



## Early understanding of ability



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### ABSTRACT

Preschoolers' understanding of ability was examined in three studies. Three- to 5-year-olds evaluated the abilities of two characters whose performances were inconsistent with their actual abilities because of an interfering event. Results revealed an age-related change in children's understanding of ability: Three-year-olds evaluated the character who produced the better outcome as more competent, whereas 5-year-olds judged the character who originally had higher ability was more capable and predicted he would do better with no disruption. Study 2 replicated these results with modified stories and also found that the understanding of ability and false belief were related. Study 3 obtained similar results with a simplified story using concrete information about physical ability, interfering event, and observable outcome. These results suggest that an early understanding of ability as differentiated from outcomes is present before the end of preschool years. The results are discussed in relation to the similarities and differences between children's understanding of ability and belief.

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## 1. Introduction

As human beings, we often need to evaluate our own abilities and those of other people. We want to find the best barber to cut our hair, or judge whether we will do well in a new job. When a person is engaged in a task, the outcome produced often reveals the person's ability. Thus, one of the most useful cues for our evaluations of ability is observable outcome. When everything else is equal, it is reasonable to attribute a higher level of ability to the person who produces the better outcome. However, ability is also partially independent from outcome. For example, sometimes external factors may disrupt or facilitate a person's performance, leading to outcomes inconsistent with actual ability. If our understanding of ability is entirely dependent on outcome, then our evaluations of a person's ability will be unreliable. We may judge an athlete to be the best when she wins the Olympic gold medal and then consider her to be incompetent when she falls from a defective balance beam the next day. Therefore, to have a concept of ability requires us at a minimum to be able to differentiate ability from observable outcomes. When do children develop an understanding of ability, especially being able to distinguish it from observable outcomes?

The majority of the existing research suggests that children develop an understanding of ability relatively late. Early research on learned helplessness found that older elementary school students were vulnerable to repeated failures, whereas younger children were likely to remain optimistic about their performance (Fincham & Cain, 1986; Rholes, Blackwell, Jordan, & Walters, 1980). This difference was interpreted as indirect evidence that older, but not younger, children were attributing their failures to a lack of ability rather than to independent events. It may be that before children reach the late elementary

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school years, they only perceive disconnected performances and do not form an understanding of their own ability as the cause of the outcomes.

Nicholls (1978) and Nicholls and Miller (1984) conducted the earliest systematic research investigating children's understanding of ability in relation to effort and outcome. For example, Nicholls (1978) presented 5- to 13-year-olds with films showing two children working on math problems. One child spent the entire time working on the exercises, whereas the other child only worked intermittently. In the end, both characters obtained the same score or the child who spent less time actually got the higher score. Participants were asked to infer the intellectual ability of the two characters. Five- and 6-year-olds did not distinguish ability from effort and outcome. They reported the person who worked longer or obtained the better outcome was smarter. Children started to differentiate ability from effort and outcome at ages 10 or 11, but it was not until ages 12 and above that children were able to reason accurately about how ability and effort could jointly determine outcome. This developmental pattern has been replicated by most existing research on children's concept of ability (e.g., Fincham & Cain, 1986; Folmer et al., 2008; Nicholls & Miller, 1984; Rholes et al., 1980). These results have been interpreted as evidence that children do not have a mature concept of ability as differentiated from effort and outcome until middle childhood. What remains unknown from these and the learned helplessness findings is whether some primary understanding of ability might be present among the younger children (i.e., 5- and 6-year-olds).

Compared to the research on elementary school children, studies about younger children's understanding of ability have been relatively rare. The limited findings provide some evidence that young children could reason accurately about ability in at least some situations. For example, in simplified tasks, Wimmer, Wächter, and Perner (1982) presented 4- to 8-year-olds with information about two factors (e.g., high effort, low outcome) for a single character and the children were asked to infer the level of the third factor (e.g., low ability). To reduce cognitive demands, information about ability, effort and outcome was presented concretely (Ability: small vs. big boy; Effort: work vs. play all the time; Outcome: paint short vs. long section). They found that when information-processing demands were minimized, children as young as 4 were able to make adult-like inferences about ability, effort, and outcome.

Heyman, Gee, and Giles (2003) also conducted one of the few studies that investigated preschool children's reasoning about ability. To examine young children's use of information about perceived task difficulty when making inferences about ability, they presented children with stories in which two characters both finished a puzzle, but one of them found the puzzle hard whereas the other character found it easy (Study 1). Children as young as 4 were able to infer that the person who found the puzzle easy to be smarter than the person who thought the task was hard, suggesting they were sensitive to mental state information when making judgments about ability. Therefore, although most earlier findings suggest that a mature understanding of ability is not developed until middle childhood, it seems that at least some limited understanding of ability is likely to be present before kindergarten. Additional research is needed to begin to build a more comprehensive developmental picture regarding younger children's understanding of ability.

A related question on children's understanding of ability worth investigating is whether young children expect a person's ability levels in different domains to be the same or different. Most existing literature on ability has examined children's understanding of single abilities, which does not provide an answer to this question. However, researchers have examined whether children show global or domain-restricted thinking in understanding traits. Some researchers of trait understanding have found that compared to older children, younger children were more likely to generalize behaviors to only limited and similar domains (Rholes & Ruble, 1984). In contrast, other researchers have found that younger children actually showed global thinking when predicting other people's behaviors or in making self-evaluations. For instance, they did not differentiate between intellectual and social domains (Benenson & Dweck, 1986; Heller & Berndt, 1981) or isolate athletic skills (Stipek & Daniels, 1990).

Using more sensitive measures, Droege and Stipek (1993) determined that young children might show both global thinking and differentiation of traits to some degree. When asked to select classmates to be team members for an academic competition or as playmates, both kindergarteners and older children preferred those who were both smart and nice. However, even kindergarteners implicitly differentiated the two domains by giving greater weight to the trait relevant for the target activity. Taken together, the findings are not conclusive about whether younger children show differentiated or global thinking or both in generalizing trait-related behaviors across different situations. Most of the studies on trait understanding focused on social-moral characteristics, and it will be interesting to see whether children's perception of ability follows similar or different developmental patterns as these attributes.

The present study aims to investigate the early development of ability understanding among preschool children, focusing on whether children differentiate ability from observable outcome. Although ability is often a cause of outcome and outcome is often a good indicator of ability, there are circumstances when the two can be inconsistent. One intervening factor is the person's effort, which has been the focus of investigation in most existing research. Another factor that has received little attention is the role of intervening events. For example, it is possible that a capable person may perform badly if disrupted by an accident, and an incompetent person may exhibit a good outcome when his or her performance is externally facilitated. Since previous research has focused on children's reasoning about ability in relation to effort and outcome information, it remains unanswered when children start to differentiate ability from outcome, especially when the two are inconsistent due to an obstacle or intervening event.

Previous studies on children's reasoning of ability and outcome typically ask children to infer the levels of ability based on information about effort and outcome. It is possible that reasoning about ability in terms of two constraining factors is challenging for young children, even if they have some preliminary understanding of ability. To make the correct inference or

offer the relevant explanation, children have to pay attention to both effort and outcome information, notice the inconsistent relation between the two, and then use ability to reconcile the contradiction. Children's performance could be diminished if they have difficulty with any of these processes. We expect that children might show a higher level of understanding when reasoning about ability in relation to outcome information alone.

