the words, Sam or Sally?	*Intention:* Who meant to cut out the orange star, Sally or Sam?
Justification A: Why do you think it was Sam/Sally?	*Justification A:* Why do you think it was Sally/Sam?	*Justification A:* Why do you think it was Sally/Sam?
Justification B: Why don't you think it was Sally/Sam?	*Justification B:* Why don't you think it was Sam/Sally?	*Justification B:* Why don't you think it was Sam/Sally?

Appendix C. Descriptions of the three awareness–intentionality tasks

Task 1	Task 2	Task 3
Introducing characters This is Jenny and this is Steve.	*Introducing characters* This is Steve and this is Jenny.	*Introducing characters* This is Jenny and this is Steve.
Scenario 1 Over here, Jenny is walking into her room, and there's a big stack of blocks on the floor. Jenny is looking at something else, so she does not see the blocks.	*Scenario 1* Over here, Steve is looking at this red balloon, so he does not see these balloons on the floor.	*Scenario 1* Over here, Jenny is drawing with some markers, but she's watching TV so she's not looking at her paper and doesn't see what she's drawing.
Scenario 2 Over here, Steve is walking into his room and there's a big stack of blocks on the floor. Steve is looking down, so he does see the blocks on the floor.	*Scenario 2* Over here, Jenny is looking down, so she does see the balloons on the floor.	*Scenario 2* Over here, Steve is drawing with markers while the TV is on, but he is looking at his paper so he does see what he's drawing.

Appendix C (*continued*)

Task 1	Task 2	Task 3
Event 1 Over here, Jenny walks into the blocks and knocks them over. Remember, Jenny was looking at something else, so she did not see the blocks. *Event 2* Over here, Steve walks into the blocks and knocks them over. Remember, Steve was looking down, so he did see the blocks. **Questions** *Intention:* Who meant to knock over the blocks, Steve or Jenny? *Justification A:* Why do you think it was Steve/Jenny? *Justification B:* Why don't you think it was Jenny/Steve?	*Event 1* Over here, Steve steps on the blue balloon and it pops. Remember, Steve was looking at this red balloon, so he didn't see the balloons on the floor. *Event 2* Over here, Jenny steps on the blue balloon and it pops. Remember, Jenny was looking down, so she did see the balloons. **Questions** *Intention:* Who meant to pop the balloon, Steve or Jenny? *Justification A:* Why do you think it was Jenny/Steve? *Justification B:* Why don't you think it was Steve/Jenny?	*Event 1* Over here, Jenny goes over the edge of her paper and draws on the table. Remember, Jenny was watching TV and didn't see what she was drawing. *Event 2* Over here, Steve goes over the edge of his paper and draws on the table. Remember, Steve was looking at his paper, so he did see what he was drawing. **Questions** *Intention:* Who meant to draw on the table, Jenny or Steve? *Justification A:* Why do you think it was Steve/Jenny? *Justification B:* Why don't you think it was Jenny/Steve?

Appendix D. Coding scheme

1. *Belief:* Reference to the character's beliefs or thoughts about the consequences of the act (e.g., "because she knew what would happen if she stepped on it").
2. *Skill:* Reference to the character's skill or ability to perform the action (e.g., "because she knows how").
3. *Awareness:* Reference to the character's awareness of the act (e.g., "because he was looking at them and knew they were there").
4. *Awareness illogical:* Illogical reference to the character's awareness of the act (e.g., "She meant to because she wasn't looking at them and didn't know they were there"); responses fell into this category only for the awareness–intentionality measure.
5. *Desire:* Reference to the character's desire for the outcome (e.g., "because she wanted to").
6. *Intention:* Reference to the character's intention to perform the act (e.g., "because she threw the food on purpose" or "because he tried to water the plant").
7. *Action:* Reference to an action/behavior of the character that was relevant to the intentionality of the act (e.g., "because she threw the food").
8. *Age:* Reference to the character's age (e.g., "because she's older").
9. *Other:* Irrelevant information or responses that did not fit into other categories.
10. *Don't know:* "I don't know" or simply "because".

It was possible for any one response to be coded as containing more than one type of explanation. For example, if a participant stated that Sally meant to type the words because "she is older and knows how," this would be coded as both age (she is older) and skill (she knows how). However, only one type of explanation was coded for each question even when repetitions were offered.

(For the complete coding scheme [with additional examples], please contact the first author.)

