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Trust me, I'm a competent expert: Developmental differences in children's use of an expert's explanation quality to infer trustworthiness

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A B S T R A C T

In this study, we examined how 3-, 4-, 5-, and 7-year-old children respond when informants who are labeled as experts fail to provide high-quality explanations about phenomena within their realm of expertise. We found that 4-, 5-, and 7-year-olds discounted their initial trust in an expert who provided low-quality explanations in a task related to the expert's area of expertise. The 5-year-olds' distrust of the expert who provided low-quality explanations also generalized to additional learning tasks. When an expert provided explanations consistent with the expert's labeled expertise, 5-year-olds maintained a similar level of trust in the expert, but 7-year-olds displayed an increased level of trust in the expert within the expert's area of expertise. We did not find consistent preferences in 3-year-olds' judgments. We discuss the implications of these findings for age-based differences in children's relative weighting of trait-based versus real-time epistemic cues when evaluating informant reliability.

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Introduction

By early preschool, children are remarkably selective when making decisions about who to trust in learning situations (see Harris, 2012, and Mills, 2013, for reviews). They attend to both epistemic cues that reflect the quality of an informant's knowledge, such as accuracy (Birch, Vauthier, & Bloom, 2008; Vanderbilt, Heyman, & Liu, 2014) and expertise (Sobel & Kushnir, 2013), as well as social cues, including cues to group membership such as accent (Kinzler, Corriveau, & Harris, 2011) or gender (Taylor, 2013), benevolence (Landrum, Mills, & Johnston, 2013), and relative social dominance (Bernard et al., 2016). Previous research has examined the development of children's use of these two types of cues independently when making judgments (see Harris, Koenig, Corriveau, & Jaswal, 2018, for a review). Researchers have also explored children's relative weighting of multiple cues when deciding between informants, including social versus epistemic cues (Castelain, Bernard, Van der Henst, & Mercier, 2016; Corriveau, Kinzler, & Harris, 2013; Elashi & Mills, 2014; Johnston, Mills, & Landrum, 2015; Liu, Vanderbilt, & Heyman, 2013; Reyes-Jaquez & Echols, 2013; Terrier, Bernard, Mercier, & Clément, 2016) and two social cues (Chen, Corriveau, & Harris, 2013). These studies have typically contrasted a *trait-based* cue that provides insight to an enduring characteristic of the informant, such as group membership, with a *real-time* cue that is based on the informant's actions in a particular learning situation such as accuracy. To date, however, little research has examined how children weigh two different epistemic cues. Children's ability to weigh two epistemic cues, however, has critical consequences for their ability to evaluate explanations from a variety of different sources.

In the current study, we explored young children's informant preferences when given access to information about two epistemic cues: expertise (trait-based) and competency (real-time). We asked whether children take into consideration informants' competency, as demonstrated by the quality of their explanations, when presented with two informants who have differing levels of expertise. The ability to weigh these two epistemic cues is critical for children's learning across a number of domains. From an early age, children are faced with testimony from individuals they view as experts such as their teachers, their parents, and even scientists on television shows. These experts, however, do not always provide high-quality explanations (Kurkul & Corriveau, 2018). For example, consider this anecdote offered by Mills and colleagues to illustrate a low-quality explanation: "A child turns to his parents and asks, 'How does a cheetah run so fast?' One parent answers, 'Yes, isn't it fast? It can run up to 75 miles per hour'" (Mills, Sands, Rowles, & Campbell, 2019). In this instance, the child has not received a high-quality answer that includes information that fully answers his question, although the content of the answer was relevant and accurate. Here, the child may view cheetahs' running as outside of the expertise of his parents, but what if he had received that answer from a zookeeper, scientist, or veterinarian? To what extent do children attend to the quality of an expert's explanations within the expert's realm of expertise, and does this influence their trust in said expert? In the current study, we explored these questions by examining how children judged a particular group of experts—scientists—as informants when they provided high-quality versus low-quality explanations. Below, we first review the development of children's understanding of expertise before turning to their consideration of informant competency.

Children's understanding of expertise

Children display an understanding of expertise early in development. Beginning at around 3 years of age, children can indicate that certain individuals are more knowledgeable about particular areas than others (Aguiar, Stoess, & Taylor, 2012; Lutz & Keil, 2002). For example, 3-year-olds identify that doctors know more about medical problems than mechanics. Children also expect experts' knowledge to extend to related domains (e.g., a doctor should know not just more about medicine but also about underlying biological principles) beginning at around 4 years of age (Lutz & Keil, 2002). Beginning around 6 years of age, children also attribute this understanding of underlying principles or knowledge of broader related domains to experts with a more specialized background, such as an expert in poodles rather than an expert in animals (Landrum & Mills, 2015). Children's attribution of general knowledge to those with specialized backgrounds aligns with evidence that children may perceive of individuals in less disciplinary-specific terms than adults (Danovitch & Keil, 2004). Children are also exposed to the idea of particular professions, such as scientists, being associated with broad expertise early in development. In the case of scientists in particular, this may be due in part to media depictions of scientists as experts in all things related broadly to science. For example, just a selection of *Bill Nye the Science Guy* episodes features scientist Bill Nye explaining meteorology, space exploration, and volcanoes. Given the less disciplinary-specific nature of children's views of scientists, we chose this as our expert category in the current study.

Children also use information about an individual's expertise to make decisions about not just what experts know but also who to trust when learning new information (Koenig & Jaswal, 2011; Sobel & Corriveau, 2010). For example, 5-year-olds will defer to the expert whose knowledge base most closely aligns with the learning task at hand (Kushnir, Vredenburgh, & Schneider, 2013; Landrum et al., 2013). Children do not always defer to experts, however, when learning new information. Instead, beginning at 3 years of age, children endorse the claims of a nice ignorant informant over those of a mean expert (Landrum et al., 2013), suggesting that children may prioritize informants' perceived benevolence and intent to be helpful over their perceived knowledge base (Landrum, Eaves, & Shafto, 2015). Children also attend to the kinds of claims made by experts when making decisions of trustworthiness. For example, children as young as 3-years-old reject experts' claims if they are counterintuitive to the children's own understanding, and this skepticism increases with age (Lane & Harris, 2015). Thus, starting during early childhood, there are limits to the extent to which children will blindly trust an expert.

