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Preschoolers Use Questions as a Tool to Acquire Knowledge From Different Sources

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Preschoolers Use Questions as a Tool to Acquire Knowledge From Different Sources

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How do children use questions as tools to acquire new knowledge? The current experiment examined preschool children's ability to direct questions to appropriate sources to acquire knowledge. Fifty preschoolers engaged in a task that entailed asking questions to discover which special key would open a box that contained a prize. Children solved simple and complex problems by questioning two puppet experts who knew about separate features of each key. Results indicate dramatic developmental differences in the efficiency and efficacy of children's questions. Although even 3-year-olds asked questions, their questions were largely ineffective and directed toward inappropriate sources. Four-year-olds directed questions toward the appropriate sources but asked approximately equal numbers of effective and ineffective questions. Only 5-year-olds both asked the appropriate sources and formulated effective questions. Implications for the development of problem-solving abilities are discussed.

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Young children encounter problems on a regular basis, from simple ones, like how to find a missing object, to more complex ones, like how to operate a sophisticated new toy. Some problems can be solved by using prior knowledge that children already possess. Other problems, however, require the help of outside sources, and the best way to obtain information from these sources is often to ask questions.

Although developmental research indicates that asking questions to acquire information is widespread even among very young children (Callanan & Oakes, 1992; Hickling & Wellman, 2001), little is known about how the highly complex cognitive skill of using questions as an epistemic tool is acquired and what the developmental trajectory might be. In many ways, research on problem solving suggests that it is not until the early to middle elementary school years that children can effectively and efficiently seek evidence to solve complex problems. Even then, elementary school children make a number of errors in how quickly they jump to conclusions regarding their answer to problems (Chen & Klahr, 1999; Samuels & McDonald, 2002), and efficient problem solving is often difficult even for adults (e.g., Schauble, 1996). At the same time, however, other research suggests that even preschoolers possess rudimentary problem-solving skills, such as the ability to use strategies such as means-end analysis to isolate subgoals (Klahr, 1985). To better understand the developmental trajectory of the ability to use questions as a cognitive tool, the current research examines young children's ability to direct questions to the appropriate sources of information to solve problems.

In order for children to use questions efficiently in the service of problem solving, it is necessary for children to achieve some level of proficiency in at least three component skills. First, once children recognize that there is a problem that they cannot solve on their own, they need to be able to determine who will be able to give them informative and accurate answers to their questions. Recent research on children's source knowledge indicates that even 3- and 4-year-olds are capable of distinguishing knowledgeable from less knowledgeable or reliable sources. For example, preschoolers are more likely to learn words from sources that have been knowledgeable in the past when contrasted with sources who admit ignorance or who have named familiar objects inaccurately (e.g., Birch, Vauthier, & Bloom, 2008; Jaswal & Neely, 2006; Koenig & Harris, 2005; Sabbagh & Baldwin, 2001). Preschoolers can also recognize that different informants know different things: Even 3-year-olds recognize that biological experts, such as doctors, know different things than mechanical experts, such as car mechanics (Lutz & Keil, 2002). In the elementary school years, children's understanding of how knowledge varies between people becomes more sophisticated as they gain the ability to distinguish between less familiar experts, such as moral advisors and scientific experts (Danovitch & Keil, 2004, 2007). The extent to which young children can apply their ability to distinguish between sources to problem-solving tasks involving questions is unknown. However, given that 3-year-olds can determine which of two experts will know a specific fact (e.g., Lutz & Keil, 2002), we anticipate that preschool-aged children have the ability to determine the appropriate source for their questions, at least for familiar or clearly labeled experts.

After the appropriate knowledgeable source has been identified, children need to apply a second skill: They need to be able to formulate effective questions in order to obtain the information needed to solve a problem. Although less is known about this ability, it is clear that young children can formulate questions to receive information. Even 2- and 3-year-olds request causal explanations, and such requests increase in frequency with age (Callanan & Oakes, 1992; Chouinard, 2007; Frazier, Gelman, & Wellman, 2009; Hickling & Wellman, 2001; Wellman, Hickling, & Schult, 1997). Children also formulate questions to obtain specific information, such as to identify an unfamiliar object (Kemler Nelson & O'Neil, 2005), to distinguish between two objects concealed inside a box (Chouinard, 2007), or to learn information important for a particular conceptual category (Greif, Kemler Nelson, Keil, & Gutierrez, 2006). Although the ability to formulate different kinds of questions to seek different kinds of information indicates that young preschoolers have at least a rudimentary capacity to use questions as problem-solving tools, the ability to formulate an *effective* question—a question that is worded to obtain the information needed to solve a problem-is a much more complex task.

To perform this task, children must determine the kind of question that will provide them with the information they need. In general, research on the use of questions to solve problems provides children with preselected questions or options to solve a problem. Given sufficiently constrained tasks, elementary school-aged children can distinguish between effective and ineffective questions or tests for information (e.g., Samuels & McDonald, 2002; Sodian, Zaitchik, & Carey, 1991). In tasks in which children generate their own questions to determine the correct answer from a set of options, 6- to 12-year-olds are often able to ask questions that help them solve problems (Eiser, 1976; Mosher & Hornsby, 1966).

As most of the research relevant to this capacity involves elementary school-aged children, little is known about how the efficiency and informativeness of question-asking develops across early childhood. However, there is some evidence that 4- and 5-year-olds can ask effective questions in constrained experimental tasks (e.g., determining which of two objects is hidden inside a box; Chouinard, 2007). Chouinard (2007) found that more than 90% of the questions asked by 4- and 5-year-olds in one study were effective

(3-year-olds were not tested). Although this indicates that young children can ask effective questions to solve simple problems, much remains to be understood about the developmental trajectory of this highly complex cognitive skill. Giving children problems that vary in difficulty should make it possible to more thoroughly examine the variability in the developing ability to use questions efficiently and effectively. By classifying children's questions into more specific categories, it becomes possible to determine if children's problem-solving errors are due to having difficulty staying on task, determining how to word a question, or with some other aspect of the task. It is also possible to examine how the characteristics of effective questions may vary to better understand changes in strategy use across development.