To further reduce the demands of making novel inferences, instead of asking children to infer ability based on other factors, we explicitly presented them with information indicating the characters' ability in doing a task. Children are then informed about an interfering event, which produced performance inconsistent with their actual ability. The key questions that were then asked were what would happen later when there is no interfering event, which character will perform better, and who has higher ability. If children can differentiate ability from outcome, their prediction and evaluation should not be influenced by the accidental outcome information. Even if the higher ability character produces a worse outcome due to the disrupting event, she should still be viewed as capable and able to perform better in the absence of the disruption. Alternatively, if children lack a concept of ability as separate from outcome, they may simply judge the person's competence and future performance in accordance with the most recent performance. Since Wimmer et al. (1982) suggest that concrete situations and information may facilitate young children's performance, we also assessed children's understanding of ability using concrete situations, such as baking, choosing a path to a destination, or running.

## 2. Study 1

To assess whether preschool children have an understanding of ability differentiated from outcome, we presented 3-, 4-, and 5-year-olds with stories in which one person had higher ability than another in doing a concrete task (e.g., baking or choosing a path) as indicated by their ability-related choices. Subsequently, because of an unforeseen event, their actual performance becomes reversed (i.e., success accrued to the low instead of the high ability actor). Of most interest was whether children's reasoning about the two actors' abilities and future performance is influenced by the accidental outcome. In addition, to assess whether children's reasoning about ability shows a general "halo effect" (i.e., expecting a person with higher ability in one task will also be better at other unrelated tasks), we also examined their evaluation of the characters' abilities in a different and unrelated task (e.g., singing).

### 2.1. Method

**Participants:** Fifty-five children from one preschool in a middle-sized city in China participated. Participants were 17 three-year-olds (10 girls, range = 30–47 months,  $M = 38.2$  months), 19 four-year-olds (9 girls, range = 48–58 months,  $M = 50.5$  months), and 19 five-year-olds (9 girls, range = 60–70 months,  $M = 66.1$  months). The majority of the participants were from middle class families.

**Design and materials:** We presented children with two stories that each involved two characters doing a concrete activity (baking a cake or finding the path to a flag). Each story demonstrated that one character had high ability and the other character had low ability. However, an unexpected event made their final performance inconsistent with their actual competence. At the end, a third character restated each character's final performance. Children were asked to predict which character would do better with no interfering event, judge which character was more capable, and predict which character would be better at an unrelated task. The stories were told to the children in Mandarin. Pilot testing suggested that without the unforeseen event, the predictions and judgments of children from all three age groups were consistent with the characters' original ability. Among the 26 participants who were tested without the intervening event, 7 of the 9 three-year-olds, 8 of the 10 four-year-olds, and 6 of the 7 five-year-olds predicted the high ability character would do better at the same task and chose this character as being more capable.

The materials for the *Baking Ability* story included three different dog puppets that were employed to act out the story. Toys for baking included one red cup and one green cup (used as containers for spice and sugar), and two pieces of cake made of wood. A toy gold medal served as the reward. For the *Flag Ability* story, a foam board was painted to show a short garden maze, with two symmetrical straight roads leading from one end of the board to the other end. A red flag with a short stick could be stuck into the foam board. Two princess figures (Snow White and Bell) served as the characters who tried to follow the path to the flag, and a green toy turtle was the character who made the judgment and gave the medal at the end.

**Procedure:** Children were tested individually in a quiet room at the preschool during normal daytime hours. Each child heard both stories in a counterbalanced order in a session that lasted about ten minutes. The child was first introduced to the puppet characters and was asked to name each of them. Children had no difficulty in remembering the characters. Then the experimenter read the story to the child and acted it out using the puppets and toys. For example, the narrative for the *Baking Ability* story was as follows: "Tom and Mike are baking cakes today, and Snoopy says he will give the one who cooks better a big medal as an award. Snoopy says, 'This red cup has spice, and this green cup has sugar. Sugar is good for your cake; it makes your cake sweet. Spice is bad for your cake; it makes your cake spicy. You can choose either one to add to your cake.' Tom says, 'I think sugar is good. I choose sugar!' Mike says, 'I think spice is good. I choose spice!' (The cups were placed close to their cakes). Then Tom and Mike go out to wash their hands. When they are not in the room, Snoopy comes and switches their cups (the two cups were switched and remained at the switched location until the end of the testing). After Tom and Mike come back, they do not notice Snoopy has switched their cups, and they start baking. After they finish, Snoopy comes to taste the cakes, and says to Mike, 'Mike, you cooked a good cake! It is very sweet! I will give this medal

to you as an award.' (Snoopy put the medal on for Mike.) Then Snoopy says to Tom, 'Tom, you cooked a bad cake! It is too spicy!'" The order of Snoopy's comment to the two characters was counterbalanced.

The child was asked three memory questions immediately after each story: 1 *Memory of Performance* question: "Who made a better cake?" 2 *Memory of Intervening Event* question: "Did Snoopy switch the cups?" 3 *Memory of Initial Choice* question: "Who chose the green sugar cup at the beginning of the story?" The order of the questions was counterbalanced across participants. Feedback was provided and the story was clarified if children did not give correct answers to any of these questions.

Next, the child was asked three test questions in the following order: 1 *Prediction of Future Performance* question: "Next time, Snoopy is not at home, so he will not switch the cups around. Tom and Mike are going to make more cakes. Who do you think can make a better cake, Tom or Mike?" 2 *Judgment of Ability* question: "Who is better at baking, Tom or Mike?" 3 *Judgment of Unrelated Ability* question: "Who can sing a better song, Tom or Mike?" The order of the characters' names in each question was counterbalanced across participants. The *Flag Ability* story is of a similar structure and is presented in [Appendix A](#).

## 2.2. Results

**Scoring:** Children's correct and incorrect responses to the memory and test questions were scored as 1 and 0. For the memory questions, children received a score of 1 for the *Memory of Performance* question by correctly remembering who cooked the better cake or found the flag. They received a score of 1 for the *Memory of Intervening Event* question by acknowledging that the cups or the flag were switched or moved. For the *Memory of Initial Choice* question, children got a score of 1 by choosing the correct location for the cup or the flag at the beginning of the story. For each test question, children got a score of 1 if they selected the character who chose the sugar cup or the correct road at the beginning of the story. Children received a score of 0 on a question if they did not give the correct answers listed above.

**Group and task differences:** Children did relatively well on the memory questions. All children except one 4-year-old answered correctly for the *Memory of Performance* question for both stories. All children answered the *Memory of Intervening Event* question correctly. For the *Memory of Initial Choice* question, 14 out of 17 of the 3-year-olds and all the 4- and 5-year-olds answered the *Flag Ability* story correctly. Seven out of 17 of the 3-year-olds, 12 out of 19 of the 4-year-olds, and 18 out of 19 of the 5-year-olds answered the *Memory of Initial Choice* question in the *Baking* story correctly. Excluding children who did not pass all of the memory questions did not change the pattern of results, so all data were used for subsequent analyses.

A preliminary non-parametric test revealed no differences among the corresponding test questions for the two stories, so we created a total score for each test question by combining the answers for the two stories. The score of each question ranged from 0 to 2.