Children's understanding of informant competency

In addition to children's perception of an expert's benevolence or the plausibility of an expert's claims, recent research suggests that children are sensitive to a number of real-time epistemic cues displayed by informants whose expertise status is unknown, including accuracy (Corriveau et al., 2013; Fusaro, Corriveau, & Harris, 2011; Ronfard & Lane, 2018) and competency (Corriveau & Kurkul, 2014). In the current study, we chose to focus on children's attention to an expert's competency, as demonstrated by explanation quality, for three reasons. First, previous research suggests that young children do attend to the content of an expert's claim, specifically the relevancy of the claim to the expert's knowledge base and the claim's intuitiveness, when deciding whether or not to trust a particular claim (Lane & Harris, 2015). Previous research, however, has not examined whether children used the content of an expert's claim when deciding whether or not to trust that expert in subsequent tasks. Second, similar to children's understanding of expertise, children's attention to explanation quality is early developing and research suggests that even 2-year-olds attend to explanation content as an indicator of quality, selecting strong explanations based in perceptual evidence over weak circular explanations (Castelain, Bernard, & Mercier, 2018). Children also use the quality of an informant's explanation to decide whether or not to learn from that informant (Baum, Danovitch, & Keil, 2008; Castelain et al., 2018; Corriveau & Kurkul, 2014; Mercier, Bernard, & Clément, 2014; but see Bernard et al., 2016). For example, 3- and 5-year-olds prefer to learn new explanations from an informant who had previously provided noncircular explanations (i.e., high-quality explanations) over an informant who had previously provided circular explanations (i.e., low-quality explanations) (Corriveau & Kurkul, 2014). In these studies, however, children were not given information about the expertise of the informants, so their perceptions of informants were based solely on explanation quality. Third, given that experts are expected to display knowledge about particular subjects, it would follow that they should also display high levels of competency. Thus, examining children's evaluation of experts as informants when presented with different cues to informant competency provides an opportunity to explore three related questions. First, does the skepticism children can apply to experts' claims (e.g., Lane & Harris, 2015) extend to experts' low-quality explanations? Second, does children's distrust of informants who provide low-quality explanations (e.g., Corriveau & Kurkul, 2014) extend to experts who provide low-quality explanations? Finally, when children are faced with both trait-based and real-time epistemic cues, how does that affect their judgment of informants?

An expert providing weak or low-quality explanations is displaying contradictory epistemic cues. Note, however, that the distinction between circular and noncircular explanations is not a difference in accuracy. Thus, providing a circular explanation is not an instance of that informant being inaccurate. Instead, these explanations vary in their informativeness; noncircular explanations provide additional information, whereas circular explanations do not provide information beyond what was included in the original question. Recent research suggests that the quality of explanations children receive may influence their satisfaction with responses and their desire to seek out additional information (Mills, Danovitch, Rowles, & Campbell, 2017; Mills et al., 2019). In particular, children who received low-quality, but accurate, circular explanations about animals' characteristics were more likely to seek out further information from other sources. In these studies, however, children were not made aware of expertise of the source of the explanation. Would children have sought out additional information or displayed a difference in their evaluation of the information if it had been provided by an expert rather than a neutral source? Do children recognize when experts provide low-quality explanations, or do children defer to the trait-based cue of expertise instead?

The current study

Previous research exploring children's use of explanation quality when evaluating informants has focused on children's judgments of informants with unknown expertise. Here, we asked whether children attend to explanation quality (noncircular explanations vs. circular explanations) when the informants' expertise is known. We also explored age-based differences in children's use of expertise and explanation quality given past work indicating a developmental progression of children's attention to both expertise and competency separately. We presented 3-, 4-, 5-, and 7-year-olds with two informants—an expert (i.e., a scientist) and a non-expert (i.e., a girl)—each of whom provided explanations for the functions of novel objects. In the first task, children were invited to endorse the explanation of one of two informants when told only about the informants' expertise to assess their *initial preference* for learning from an expert versus a non-expert in a task unrelated to the expert's background (i.e., a neutral task). Here, we selected an expert label that children would be familiar with and predicted that children's familiarity with scientists as experts would lead them to show an initial baseline preference for them starting at a young age.

We then examined whether children attended to differences in informants' explanation quality when informants provided explanations about phenomena related to the experts' background (e.g., nature). In the *training* task, children had access to both information about a trait-based epistemic cue (the informants' expertise) and a real-time epistemic cue (the informants' competency as indicated by explanation quality). For some children these cues were consistent and the expert also provided high-quality noncircular explanations, but for others these cues were in conflict and the expert provided low-quality circular explanations. We asked whether children would maintain their initial preference for the expert or potentially demonstrate an increase in their preference, as would be expected in the face of consistent trait-based and real-time epistemic cues. An alternative hypothesis was that children's preference for the expert would decrease, particularly in the face of conflicting trait-based and real-time epistemic cues (i.e., the scientist providing low-quality explanations). Given that younger children (i.e., 3-year-olds) may have difficulty in attending to explanation quality as a cue when making inferences about informants (Corriveau & Kurkul, 2014), and in this study children were asked to attend to multiple cues, we predicted that younger children may have a more difficult time in weighing these cues. In contrast, we predicted that older children (5- and 7-year-olds) would be able to attend to and weigh multiple cues. Given recent evidence that elementary school-aged children sought out additional information when presented with low-quality explanations (Mills et al., 2017, 2019), and that by 5 years of age children reliably recognize and do not endorse low-quality explanations (Corriveau & Kurkul, 2014), we predicted that older children would weigh the real-time competency cue over the trait-based expertise cue.