We anticipate developmental improvements in the efficacy of children's questions, given that older children are likely to have more experience asking questions. During the course of development, not only should children be more likely to ask effective questions, but the kinds of effective questions they ask should reveal more sophisticated strategies of obtaining infor-Previous research examining question use in elementary mation. school-aged children has found that children shift from a "hypothesis scanning" strategy, generating a series of questions bearing no clear relation to the previous questions and knowledge obtained, to a "constraint seeking" strategy, asking questions to eliminate as many alternatives as possible with each question, slowly narrowing down to the right answer (Mosher & Hornsby, 1966). One possible extension of these findings is that young children or novices in a particular domain may use a less advanced hypothesis-scanning strategy to obtain new information, generating questions in a trial-and-error format. In contrast, older children or experts in a domain may be more aware of the potential alternatives for a given problem, and thus, they may be more capable of using a constraint-seeking strategy to solve a problem, asking direct questions to narrow down the options. Indeed, direct strategies may be more effective over time than trial-and-error strategies, especially when there are multiple options to consider, thus potentially freeing up cognitive resources for other aspects of problem solving.

A third skill required for using questions efficiently in the service of problem solving is the ability to successfully use the information received. Once a child has used questions to acquire information relevant to the problem-solving task at hand, children must apply the information they have acquired from asking questions. One way to examine this skill is to see how often children solve problems correctly after receiving sufficient information from asking questions. In one study, 4- and 5-year-olds were quite successful at applying the answers from their questions to solve a problem (Chouinard, 2007). When children did obtain incorrect answers, it was not because they did not apply the knowledge gained but because they had not received the knowledge they needed to solve the problems due to the fact that their questions were not sufficiently specific or appropriate. In many cases, this final step of applying the knowledge to solve a problem may be fairly straightforward as long as the appropriate sources have been questioned and effective questions have been asked. On the other hand, it is possible that for complex problems, even if 3- to 5-year-olds have asked enough effective questions, they may have difficulty keeping track of the correct answers and applying what they have learned.

Each of these three component skills—determining whom to question, formulating effective questions, and applying information—is important in order to use questions as an epistemic tool. Yet to date, these component skills have generally been studied separately or in tasks that are not related to problem solving. For instance, in some research, children are asked to indicate which of two sources they would like to ask to find out the name of a new object. Regardless of which source the children indicate, each of the sources provides his or her own label, and children are asked which label they think is correct (e.g., Koenig & Harris, 2005). In these studies, children do not actually generate the questions, and they do not interact with the sources themselves with the goal of solving a problem.

Although examining what children understand about whom to question in order to obtain information as well as examining how they respond to information presented to them is useful, children must also actively seek information from those around them to learn about the world (e.g., Callanan, 2006; Paradise & Rogoff, 2009; Rogoff, 2003). For instance, children ask questions for the purpose of advancing their understanding, and if they are not satisfied with the answers, they often repeat their questions (Kemler Nelson, Egan, & Holt, 2004) or make up their own explanations (Frazier et al., 2009). In other words, children are often actively trying to learn from others, and they engage a number of skills to help them in this process. Moreover, these skills are interconnected: Failing to recognize what source is the most likely to know the answer to a question or failing to generate an appropriately effective question may keep a child from obtaining the information needed to solve a problem. Studying these component skills together allows us to better understand children's strengths and weaknesses as active problem solvers.

The objective of the current study, therefore, is to examine these component skills empirically using novel problem-solving tasks. In the current study, children ages 3 to 5 years were presented with several problems to solve (figuring out which key to use to open a box that has a prize in it) and were given the opportunity to ask questions to two different experts. Importantly, children were presented with problems of two levels of difficulty to examine variability in children's questions depending on problem complexity. To assess children's ability to direct questions to appropriate experts as well as to coordinate information from multiple sources to solve problems, two sources of information with different expertise were also provided.

Based on what is known about the development of each of these component skills separately, we expected developmental heterogeneity. That is, some of the component skills required for children to successfully ask questions to solve problems developmentally precede others. For this study, we had three hypotheses regarding the developmental time course of these components. First, we hypothesized that young children would direct questions toward the appropriate sources before they could formulate effective, informative questions to obtain information from these sources. In other words, we expected children to know to whom to direct their questions before they know what to ask. Second, we predicted developmental improvement in the efficiency of children's questions across early childhood and problem difficulty. For example, older children were expected to ask a greater proportion of effective questions that were direct as opposed to trial and error, and children in all age groups were expected to be less effective at asking questions for complex problems. Finally, we hypothesized that as long as children were asking effective questions, they would be able to use this knowledge to obtain the right answers for solving the problems, regardless of the complexity of the problem.

EXPERIMENT

Method

Participants. Sixteen 3-year-olds (M=3;6; 7 males and 9 females), eighteen 4-year-olds (M=4;6; 9 males and 9 females), and sixteen 5-year-olds (M=5;3; 10 males and 6 females) participated in this study, recruited from preschools in Richardson, Plano, and Dallas. The sample was approximately gender balanced and reflected the distribution of ethnic groups in the community: approximately 82% Caucasian, 12% African American, and 6% other races. Children were tested in a quiet room in the preschool; each session took 10 to 15 minutes. An additional four children participated but were dropped from the final sample due to either inability to engage with the task (one 3-year-old) or experimenter error in responding to the children's questions (one 3-year-old and two 4-year-olds).

Overview. First, children went through an introduction and training phase designed to help them feel comfortable asking questions and to

introduce them to the puppet experts. Next, children were asked to solve several novel problems consisting of determining which one of four special "blickets" (cards varying in background color and black shape in the center of the card) would open a slot in a box. To solve the problems, children were invited to question two puppets who knew different things about the blickets: One puppet knew all about the shape on each blicket that would work in each slot (the "shape expert"), while the other puppet knew all about the color of each blicket that would work in each slot (the "color expert"). Children asked the puppets questions, and the puppets responded in a scripted manner. If children did not want to ask a question or felt ready to guess, they were permitted to try the blicket to see if it was the correct one for that particular slot. Once a child had determined which blicket worked in that slot, the trial was over, and the child would move on to the next slot and a new set of blickets. Children engaged in two sets of test trials: one set of simple trials, for which only the color or the shape of the blickets varied (two trials total), and one set of complex trials, for which both the color and the shape of the blickets varied (three trials total).

Materials. Five sets of "blickets" were developed for the study, with each set containing four blickets. Blickets were laminated cards approximately 3 inches \times 2 inches, varying in the shape on the card (always in black ink) as well as the background color of the card. The format of the blickets was based on work by Diamond, Carlson, and Beck (2005) finding that younger children do better sorting cards by different dimensions if the dimensions are kept separate (e.g., colorless shapes were presented on a colored background, like a black star on a red background) instead of together (e.g., a star that is red, so that both the color and shape are varied within the same unit). One set of sample blickets is shown in Figure 1.