To analyze the combined data, we conducted a two-way repeated measure ANOVA, 3 (Age)  $\times$  3 (Test question), with age as a between-group and test question as a within-group variable. We found main effects for both age,  $F(2, 52) = 8.24$ ,  $p < .001$ ,  $\eta^2 = .24$  (percent correct  $M_s = 35, 46$ , and  $68$  for 3-, 4-, and 5-year-olds respectively), and for test question,  $F(2, 104) = 7.02$ ,  $p < .001$ ,  $\eta^2 = .12$ . Post hoc Bonferroni tests (familywise  $p < .05$ ) revealed that children's performance was better on the *Prediction* test question (percent correct  $M_s = 59.2$ ,  $S.D.s = .57$ ) than on the *Judgment of Ability* and of *Unrelated Ability* questions (percent correct  $M_s = 49.4$  and  $40.0$ ,  $S.D.s = .68$  and  $.71$ ).

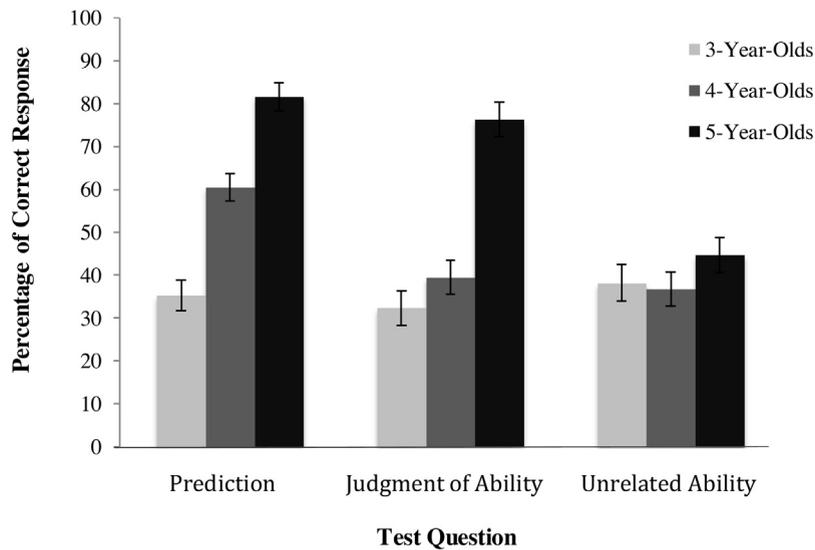
A two-way, Age-by-Test Question interaction occurred,  $F(4, 104) = 3.75$ ,  $p = .007$ ,  $\eta^2 = .13$ . We then further analyzed the simple main effect of age for each test question separately, as displayed in [Fig. 1](#). For the *Prediction of Future Performance* question, 4- and 5-year-olds predicted that the character who originally had higher ability would do better next time, whereas 3-year-olds predicted the character who performed better in the end would do better next time. For the *Judgment of Ability* question, the 5-year-olds judged the character who demonstrated higher ability initially as more competent, while the 3- and 4-year-olds judged the character who performed better as more capable. There were no differences among the three groups on the *Judgment of Unrelated Ability* question.

**Comparisons to chance:** Children's responses for each of the three test questions were compared to a chance level of 1 out of 2. For both the *Prediction of Future Performance* and the *Judgment of Ability* questions, the 3-year-olds were below chance,  $t_s < -2.58$ ,  $p_s < .02$ , the 4-year-olds were at chance,  $p_s > .16$ , and the 5-year-olds were above chance,  $t_s > 3.29$ ,  $p_s < .01$ . All age groups scored at chance on the *Judgment of Unrelated Ability* question.

**Relations among the test questions:** To examine whether children's answers on the three test questions were related, simple and age-partialled Pearson correlations were calculated as shown in [Table 1](#). Performance on the *Prediction of Future Performance* and the *Judgment of Ability* questions was strongly related both without and with age partialled,  $r_s = .71$  and  $.59$ ,  $p_s < .001$ . No correlations were found between the *Judgment of Unrelated Ability* question and the other two questions.

## 2.3. Discussion

The results from Study 1 revealed an age-related change in the judgments of ability between 3 and 5 years. Five-year-olds predicted and judged the relative competence of the two characters according to their ability-related choices, despite the interference of the unexpected event and the resulting misleading performance. In contrast, 3-year-olds were more likely to base their prediction and judgment answers on the actual performance. In addition, all three age groups were found to be at chance for the *Judgment of Unrelated Ability* question, and no correlation was found between this question and the other



**Fig. 1.** Mean percentage of correct responses by age for each of the test questions for the combined *Ability* story in Study 1.

two questions, suggesting that preschoolers' reasoning about ability was not global or based on valence alone (e.g., expect that a person who is good at one thing must also be good at other things).

Previous studies on the understanding of ability suggest that 5- and 6-year-olds do not understand ability as a separate concept from outcome (e.g., Nicholls, 1978; Nicholls & Miller, 1984; Finchman & Cain, 1986; Folmer et al., 2008; Rholes et al., 1980). The 3-year-olds in the present study did not exhibit this understanding either. They relied on the observable outcome to predict a person's future performance and evaluate his ability, even if his level of ability had been established. However, we found that 5-year-olds were able to reason correctly about people's abilities independently from immediate performance, which is earlier than has been documented in previous research. It is likely that examining children's reasoning about ability only in relation to outcome information and in concrete tasks reduced cognitive demands, which may have helped to reveal a higher level of understanding among older preschoolers than in previous studies.

The change we found in early understanding of ability parallels another landmark cognitive development during the preschool years—the understanding of false beliefs. At 3 years, children typically fail to understand that people may hold inaccurate views of reality, and they develop this understanding at 4 or 5 years of age (e.g., Wimmer & Perner, 1983; Gopnik & Astington, 1988; Wellman, Cross, & Watson, 2001). Given the similar age of these changes, it is an intriguing possibility that the understanding of ability and false belief may be related developments. Unlike the observable outcome or reality, both ability and mental states are unobservable characteristics that we attribute to people. The understanding of ability and false belief may both involve recognizing a state of a person and appreciating that the state, rather than the immediate performance for ability or reality for false belief, should lead to better predictions for what the person can do. In order to count as having a concept of ability or false belief, we need to be able to distinguish these characteristics from observable external reality.

On the other hand, even if the understanding of ability and belief share similar developmental patterns, they may not be related since the two also differ in significant ways. For instance, in the typical false belief task (Wimmer & Perner, 1983), beliefs are assumed to be formed through perceptual information (Wellman & Bartsch, 1988)—for example, a story character sees where a piece of chocolate cake is first placed. These beliefs can be established or changed quickly if new information is

**Table 1**  
Simple and age-partialled correlations among the three test questions for the combined *Ability* stories in Study 1.

	Prediction	Judgment	Unrelated ability
Simple correlations			
Age (in months)	.57***	.51***	.13
Prediction		.71***	.20
Judgment			.24
Age-partialled correlations			
Prediction		.59***	.15
Judgment			.20

available, although there are other examples of beliefs that are more resistant to change (Jaswal, 2010; Miller, Holmes, Gitten, & Danbury, 1997; Mitchell, Robinson, Isaacs, & Nye, 1996). Nonetheless, there do not seem to be comparable experiences that would lead to a quick appearance or change in ability because abilities usually require some form of practice. Belief and ability also have different predictive powers for behaviors. We can only predict one-time and target-specific behaviors based on a person's perceptual belief (e.g., where he will look for the chocolate he saw), but cannot predict multiple behaviors even for similar objects (e.g., where he will look for another piece of hidden chocolate). However, when a person has high ability in an area (e.g., baking chocolate cakes), we can predict that he will perform well each time he does that task or other tasks involving similar ability (e.g., baking chocolate cookies). Nonetheless, are children's understanding of ability and false belief related? We explore this question in Study 2.