We were also interested in how children used both cues when deciding which informant to trust following access to information about the informants' explanation quality (*posttraining preference*). In this task, we were interested in whether children's preference for the expert increased, decreased, or remained consistent from the baseline measurement in the initial preference task to a near-transfer posttraining preference task (i.e., evaluating explanations about the functions of novel objects). We assessed whether any changes in children's preference for the expert between the initial and training trails were maintained or whether children returned to their original level of trust in the expert. Consistent with past research, we predicted that older children, but not younger children, would generalize their knowledge of competency to discount their trust in the expert in posttraining preference trials if they had been exposed to conflicting epistemic evidence about the informants' expertise and competency.

Method

Participants

In total, 131 children participated: 32 3-year-olds (19 girls; *M* = 3;7 [years;months], *SD* = 2 months, range = 3;2–3;11), 45 4-year-olds (22 girls; *M* = 4;5, *SD* = 3 months, range = 4;0–4;10), 37 5 year-olds (16 girls; *M* = 5;3, *SD* = 3 months, range = 5;0–5;9), and 17 7-year-olds (13 girls; *M* = 7;3, *SD* = 5 months, range = 6;6–8;1). Children spoke English as their first language and were recruited from a children's exhibit at a science museum and preschools in a university city in the northeastern United States. Information about socioeconomic status was not collected for the children, but both the museum and preschools serve predominantly mid- and high-socioeconomic status families (Soren, 2009).

Sample sizes are consistent with the results of two power analyses and previous research using similar procedures. The minimum sample size parameter was 8 children per condition/age group, based on an estimation in G*Power 3.1 using an effect size of $d = 1.56$ (Corriveau & Kurkul, 2014; 5-year-old children's judgments in training task vs. chance in Study 2), $\alpha = .05$ and $\beta = .95$. The maximum sample size parameter was 29 children per condition per age group, based on an estimation using an effect size of $d = 0.54$ (Corriveau & Kurkul, 2014; 3-year-old children's judgments in training task vs. chance in Study 2), $\alpha = .05$ and $\beta = .80$. We also used a time-based stopping point, collecting data with all children within a particular time frame, resulting in slightly different numbers of children in each age group. This age group imbalance works in favor of a priori calculations, however, given that older children (5-year-olds) in past research typically displayed larger effects than younger children, thereby justifying smaller samples for older children.

Materials

Children were shown two images of female informants on a laptop computer. One informant wore a black T-shirt, and the other wore a white lab coat over a black T-shirt. The informants were matched for attractiveness and displayed neutral affect. Participants were also shown eight novel objects and four biological phenomena on the laptop screen (see Table 1 for descriptions of the novel objects and phenomena). All materials received approval from Boston University's institutional review board, and informed consent was obtained from all participants' parents or legal guardians.

Procedure

Children sat with an experimenter at a table in a quiet room. All children in the study participated in four tasks in a fixed order: an *initial preference* task, a *training* task, a *posttraining preference* task, and an *explicit judgment* task. Each task is described in more detail below.

Initial preference

We first assessed children's preference for learning from an expert versus a non-expert prior to receiving information about that expert's competency. The experimenter presented children with computer images of the two female informants and described their expertise by saying, "Look at these two people." Then, pointing at the informant in the black T-shirt (the non-expert), the experimenter

Table 1
Novel objects and biological phenomena with corresponding explanations used in the initial preference, training, and posttraining preference tasks.

Task	Target object	Informant 1's response	Informant 2's response
Initial preference	Large metal clamp	It's metal so it can pick things up	It's metal so it can hold things together
	Small metal strainer	It has holes in the middle so water can go through it	It has holes in the middle so milk can go through it
	Yellow plastic object with black button	It has a black button on it so you can push it	It has a black button on it so you can hold it
	Rectangular object with hole	There is a circle here to put pencils in	There is a circle here to put crayons in
Training	Polar bear	They have white fur because their fur is white and not another color. (circular)	They have white fur because it helps them to hide from their enemies. (noncircular)
	Bees	They make a buzzing sound because it's the sound bees make. (circular)	They make a buzzing sound because their wings move very fast. (noncircular)
	Rain	It rains because water falls from the sky and gets us wet. (circular)	It rains because the clouds fill with water and get too heavy. (noncircular)
	Flowers and trees	They grow because their stems get longer and longer and they get taller. (circular)	They grow because we feed them water and the sun gives them light. (noncircular)
Posttraining preference	Plastic hook	It has a triangle in the middle so we can look through it	It has a triangle in the middle so we can put our fingers through it
	Metal hook	It has hooks so that we can hang scarves on it	It has hooks so that we can hang hats on it
	Metal sprinkler head	It's shiny so we can see it from far away	It's shiny so it looks bright just like the sun
	Plastic stopper	It has a round thing there so we can spin it on the table	It has a round thing there so we can roll it on the table

said, "One is a girl who knows all about stores and how they work."[1] The experimenter then pointed at the informant in the lab coat (the expert) and said, "One is a scientist who knows all about living things and how they work. They are going to tell us about some things." We chose to use the label "scientist" to describe the expert because this is a term associated with expertise that is familiar to young children (Buldu, 2006) and scientists are often presented as experts in children's media (e.g., *The Magic School Bus, Bill Nye the Science Guy*). We also presented the scientist in a lab coat because this is a feature that children typically associate with scientists (Finson, 2002), and in subsequent trials we referred to the scientist by her title to reinforce her status as an expert.