Therefore, the blickets had different color backgrounds (red, orange, green, blue, white, pink) and different familiar black shapes (square, circle, star, moon, heart, sun) on the backgrounds. Two sets were for the simple trials and varied only in terms of either the color or the shape on the card while the other dimension was held constant. For one simple trial, only the shape differed (square, circle, sun, heart on blue background; right answer was blue square), and for the other simple trial, only the color differed (red, green, pink, orange background with star shape; right answer was red star). The order of these trials was counterbalanced between participants.

Three sets were for the complex trials and varied in both dimensions (e.g., blue star, blue moon, white star, white moon). There were no blickets repeated between trials. The order of the three complex sets was also counterbalanced.



FIGURE 1 Sample blickets.

The blickets could fit into slots on the sides of special boxes created for the study. Inside the boxes, a wireless doorbell was hidden, and a remote control was used to make the doorbell ring to make a positive sound when participants used the appropriate blicket for a given slot. The boxes were otherwise simple, covered in white wrapping paper.

In this study, children were introduced to two experts who knew different information about the blickets: One puppet knew all about the shape of the blicket that would work in each slot, while the other puppet knew all about the color of the blicket. To reinforce the expertise and to make sure children knew the colors and shapes used in the study, each puppet had a special 2-inch \times 3-inch "necklace," made of a piece of card stock attached to an elastic cord. One necklace had six different colors on it, while the other necklace had six different shapes on it. The colors and shapes were the same six that were used for the blickets.

Two experimenters were used in running this study. The first was the primary experimenter who interacted with the child, while the second was an observer who recorded the child's responses and operated the sound effects of the boxes to provide children feedback to whether or not they made the correct choice with their blicket. All sessions were recorded on a digital voice recorder. In addition, the observer kept detailed notes during the study of which puppet the child addressed each question to, what the question was, any physical or nonverbal interactions with the cards (e.g., gestures), and each question asked. Each portion of the task is described below.

Procedure

Introduction and training. After several minutes of rapport building, the experimenter told the participants they would be playing the question game. The first task was a warm-up to make sure children felt comfortable interacting with a puppet and asking questions. The experimenter introduced a

warm-up puppet, Raven, who was described as knowing all about the types of leaves and where they should come from to build a nest for a friend. Children were then shown several small laminated cards with two different kinds of leaves (heart shaped or pointy) on two different backgrounds (water or trees). The experimenter and the puppet then staged an interaction, and the experimenter asked the children for their help figuring out which leaf would work to build Raven's nest. The experimenter encouraged the child to notice that both the background and the shape of the leaf varied. Through asking questions, the child and the experimenter figured out which type of leaf Raven wanted for building his nest, and then both said goodbye to Raven. It is important to note that the experimenter did not model how to ask questions during this interaction; instead, children came up with questions themselves.

The experimenter explained that the object of the game was to unlock a box to get a special prize. The experimenter told the child that blickets were special things that could be used to open a box but that not every blicket worked on every slot: Only one special blicket worked on each slot. The children were told that they would be able to ask questions to some puppet friends to figure out which of four blickets worked in which slot and that they would know if they had found the right blicket for an opening on the box because it would make a special sound.

The experimenter then introduced the two puppets, explaining that Zebra knows all about color and could help the child figure out the right color on the blicket needed to work in each slot, while Giraffe knows all about shapes and could help the child figure out the right shape on the blicket needed to work in each slot.

Children were told that each puppet had a special "necklace" made of card stock on a string. In turn, each puppet explained that this was her special necklace that she takes with her everywhere and asked children to name either all the colors or all the shapes on it. This was to make sure children knew all of the colors and shapes used in the task. In rare instances, a child did not know the name of a color or a shape, and thus, the puppet would correct the child and then reprompt the child for the answers to all of the colors or shapes on the necklace. Once participants figured out all the colors or shapes, each puppet asked them to put the appropriate necklace around her neck to help the child remember that she knows all about color (or shape).

The experimenter then reminded the child of the rules of the game. The objective of the game was to figure out the right blicket to put in each slot in order to open the box to get the prize. Each slot used a different blicket, and children could ask questions to Zebra and Giraffe to figure out which blicket would work in each slot. Before beginning the simple trials, the experimenter made sure the child could identify which puppet knew all about color and which puppet knew all about shapes.

Simple test trials. The experimenter set a slotted box and the first four potential blickets for the first slot on the table. The experimenter told the child the following: "Let's try to figure out what's in the box! Here are some blickets that could work in this box. Let's ask our first question. Who should we ask?" The experimenter waited for the child to pick a puppet to question. Children were reprompted several times as necessary. If they were unable to come up with a question, they were asked, "Would you like to ask a question to Giraffe or Zebra, or do you want to try out a blicket to see if it opens the box?" Thus, children who did not want to ask questions were able to guess by trying out the blickets themselves.

Once the child chose an expert, the experimenter asked the child what question he or she wanted to ask. If a child asked a question before choosing a puppet, the experimenter would ask the child, "Who do you want to ask a question to?" The experimenter had prepared responses to any question the child asked. The responses were developed based on extensive piloting to determine the kinds of ineffective questions children asked. In general, the experimenter encouraged the child to ask questions about the blickets and redirected ineffective questions. The experimenter was careful not to model questions for the child, and the prepared responses facilitated this. Examples of the kinds of questions children asked (coded into different categories, discussed in the Results section) as well as the prepared experimenter responses are shown in Table 1.

After the puppet gave the child feedback, the experimenter asked the child if she wanted to ask another question. If the child said yes, the experimenter asked the child which puppet she wanted to ask for her second question and reprompted as needed. If the child did not respond within the first 30 seconds, the experimenter reminded the child that asking questions should help them find the blicket and eventually said, "Would you like to ask a question to Giraffe or Zebra, or do you want to try out a blicket to see if it opens the box?" If the child did not have a question, the above procedure was repeated. If the child did not have a question, the experimenter asked the child if he or she was ready to guess which blicket would work in the slot.