### 3. Study 2

In Study 2 we investigated the possible relation between children's understanding of ability and false belief. First, a *Change-of-location* task (Wimmer & Perner, 1983) was included to compare children's understanding of false belief and ability. Second, to gain a more closely matched comparison between false belief and ability, we devised a *Normative False Belief* story. The format of the new story resembled that of the *Change of Location* task, but instead of testing a perceptually based belief, a normative belief was introduced by telling the main character where the chocolate *should* always be put. Then, as in the *Change of Location* task, the chocolate is moved to a different place in the actor's absence. We next asked a *Standard False Belief* question of where the character will look for the chocolate. At the end, the child is shown that this knowledgeable actor does not find the chocolate, but another uninformed or ignorant person finds it. The participants are then asked a *Normative False Belief* question, to predict which character would find the chocolate next time. As illustrated in this story, the normative belief is still a belief, but it has more predictive power than perceptual belief and allows prediction of multiple future behaviors in similar situations. Therefore, if ability and perceptual beliefs are at the two ends of a continuum in terms of their predictive power for multiple behaviors, normative beliefs may be conceptualized as belonging somewhere in the middle.

The original *Baking* and *Flag Ability* tasks from Study 1 were repeated so the new tasks could be compared to them. Some minor changes were made to give the 3-year-olds the best chance to succeed. In the original *Baking Ability* story, several 3-year-olds seemed to have some difficulty in remembering the original locations of the cups. To aid children's memory, in the modified task the third character did not switch the cups but put real sugar and spice into the cups, so that children were able to see the condition before and after the interference at the same time. Moreover, in the original tasks, the disrupting character was also the judge who evaluated the performances at the end. To avoid the possibility that some children might think the judge favored the winning character, we introduced an additional character in each task, who was not involved in the contest but simply moved the ingredients for fun.

Finally, we found in Study 1 that young children do not expect a person to have the same level of ability in unrelated tasks (e.g., baking and singing). Are children conservative about their reasoning and think a specific ability can never be demonstrated across different tasks? To investigate this question, in Study 2, we added one *Judgment of Related Ability* question to each story, asking which character would perform better in a different but closely related task (e.g., baking a cake and baking a cookie).

#### 3.1. Method

**Participants:** A new sample of 57 children from the same preschool participated. There were 18 three-year-olds (11 girls, range = 36 to 47 months,  $M = 39.2$  months), 20 four-year-olds (9 girls, range = 48 to 59 months,  $M = 52.4$  months), and 19 five-year-olds (10 girls, range = 61 to 71 months,  $M = 66.3$  months). The majority of the children were from middle class families.

**Design and procedure:** We added a new *Normative False Belief* story in Study 2. In this story, two characters looked for a piece of chocolate. One character was informed by another character about where the chocolate *should* always be put (the cup with the lid). However, a third character made a mistake and put the chocolate in the wrong location. As a result, the knowledgeable actor did not find the chocolate, but an uninformed character did. The specific story and questions are presented in [Appendix B](#). To test whether the results of the first study would replicate and to serve as a comparison to the new task, we also presented children with the two original ability stories from Study 1, with the two modifications mentioned above.

Each child heard three stories in a counterbalanced order in one session that lasted less than fifteen minutes. Children also completed the standard *Change of Location False Belief* task at the end of the session. The testing procedure was the same as in Study 1, except that the child was asked four instead of three test questions: *Prediction of Future Performance*, *Judgment of Ability*, *Judgment of Related Ability* and *Judgment of Unrelated Ability* questions.

#### 3.2. Results and discussion

We used similar coding for children's responses as in Study 1. Children received a score of 1 for each correct answer and a score of 0 for each incorrect answer on the memory questions. For each test question, children received a score of 1 if they

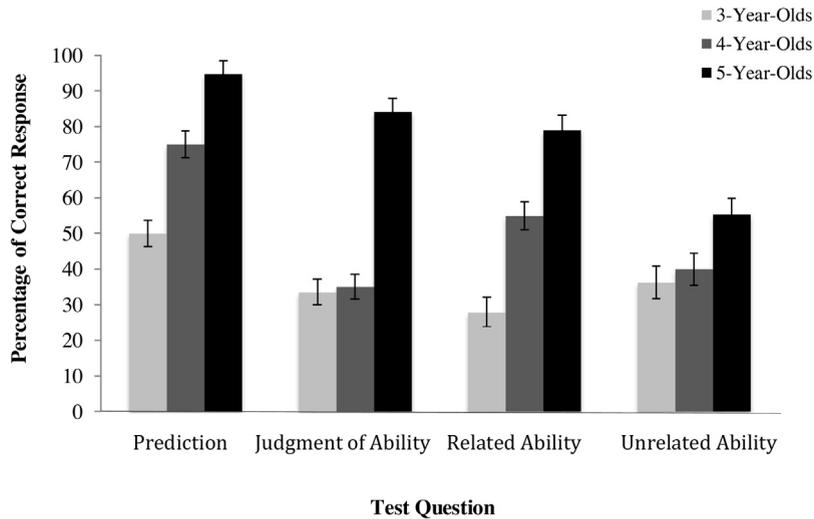


Fig. 2. Mean percentage of correct responses by age for each of the test questions on the combined *Ability* story in Study 2.

chose the character who demonstrated higher ability at the beginning of the story. They got a score of 0 if they chose the character who happened to perform better in the end. For the *Standard False Belief* questions, children got a score of 1 if they chose the original location of the chocolate and a score of 0 if they chose the actual location in the end.

Children did very well on the *Memory* questions. All children except one 3-year-old answered correctly for the *Memory of Performance* question for all stories. All 4- and 5-year-olds and at least 78% of 3-year-olds answered correctly for each of the *Memory of Intervening Event* question for all stories. All 5-year-olds, 85% of 4-year-olds, and 78% of 3-year-olds correctly answered the *Memory of Initial Choice* question of each story.

Similar to Study 1, a non-parametric test revealed no differences between the *Baking and Flag Ability* stories, so we combined them in subsequent analyses as in Study 1. The scores for each question of the combined *Ability* stories ranged from 0 to 2.

**The combined *Ability* stories:** A 3 (age: 3, 4, 5)  $\times$  4 (test question: prediction, judgment of ability, related ability, unrelated ability) repeated measure ANOVA revealed main effects for both age,  $F(2, 54) = 12.95, p < .001, \eta^2 = .32$  (percent correct  $M_s = 36.8, 51.3, \text{ and } 78.3$  for 3-, 4-, and 5-year-olds, respectively), with 5-year-olds performing significantly better than 3- and 4-year-olds, and for test question,  $F(3, 162) = 10.95, p < .001, \eta^2 = .17$ . Post hoc Bonferroni tests (familywise  $p < .05$ ) revealed that children's performance was better on the *Prediction of Future Performance* question (percent correct  $M = 73.3$  and  $S.D. = .65$ ) than on the *Judgments of Ability Related Ability*, and the *Unrelated Ability* questions (percent correct  $M_s = 50.9, 53.9, 43.8$  and  $S.D.s = .64, .76, .80$ , respectively). Scores on the latter three questions were not different from each other.

