

Ronfard, S., Butler, L. P., & Corriveau, K.H. (2020). The Questioning Child: A Path Forward. In Butler, L. P., Ronfard, S., & Corriveau, K. H. (Eds.) (2020). *The Questioning Child: Insights from Psychology and Education*. New York: Cambridge University Press.

The Questioning Child: A Path Forward

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In this volume, we have brought together leading researchers in psychology and education with the goal of generating an overview of key issues pertaining to the role of questioning in development, to assess where the field stands in terms of investigating these issues, and to chart a path forward for this research in the coming years. In our introduction, we outlined three broad questions of interest to researchers and educators:

- 1. Where do questions come from, and how do children engage in questioning across development?*
- 2. To what extent is questioning universal, and in what ways is it socialized?*
- 3. What role does question-asking play in learning more broadly, in both formal and informal environments?*

In this concluding chapter we revisit these three key questions, weaving together the contributors' insights before laying out a roadmap to highlight promising avenues of focus for future researchers in the field.

1. Where do questions come from, and how do children engage in questioning across development?

This two-part question can be broken up into three separable questions: (1) Where does the capacity to ask questions come from? (2) How are questions generated? (3) What does question-asking look like across development? We discuss each of these in turn below.

(1) Where does the capacity to ask questions come from?

As Carruthers (Chapter 2) points out, theoretical discussion of curiosity, as well as our intuitive notions of curiosity, either explicitly or at least implicitly incorporate metacognition into the concept. We are curious and ask questions when we *don't know* something and *want to know* more about it. Carruthers proposes an alternative view, in which curiosity is rooted in a non-metacognitive, affective state or attitude, one most likely evolutionarily sculpted to motivate inquiry-driven behaviors that enable an organism to acquire relevant information. One advantage of this proposal is that it allows for the existence of curiosity driven behaviors across species while acknowledging that such behaviors can also be triggered by metacognitive processes as these processes develop and as individuals acquire greater control over these exploratory behaviors.

This proposal is generally consistent with the ones put forth by Harris (Chapter 3) and Wellman (4). Although on Carruthers' argument, metacognition is not necessary even for behaviors that may appear to require it (at least prior to age 2), Harris argues that metacognition, specifically an awareness of uncertainty, is a core driver of early questioning behaviors. He does agree with Carruthers' proposal that toddlers' early questioning may well be more akin to an affective response to unusual or unexpected stimuli or events particularly in the first year. However, Harris diverges from Carruthers' proposal by arguing that children's questions quickly become shaped by metacognitive processes during the second year. In making this argument, Harris points to empirical work documenting children's early sensitivity to speaker accuracy as early as 12-months (Begus & Southgate, 2012; Kovács, Tauzin, Tèglàs, Gergely, & Csibra, 2014), children's greater retention of information provided following points as early as 16 months (Begus, Gliga, & Southgate, 2014; Lucca & Wilbourn, 2017), as well as children's

developing capacity to make requests for clarifications during conversations between 14 and 20 months (Gallagher, 1981; Ninio & Snow, 1996).

The proposal put forth by Wellman (Chapter 4), namely that from the outset children seek to learn and understand via their questions, may help resolve this tension. Wellman's account does not require metacognition at the outset but allows for a potentially increasing role of metacognition over the course of development. Indeed, metacognition appears to play an increasing role in children's questions as children transition from infancy into toddlerhood. For example, children begin to use questions to resolve communicative breakdowns (Wellman, Song, & Peskin-Shepard, 2017) by age two, around the same time as they begin to seek explanations in conversation (Chouinard, 2008). The co-occurrence of these two types of questioning is revealing for two reasons. First, in order for children to learn from the explanations they are given they need to monitor the responses they receive. Second, requests for explanations and request for clarifications work together to help children steer conversations in ways that support their ability to acquire information from other people. This dual role of question-asking as a social learning strategy and as a strategy for managing interactions deserve more research. Specifically, we need to know more about how children learn to deploy these two types of questions during conversations to manage interactions in ways that allow them to obtain the information they want or need. By focusing on conversation as the focus of inquiry rather than on individual questions, we will be better positioned to explain how children's questions shape their cognitive development.