If children chose the right blicket, the observer would surreptitiously press the remote control that made the doorbell ring inside the box. Then the experimenter would move on to the next slot, repeating the procedure. If children chose the wrong blicket, they were able to ask more questions to figure out which blicket was the right one or to guess again. Children were allowed to miss as many times as it took for them to determine which

Question type	Example questions	Experimenter response
Effective	Direct: "Which shape/color is it?" Trial-and-error: "Is it [specific shape/specific color]?"	Puppet answers accurately. Puppet answers accurately.
	Confirmatory: "Is it [specific shape/specific color]?" after eliminating all other options.	Puppet answers accurately.
Ineffective	Off-task: "Is your father a fireman?"	Puppet answers accurately, then experimenter reminds the child of the purpose of the game.
	Irrelevant: "Why aren't there gold blickets?"	Puppet answers accurately, then experimenter reminds the child of the purpose of the game.
	Vague: Pointing, "Is it this one?"; "Which blicket is it?"	"Zebra/Giraffe doesn't know WHICH blicket it is, only what color/shape it is."
	Repeated: "Is it [specific shape/ specific color]?" after previously asking that question.	Puppet answers accurately, then experimenter reminds the child of the purpose of the game.
	Wrong expert: Child directs question to the wrong expert.	"I don't know about shape/color, I only know about color/shape."
Clarification	"Am I supposed to pick a puppet first?"	Experimenter answers accurately.

TABLE 1 Examples of Children's Questions and Experimenter Responses to Specific Questions

blicket worked in the slot. If children did not want to ask any more questions, they were asked which blicket they thought would open the box for that slot. Once the child selected the right blicket for each slot, the box was opened and the child received a small prize (a bouncing ball, bean bag animal, or toy race car).

Complex test trials. For the complex trials, the procedure was identical. The complex trials were used to give children the opportunity to coordinate information from two experts to solve problems.

RESULTS

Overview of Coding Scheme

Each transcript was examined to identify children's questions. Any utterance that began with typical question words (e.g., who, what, when, does), any phrase that indicated that the child might have been searching for information (e.g., "this one?" or names of colors or shapes), and any pointing or gesture toward the cards marked by the observer was marked as a question. For any question marked as a gesture by the observer, the recordings of the sessions were examined to understand the interaction in more detail.

Each question a child asked was then coded for several kinds of information (sample questions for each category are included in Table 1). First, each question received a global code for whether it was effective (on-task and able to obtain information that would help distinguish between the options for solving the problem), ineffective (off-task, vague, or otherwise unable to help obtain information for solving the problem), or a clarification of the protocol. Next, each effective and ineffective question received a specific category code to provide more information about the characteristics of the question. Finally, we coded whether the question was directed at the appropriate expert (or if that was not applicable, which was true when the question was off-task, too vague to tell whether or not the expert was right, or aimed at general clarification). Thus, each question received multiple codes, and these two components of problem solving determining whom to question and formulating effective questions—were coded independently.

In addition, the youngest children sometimes struggled to come up with well-worded questions themselves, but they still used a combination of words and gestures to request information. For instance, a child might use one word, such as "this," and gesture toward one of the blickets. Therefore, we made a distinction in the coding between normal questions and these less well-worded ones, which we labeled as incomplete questions. The percentage of questions that were considered normal and incomplete is described in the first part of the "Results" section.

There were three types of effective questions: direct, trial-and-error, and confirmatory. *Direct* questions were ones in which the child requested specific information (e.g., "Which color is it?"), whereas *trial-and-error* questions were ones in which the child tested a specific hypothesis (e.g., "Is it blue?"). *Confirmatory* questions were not necessary by process of elimination for determining which blicket worked in the slot, but they were still effective because they confirmed whether or not the child's hypothesis was correct. For instance, a question about color when all blickets were the same color was considered confirmatory. Likewise, if a child had constructed trial-and-error questions to isolate one remaining potential blicket but still asked a question about that blicket, that last question was considered confirmatory.

There were a number of different types of ineffective questions, and each one received the specific code that best captured the weaknesses in the question: off-task, irrelevant, vague, repeated, or wrong expert. Some ineffective questions were off-task (e.g., "Is your father a fireman?"). The rest of the ineffective questions still related to the task in some way. Questions were categorized as *irrelevant* if they were related to the task but not relevant to determining which blicket worked in a given slot. For example, if a child asked about the edges of the boxes (which was unrelated to figuring out which blicket worked in the slot), the question was coded as irrelevant. Questions were categorized as *vague* if it was not clear from the question what the child was asking (e.g., "Which one is the red one?") or if the question could not be answered by the puppet (e.g., "Which blicket is it?"). Questions were considered repeated if they were repeated for any purpose beyond the process of elimination, hinting at perseveration (e.g., if the child had already asked if the blicket was blue and asked the same question again). Finally, questions that would have been coded as effective but were directed to the wrong target were coded as wrong expert.¹ Because each question was coded for effectiveness as well as whether or not it was directed toward the appropriate expert, a child could also ask other kinds of ineffective questions to the wrong expert; the general code for each question would capture these errors. The frequency of questions for the effective and ineffective categories is listed in Table 2.

The coding scheme was developed by extensive review of the questions, and it allowed for the categorization of 100% of the responses. One research assistant was trained on the coding scheme and coded 100% of the responses. Inter-rater reliability was established by independent coding by the first author of 25% of the participants' questions including a subset from each age group. Coders were blind to the age of the participants when reviewing the data. Overall, across all of the coding response categories, Cohen's kappa was 1.00 for the question type.

¹One difficulty with the coding scheme was in determining how to best interpret the questions categorized as "wrong expert." These questions were linguistically effective, but they were directed toward the wrong source. As a result, children were not obtaining any relevant information needed for problem solving. Still, by classifying these questions as "ineffective," we may be underestimating children's ability to form questions that are linguistically effective. Therefore, we repeated the analyses related to when children ask effective questions for problem solving treating the "wrong expert" questions as effective.

Overall, when the "wrong expert" questions were counted as effective, although the magnitude of some of the developmental differences was reduced, the results remained consistent with the original analyses. Five-year-olds generally asked more effective questions than younger children. Details of these analyses may be obtained from the first author.