There was also a two-way, age-by-test question interaction,  $F(6, 162) = 2.47, p = .032, \eta^2 = .08$ . We further analyzed the simple main effect of age for each test question separately (Fig. 2). The patterns were similar to those in Study 1. Four- and 5-year-olds were more likely than 3-year-olds to predict that the character who showed higher ability at the beginning would do better next time on the same task and on the related task. Five-year-olds reported the character who demonstrated higher ability as more capable, while 3- and 4-year-olds claimed the character who had the better outcome was more capable. Lastly, similar to Study 1, the three age groups did not differ in their scores on the *Judgment of Unrelated Ability* question.

Children's responses on each of the four test questions were also compared to a chance level of 1 out of 2. For the *Prediction of Future Performance* question, 3-year-olds were not different from chance  $t(18) = 0.00, p = 1.00$ ; 4- and 5-year-olds were above chance,  $t_s > 2.94, p_s < .01$ . For the *Judgment of Ability* and *Related Ability* questions, 3-year-olds were below chance,  $t_s < -2.38, p_s < .03$ ; 4-year-olds were at chance,  $-1.83 < t_s < .62, p_s > .08$ ; and 5-year-olds were above chance,  $t_s > 3.64, p_s < .01$ . All age groups scored at chance on the *Judgment of Unrelated Ability* question.

**Standard False Belief** questions: There were two standard measures of children's understanding of false belief: the standard *Change of Location* task and the *Standard False Belief* question embedded in the *Normative False Belief* story. The two measures were strongly correlated both without and with age controlled:  $r = .79$  and  $.53, p_s < .001$ . A non-parametric test revealed no differences between the two questions, so we combined them to create a single standard false belief measure that ranged from 0 to 2. A one-way ANOVA revealed a significant main effect for age,  $F(2, 54) = 37.67, p < .001, \eta^2 = .58$ . Five-year-olds performed better than the 3- and 4-year-olds, and 4-year-olds performed better than 3-year-olds (percent correct  $M_s = 11.1, 50.0, \text{ and } 100.0$  for 3s, 4s and 5s).

**Normative False Belief** question: A log-linear analysis was performed to test for age differences in children's success on the *Normative False Belief* question. The best-fit model revealed age differences in children's responses:  $X^2(2, N = 57) = 14.39, p < .001, d = 1.16$ . Post hoc analyses revealed that 5-year-olds performed better than 4- and 3-year-olds on this question ( $p_s < .01$ ) (percent correct  $M_s = 56.0, 70.0, \text{ and } 100.0$  for 3s, 4s and 5s). Five-year-olds were more likely than 3- and 4-year-

**Table 2**  
Simple and age-partialled correlations among the *Ability* and *False Belief* questions in Study 2.

Simple (age-partialled) correlations	<i>Ability</i> questions				<i>False belief</i> questions	
	Prediction	Judgment	Related ability	Unrelated ability	Normative false belief	Combined false belief
Age (in months)	.57***	.57***	.53***	.18	.44***	.79***
<i>Ability</i> questions						
Prediction		.63*** (.45**)	.55*** (.35*)	.43*** (.41**)	.54*** (.39**)	.66*** (.41**)
Judgment			.46*** (.23)	.20 (.12)	.48*** (.31*)	.52*** (.14)
Related ability				.42*** (.39**)	.46*** (.30)	.44*** (.06)
Unrelated ability					.32* (.28*)	.16 (.03)
Normative false belief						.49*** (.25)

\*  $p < .05$  (two-tailed).

\*\*  $p < .01$  (two-tailed).

\*\*\*  $p < .001$  (two-tailed).

olds to predict the person who was informed about the location of the chocolate, rather than the person who found the chocolate last time, would find the chocolate again.

**Relations among the questions of the *Ability* stories and the *False Belief* questions:** Pearson correlations were calculated to examine the relations among the questions of the ability and false belief stories. The combined *False Belief* measure was positively correlated with the *Prediction of Future Performance*, the *Judgment of Ability* and the *Judgment of Related Ability* questions of the combined *Ability* stories ( $.44 < r_s < .66$ ,  $ps < .001$ ). Multiple simple and age-partialled correlations were found between the *Normative False Belief* question and the test questions of the combined *Ability* stories (Table 2). Children's responses on the combined *False Belief* measure and the *Normative False Belief* question were also positively correlated ( $r = .49$ ,  $p < .001$ ).

The results for the ability questions were consistent with what was found in Study 1. Specifically, 5-year-olds predicted correctly that the character who demonstrated higher ability, rather than the character who accidentally performed better, would succeed in a similar situation without interruptions and also judged him to be more capable. In contrast, 3-year-olds predicted at chance and they judged the character who coincidentally had a better outcome as more capable.

We explored in Study 2 the relation between children's false belief understanding and ability understanding. Children's performance on the combined *Standard False Belief* measure correlated with their responses on the *Prediction of Future Performance* and the *Judgment of Ability* questions. Children's response to the *Normative False Belief* question was related to their responses to the *Standard False Belief* question and the questions that assessed ability. These results suggest that children's understanding of ability and false belief may be related developments.

We also found children's response pattern on the *Judgment of Related Ability* question was similar to their responses on the *Prediction of Future Performance* and *Judgment of Ability* questions. In contrast, all age groups were at chance for the *Judgment of Unrelated Ability* question. Taken together, the current results and those from Study 1 do not indicate that preschool children show a "halo effect" in evaluating abilities—they do not expect that a person who is good at one task will perform better in other unrelated tasks. However, the results do show that older preschoolers understand that a person's ability could be exhibited in different tasks, as long as the tasks are related and so require similar underlying ability.

#### 4. Study 3

Studies 1 and 2 revealed an age-related change in preschool children's understanding of ability. In Study 3, we examined whether young preschoolers might show more advanced reasoning about ability when the information processing demands of the tasks were kept to a minimum. We simplified the ability story in multiple respects. In the new story, we tested children's understanding of physical ability (i.e., running). Two characters who differed in running ability were running towards the same place. The situation was concrete and very familiar to young children. The story only involved the two target characters, with no interfering person or judge. We explicitly informed the children about the characters' running ability in the story, so there was no need for them to make even the most basic inference about the characters' actual ability. The interfering event was very simple and observable: a stone on the road made the more able character in the story stumble in front of everyone. The outcome information was also obvious and objective: children could see which character reached the destination first. We were interested in whether younger preschoolers would perform better on this task, as well as whether children's reasoning about ability and false belief would remain related when the ability story was substantially simplified.

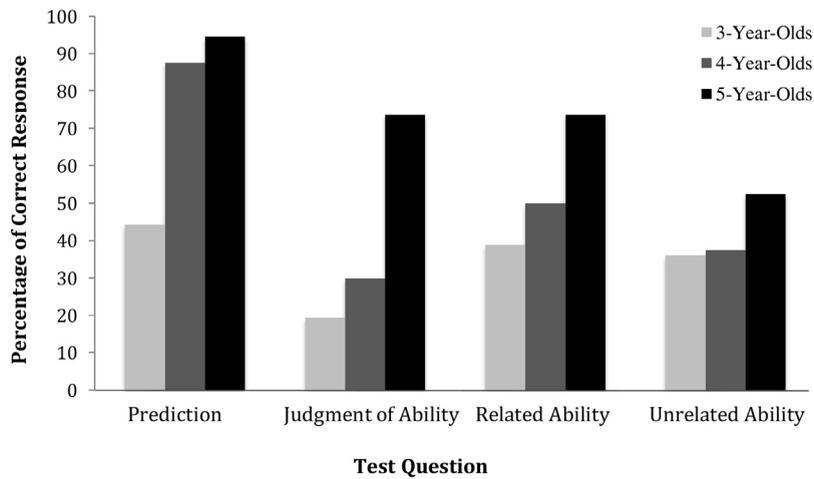


Fig. 3. Mean percentage of correct responses by age for each of the test questions on the *Physical Ability* story in Study 3.