In sum, our contributors agree that metacognition may not be a necessary component of the question asking process early in ontogeny, and Carruthers' proposed affective questioning attitudes seem like a likely candidate for a developmental starting point. The contributors also

agree that metacognition plays a role in the questioning process later in development. However, they differ on a key open question, namely when and how metacognition becomes incorporated into the questioning process. As Carruthers notes some (but not all of the results) highlighted by Harris can be interpreted without appealing to metacognition. This suggests the need for additional research.

One way forward may be for researchers to carefully break down the process of questioning into broad components, and then ask when in development and in what ways metacognition plays a role for each of these constituent components. For example, Ronfard, Zambrana, Hermansen, and Kelemen (2018) suggest that the questioning process can be separated into four components: question initiation, question formulation, question expression, and following-up on one's question based on the response received (see also Mills and Sands, Chapter 8). This separation into components may be a critical piece of the puzzle, because the role of metacognition and its incorporation into the questioning process is likely to differ across components. Whether or not future research takes this approach, we believe it will be best served not by asking "*when* does metacognition drive infants and toddlers' information seeking questions?" but rather by asking three related questions, "under what circumstances and in what ways does metacognition influence infants and toddlers' search for information?", "how does this change over development?" and "how is this developmental sequence shaped by variations in the conversational environments children are exposed to?"

Indeed, we urge researchers to carefully consider the relations between questioning attitudes such as curiosity, pointing, and question-asking. These relations may be key to the development of questioning in conversation in early development. Specifically, an important issue here is understanding how children learn that pointing reliably elicits information from a

caregiver and, in turn, how they develop the expectation that they will receive a response – an expectation that boosts their retention of the to-be-provided information (Lucca & Wilbourn, 2016). Currently, the strongest hypothesis for this development is that children learn to use pointing to request information through interactions with their caregivers (Begus & Southgate, 2018; Lucca & Wilbourn, 2016). Indeed, caregivers in Japan and the United States interpret children's points as request for information (Kishimoto et al., 2007; Wu & Gros-Louis, 2014). Additional studies using longitudinal designs are needed to explore the relation between parental responsiveness to infant pointing and the development of infant's questioning behaviors – not only their expectation for information but also their sensitivity to speaker accuracy. Such research will eventually need to be followed up with intervention research to provide causal evidence that caregiver-child interactions (which are culturally influenced and thus vary widely) are indeed a key mechanism supporting observed developments in children's question-asking behaviors. If communicative interactions are shown to play such an important role in the development of question-asking in infancy, then we would expect large differences in the onset of this type of question asking given the wide range of communicative practices across the globe. This would support the claim of Callanan, Solis, Castenada, and Jipson (Chapter 5) and Gauvain and Munroe (Chapter 10) that questioning is a cultural practice acquired over time as children interact with others in culturally determined ways.

Children's questions can either spark or extend conversations. They are signposts that shape how conversations unfold and thus what is learned. For the most part, research on question asking has mostly focused on individual questions and sometimes on sequences within a conversation, for example whether and how children follow up explanatory and non-explanatory responses (Chouinard, 2008; Frazier, Gelman, and Wellman, 2016; Kurkul & Corriveau, 2017).

Research will benefit from taking a step back to investigate how children learn to combine requests for both explanation and clarification in order to steer conversational exchanges in ways that scaffold their learning as well as the ways in which the ability to steer an exchange is – or is not – supported by the surrounding conversational environment and cultural practices.

(2) How are questions generated?

This is an important question for both psychologist and educators. Unfortunately, we know little about this process (Coenen, Nelson, & Gureckis, 2018; Ronfard et al., 2018). Surveying the chapters in this volume, a distinction can be made between contexts in which children possess an accurate and relatively complete understanding of the search space and can use questions to identify an answer to their query, as contrasted with contexts in which there is no clear answer and children lack a representation of the search space. The former is typically assessed using 20-questions type paradigms where children have been given a set of items and have to identify the target. While this setup may seem artificial, there are many real-world cases where search unfolds in much this way. Consider for example a mechanic trying to diagnose a problem with a car. The mechanic has a good sense of the possible problems and through a series of questions can identify the root cause of the mechanical failure. This kind of search process is also present in other diagnostic searches – for example a doctor’s search for what ails a patient or a teacher’s search for why a student has a misconception. Jones, Swaboda, and Ruggeri (Chapter 7) review research that demonstrates surprising strengths in children’s ability to engage in this type of search, as well as rapid developments. Importantly, they note that the efficiency of search (for children and adults), that is how much uncertainty is reduced by each question, depends on the questioner’s prior knowledge, biases, and expectations, as well as on specific task