Then, to assess whether children initially preferred an informant based on this information, we used a paradigm similar to that used in previous informant preference studies (e.g., Corriveau & Harris, 2009). In each of four trials, the experimenter pointed to a novel object that appeared between the informants on the computer screen (e.g., a large metal clamp) and said, "Look at this object. I wonder why [e.g., it's metal]. Let's see why these two think [e.g., it's metal]." Children were shown a video with both informants providing differing explanations that were noncircular and equivalent in plausibility (see Table 1 for sample explanations). Immediately following the video, the experimenter repeated both explanations and asked, "What do you think? Like what the girl said or what the scientist said?" Both verbal (e.g., "What the scientist said") and nonverbal (e.g., pointing) responses were accepted in this and all subsequent tasks. The order of explanations and which informant was the expert were counterbalanced across participants. Previous research examining children's attention to multiple cues about informants has also used a similar phased introduction of cues. For example, Johnston et al. (2015) presented children with information about informants' benevolence or competence, invited children to complete an initial preference trial, and then introduced information about the second cue. The functions of the artifacts in the initial preference trial were also outside of the domains of knowledge of both informants, so if children did display a preference in this task, it was because they were drawing inferences based on the cue to expertise that was shared prior to the task.

Training

Children were randomly assigned to participate in one of two conditions. In the expert/noncircular condition, the expert provided noncircular explanations and the non-expert provided circular explanations. By contrast, in the expert/circular condition, the expert provided circular explanations and the non-expert provided noncircular explanations.

In both conditions, the experimenter introduced the task by saying, "Here are the same two people. Remember, this one is a scientist and this one is a girl. They think that they can explain some things. Let's see what they say." Children participated in four training trials. For each of the trials, children were presented with a still frame of an entity on a table between the two informants. The experimenter pointed to the entity and said, "Look, here is a picture of [e.g., a polar bear]. Now these two think that they know why polar bears are white. Let's see what they think." Explanations were based on previous research examining children's preference for noncircular explanations (Corriveau & Kurkul, 2014; see Table 1 for sample explanations). Critically, the explanations presented all were accurate but differed in the quality of the information offered. Following the completion of the video, the experimenter repeated both explanations and asked, "Why do you think [e.g., polar bears are white]? Like what the girl said or what the scientist said?" The order of explanations was counterbalanced across participants.

Posttraining preference

The experimenter introduced the posttraining preference task by saying, "Here are the same two people again, the girl and the scientist. They are going to explain some things that we don't know about. Let's see what they say." As in the training task, children were presented with a still frame of an object on a table between the two informants. The experimenter pointed to the object and said, "Look at this object. I wonder why it has [e.g., hooks on it]. Let's see why these two think it has [e.g.,

[1] We introduced a knowledge base for the "girl" informant so that she was not perceived as ignorant but rather was perceived as knowledgeable in a domain that was not relevant to the items (i.e., scientific phenomena) presented in the training task.

hooks on it].” The experimenter then played the video, and both of the informants shared their explanations (for the full set of objects and explanations, see Table 1). The explanations were always non-circular and equivalent in plausibility. The experimenter then repeated the two explanations and asked, “What do you think? Like what the girl said or what the scientist said?” The experimenter pointed to each informant sequentially. The order of the explanations and the informant offering each explanation were counterbalanced across participants.

Explicit judgment

Finally, children were asked to explicitly evaluate which informant provided better explanations. Children were asked, “Do you remember when these two people were explaining some things that we know about like polar bears and rain?” Children were then asked a series of three questions about the informants’ explanations: “Was the girl very good or not very good at explaining these things?”, “Was the scientist very good or not very good at explaining these things?” and “Which one was better at explaining these things, the girl or the scientist?”

Measures

Preference for the expert

For the initial preference, training, and posttraining preference tasks, children were given 1 point each time they selected the expert (i.e., the scientist). For each of these tasks, children could receive up to 4 points (four trials per task). Higher scores indicated a higher level of preference for the expert.

Explicit judgment

For the explicit judgment task, children were given 1 point for every time their answer favored the expert. Thus, for the question about the girl, children received 1 point if they indicated that she was “not very good.” In contrast, children received 1 point if they responded that the scientist “was very good.” Children also received 1 point if, in the forced-choice question between the girl and the scientist, they selected the scientist. Children could receive up to 3 points (three questions total) for the explicit judgments task. As with the preference for the expert score, higher scores indicated a higher level of preference for the expert.

Results

Initial preference for the expert

Table 2 (top panel) and Fig. 1 display children’s mean preference for the expert scores for the initial preference task. Children’s initial preference for learning from the expert was compared with 50% chance. The 3-year-olds’ scores did not differ significantly from chance, $t(31) = 0.82$, $p = .420$. The initial preference scores of 4-year-olds, $t(44) = 4.17$, $p < .001$, 5-year-olds, $t(37) = 7.78$, $p < .001$, and 7-year-olds, $t(16) = 6.20$, $p < .001$, all were significantly greater than chance. An examination of children’s individual preference patterns also indicated that approximately 47% of 4-year-olds, 70% of 5-year-olds, and 65% of 7-year-olds selected the expert three or more times in the initial preference task, displaying a clear preference for the expert over the non-expert. Thus, with the exception of 3-year-olds, children displayed a preference for learning from the expert over the non-expert before learning about the expert’s explanation quality.

To further explore age-related differences in children’s initial preference for learning from an expert, we conducted a one-way analysis of variance (ANOVA) on children’s total preference for the expert by child age (3, 4, 5, or 7 years). Analyses indicate a main effect of age, $F(3, 127) = 5.46$, $p = .001$, partial $\eta^2 = .11$. Follow-up post hoc Bonferroni comparisons indicate that 5-year-olds displayed a significantly higher initial preference for the expert than 3-year-olds (mean difference 95% confidence interval (CI) [−1.14, −0.28], $p = .001$), but no other age groups differed significantly from each other.