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TABLE 2 be for Simple and Complex	TABLE 2 stion Type for Simple and Complex	TABLE 2 s of Question Type for Simple and Complex		Trials by Age
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	stion Typ	is of Question Typ	TABLE	be for Sir

		Effectiv	e questions			IJ	neffective ç	questions			
	Direct	Trial-and- error	Confirmatory	Total	Off-task	Irrelevant	Vague	Repeated	Wrong expert	Total	Clarification questions
Simple trials 3-year-olds	2	15	2	19	0	1	36	0	14	51	8
(N = 16) 4-year-olds	10	16	٢	33	4	1	21	4	4	34	6
(N = 18) 5-year-olds (N = 16)	21	10	10	41	0	ю	23	0	1	27	4
Complex trials 3 -year-olds $(N = 16)$	S	L	7	14	0	7	32	18	11	63	11
4-year-olds $(N-18)$	24	15	6	48	4	0	14	15	4	37	13
5-year-olds (N = 16)	50	10	Q	99	0	0	16	10	4	30	6
<i>Note</i> . Each que code based on t	lestion wa	s coded as eit teristics of th	her effective, inef e question.	fective, o	r clarificatio	n. Effective a	und ineffec	tive question	is also rece	ived a spe	scific category

Overview of Data Analyses

Analysis of the coded data centered on the three main hypotheses outlined in this study. The first two sets of analyses focused on examining the first two hypotheses of the study: whether children directed questions toward appropriate sources before they could use their questions effectively to obtain information from these sources, and how the questions used differed across development and problem complexity. To examine these hypotheses, we first examined developmental differences in the ability to direct questions toward the appropriate expert for problem solving. Second, we examined how effective children's questions were and what kinds of developmental changes there were in the effective and ineffective questions children asked. Finally, to examine the third hypothesis, that as long as children are asking effective questions, they would be able to obtain the right answers for solving the problems, we determined how efficient children were at solving each problem. The analyses for each of these issues will be presented in turn.

When Do Children Direct Questions to the Appropriate Sources?

The first hypothesis was that young children would direct questions toward the appropriate sources before they would use their questions effectively to obtain information from these sources. To examine this issue, we determined the proportion of children who asked questions, and for those who did ask questions, if their questions were directed toward the appropriate source. It was then possible to examine age-related changes in children's ability to direct questions to appropriate sources. The next section addresses children's ability to formulate effective questions to determine if this skill is developed later.

Thus, for each child, we calculated the number of trials (out of a maximum of five) in which a child asked a question. A one-way analysis of variance (ANOVA) was conducted to compare the number of trials in which children asked questions across development, including incomplete questions (questions in which a word combined with a gesture were interpreted as a request for information), finding no difference between the age groups, F(2, 47) = 1.97, p = .15. In an analysis not including incomplete questions, there was a significant difference between age groups in the number of trials in which children asked questions, F(2, 47) = 3.51, p = .04. On average, 5-year-olds asked at least one question for almost all of the trials (M = 4.63, SD = 0.89), while 3-year-olds and 4-year-olds asked at least one question for slightly fewer trials (M = 3.13, SD = 1.86 and M = 3.61, SD = 1.91, respectively). This indicates that older children asked complete questions on more trials than younger children.

In reviewing the patterns for the different trial types, for the simple trials, it was found that 3-year-olds asked some sort of question for 84% of the trials (19% of these were incomplete), 4-year-olds asked questions for 89% of the simple trials (13% incomplete), and 5-year-olds asked questions for 100% of the simple trials (0% incomplete). For the complex trials, children did not ask questions as frequently. Three-year-olds asked questions on 65% of the complex trials (9% of these incomplete), 4-year-olds asked questions for 74% of the trials (8% incomplete), and 5-year-olds asked questions for 89% of the test trials (0% incomplete). Thus, older children were more likely than younger ones to ask questions, but even 3-year-olds asked questions on more than half of the trials for both simple and complex trials.

The incomplete questions involved a child gesturing toward some aspect of the blickets and providing one or two word utterances, such as, "This?" The rest of the data analyses, unless otherwise noted, include these questions, as they were taken as requests for information. Although a small minority of children's questions were categorized as incomplete, as described above, it is important to note that including these as questions may overestimate the performance of the 3-year-olds.

Next, to examine if children directed their questions to the right sources, for each child, the total number of task-related questions asked was calculated. Any question in which it could be determined whether or not the child was asking the appropriate expert was included in this analysis. For this count, therefore, we did not include questions in which it could not be determined if the child was asking the correct expert (e.g., clarification, off-task, irrelevant, and most vague questions). Incomplete questions were included only in cases in which it could be determined if the child was asking the correct expert. Of these questions, we calculated the number of questions that were directed toward the right expert (questions regarding color to Zebra and questions regarding shape to Giraffe).

Six of the sixteen 3-year-olds (38%), three of the eighteen 4-year-olds (17%), and one of the sixteen 5-year-olds (6%) did not ask any questions where it could be determined whether or not they were asking the correct expert. Most of these children were either guessing or asking questions like, "Is it this one?" Such vague questions make it impossible to determine whether or not children recognized that the experts knew different things during the task, even if they had seemed to understand this before beginning the study.

To examine whether each age group was directing their questions toward the appropriate experts at greater-than-chance levels, several one-sample *t*-tests were conducted to compare the percentage of questions for each child from each age group directed to the right expert to chance (50%). Three-year-olds directed their questions to the right expert on average 56% of the time, no different from chance, t(9) = 0.59, p = .57. Only four of the sixteen 3-year-olds (25%) consistently directed questions toward the right experts at greater-than-chance levels. In contrast, 89% of questions by 4-year-olds and 95% of questions by 5-year-olds were directed toward the right expert, t(12) = 9.37, p < .01 and t(14) = 13.37, p < .01, respectively. Twelve of the eighteen 4-year-olds (65%) and fourteen of the sixteen 5-year-olds (88%) directed questions toward the right expert at greater-than-chance levels.

When Do Children Ask Effective Questions for Problem Solving?

The second hypothesis was that older preschoolers would show more sophisticated strategies than younger ones, asking a greater number of effective questions as well as a greater proportion of effective questions that were direct as opposed to trial-and-error. We also expected that children would ask fewer effective questions for complex trials than for simple ones. To examine these issues, we categorized children's questions and compared the differences across development for simple and complex trials. We also examined if children learned from asking ineffective questions to ask effective ones.

To categorize children's questions, for each child, we calculated the number of each type of question for each of the five trials (two simple and three complex). To obtain a global summary of children's performance, we conducted several repeated-measures ANOVAs comparing the number of effective and ineffective questions per age group for the simple trials and the number for complex trials. See Figure 2 for a graph of the means for simple and complex trials.