characteristics. This is because the value of search strategies like hypothesis-scanning questions or constraint-seeking questions depend on one's knowledge of or expectations about the likelihood of various hypotheses in the search space. If all hypotheses are equally likely then it is better to try to reduce the number of hypotheses by seeking to rule out as many as possible using a constraint-seeking approach. In contrast, if one hypothesis seems particularly likely then it makes more sense to focus on that hypothesis and take a hypothesis-scanning approach. This ability to engage in ecological learning, that is the ability to flexibly adapt search strategies based on task characteristics, is also present early in development and develops rapidly between the preschool and elementary years. This line of work is particularly promising, as it may help provide a rich understanding of children's abilities to adapt their search based on the context and the task. Moreover, the paradigms and analytic tools developed in this line of inquiry, such as the formal quantification of information gain (Jones, Swaboda, and Ruggeri, Chapter 7)), provide a solid foundation for better understanding exactly how and to what extent prior knowledge, biases, and expectations shape search and how this affects learning. Thus far, we know that these variables matter for how children search for information, but have yet to fully understand and quantify their impact more broadly. Indeed, it will likely be easier to measure the impact of children's prior knowledge and cognitive abilities on this type of search than on more open-ended questioning tasks. For example, the more controlled setting of 20-questions type games seems ideal to better understand how different parts of the questioning process (representing the search space, identifying relevant dimensions of that space, updating the representation of the search space following answers) call upon different facets of executive functions skills – working memory, cognitive flexibility, inhibition (see Jones and colleagues, Chapter 7 for other next steps). Of course, these processes may be different when children do not have a

representation of the search space but understanding how they search when they do have such a representation will provide us with theoretical and analytical tools to gain that knowledge.

As noted, there are many cases where children do not have an accurate representation of the search space. Indeed, children's questions are diagnostic both of what they know *and* of what they don't know (Neale, Morano, Verdine, Golinkoff, and Hirsh-Pasek, Chapter 9) and are frequently used by caregivers, teachers, and researchers to better understand how children think about a particular domain of inquiry. Research investigating these types of questions suggests that children's concepts and intuitive theories influence the questions that children generate. For example, children's concepts of animals and artifacts shape the kind of information they seek when encountering novel exemplars of each kind (Greif, Kemler Nelson, Keil, & Gutierrez, 2006) and children's questions are increasingly concerned with the mind as their Theory of Mind (ToM) is developing (Chouinard, 2008; but see Gauvain, Munroe, & Beebe, 2013). In addition to these data, work by Chouinard (2008), Frazier, Gelman, and Wellman (2009; 2016) and Kurkul and Corriveau (2017) reveals that when children do not receive an informative response to their questions, they often follow up by either asking their question again or coming up with their own explanation. These data come exclusively from children growing up in the United States. Nevertheless, they suggest that when children ask a question, they are likely to have some expectation about what would count as an answer. Whether they voice such opinions, however, may differ by culture. Indeed, Kurkul and Corriveau (2017) report that children from families with lower socio-economic status tend to provide their own explanations less often than peers from more advantaged backgrounds (see also Gauvain & Munroe, Chapter 10).

In sum, research on children's use of questions when they possess and do not possess (complete) information about the search space has uncovered suggestive evidence that the

question generation process is complex and influenced by multiple factors. However, our understanding of this process remains limited. Indeed, as Coenen, Nelson, and Gureckis (2018) have pointed out in their review of research on inquiry in children and adults, there is still much we do not know (see also Ronfard et al., 2018). Specifically, we need more clarity on how prior knowledge and cognitive biases shape the question-generation process and the processing of responses to these questions? Answering this question is critical to understanding how question-asking helps children restructure their representation of a domain. That is, the role of question asking for cognitive development.