Table 2
Mean scores (and standard errors) of children's preference for the expert by age, task, and condition.

Task	Expert's explanation	3-year-olds	4-year-olds	5-year-olds	7-year-olds
Initial preference	Average	2.16 (0.19)	2.58 (0.13)***	3.00 (0.13)***	2.71 (0.11)***
Training	Circular	1.94 (0.29)	1.91 (0.17)	1.82 (0.25)	0.63 (0.18)***
	Noncircular	1.93 (0.36)	2.41 (0.23)	3.07 (0.18)***	3.67 (0.17)***
Posttraining preference	Circular	1.61 (0.35)	2.26 (0.18)	2.45 (0.21)*	2.00 (0.33)
	Noncircular	1.64 (0.23)	2.73 (0.22)**	3.27 (0.27)***	2.56 (0.18)*
Explicit judgment	Circular	1.56 (0.22)	1.52 (0.20)	1.45 (0.18)	0.63 (0.42)
	Noncircular	1.71 (0.24)	1.95 (0.10)***	2.00 (0.14)**	2.33 (0.33)*

Note. Significance levels are noted for comparisons with 50% chance. Initial preference, training, and posttraining preference scores ranged from 0 to 4 (50% chance = 2.00). Explicit judgment questions ranged from 0 to 3 (50% chance = 1.50).
*p < .05.
**p < .01.
***p < .001.

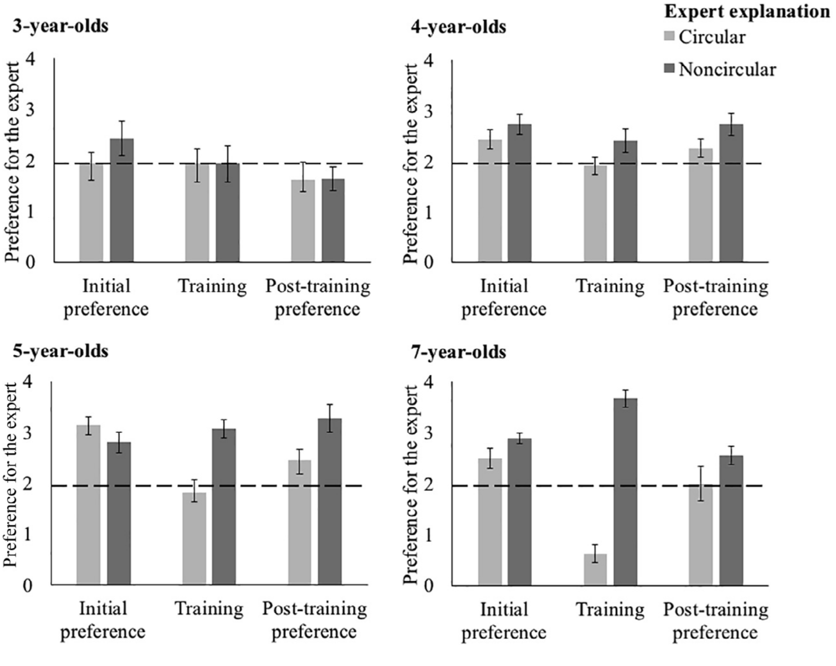

Fig. 1. Mean preference for expert scores by age group, condition, and task. Error bars represent 1 standard error of the mean. Dashed line represents 50% chance (i.e., 2/4).

Preference for the expert across each task

Table 2 (middle panels) and Fig. 1 display children's mean preference for the expert scores for the initial preference, training, and posttraining preference tasks. We used two mixed-effects models to examine the difference between children's preference for the expert over the course of the study. Here, we use children's initial preference for the expert in each age group as a baseline so that we can directly assess changes in their preference as a result of exposure to information about the informants' competency. The first model examined children's preference for the expert in the initial preference task and the training task to assess whether children's preference for the expert was maintained after gaining access to information about her explanation quality. The second model examined whether children's posttraining preference for the expert differed from their initial preference. This model reflected whether children's preference for the expert was affected by the information about explanation quality that they gained during the training task. In both of these models, we examined the impact of age (3, 4, 5, or 7 years), condition (expert/circular or expert/noncircular), and task (Model 1: initial preference or training; Model 2: initial preference or posttraining preference) with a random effect of participant on children's preference for the expert.

Model 1: Preference for the expert in the initial preference and training tasks

The interaction among age, condition, and task significantly predicted children's preference for the expert, $F(3, 246) = 6.91$, $p < .001$, when comparing the initial preference and training tasks. The interactions between age and condition, $F(3, 246) = 5.25$, $p = .002$, and between condition and task, $F(1, 246) = 15.91$, $p < .001$, in addition to the main effects of age, $F(3, 246) = 5.27$, $p = .002$, condition, $F(1, 246) = 30.88$, $p < .001$, and task, $F(1, 246) = 11.87$, $p = .001$, also significantly predicted children's preference for the expert. The interaction between age and task was not significant, $F(3, 246) = 0.30$, $p = .823$.

To better understand the significant three-way interaction among age, condition, and task, planned mixed-effects models were run by age and condition to examine how children's preference for the expert differed between the initial preference and training tasks. Thus, these models each included a fixed effect of task and a random effect of participant. For a summary of parameter information for each of the models, see Table 3.