#### 4.1. Method

**Participants:** A new sample of 53 children from the same preschool participated. There were 17 three-year-olds (12 girls, range = 39 to 47 months,  $M = 43.2$  months), 19 four-year-olds (7 girls, range = 49 to 58 months,  $M = 52.7$  months), and 17 five-year-olds (8 girls, range = 60 to 71 months,  $M = 65.4$  months). The majority of children were from middle class families.

**Design and procedure:** The *Physical Ability* story was told to children with corresponding illustrations shown on a computer screen. In the story, two characters with blue and green outfits were running to a house to deliver letters. The child was explicitly told that one character ran faster than the other. Next, the faster character was shown to stumble on a stone on the road, and as a result the slow character reached the house first. We followed similar procedures as in Studies 1 and 2. Each child heard this *Physical Ability* story and the memory and test questions in one five-minute session. They also completed a *Change of Location False Belief* task at the end. The specific story and questions are presented in [Appendix C](#).

#### 4.2. Results and discussion

**Physical Ability** story: Children received a score of 1 for answering each memory question correctly. They received a score of 1 on each test question by choosing the faster runner, rather than the person who reached the destination first. Each incorrect answer was coded as 0.

All children answered correctly for the *Memory of Performance* and *Memory of Intervening Event* questions. On the *Memory of Stated Ability* question, 76.5% of the 3-year-olds, 73.7% of the 4-year-olds and 94.1% of the 5-year-olds answered correctly.

A McNemar test indicated that children's performance was better on the *Prediction of Future Performance* question (percent correct  $M = 67.7$ ,  $S.D. = .47$ ) than the *Judgment of Ability* (percent correct  $M = 51.6$ ,  $S.D. = .50$ ),  $p = .049$ ,  $d = .56$ ; the *Related Ability* (percent correct  $M = 53.2$ ,  $S.D. = .50$ ),  $p = .021$ ,  $d = .67$ ; and *Unrelated Ability* (percent correct  $M = 37.1$ ,  $S.D. = .48$ ) questions,  $p = .002$ ,  $d = .94$ .

To test the effect of age, a log-linear analysis was performed separately on the four test questions. The best-fit model revealed effects of age on children's responses on the *Prediction of Future Performance* question,  $X^2(2, N = 53) = 6.99$ ,  $p = .032$ ,  $d = .67$ ; and the *Judgment of Ability*,  $X^2(2, N = 53) = 16.73$ ,  $p < .001$ ,  $d = 1.36$ ; and *Related Ability* questions:  $X^2(2, N = 53) = 22.54$ ,  $p < .001$ ,  $d = 1.72$ . No age difference was found for the *Judgment of Unrelated Ability* question.

We then analyzed the age differences for each question (Fig. 3). Five-year-olds performed better than 3-year-olds on the *Prediction of Future Performance* question,  $X^2(1, N = 34) = 6.98$ ,  $p = .008$ ,  $d = 1.02$ , and on the *Judgment of Ability*,  $X^2(1, N = 34) = 15.78$ ,  $p < .001$ ,  $d = 1.86$  and *Related Ability* questions,  $X^2(1, N = 34) = 22.50$ ,  $p < .001$ ,  $d = 2.80$ . Five-year-olds predicted the faster runner would reach the destination first when there was no stone on the road. They also claimed this character was the faster runner and would win a new race, whereas 3-year-olds were more likely to choose the character who happened to succeed at the end for all of these questions. In addition, 5-year-olds performed better than 4-year-olds on the *Judgment of Ability*,  $X^2(1, N = 36) = 8.91$ ,  $p = .003$ ,  $d = 1.15$  and *Related Ability* questions:  $X^2(1, N = 36) = 7.23$ ,  $p = .007$ ,  $d = 1.00$ . Lastly, 4-year-olds performed better than 3-year-olds for the *Judgment of Related Ability* question:  $X^2(1, N = 36) = 5.71$ ,  $p = .021$ ,  $d = .87$ . Four-year-olds were more likely than 3-year-olds to predict the actual faster runner would win a new race.

Further analyses revealed that 3- and 4-year-olds' responses to the *Prediction of Future Performance* question were not different from the chance score of .5,  $ps > .11$ , whereas the 5-year-olds were significantly above chance,  $t(17) = 4.75$ ,  $p < .01$ . For the *Judgment of Ability* and the *Related Ability* questions, 3-year-olds were below chance,  $ts < -2.50$ ,  $ps < .02$ ; 4-year-olds were at chance,  $ps > .51$  and 5-year-olds were above chance,  $ts = 4.75$ ,  $p < .001$ . All age groups were not different from chance on the *Judgment of Unrelated Ability* question.

**Table 3**Simple and age-partialled correlations among the three test questions for the *Physical Ability* story in Study 3.

	Prediction	Judgment	Related ability	Unrelated ability
Simple correlations				
Age (in months)	.32 <sup>*</sup>	.53 <sup>***</sup>	.56 <sup>***</sup>	.09
Prediction		.38 <sup>**</sup>	.42 <sup>***</sup>	.01
Judgment			.51 <sup>***</sup>	.34 <sup>*</sup>
Related ability				.21
Age-partialled correlations				
Prediction		.26 <sup>*</sup>	.32 <sup>*</sup>	-.02
Judgment			.30 <sup>*</sup>	.19
Related ability				.19

\*  $p < .05$  (two-tailed).\*\*  $p < .01$  (two-tailed).\*\*\*  $p < .001$  (two-tailed).

Simple and age-partialled correlations were found among the *Prediction of Future Performance*, *Judgment of Ability* and *Related Ability* questions,  $ps < .05$  as shown in Table 3.

**Change of Location False Belief** task: Log-linear analyses revealed a difference between 3- and 5-year-olds' responses to the *Change of Location False Belief* task,  $X^2(1, N = 34) = 18.86, p < .001, d = 2.23$ , (percent correct  $M_s = 17.6$  and  $88.2$ ,  $S.D.s = .39$  and  $.33$ ) and between the 3- and 4-year-olds' responses,  $X^2(1, N = 36) = 9.92, p = .002, d = 1.23$  (percent correct  $M_s = 17.6$  and  $68.4$ ,  $S.D.s = .39$  and  $.48$ ).

**Relations between the False Belief and Ability questions:** Children's responses to the standard *Change of Location False Belief* task and the *Prediction of Future Performance* question were positively related, both without and with controlling for age ( $r_s = .34$  and  $.29, ps = .013$  and  $.032$ ).

Children's responses to the *Physical Ability* story were similar to their responses in the previous two studies. Five-year-olds' predictions and judgments were based on the character's actual ability rather than the results from the latest situation, whereas younger children's evaluations were influenced by the observable outcome. Children's reasoning of ability in this simplified story was also correlated with their understanding of false belief, providing more evidence that the understanding of ability and false belief might be related developments.