(3) What does question-asking look like across development?

In Table 1, we provide a non-exhaustive and partial review of the developmental results discussed in this volume from birth to adolescence. A full review of existing research on question-asking across childhood is beyond the scope of this chapter, but see Ronfard et al. (2018) for a recent review. While perusing this table, three limitations must be kept in mind. First, almost all of the data we possess on question-asking have been collected in W.E.I.R.D countries (Henrich, Heine & Norenzayan, 2010; Nielsen, Haun, Kärtner, & Legare, 2017). Second, most developmental studies on question-asking that have been conducted in laboratory settings (and some that have drawn on recorded conversations between caregivers and their parents) have used cross-sectional rather than longitudinal designs. Thus, although we have a general idea of age-related differences, we do not have much data on how the performance of individual children changes over time. Finally, much of the data that has been collected has revealed large individual differences in children's performance at every age that has been tested. Many authors in this volume have speculated about the source of these individual differences but

little research has been conducted on them. We urge future research to consider exploring the important factors resulting in these within-culture individual differences, and suggest that this might be an important way forward. At the moment, there is a lot variability in the development of question-asking that we cannot account for.

Table 1. A non-exhaustive review of the developmental results discussed in this volume.

1-years-old	Children’s are sensitive to speaker accuracy (Begus & Southgate, 2012; Kovács, Tauzin, Tèglàs, Gergely, & Csibra, 2014), they show greater retention of information provided following their points (Begus, Gliga, & Southgate, 2014; Lucca & Wilbourn, 2017), and they begin asking for clarifications during conversations (Gallagher, 1981; Ninio & Snow, 1996).
2-years-old	US children from middle class homes increasingly ask for explanations and not just facts (Callanan & Oakes, 1992; Chouinard, 2008; Hickling & Wellman, 2001) and have begun to master the syntax of wh-questions (Bloom, Merkin, & Wooten, 1982). They also use questions to repair communicative breakdowns (Wellman, Song, & Perskin-Shepard, 2017).
3-years-old	
4-years-old	Children generate predominantly informative as opposed to redundant or uninformative questions, rely predominantly on hypothesis scanning approach on twenty-questions type paradigms (Legare, Mills, Souza, Plummer, & Yasskin, 2013), monitor the responses they obtain to their question and follow up by providing their own explanation or by repeating their question (Chouinard, 2008; Frazier, Gelman, and Wellman, 2016; Kurkul & Corriveau, 2017). They prefer and remember satisfying explanations (Frazier, Gelman, and Wellman, 2016) and can engage in extended bouts of questioning on a single topic with a responsive caregiver (“Passages of intellectual search”, Tizard & Hughes, 1984).
5-years-old	Children can select the most informative question – the question that generates the greatest reduction in uncertainty – when given information about the likelihood of possible hypotheses (Ruggeri, Sim, & Xu, 2017). However, overconfidence in their own knowledge and abilities sometimes lead children to attempt to guess answers rather than asking a question of a knowledgeable source when they are given the option (Aguiar, Stoess, & Taylor, 2012; Robinson, Butterfill, & Nurmsoo, 2011). Children are

	<p>increasingly able to coordinate what to ask and whom to ask when asking questions (Mills, Legare, Bills, & Mejias, 2010; Mills, Legare, Grant, & Landrum, 2011; Mills & Landrum, 2016).</p>
<p>6- to 11-years-old</p>	<p>Transition to relying predominantly on a constraint-seeking approach on twenty-questions type paradigms (Ruggeri & Feufel, 2015; Ruggeri & Lombrozo, 2015) and increasing metacognitive awareness of using this strategy (Mosher & Hornsby, 1966). Relative to adults, children this age still ask many redundant questions – questions that provide information they already obtained (Ruggeri, Lombrozo, Griffith, & Xu, 2016). However, even at this age, children demonstrate “ecological learning”. They adjust their questioning strategy to match the probability distribution of hypotheses on the task they are asked to complete (Ruggeri & Lombrozo, 2015).</p>
<p>Adolescence</p>	<p>Questioning continues to develop in adolescence and adulthood where questioning is increasingly deployed to support argumentation. Through sustained practice, authentic learning opportunities, and scaffolding by teachers, adolescents can learn to use evidence (and to seek it) not only to support their own claims but also to weaken the claims of others (see Kuhn, Modrek, & Sandoval, Chapter 12).</p>