For the simple trials, we examined the number of effective and ineffective questions for each trial and each age group. Thus, a repeated-measures ANOVA, with number of each question type (effective vs. ineffective) and trial number (first or second) as within-subjects factors and age group as the between-subjects factor, was conducted. There was no main effect of trial number: Children asked approximately the same number of questions for both trials. There was also no main effect of the number of effective and ineffective questions: Children asked approximately the same number of ineffective and effective questions overall for the two trials. There was, however, an interaction between the age group and the number of effective and ineffective questions, F(2, 47) = 3.74, p = .03, partial $\eta^2 = .14$. On average, for each simple trial, 3-year-olds asked more ineffective questions (M = 1.59, SD = 1.24) than effective ones (M = 0.59, SD = 0.84), t(15) = 2.48, p = .03. Four-year-olds asked approximately the same number of effective (M = 0.86, SD = 0.85) and ineffective questions (M = 0.94, SD = 1.23),



FIGURE 2 Average number of effective and ineffective questions asked per simple (top panel) and complex trials (bottom panel) per age group.

t(17) = 0.24, p = .81. Five-year-olds asked more effective questions (M = 1.28, SD = 0.84) than ineffective ones (M = 0.88, SD = 1.24), but this was not a significant difference, t(15) = 1.19, p = .15.

For simple trials, there was also an interaction between the trial number and question type, F(1, 47) = 4.13, p < .05, partial $\eta^2 = .08$. Overall, children asked significantly more ineffective questions for the first trial (M = 1.32, SD = 1.59) than for the second trial (M = 0.95, SD = 1.22), t(49) = 2.11, p = .04. Children asked approximately the same number of effective questions for the first trial (M = 0.84, SD = 0.93) and the second trial (M = 0.98, SD = 1.06), t(49) = 1.00, p = .32. Thus, children's questioning seemed to become more efficient from the first trial to the second one. There were no interactions between question type, trial number, and age group.

For the complex trials, we examined the number of effective and ineffective questions for each of the three complex trials and each age group. Therefore, a repeated-measures ANOVA, with number of each question type (effective vs. ineffective) and trial number (first, second, or third) as within-subjects factors and age group as the between-subjects factor, was conducted.

As in the simple trials, there was no main effect of trial number or question type. There was an interaction between the age group and question type in complex trials, F(2, 47) = 10.21, p < .01, partial $\eta^2 = .03$. On average, for complex trials, 3-year-olds asked more ineffective questions (M = 1.35, SD = 1.16) than effective ones (M = 0.29, SD = 0.84), t(15) = 2.94, p = .01. Four-year-olds asked approximately the same number of effective questions (M = 0.89, SD = 0.85) and ineffective questions (M = 0.69, SD = 1.15), t(17) = 0.94, p = .36. Five-year-olds asked more effective questions (M = 1.38, SD = 0.84) than ineffective ones (M = 0.61, SD = 1.23), t(15) = 2.72, p = .02. There was no interaction between age group, question type, and trial number, F(2, 94) = 2.01, p = .14.

To examine differences in the average number of effective and ineffective questions for simple trials compared to complex trials, a repeated-measures ANOVA was conducted with the average number of each question type (effective vs. ineffective) and trial type (simple vs. complex) as withinsubjects factors and age group as the between-subjects factor. The only significant difference was an interaction between question type and age group: Older children asked more effective questions than younger children, F(2, 47) = 8.20, p < .01, partial $\eta^2 = .26$. Thus, despite the fact that the complex trials should require more effective questions to solve the problems accurately, children did not ask significantly more overall questions or more effective questions for those trials than the simple trials.

Finally, to determine if there were differences in the total number of trials in which children asked an effective question, a one-way ANOVA was conducted comparing the total number of trials in which an effective question was asked (out of a maximum of five) as the dependent variable and age group as the between-subjects variable. There was a significant difference between the age groups, F(2, 49) = 7.60, p < .01. Five-year-olds asked effective questions for the majority of the five trials, on average (M = 4.06, SD = 1.65). Four-year-olds asked effective questions for about half of the trials (M = 2.78, SD = 2.39), and 3-year-olds asked effective questions rarely, on average (M = 1.31, SD = 1.82). However, it is important to note that 3-year-olds can construct effective questions, even if they do so infrequently.

To examine the kinds of effective questions children were asking, a repeated-measures ANOVA was conducted to compare the number of questions asked for each question type (direct, trial-and-error, and confirmatory) across all five trials with age group as a between-subjects variable. There was a main effect of effective question type, F(2, 94) = 4.65, p = .01, partial $\eta^2 = .09$. When children asked an effective question, they were more likely to ask a direct one (M=2.3, SD=2.68) than a trial-and-error question (M = 1.45, SD = 2.94) or a confirmatory question (M = 0.71, SD = 1.27). There was also an interaction with age group, F(4, 94) = 3.21, p = .02, partial $n^2 = .12$. Three-year-olds asked more trial-and-error questions (M = 1.38, SD = 3.0) than direct questions (M = 0.44, SD = 2.72) and confirmatory questions (M = 0.25, SD = 1.24). Four-year-olds asked approximately the same number of trial-and-error questions (M = 1.72, SD = 3.0) and direct questions (M = 1.88, SD = 2.72), with fewer confirmatory questions (M = 0.89, SD = 1.23). Five-year-olds asked far more direct questions (M =4.44, SD = 2.72) than trial-and-error questions (M = 1.25, SD = 3.0) and confirmatory questions (M = 1.00, SD = 1.24).

To examine the kinds of ineffective questions children were asking, a repeated-measures ANOVA was conducted with the number of vague, repeated, wrong expert, and unrelated questions (grouping off-task or irrelevant questions together to simplify analysis) totaled across all five trials as the within-subjects variable and age group as the between-subjects variable. There was a main effect of question type, F(3, 141) = 11.26, p < .01, partial $\eta^2 = .19$. The majority of children's ineffective questions were too vague (M = 2.88, SD = 3.54) as opposed to repeats of questions already answered (M = 0.94, SD = 2.55), unrelated to the task at hand (M = 0.29, SD = 1.34), or otherwise accurate but directed toward the wrong expert (M = 0.77, SD = 1.49). There was no interaction with age.

In sum, 5-year-olds asked more effective questions than younger children, and the majority of their effective questions were direct. Four-year-olds asked similar proportions of effective and ineffective questions as well as trial-and-error and direct questions. In contrast, 3-year-olds asked more ineffective questions than effective ones, and when they did ask effective questions, they were more likely to be trial-and-error questions. The most common ineffective questions were categorized as vague as opposed to the other categories, and this held true across development.