These analyses indicated that for the 3-year-olds, children's preference for the expert did not differ significantly between the initial preference and training tasks in either condition. The 4- and 5-year-olds' preference for the expert in the expert/circular condition decreased between initial preference and training [4-year-olds: $F(1, 44) = 4.38$, $p = .042$, $B = -0.52$; 5-year-olds: $F(1, 42) = 19.18$, $p < .001$, $B = -1.32$], but their preference for the expert in the expert/noncircular condition did not change between the initial preference and training tasks. Comparisons with chance indicated that the 5-year-olds' preference for the expert decreased to chance levels in the expert/circular condition, $t(21) = -0.72$, $p = .478$, but remained above chance in the expert/noncircular condition, $t(14) = 5.87$, $p < .001$. The 7-year-olds displayed changes in their preference for the expert in both the expert/circular and expert/noncircular conditions; their preference for the expert decreased in the expert/circular condition, $F(1, 14) = 50.81$, $p < .001$, $B = -1.88$, and increased in the expert/noncircular condition, $F(1, 16) = 15.08$, $p = .001$, $B = 0.78$. Comparisons with chance indicated that 7-year-olds' preference for the expert was significantly below chance in the expert/circular condition, $t(7) = -7.51$, $p < .001$, and significantly above chance in the expert/noncircular condition, $t(8) = 10.00$, $p < .001$, during the training task.

Overall, the results of Model 1 and its follow-up analyses indicate that 3-year-olds are not sensitive to explanation quality when selecting between an expert informant and a non-expert informant, whereas 4-, 5-, and 7-year-olds are. We also found age-based differences in children's response to information about an expert informant's competency; the 4-, 5-, and 7-year-olds discounted an expert who displayed a lack of competency, but only the 7-year-olds increased their trust in an expert who displayed competency. An examination of children's individual preference patterns supports that these results were evident in the majority of individual children's responses. Children's preference patterns in the expert/circular condition indicated that 48% of 4-year-olds, 77% of 5-year-olds, and 90% of 7-year-olds displayed a decrease in their preference for the expert between the initial preference and training tasks (i.e., selected the expert on fewer trails in the training task than in the initial preference task). An opposite pattern occurred in the expert/noncircular condition; no 5- or 7-year-olds displayed a decrease in their preference for the expert when she provided high-quality explanations, but 40% of 5-year-olds and 70% of 7-year-olds increased their trust in the expert.

Model 2: Preference for the expert in the initial preference and posttraining preference tasks

The interaction among age, condition, and task was a marginally significant predictor of children's preference for the expert, $F(3, 246) = 2.52$, $p = .059$, when comparing the initial preference and posttraining preference tasks. The main effects of age, $F(3, 246) = 13.62$, $p < .001$, condition, $F(1, 246) = 7.22$, $p = .008$, and task, $F(1, 246) = 5.06$, $p = .025$, also significantly predicted children's preference

Table 3
Parameter estimates for mixed-effects model (Model 1) examining children's preference for the expert in the initial preference and training tasks by age group and condition.

	F (*df*)	*B*	*SE*	95% confidence interval
3-year-olds				
Expert/circular				
Task	0.00 (1, 34)	0.00	0.36	−0.73, 0.73
Expert/noncircular				
Task	1.07 (1, 26)	−0.50	0.48	−1.49, 0.49
4-year-olds				
Expert/circular				
Task	4.38 (1, 44)	−0.52*	0.25	−1.02, −0.02
Expert/noncircular				
Task	0.86 (1, 42)	−0.27	0.29	−0.87, 0.32
5-year-olds				
Expert/circular				
Task	19.18 (1, 42)	−1.32***	0.30	−1.93, −0.71
Expert/noncircular				
Task	0.97 (1, 28)	0.27	0.27	−0.29, 0.82
7-year-olds				
Expert/circular				
Task	50.81 (1, 14)	−1.88***	0.26	−2.44, −1.31
Expert/noncircular				
Task	15.08 (1, 16)	0.78**	0.20	0.35, 1.20

*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 4
.Parameter estimates for mixed-effects models examining children's preference for the expert in the initial preferences and posttraining tasks by age group and condition.

	F (*df*)	*B*	*SE*	95% confidence interval
3-year-olds				
Expert/circular				
Task	0.64 (1, 34)	−0.33	0.42	−1.18, 0.51
Expert/noncircular				
Task	3.92 (1, 26)	−0.79	0.40	−1.60, 0.03
4-year-olds				
Expert/circular				
Task	0.45 (1, 44)	−0.17	0.26	−0.70, 0.35
Expert/noncircular				
Task	0.03 (1, 42)	−0.05	0.29	−0.62, 0.53
5-year-olds				
Expert/circular				
Task	6.70 (1, 42)	−0.68*	0.26	−1.21, −0.15
Expert/noncircular				
Task	3.44 (1, 28)	0.60	0.32	−0.06, 1.26
7-year-olds				
Expert/circular				
Task	1.75 (1, 14)	−0.50	0.38	−1.31, 0.31
Expert/noncircular				
Task	2.57 (1, 16)	−0.33	0.21	−0.77, 0.11

*$p < .05$.

for the expert. The interactions between age and condition, $F(3, 246) = 0.10$, $p = .961$, between age and task, $F(3, 246) = 1.11$, $p = .346$, and between task and condition, $F(1, 246) = 1.26$, $p = .263$, were not significant predictors of children's preference.

To better understand the marginally significant three-way interaction among age, condition, and task—and to maintain consistency in analyses between the two models—planned separate mixed-effects models were conducted by age (3, 4, 5, or 7 years) and condition (expert/circular or expert/noncircular) to examine the impact of task on children's preference for the expert. As in previous follow-up analyses, the models included a fixed effect of task and a random effect of participant. For a summary of parameter information for each of the age group models, see Table 4.

Inspection of Tables 2 and 4 indicates that children of all age groups did not significantly modify their preference for the expert from the initial preference task to the posttraining preference task when the expert provided noncircular explanations. The 4-, 5-, and 7-year-olds in the expert/noncircular condition maintained a consistent preference for learning from the expert; by contrast, the 3-year-olds' preference was at chance. A different pattern of performance emerged when the quality of the explanation differed from the informants' stated expertise (i.e., the expert/circular condition). Whereas 5-year-olds displayed a significant decrease in their trust for an expert informant if she provided circular explanations, 3-, 4-, and 7-year-olds did not significantly modify their trust between the initial preference trials and the posttraining preference trials.