2. To what extent is questioning universal, and in what ways is it socialized?

This is a key question raised by Callanan, Solis, Castañeda, and Jipson, (Chapter 5) and by Gauvain and Munroe (Chapter 10). Both challenge us to make a distinction between taking an inquisitive stance (questioning with a big Q) and question-asking per se. Taking an inquisitive stance is likely a human universal (see also Carruthers, Chapter 2) but the way in which this stance is expressed both verbally and nonverbally is likely to differ across cultures as children are socialized into the cultural practices of their communities. As both sets of authors remind us, there are a myriad of ways in which children can acquire information from others, only one of which is explicit questions. Thus, a greater understanding of how *and* why children's reliance on these different methods knowledge acquisition differs across cultures is needed. Notably, this does not mean that research cannot or should not focus on the benefits that might accrue from asking questions. However, before these benefits can be claimed to be both related and unique to asking questions (that is, that they can only be obtained through question-asking, rather than through other behaviors, including some behaviors that are non-communicative) much more extensive comparative research needs to be conducted. In what follows, we briefly echo some of the important points made by both chapters before outlining some next steps towards better understanding the socialization of question-asking.

By encouraging us to think of questions as a cultural practice, Callanan, Solis, Castañeda, and Jipson (Chapter 5) remind us to beware of inferring that an absence of question-asking in a cultural group necessarily entails an absence of supports for thinking or learning in that group. Their chapter highlights the need for not only greater cultural diversity in research on big-Q questioning but also greater methodological diversity in research on question-asking specifically.

Indeed, in order to better understand *how* cultural repertoires of practices (Gutiérrez & Rogoff, 2003) shape the development of question-asking specifically and questioning more broadly, we need to collect data at home and in the lab using methods that are likely to highlight nuanced cultural variability in children's use of questions to gather information. This includes collecting data across multiple settings (e.g., peer-dominated activities, caregiver-dominated activities, conversations about academic vs. non-academic topics, during dinnertime and bath time as well as during less reflective times of the day), using multiple methods (e.g., observation, semi-structured experimental tasks, parent reports through diary entries). In addition to increasing the diversity of the methods we use to collect data on how children ask questions, more information is needed about what explains variation in the conversational environments that caregivers create for their children (both within and across cultures) and how this variation is tied to children's use of questions to obtain information.

In their chapter, Gauvain and Munroe (Chapter 10) provide researchers with theoretical and methodological tools for thinking more deeply about the socialization of question-asking. Specifically, they point to sociocultural approaches to development and theories of language socialization. These approaches are consistent with many of the findings reported in this volume which suggest an important role for communicative interactions (which are shaped by culture) in the development of question-asking: learning to expect information in response to one's points (Lucca, Chapter 6); caregivers' use of questions and its implications for children's language development (Zambrana, Hermansen, & Rowe, Chapter 11); learning from questions and by asking questions in the classroom (Kuhn, Modrek, & Sandoval, Chapter 12).

One challenge to increasing our understanding of the socialization of asking-questions is that the absence of questions does not necessarily imply that questions are not being generated,

only that they are not being asked of the interlocutors. Indeed, as research reviewed by Gauvain and Munroe (Chapter 10) and Callanan and colleagues (Chapter 5) demonstrates, there are many cases across cultures in which certain questions are not allowed to be asked: for example when asking a question would challenge authority or if the topic of the question is taboo. An additional challenge is that there appears to be multiple paths through which culture might influence question-asking. A greater understanding of the effect of culture on question-asking requires targeted research on these various pathways. Below, we discuss some of these non-exclusive pathways but note that there are likely to be other ways as well.

First, cultural practices may directly shape the development of children's question-asking. Early infant-caregiver interactions are known to differ greatly across cultures. If, as we suspect, variability in such interactions accounts for unique variation in the early development of questioning – for example, by helping children develop an understanding of the information-eliciting function of points – then we would expect differences across cultures in the onset of the particular developmental milestones associated with questioning, as described in the previous section.