To determine if children asked effective questions after feedback to ineffective ones, for each ineffective question, we determined whether it was followed by an effective question, another ineffective question, or something else (e.g., no question due to being at the end of the trial, or a clarification question). A one-way ANOVA was conducted to compare the percentage of ineffective questions followed by effective questions (as opposed to ineffective questions) across development. For the purposes of data analysis, questions that were directly followed by a clarification question were not included, as learning may have taken place after the clarification questions. Likewise, it is difficult to tell if learning took place as a result of ineffective questions that were at the end of the trial; children may have had some insight into the right answer based on the response to the ineffective questions and their previous questions, and so these questions were also not included. There was a significant difference between the age groups, F(2, 30) =4.93, p = .014. Only 13% of 3-year-olds followed up an ineffective question with an effective one compared with 31% of 4-year-olds and 52% of 5-year-olds. Three of the sixteen 3-year-olds (19%), five of the eighteen 4-year-olds (28%), and one of the sixteen 5-year-olds (6%) only followed ineffective questions with clarification questions or guesses, which were not categorized as effective or ineffective. In addition, three of the eighteen 4-year-olds (17%) and five of the sixteen 5-year-olds (31%) only asked effective questions, and so it was impossible to determine if, had they asked ineffective questions, they would have learned in response to feedback.

Can Children Apply the Knowledge They Have Acquired to Successfully Solve Problems?

Our final hypothesis was that as long as children are asking effective questions, they would be able to obtain the right answers for solving the problems. Because children would eventually obtain the right answer from guessing because there were only four possible right answers, we calculated how many attempts on the box it took for children to obtain the right answer across development. Next, we examined each trial to determine if children had asked enough effective questions to obtain the information needed to solve the problem. We then compared the performance of children who had asked enough effective questions to those who had not to determine if asking effective questions helped them solve the problems more efficiently.

First, we counted the average number of attempts on the box per trial children made before getting the right answer for simple and complex trials. This included any attempts on the box, regardless of whether or not children had asked questions for those trials. There was no effect of trial type, but there was a trend toward an age difference, F(2, 47) = 2.38, p = .10, partial $\eta^2 = .09$. Three-year-olds took slightly more attempts on average per trial to find the right blicket (M = 2.29, SD = 0.76) than 4-year-olds (M = 2.00, SD = 0.76) and 5-year-olds (M = 1.71, SD = 0.76).

Next, we calculated the number of simple trials and the number of complex trials for each child where the child asked enough effective questions to deduce the right answer based on the answers received from the experts. By examining the questions asked for each trial, it was possible to determine if children asked enough questions about the color and/or shape of the blickets to eliminate all but one option as being the right one for that particular trial. A one-way ANOVA was conducted to compare the number of trials (out of a maximum of five) in which children asked enough questions to obtain the right answer across development, finding that there were developmental differences, F(2, 47) = 12.40, p < .01. For the simple trials, 13% of the 3-year-olds, 44% of the 4-year-olds, and 75% of the 5-year-olds asked enough questions for both trials. For the complex trials, a smaller percentage of children asked enough questions for all of the trials: 0% of the 3-year-olds, 17% of the 4-year-olds, and 38% of the 5-year-olds.

We then used *t*-tests to compare the number of attempts on the box for each trial for children who had asked enough effective questions compared to children who had not. For each trial except for the first complex trial, children who asked enough questions to obtain the information to determine which blicket worked in the box took fewer attempts to find the right blicket than those who did not ask enough questions (simple trial 1: t(48) = 5.58, p < .01; simple trial 2: t(48) = 5.73, p < .01; complex trial 1: t(47) = 0.44, p = .66; complex trial 2: t(48) = 2.51, p = .02; complex trial 3: t(47) = 2.27, p = .03). Thus, children's effective questions were helpful in solving the problems more efficiently.

Finally, to examine if there were any age differences in the ability to use the information generated by the questions, we collapsed the data from all the trials together for one additional analysis. An ANOVA was conducted to compare the number of attempts on the box for trials in which children asked enough effective questions and trials in which children did not do so, with age group as a between-subjects variable. Replicating what was found in the previous analysis involving *t*-tests, children who asked enough effective questions to obtain the information to solve the problem took fewer attempts to find the right blicket than those who did not ask enough questions, F(1, 242) = 41.01, p < .01, partial $\eta^2 = .145$. There was no effect of age or an interaction. In other words, regardless of age, children who asked enough effective questions to obtain the information needed for problem solving were more successful at problem solving than those who did not.

DISCUSSION

The current study examined preschool children's ability to ask questions to two different experts in a novel problem-solving task. Our first hypothesis was that there would be developmental differences in when children were able to demonstrate each of these skills: We expected that young children would direct questions toward the appropriate sources before they would use their questions effectively to obtain information from these sources. The results supported this hypothesis. Three-year-olds generally had difficulty directing questions to the appropriate experts, and they asked more ineffective questions than effective ones. Four-year-olds were successful at directing their questions to the correct expert, but they were not as successful at generating effective questions, asking similar proportions of ineffective and effective questions. Only 5-year-olds succeeded both at knowing who to ask and at asking more effective questions than ineffective ones.

Although 3-year-olds were not successful at directing questions to appropriate sources in this task, it is possible that their ability might be improved under different conditions. In the current experiment, the problems in the task called for two unfamiliar experts: a color expert and a shape expert. Previous research has suggested that children's notions of expertise might emerge first with familiar adult roles (Lutz & Keil, 2002). Learning new kinds of expertise may be difficult for 3-year-olds, who often have difficulty identifying and reporting the sources of their own knowledge (Gopnik & Graf, 1988; O'Neill, Astington, & Flavell, 1992; Taylor, Esbensen, & Bennett, 1994) and thus may have difficulty keeping track of the knowledge of others. Moreover, because children at least as young as 5 believe that knowledge clusters in certain ways (e.g., some people may be experts in natural science while others may be experts in social science; Keil, Stein, Webb, Billings, & Rozenblit, 2008), it may be challenging for young children to learn expertise that may seem arbitrary. Still, preschoolers have been shown to be capable of learning about new kinds of experts within the context of a research study (e.g., eagle experts and bicycle experts; Lutz & Keil, 2002). Future research should investigate how children's ability to distinguish between and question appropriate sources depends on the nature and plausibility of the domains of expertise.