## 5. General discussion

Across three studies, we found an age-related change between 3 and 5 years in children's understanding of ability. Three-year-olds' reasoning about ability was influenced by the immediate performance of the person, even if that performance was caused by an observable interfering event. In contrast, 5-year-olds were able to judge the characters' ability independently from their performance, suggesting that they could distinguish ability from outcome. Therefore, although most existing findings suggest that understanding of ability as differentiated from effort and outcome emerges in middle-childhood (Nicholls, 1978; Nicholls & Miller, 1984; Rholes and Ruble, 1984), our results reveal that a basic understanding of ability is evident before children reach the end of their preschool years.

Several features of our study might account for the earlier understanding found compared to earlier studies. Previous studies assessed whether children were able to make inferences about ability based on both effort and outcome information (e.g., Nicholls, 1978; Nicholls & Miller, 1984). The current study focused on reasoning about ability only in relation to outcome, making the stories cognitively less challenging for young children. Moreover, information about ability and outcome was also presented in concrete terms in the stories, which may have helped reduce information-processing demands.

In addition to the task differences, there is also an intriguing possibility that children might understand ability as separate from outcome before they understand ability as differentiated from effort. In reality, outcomes are typically visible and easy to discern. Although there are also cues for effort, such the time spent on a task, often it can be difficult for an outside observer to determine the effort level of another person. Therefore, it is conceivable that children may first notice inconsistencies between ability and outcome before those between ability and effort. Noticing the inconsistencies between two factors might help children realize the two concepts are different. Moreover, once children are able to differentiate ability from outcome, the inconsistencies between the two might then alert them to the moderating role of effort, thus facilitating their understanding of ability as a separate concept from effort. In this sense, the early understanding of ability in relation to outcome as found in the current study might be an important first step to later development in reasoning about the relation between ability and effort.

We found that preschoolers were flexible in reasoning about ability in relation to specific tasks. They expect a person who is good at one task would perform well in the same or very similar tasks, but not on unrelated tasks. That is, they do not simply view high ability in one activity as a general, positive characteristic that implies success in all tasks. At the same time, they also do not simply equate ability with good performance in just one particular task. They are aware that related tasks, even if not exactly equivalent, may nevertheless require and reveal the same underlying ability.

The absence of a halo effect in children's judgments of unrelated ability is consistent with recent findings on children's expectations of expertise. For example, [Koenig and Jaswal \(2011\)](#) also found that children did not expect expertise to generalize to an unrelated domain (they preferred a dog expert over a dog novice in terms of names of dogs but showed no preference for the names of artifacts). Interestingly, they found a "pitchfork effect" for incompetence. That is, children expected people who were incompetent in one domain also to be incompetent in another domain. Our tasks involve both a competent and an incompetent character simultaneously, which did not allow us to differentiate children's judgments of competence versus incompetence. However, because we asked "who can sing a better song," it is possible that this question made children focus on competence more than incompetence. Future tasks that involve only competent or incompetent characters will help tease the different possibilities apart.

Two possible cognitive processes might be underlying children's reasoning about the generalization of ability. First, children might adopt an "individual-based approach." That is, based on information about an individual's competence in a specific domain, children might form a global impression of the individual and rely on it to evaluate whether the person is competent or incompetent in a different task. Alternatively, children might adopt a "task-based approach." Given information about an individual's competence in a certain domain, children might assess the relatedness of the new domain to the known domain to evaluate the individual's competence in the new task.

The absence of a halo effect in our findings and the findings on children's expectations of expertise ([Koenig & Jaswal, 2011](#)) lend support to the second strategy. However, it does not exclude the possibility that both strategies could be used depending on the situation. For example, it is possible that when children are not sure about whether two domains are related (e.g., when the new domain is novel), they might rely more on the global impression of the individual. Moreover, children might be more likely to form and use a global impression for some domains rather than others. For example, studies on children's understanding of traits suggest that, although young children could distinguish intellectual ability from social traits (e.g., [Droege & Stipek, 1993](#)), they tend to expect a person's level of intellectual ability to match the valence of her social traits (e.g., [Benenson & Dweck, 1986](#); [Heyman et al. 2003](#)), and they were more likely to misremember the intellectual ability information to match the valence of social trait information than the other way around ([Heyman et al., 2003](#)). It will be interesting to investigate children's evaluations of different types of ability and traits to examine the situations or domains where global thinking is most pronounced.

Importantly, we found similar developmental transitions in the understanding of ability and false belief, and that performance on the two was correlated. There may be different ways to account for this relation. One simple explanation might be that because recent reality was more perceptually salient than ability or false belief, younger children were simply swayed by the reality. In addition, both executive function ([Carlson, Moses, & Hix, 1998](#); [Frye, Zelazo, & Palfai, 1995](#)) and verbal skills ([Milligan, Astington, & Dack, 2007](#)) have been shown to be related to the development of false belief. Consequently, changes in one or both of these processes might also underlie the relation between the understanding of ability and the understanding of false belief. It will be important to include the assessment of these cognitive skills to test this possibility in future work.

A final possibility is that the two developmental effects might share an underlying conceptual similarity. Both beliefs and abilities involve understanding internal attributes of the person as partially independent from objective reality. In understanding beliefs, children increasingly recognize that people may hold representations that do not match reality. Similarly, in understanding ability, children gradually learn that people can have competences that at times are inconsistent with actual performance. This independence of internal attributes and reality might be essential to a first understanding of beliefs and abilities, and might account for the correlations between children's responses to both types of tasks.

The understanding of ability and belief may not be identical and develop in parallel in every respect. There are also important differences between the two. Ability and perceptual beliefs might be conceptualized as being at the two ends of a continuum in terms of formation and predictive power. Ability can predict multiple behaviors in similar situations for a relatively long period of time. Beliefs, especially perceptually based beliefs, cannot predict multiple behaviors across situations. Normative belief might be viewed as a transitional state between belief and ability. In the *Normative False Belief* task, the character is informed about where the chocolate *should* be put. This information becomes part of the enduring knowledge of the person and similar to ability, may enable others to predict multiple rounds of the person's behaviors.

Ability and belief also differ in the factors that affect their formation and change. As illustrated in the *Change of Location False Belief* task, information from the world can lead to the rapid formation or change in perceptually based beliefs. Even the more persistent beliefs, as illustrated in the *Normative False Belief* task, can be gained relatively rapidly through being adequately informed. In contrast, the formation of ability requires more than a change in the world, and is often a result of intentional practice and learning. Most of the time these changes take much effort from the self and a reasonable amount of time to accomplish. The existing literature shows that children start to understand how a person's informational access will affect his or her belief at about age 4 (e.g., [Pillow, 1989](#); [Povinelli & deBlois, 1992](#); [Pratt & Bryant, 1990](#); [Wimmer, Hogrefe, & Perner, 1988](#)). It remains to be examined how much preschool children also understand about what factors govern changes in ability.

Younger children's failure to understand false beliefs has been interpreted as showing that they do not grasp the representational nature of the mind ([Perner, 1991](#)). That is, they do not understand that people represent the world in their minds and act based on those representations. Our results regarding children's similar understanding of ability and false beliefs suggest a new possible way to analyze perceptually based belief in terms of its formation and stability. Older preschoolers understand that a person's level of ability will last unless some new learning or practice occurs. In a similar fashion, they

understand that a person's belief will remain the same until new perceptual input is received. In both the ability and false belief stories, no adequate conditions for the formation of new ability or belief exist, so older preschoolers' predictions and evaluations reflect the characters' initial ability and belief.