Second, as discussed above, cultural practices might shape children's willingness to ask questions and of whom they ask those questions. Under this proposal, children across and within cultures may not necessarily differ in the number of questions they generate but rather in whether they express these questions to familiar and unfamiliar adults. For example, children may prefer to seek out peers rather than adults if they have a question in mind because asking an adult may be culturally unacceptable or taboo given the topic of the question.

Third, cultural differences in what is talked about with children may shape what children know about a topic (their prior knowledge) and thus shape the kinds of questions they ask about

such topics (for example, parent-child conversations about death or sex, Davies & Robinson, 2010; Rosengren et al., 2014). Under this proposal, differences across groups of children reflect differences in prior knowledge rather than reduced interest. This is because knowing more about a topic makes one less confident in one's knowledge (Kruger & Dunning, 1999) and perhaps more likely to seek out information. In addition, individuals who know more generate more precise questions (Graesser & Olde, 2003). Thus, group differences in the prior knowledge available to children could lead to differences in the number and type of questions children ask.

Fourth, being questioned about their own knowledge, being asked follow-up questions about their explanations, and being asked to clarify what they mean may lead children to internalize question-asking as a form of self-monitoring, improve their comprehension and indeed their propensity to detect inconsistencies in their knowledge thereby increasing the frequency with which they ask questions (see King, 1990, 1992; Rosenshine, Meister, & Chapman, 1996). Some experimental research appears to be consistent with this hypothesis: having been asked to explain their prediction, children engaged in more sophisticated causal reasoning, than when they were just asked to describe an interaction (Legare & Lombrozo, 2014). Notably, as mentioned above, all of the research to date exploring the impact of question-asking and explanations has focused on cross-sectional data, and to understand the long-term impact of being encultured in an environment which supports question-asking and explanations more longitudinal data is needed.

Fifth, caregivers' conversational style – how often they ask questions and the type of questions they ask – may signal a distinctive stance toward the exchange of ideas via conversation and about how knowledge is structured and thus may influence children's epistemological development (Ronfard, Bartz, Cheng, Chen, & Harris, 2017). Similarly, a

caregiver's willingness to engage in explanations – and the type of explanations they give – may also signal to their child the likelihood that the caregiver will be a useful source of information in the future. Some research has speculated on this relation (Kurkul & Corriveau, 2017), but as Callanan and colleagues note, longitudinal data is needed to support this hypothesis.

In sum, we agree with Callanan et al. (Chapter 5) and Gauvain and Munroe (Chapter 10) that questioning is a cultural practice and that its absence in some cultures or its lower frequency does not imply a lack of thinking or learning. More research is needed to better understand variability in the impact of exposure to questions as well the relation between question-asking, how children learn, and how they think about the learning process. There are multiple ways in which culture may influence children's question-asking practices. Some of the pathways are likely to have minor influences on children's learning while others may be more consequential.

3. What role does question-asking play in learning more broadly, in both formal and informal environments?

The contributors to this volume reveal that question-asking shapes learning in at least two ways. Children's questions shape their interactions with others and thus what they learn. Adults' questions also shape what children learn. We therefore review each question in turn: (1) What role do children's questions play in learning? (2) What role do questions *to* children play in learning?

(1) What role do children's questions play in learning?

Conversations are a powerful means of gathering information. Children's questions support learning because they help generate and direct pedagogical exchanges. As Baldwin and Moses

(1996) put it, questions “allow children to gather just the information they want, on just the topic that interests them, at just the time they require it” (Baldwin & Moses, 1996, p. 1934). More specifically, questions allow children to obtain explanations and to clarify what others are telling them (Harris, Chapter 3; Wellman, Chapter 4). Moreover, even when children fail to obtain an explanation, they may still learn by formulating their own. This is because the process of explaining itself can generate learning (see Walker & Nyhout, Chapter 13; Wellman, Chapter 4). However, the beneficial impacts of asking questions on learning are not yet fully understood. This is a ripe area for future research and Wellman (Chapter 4) outlines three non-exclusive hypotheses for why questions may be so effective at scaffolding learning that we hope will be explored in future research: (1) children’s questions are (often) focused on topics that children are intrinsically motivated to learn about; (2) children’s questions are triggered by uncertainty and novelty and thus push children to learn about things they don’t already know; and (3) children’s questions may (sometimes) force them to process information more deeply because it requires them to think through what they already know. As Wellman (Chapter 4) points out such research will benefit from comparing and contrasting the effect of questions on learning with the effects of explaining and predicting.