Overall, the results of Model 2 and its follow-up analyses indicate that, consistent with the findings of Model 1, 3-year-olds are insensitive to both expertise and explanation quality when selecting between an expert informant and a non-expert informant. These analyses also indicate that 4-year-olds' preference for the expert did not change significantly between the initial preference and posttraining preference tasks, although comparisons with chance indicate that 4-year-olds in the expert/noncircular condition maintained their initial preference for the expert (i.e., endorsed the expert significantly more than chance), whereas 4-year-olds in the expert/circular condition do not. As with our interpretation of the findings of Model 1, we cautiously interpret this finding to indicate 4-year-olds' potential discounting of the expert when she provided circular explanations. The 5-year-olds in the expert/circular condition displayed a significant decrease in their preference for the expert between the initial preference and posttraining preference tasks, although we note that their preference for the expert remained above chance in the posttraining preference task. This finding is consistent with 5-year-olds' discounting of the expert between the initial preference and training tasks in the expert/circular condition. Discounting between the initial preference and posttraining preference trials was displayed by 55% of the 5-year-olds in the expert/circular condition. The 5-year-olds in the expert/noncircular condition maintained a similar level of preference for the expert across the initial preference and posttraining preference tasks, and an evaluation of children's individual preference patterns indicated that 53% of 5-year-olds increased their trust in the expert in the expert/noncircular condition. Together, these findings indicate 5-year-olds' continued trust in the expert over the non-expert in the expert/noncircular condition. The 7-year-olds' preference for the expert did not differ significantly between the initial preference and posttraining preference tasks in either condition, although 40% of 7-year-olds decreased their trust in the expert between the two tasks in the expert/circular condition. In addition, 7-year-olds in the expert/noncircular condition demonstrated a greater than chance level of preference for the expert in the posttraining preference task. This finding is distinct from the differences found between the initial preference and training tasks for 7-year-olds in the analysis of Model 1, where 7-year-olds either gave additional credit to the expert (expert/noncircular condition) or discounted the expert (expert/circular condition), based on the kind of explanation she provided. Here, 7-year-olds seemed to limit the extent to which explanation quality affected their judgments to the task where the high-quality versus low-quality explanations are being provided.

Explicit judgment

Table 2 (bottom panel) displays children's mean preference for the expert scores for the explicit judgment task. To examine the impact of age (3, 4, 5, or 7 years) and condition (expert/circular or expert/noncircular) on children's explicit judgment of the expert, we conducted a two-way ANOVA. Results indicated a significant interaction between age and condition, $F(3, 123) = 3.30$, $p = .023$, partial

η^2 = .08, and a significant effect of condition, $F(1, 123) = 20.21$, $p < .001$, partial η^2 = .14, but not a significant main effect of age, $F(3, 123) = 0.46$, $p = .712$, partial η^2 = .01. To further examine the interaction between age and condition, we conducted a separate one-way ANOVA for each age group examining the impact of condition on children's endorsement of the expert with Bonferroni-corrected alpha levels of .05/4 = .013. Condition did not affect 3- or 4-year-olds' preference for the expert in the explicit judgment questions [3-year-olds: $F(1, 30) = 0.24$, $p = .632$, partial η^2 = .01; 4-year-olds: $F(1, 43) = 3.67$, $p = .062$, partial η^2 = .08]. Note that 4-year-olds in the expert/circular condition displayed chance-level preferences, $t(22) = 0.11$, $p = .913$, whereas in the expert/noncircular condition they preferred the expert at greater than chance levels, $t(21) = 4.39$, $p < .001$. Condition had a marginally significant effect on 5-year-olds' preference for the expert when explicitly asked about explanation quality, $F(1, 35) = 4.77$, $p = .036$, partial η^2 = .12 (p value meets α threshold of .05, but not Bonferroni corrected .013). For 7-year-olds, condition significantly predicted their preference for the expert, $F(1, 15) = 10.37$, $p = .006$, partial η^2 = .41. For both 5- and 7-year-olds, children in the expert/noncircular condition displayed a greater preference for the expert than children in the expert/circular condition, and in the expert/noncircular condition their preference for the expert in the explicit judgment task was significantly greater than chance [5-year-olds: $t(14) = 3.62$, $p = .003$; 7-year-olds: $t(8) = 2.50$, $p = .037$].

Discussion

Starting at a young age children are able to evaluate the quality of explanations provided to them, and by early elementary school children use explanation quality to guide their trust in informants (Corriveau & Kurkul, 2014) and their learning decisions (Mills et al., 2017, 2019). Past research, however, has often evaluated children's judgments of explanations when children do not have access to the expertise of the informant. In this study, we examined how children evaluate high-quality versus low-quality explanations when they are provided by an expert and how explanation quality affects children's trust in the expert informant.

Taken together, our results indicate age-related differences in children's relative weighting of information about informant competency and informant expertise. Consistent with previous research, 3-year-olds showed no preference for learning from either informant based on labeled expertise (Landrum et al., 2013), nor did they display a selective preference in the training, posttraining preference, or explicit judgment task. By contrast, consistent with our predictions, 4-, 5-, and 7-year-olds all displayed an initial preference for learning from the expert prior to learning about the informants' competency. When evaluating the informants' explanations for phenomena within the expert's domain of expertise, 4-, 5-, and 7-year-olds privileged competency over expertise when the expert provided circular (or low-quality) explanations and endorsed the expert's explanations at significantly lower rates. In addition to discrediting the expert when she provided low-quality explanations, 7-year-olds endorsed the expert at significantly higher rates than their initial preference if she provided noncircular explanations for familiar scientific phenomena. Thus, our data suggest that, starting at around 4 years of age, children do not consistently endorse an expert if that expert provides low-quality explanations, consistent with low levels of competency, in the expert's stated area of expertise. At around 7 years of age, children may also show increased trust in an expert if that expert provides a high-quality explanation, or displays a high level of competency, within the expert's area of stated expertise.