In contrast, younger children do not understand that a person may have lasting ability or belief. For them, a person's ability or belief is updated automatically with the immediate situation. Therefore, their predictions of the person's behavior or performance reflect the outcome or reality. In this way, we are able to bring the understanding of belief and ability under a single framework: both are about recognizing a person's internal attribute as independent from the reality. From this perspective, what distinguishes ability and perceptually based belief might not be qualitative but quantitative. Perceptually based beliefs can be formed and changed relatively quickly with new perceptual input, whereas changing ability usually requires something more than an update from new information.

Children's recognition of ability may have implications for their learning. If we do not understand ability as partially independent from outcome, we may rely too heavily on outcomes to evaluate our own abilities. This approach will be fine when outcomes accurately reflect ability. However, when outcomes are affected by an unexpected event, young children will not have a clear idea about their ability. For example, a child who makes a lucky correct guess for a math problem might take the positive outcome as evidence for their good ability, even if they do not really know that math operation. When children start to understand ability as partially independent from outcome, they may become more able to pay attention to their actual skills in a task, especially when there are unexpected interfering factors. This understanding might thus help children to be better prepared for transitions to formal education in school. Furthermore, recognizing the competence levels of other people may also enable children to seek and learn information from reliable informants. Research on children's trust in testimony reveals that children as young as 3 years spontaneously track informants' past performance when learning from them (e.g., [Koenig & Harris, 2005](#)), but it is not until age 5 that children become sensitive to whether the performance was due to excusable reasons ([Nurmsoo & Robinson, 2009](#); [Robinson & Nurmsoo, 2009](#)). It is possible that this change in children's selective trust is related to their understanding of ability. As preschoolers become more able to differentiate ability from outcome, they may also become increasingly sensitive to whether an outcome is a reliable indicator for a person's ability and to determine flexibly about whether to use it to guide their learning.

The current studies were conducted with Chinese children. The age-related change from 3 to 5 years in false belief understanding resembled that found with Western children ([Wellman et al., 2001](#)). We did not expect there would be dramatic cross-cultural differences between Chinese and Western children in the origin of the ability concept, especially since the understanding of ability was related to false belief understanding. However, this similarity does not exclude the possibility that there may be cross-cultural variations in children's reasoning about other aspects of ability, such as whether ability can or cannot be changed. [Lockhart, Nakashima, Inagaki, and Keil \(2008\)](#) found that Japanese children are more likely than their American peers to believe that negative psychological and physical traits (e.g., poor learner, slow runner) could be changed towards the positive. Moreover, there might also be substantial cross-cultural differences in developmental endpoints for ability and learning concepts. For example, [Li \(2012\)](#) proposed that in conceptualizing learning and developing abilities, Western people emphasize cultivating the mind to understand the world, while East Asian people view learning as perfecting the self morally and socially. It will be important to investigate the developmental process by which children's basic conceptions of ability develop into more comprehensive views through the influence and integration of cultural values.

Real life situations are often complex and constantly changing. To learn and function well we have to distinguish our own and others' actual ability from various situational factors. Our results showed that by the end of preschool, children can already recognize that ability is not identical with observable outcomes. The emerging understanding of ability in the preschool years may well be a precursor for a more mature understanding of ability during middle childhood, when children perceive ability as differentiated from both outcome and effort.

## Appendix A.

### *The Flag Story in Study 1*

Today, Snow White and Bell are playing in the Turtle's garden. They both say they know the roads better in the garden. So the Turtle puts a red flag at the end of one of the roads, and says he will give a big medal to the one who finds the flag. Snow White says, "I think the right road is correct. I will take the right road!" Bell says, "I think the left road is correct. I will take the left road!" Then they start walking on the roads they choose. When they are half way there, the Turtle secretly moves the flag to the end of the left road. When they reach the ends of the roads, the Turtle says to Bell, "You found the flag! You must know my garden better. I will give you this big medal as an award!" Then he puts the medal on Bell. He then says to Snow White, "You didn't find the flag, so I don't have an award for you."

Memory Questions:

- 1) *Memory of Performance* question: Who found the flag?
- 2) *Memory of Intervening Event* question: Did the Turtle move the flag?
- 3) *Memory of Initial Choice* question: Who chose the left road?

### Test Questions:

- 1) *Prediction of Future Performance* question: Next time, the Turtle is not at home, so he will not move the flag. There is a flag somewhere in the garden. Who do you think can find the flag, Snow White or Bell?
- 2) *Judgment of Ability* question: Who is better at finding the path in the garden, Snow White or Bell?
- 3) *Judgment of Related Ability* question: Who can sing a better song, Snow White or Bell?

### Appendix B.

#### *The Normative False Belief Story in Study 2*

Today, the Frog is playing outside and the Elephant is waiting for the Squirrel to come home from the grocery store. The Squirrel comes back with a piece of chocolate. The Squirrel says to the Elephant, “We should always put the chocolate into the orange cup with the lid, so it will not melt.” They put the chocolate into the orange cup and then go out to play together with the Frog. The Sheep comes in and uses the chocolate to make a cake. When she finishes, she puts the rest of the chocolate into the yellow cup by mistake.

#### **Standard False Belief Question**

When the Elephant comes back, where will he look for the chocolate?

(After the answer is recorded, the narrative continued without giving feedback to the child). The Elephant and the Frog come in to look for the chocolate. The Elephant goes to the orange cup, and the Frog goes to the yellow cup. The Elephant does not find the chocolate. The Frog finds the chocolate.

#### **Memory Questions:**

- 1) *Memory of Performance* question: Who found the chocolate?
- 2) *Memory of Intervening Event* question: Did the Sheep move the chocolate or not?
- 3) *Memory of Experience* question: Who helped the Squirrel put the chocolate away at the beginning?

#### **Normative False Belief Question:**

Tomorrow the Squirrel is going to buy another piece of chocolate and put it away. The Sheep is not at home tomorrow, so she will not move the chocolate. Who do you think is more likely to find the chocolate? The Elephant or the Frog?

### Appendix C.

#### *The Physical Ability Story in Study 3*

Mr. Green runs faster than Mr. Blue. Today, they are going to send some letters to the house at the end of the road. They start to run at the same time from the same place. Mr. Green stumbles on a stone on his way to the house. Mr. Blue is the first to get to the house.

#### Memory Questions:

- 1) *Memory of Performance* question: Who was the first to get to the house?
- 2) *Memory of Intervening Event* question: Did Mr. Green stumble on a stone on his way to the house or not?
- 3) *Memory of Stated Ability* question: At the beginning, who did I say could run faster?

#### Testing Questions:

- 1) *Prediction of Future Performance* question: Tomorrow, they are going to send some letters again to another house. This time there is no stone on the road, so no one will stumble. Who do you think will be the first to get to the house, Mr. Green or Mr. Blue?
- 2) *Judgment of Ability* question: Who is a faster runner, Mr. Green or Mr. Blue?
- 3) *Judgment of Related Ability* question: If they are going to have a race, who will win, Mr. Green or Mr. Blue?
- 4) *Judgment of Unrelated Ability* question: Who can sing a better song? Mr. Green or Mr. Blue?

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