References

Amsterlaw, J. (2006). Children's beliefs about everyday reasoning. *Child Development, 77*, 443–464.

Astington, J. W. (2001). The paradox of intention: Assessing children's meta-representational understanding. In B. Malle, L. Moses, & D. Baldwin (Eds.), *Intentions and intentionality: Foundations of social cognition* (pp. 85–104). Cambridge, MA: MIT Press.

Astington, J. W., & Gopnik, A. (1991). Theoretical explanations of children's understanding of the mind. *British Journal of Developmental Psychology, 9*, 7–31.

Bartsch, K., & Wellman, H. M. (1995). *Children talk about the mind*. New York: Oxford University Press.

Brandone, A. C., & Wellman, H. M. (2009). You can't always get what you want: Infants understand failed goal-directed actions. *Psychological Science, 20*, 85–91.

Carpendale, J. I., & Chandler, M. J. (1996). On the distinction between false belief understanding and subscribing to an interpretive theory of mind. *Child Development, 67*, 1686–1706.

Carpendale, J. I. M., & Lewis, C. (2004). Constructing an understanding of mind: The development of children's social understanding within social interaction. *Behavioral and Brain Sciences, 27*, 79–96.

Dodge, K. A. (1980). Social cognition and children's aggressive behavior. *Child Development, 51*, 162–170.

Dunphy-Lelii, S., & Wellman, H. M. (2004). Infants' understanding of occlusion of others' line-of-sight: Implications for an emerging theory of mind. *European Journal of Developmental Psychology, 1*, 49–66.

Evans, E. M. (2001). Cognitive and contextual factors in the emergence of diverse belief systems: Creation versus evolution. *Cognitive Psychology, 42*, 217–266.

Feinfield, K. A., Lee, P. P., Flavell, E. R., Green, F. L., & Flavell, J. H. (1999). Young children's understanding of intention. *Cognitive Development, 14*, 463–486.

Flavell, J. H., Green, F. L., Flavell, E. R., & Lin, N. T. (1999). Development of children's knowledge about unconsciousness. *Child Development, 70*, 396–412.

Gopnik, A., & Schulz, L. (Eds.). (2007). *Causal learning: Psychology, philosophy, computation*. Oxford, UK: Oxford University Press.

Harris, P. L. (2007). Trust. *Developmental Science, 10*, 135–138.

Joseph, R. M., & Tager-Flusberg, H. (1999). Preschool children's understanding of the desire and knowledge constraints on intended action. *British Journal of Developmental Psychology, 17*, 221–243.

Lagattuta, K. H. (2005). When you shouldn't do what you want to do: Young children's understanding of desires, rules, and emotions. *Child Development, 76*, 713–733.

Lutz, D. J., & Keil, F. C. (2002). Early understanding of the division of cognitive labor. *Child Development, 73*, 1073–1084.

Malle, B. F., & Knobe, J. (1997). The folk concept of intentionality. *Journal of Experimental Social Psychology, 33*, 101–121.

Malle, B. F., Moses, L. J., & Baldwin, D. A. (2001). Introduction: The significance of intentionality. In B. F. Malle, L. J. Moses, & D. A. Baldwin (Eds.), *Intentions and intentionality: Foundations of social cognition* (pp. 1–24). Cambridge, MA: MIT Press.

Moses, L. J. (1993). Young children's understanding of belief constraints on intention. *Cognitive Development, 8*, 1–25.

Penn, D. C., & Povinelli, D. J. (2007). Causal cognition in human and nonhuman animals: A comparative critical review. *Annual Review of Psychology, 58*, 97–118.

Perner, J., Leekam, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief. *British Journal of Developmental Psychology, 5*, 125–137.

Ruffman, T. K., Olson, D. R., & Astington, J. W. (1991). Children's understanding of visual ambiguity. *British Journal of Developmental Psychology, 9*, 89–103.

Schult, C. A. (2002). Children's understanding of the distinction between intentions and desires. *Child Development, 73*, 1727–1747.

Searle, J. R. (1983). *Intentionality*. Cambridge, UK: Cambridge University Press.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences, 28*, 675–735.

Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.

Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child Development, 75*, 523–541.

Wellman, H. W., & Woolley, J. D. (1990). From simple desires to ordinary beliefs: The early development of everyday psychology. *Cognition, 35*, 245–275.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*, 103–128.