(2) What role do questions to children play in learning?

Questioning is a powerful teaching strategy. Indeed, using questions to teach has been a mainstay of Western philosophy for millennia. Within that context, questions have been used by adults to foster reasoning and comprehension. This volume’s contributors provide strong evidence for the benefits of this pedagogical approach. Specifically, the chapters by Zambrana

and colleagues (Chapter 11) and Walker and Nyhout (Chapter 13) raise two issues that cognitive developmental scientists and educators will find interesting: (1) How do questions to children scaffold learning? (2) What are the limits of questioning as an instructional strategy?

(1) Benefits and drawbacks of caregiver questions

How do questions scaffold learning? According to Zambrana and colleagues (Chapter 11) and Walker and Nyhout (Chapter 13), the short answer is that adults' questions to children catalyze children's learning because they oblige children to speak more and to think more deeply. Specifically, adults' questions to children provide opportunities for children to practice their developing language skills and focus their attention on hypotheses they may not have considered on their own. However, in doing so, adults' questions may also lead children astray suggesting that adults' knowledge of a domain is likely to determine whether their questions have a positive impact on children construction of new knowledge – a point we discuss in more length later.

Zambrana and colleagues (Chapter 11) draw on a longitudinal dataset of parent-child interactions at 1-, 2-, and 3-years-old and show that parent's questions evolve alongside their children's linguistic abilities. As children age, parents ask fewer direct questions, more indirect questions, and increase the linguistic complexity of the questions they ask. Their analyses show that the kinds of questions children ask are related to their task performance (completing the task). Thus, parents are adjusting the kinds of questions they are asking, not only based on their children's general linguistic abilities, but also on their child's ability to complete the task at hand. This is an important point because as Zambrana and colleagues remind us, when parents

use questions, they are seeking to fulfill multiple agendas – in this case, further strengthening their children’s language abilities and helping their child solve a task. Importantly, Zambrana and colleagues also find that only parents’ wh- questions at age 2 predict their child’s language abilities 2-years later when children are 4-years-old. This finding, which is consistent with prior work, implies that not all questions are equally effective in supporting children’s language development. Wh- questions are particularly powerful because they challenge children to move beyond a simple yes/no response and produce a response that is more varied.

Walker and Nyhout (Chapter 13) provide further evidence of the power of wh- questions. They review the benefits and potential pitfalls of three question prompts: requests for explanations (Why?), requests for additional explanations (Why else?), and counterfactuals (What if?). As Walker and Nyhout note, each question type has benefits and pitfalls. However, when used in combination, the different question prompts can mitigate the drawback of each question type. For example, using a request for additional explanations (Why else?) following an initial request may lead children to consider more complex hypotheses than those prompted by the initial (Why?) question, which may lead them to focus on one possibility. An interesting question for future research is whether adults have an implicit understanding of the power of these prompts. Do they use them in sequences to guide children’s thinking? Do they appropriately ask for additional explanations and counterfactuals?

Implicit in both authors’ discussion is that for questions to be effective – for questions to perform as intended, the person asking the questions and taking on the pedagogical role must be knowledgeable and judicious in how they deploy questions. Do children take into account the knowledge of the questioner when responding to queries directed at them? Recent evidence suggest that they do (Yu, Landrum, Bonawitz, & Shafto, 2018). In other words, pedagogical

questions such as those used in direct instruction may guide children's thinking about a domain based on children's reasoning about the knowledge and intentions of their informant (Shafto, Goodman, & Griffiths, 2014).

(2) Supporting inquiry in the classroom: Challenges and opportunities

In their two chapters, Kuhn, Modrek, and Sandoval (Chapter 12) and Osborne and Reigh (Chapter 14) review the current state of question-asking in the classroom and find it mostly unchanged relative to past work. Teachers, rather than students, ask many questions. This is detrimental to the development of children's inquiry skills. They suggest ways in which teachers can create environments where questions could be used to support student learning.