Children's explicit judgments of the informant also support our interpretation that children were attending to informant competency during the training task. The 4-, 5-, and 7-year-olds selectively stated that the expert was "very good" at rates greater than chance when she had also provided higher-quality explanations. By contrast, the 4-, 5-, and 7-year-olds showed no selective preference for rating the expert as "very good" or "not very good" when she had provided lower-quality explanations (although note that only 5- and 7-year-olds displayed a significant difference in their explicit judgments of competency between the expert/circular and expert/noncircular conditions). Taken together, these data indicate that children are attending to and assessing the quality of the informants' explanations when making explicit judgments about their competency.

How does gaining access to information about an expert's competency influence children's future trust in them? The comparisons of initial preference and posttraining preference performance also indicate age-related differences in children's relative weighting of the informants' displayed competency versus their stated expertise. In the expert/circular condition, 5-year-olds continued to discredit the expert in the posttraining preference task, endorsing her testimony at significantly lower rates than they had in the initial preference task. By contrast, contrary to our predictions, 4- and 7-year-olds did not significantly discredit the expert when comparing initial preference and posttraining preference trials. In the expert/noncircular condition, 4-, 5-, and 7-year-olds' trust in the expert was maintained between the initial preference and posttraining preference trials. These age groups continued to endorse the expert's testimony at above chance levels. Taken together, these results highlight a potential U-shaped developmental pattern in preference for the expert when her stated expertise conflicts with her demonstrated competency; whereas 5-year-olds selectively discount the expert's testimony, younger and older children showed no change in preference for learning from her in areas not related to her area of expertise.

Why would 5-year-olds—but not 7-year-olds—selectively discount an expert who had provided low-quality explanations? We suggest that 7-year-olds' inferences about an expert informant's credibility based on the expert's displayed competency may be domain specific. Recall that the training trials focused on explanations about scientific phenomena known to the children, but the initial preference and posttraining preference trials focused on explanations about novel artifacts. Whereas 5-year-olds were willing to extend their inferences about the informant based on her low-quality scientific explanations to her likely knowledge about artifacts, 7-year-olds were not. They appropriately discounted her testimony about scientific explanations but were unwilling to use that information to make inferences about her knowledge in a different domain. Such selective discounting likely reflects their growing understanding about the boundaries of expertise (Lane & Harris, 2015; Lutz & Keil, 2002). In future research, we hope to examine this pattern by having children also make decisions about who to learn from in a posttraining task within the informant's area of stated expertise.

Another possible explanation of our finding relies on children's developing ability to integrate various sources of information regarding an informant's credibility in contrast to their ability to attend to only one piece of information at a time (Eaves & Shafto, 2017; Johnston et al., 2015; Landrum et al., 2015). In the initial preference task children needed only to evaluate the informants based on their labeled expertise, whereas in subsequent trials they could draw from both the informants' labeled expertise and their relative demonstrated competency. It is possible that 5-year-olds prioritized the most recently presented evidence (i.e., relative competency), whereas 7-year-olds weighed information about both expertise and competency and simply applied different weights to these two cues when learning familiar information (i.e., information about familiar scientific phenomena) versus novel information (i.e., information about the functions of unfamiliar objects) (Landrum et al., 2015). Moreover, our findings with 3- and 4-year-olds may indicate that younger children have difficulty in attending to or processing real-time cues about informants' competency after previously judging informants based on another criterion such as expertise. Future research could assess the possibility that younger children may privilege the first epistemic cue that they receive information about and that 5-year-olds may privilege real-time cues by changing the order in which epistemic cues to informants' expertise and credibility are presented. In addition, the impact of different types of epistemic cues, such as expertise, competency, and accuracy, should be compared to examine whether children apply different weights to particular epistemic cues.

Future research should also examine children's interpretation of the intentions of expert informants who provide low-quality circular explanations. Children often encounter low-quality explanations from individuals they may view as experts such as their parents and teachers (Kurkul & Corriveau, 2018; Mills et al., 2019). Children, however, are motivated to seek out explanations for phenomena they do not understand (Legare, Gelman, & Wellman, 2010; Mills et al., 2017). If informants, particularly expert informants, do not provide high-quality explanations, do children view them as being intentionally unhelpful (Liu et al., 2013) or do they strive to understand whether experts' access to information may be limited (Nurmsoo & Robinson, 2009)? Does this understanding depend on children's developing theory of mind (Sabbagh & Baldwin, 2001)? Do children revise their views of experts' knowledge or reliability as informants if they repeatedly provide low-quality explanations?

In our study, we continually reinforced the expert's labeled expertise through reference to her labeled title (i.e., scientist vs. girl) and the use of distinct clothing for the two informants (i.e., a lab coat vs. a plain T-shirt). We also tested children in school and museum settings, both of which are settings that may privilege the testimony of scientists. Arguably, all of these elements may have contributed to children's initial preference for the scientist over the girl (Lane & Harris, 2015), but they also make the finding that children were willing to discount the expert within the domain of her expertise even more striking. Here, children were displaying a clear distinction between labeled expertise complemented by symbols of said expertise and demonstrated competence.

In summary, we examined children's relative weighting of two different epistemic cues: one trait based and one based on real-time evidence. Our results highlight older children's appreciation, but not younger children's appreciation, for the importance of considering not only trait-based indicators of competence but also real-time cues to credibility. Our findings also indicate that children's attention to and evaluation of explanation quality may be shaped in part by the expert status of an informant but that by elementary school children are critical of the quality of explanations—even those provided by experts.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2019.104670.

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