Our second hypothesis was that older preschoolers would show more sophisticated strategies than younger ones, asking a greater number of effective questions as well as a greater proportion of effective questions that were direct constraint seeking as opposed to trial-and-error hypothesis scanning. Indeed, although children were generally able to ask some kind of informative question in this task, there were developmental differences. Although even 3-year-olds asked questions more than half of the time for both simple and complex trials, older children were more likely than younger ones to ask questions at some point during the study. As expected, not all of the children's questions were well formed; 3-year-olds in particular sometimes combined words with gestures in a way that was interpreted as a request for information. When children did ask questions, the questions produced by 5-year-olds were more effective than the ones produced by 3- and 4-year-olds.

The differences in the kinds of questions children of different age groups asked provides information about the kinds of strategies children may have been using to solve the task. When children asked an effective question, 3-year-olds were more likely to ask a trial-and-error question, while 5-year-olds were more likely to ask a direct question. Thus, the 5-year-olds seem closer to using the constraint-seeking strategy that Mosher and Hornsby (1966) identified in older children in their research.

The lack of differences in the kinds of ineffective questions asked across development is also revealing. The majority of the ineffective questions were categorized as too vague as opposed to irrelevant or off-task, and this was true across development. Because this was a new kind of problem-solving task, it may be that some children did not have enough prior knowledge about how to frame their questions in order to obtain the information they needed to solve the task. However, older children, more so than younger ones, were often able to follow an ineffective question with an effective question, suggesting that their experience in the task aided them in learning how to form effective questions.

The third hypothesis was that as long as children were asking effective questions, they would be able to obtain the right answers for solving the problems. The results supported this hypothesis. Children who asked enough effective questions to deduce the right answer for a given trial required fewer attempts to determine which blicket would work on each slot. Thus, asking questions is a useful tool for children to obtain information to more efficiently solve a problem. It is important to note, however, that preschoolers do not seem to be as sophisticated in their questioning as older children in some other research (e.g., Chouinard, 2007): Across age groups, children asked enough questions to obtain the information needed to figure out what was inside the box for only about 50% of the simple trials and 32% of the complex trials. There were developmental improvements— 5-year-olds were more likely than younger children to ask enough questions to deduce the right answer for both simple and complex trials—but performance was still not at ceiling.

To better understand what changes in children's skills at using questions as an epistemic tool, future research should investigate the factors that affect children's ability to direct questions to different sources to solve problems. In the current study, comparing performance for simple and complex trials shows that problem complexity influences the ability for children to determine who to question, what to ask, and how to use the information obtained. For instance, children guessed more often without asking questions for the complex trials than the simple trials. One possible explanation for the increase in guessing is that children may have been less certain about how to solve the more difficult complex trials.

Another possible explanation is that children were implicitly calculating the costs and benefits of directing questions to the different sources, and the costs were greater than the benefits for complex problems. Just as young children may struggle to use memory strategies because the costs sometimes outweigh the benefits (e.g., Guttentag, 1984), they may also struggle in using questioning strategies. Using a strategy involving asking questions to different sources may have been costly from a cognitive and linguistic perspective. Although the amount of information children can keep track of in their working memories increases during the course of development (e.g., Bayliss, Jarrold, Baddeley, Gunn, & Leigh, 2005), young children's resources are relatively limited, and so they may be particularly affected by the costs of keeping track of multiple pieces of information. Thus, in determining what to ask, the cognitive demands of generating effective questions may have been constraining, particularly when trying to solve the more complex problems.

Determining the appropriate source to question may have also been seen as costly. To determine which source to question, young children may have to override the assumption that all sources should be accurate (e.g., Wilson & Sperber, 2002), which may take considerable cognitive resources. To direct questions to the appropriate source, children must understand at least two things: Some sources may not provide the information they need to help them solve their problems, and it is important to ask their questions to the sources that can actually help them. Children without a deep understanding of how people can differ in their beliefs, desires, and thoughts (related to their theory of mind; Flavell, 1999) may have difficulty keeping in mind who knows what and actively seeking the most knowledgeable source of information. Supporting this possibility, recent research suggests that children who perform better on theory of mind tasks are better at determining which of two experts would know specific facts (Danovitch, 2009). Future research could manipulate the costs and benefits for using certain strategies with problems of varying difficulty as well as measure various cognitive abilities like language, working memory capacity, and theory of mind to better understand the factors that influence young children's ability to direct questions to appropriate sources for problem solving.

An additional important direction for future research is to examine how children's ability to determine whom to question, what to ask, and how to use the information in the service of problem solving might differ depending on the task. The current task focused on children's ability to ask questions to reach the end state of finding several specific, well-constrained facts (e.g., the red key with the square works in Slot 1). Children were prompted to direct questions about the shape on the key to the shape expert and questions about the color on the key to the other expert to solve the complex problems. By using novel experts, the study design controlled for previous background knowledge that could have biased children's questioning. The design also encouraged task-related questions.

However, the task used here has some limitations. In some ways, this study design may have overestimated children's abilities: Because children were prompted to ask questions, they may have been more likely to use questions as tools than they would be spontaneously. In other ways, this study design may have underestimated children's abilities: Because both the task and the domains of expertise were unfamiliar to children, problem solving may have been more difficult. Still, this research extends our understanding of children's problem-solving abilities in important ways. Whereas previous research has focused on isolated aspects of problem-solving skills, often using forced-choice methods (e.g., Koenig & Harris, 2005), the current task allowed the examination of several aspects of the problem-solving process within the same context. Ongoing research will examine the component skills for problem solving with different kinds of problems and in both experimental and naturalistic situations to gain a more complete understanding of what develops (Mills, Legare, & Grant, 2010; Legare, Mills, Yasskin, & Clayton, 2010).

In sum, it is clear that children face an array of problems to solve throughout development, with many different desired end states, from wanting to satisfy curiosity by learning about a new animal to needing to understand the causal relationship between several different tools in order to play a new game. This research demonstrates that preschool-aged children can use questions as a tool to solve problems, and they can also direct their questions to the appropriate experts to do so. However, this ability develops dramatically with age and experience. Children seem to know to whom to direct their questions before they are capable of generating efficient, effective questions, and the ability to coordinate information between sources seems to be achieved even later. Future research on the cognitive mechanisms underlying children's capacity to use questions as an epistemic tool will provide important insight into how to scaffold and strengthen children's problemsolving skills.

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