Kuhn, Modrek, and Sandoval (Chapter 12) focus on older children and adolescents – an age group typically ignored when discussing inquiry in childhood. As they point out, younger children are often described as incredibly curious, whereas older children are not. Kuhn et al. suggest that this is partly because older children's educational environments do not provide many opportunities for expression of curiosity, nor develop "mature" inquiry skills that would prepare them for the modern workforce. They argue that teachers might best develop and support student inquiry skills both through modeling the types of inquiry behavior they aspire to see in their students and through actively creating learning experiences in the classroom that allow for the acquisition of these skills. Drawing on experimental work, they argue for learning environments that pose children "true" questions. That is, teachers should create environments that pose a problem and then provide students with the means to answer them – a suggestion that echoes Carruther's (Chapter 2). In such environments, the role of the teacher is to ask the

appropriate question to initiate the process for students (see Osborne and Reigh (Chapter 14) and Walker and Nyhout (Chapter 13)) for how different question prompts might achieve this goal) and to use questions to help students to collaboratively weigh and discuss solutions. This latter point connects to Gauvain and Munroe (Chapter 10)'s argument that learning to question involves mastering the pragmatics involved in asking questions in the cultural environment, which occurs as one is socialized into culturally influenced pattern of interactions – in this case questioning as a component of complex argumentation.

In their chapter, Osborne and Reigh (Chapter 14) agree with Kuhn and colleagues (Chapter 12)' assessments and solutions. However, they argue that teachers' ability to modify their practice and deploy questions to support learning, rather than for rhetorical reasons, is currently hindered by the lack of a clear and agreed upon classification scheme for teachers' questions. By making categories of questions explicit, teachers can reflect on the types of questions they employ to achieve particular pedagogical goals. Osborne and Reigh note that previous attempts at categorizing questions are not helpful for teachers partly because the categories generated by previous schemes do not clearly classify all questions, nor are they clearly aligned with the pedagogical goals of science classrooms. Thus, the lack of a clear classification system makes it difficult for teachers to critically think about the *type* of question they need to achieve a particular instructional goal. Osborne and Reigh's new scheme is aligned with instructional goals in the science classroom and categorizes questions into three groups: ontic question are about how to describe and categorize phenomena, causal questions are about understanding why things happen, epistemic questions are about understanding how we know and what constitutes good evidence for a claim. They demonstrate the usefulness of this scheme with their analyses of elementary teachers' questions, which show that teachers ask many ontic

questions and very few questions about how and why a claim is made. Increasing the frequency of these questions early in children's schooling may pay important dividends in the later years when children are asked to reason and argue about evidence in more sophisticated ways (Kuhn, Modrek, & Sandoval, Chapter 12). Importantly, the goal is not just to help teachers recognize the kinds of questions they ask but also to enhance the questions asked by students. This suggests an interesting next step for research: when might it be useful to not only share the classification scheme with teachers but also with their students? Indeed, it might be helpful to teach students about the three types of questions that Osborne and Reigh have identified and to teach students when and how to deploy them during inquiry. Such knowledge about knowledge may be particularly helpful when children (and adults) need to engage in sustained reflective inquiry.

In sum, asking children questions is a powerful learning strategy that shapes children's language and cognitive development. Wh-questions seem particularly effective in shaping development. These questions help children develop their linguistic skills by encouraging them to talk more and to practice using more complex linguistic forms in their responses. Wh-questions also support children's cognitive development by pushing them to think more deeply about the domain of inquiry. However, for adults' wh-questions to drive learning forward, the questions must be asked by a knowledgeable and helpful adult who will not guide children to consider inaccurate or unlikely hypotheses. Moreover, as Kuhn and colleagues demonstrate, developing complex inquiry and argumentative skills requires a setting that incorporates multiple components: motivation – knowing you can do it but also having the freedom to do it on your own, pragmatic development – knowing how to engage in extensive back and forth that builds on the claims made by other participants, and conceptual development – understanding the link

between inquiry, evidence, and argumentation, an understanding that is fostered as one is held accountable to these standards of evidence in extended conversations.

Conclusions

This volume's contributors have provided insights into the origin of question-asking, its development, and potential sources of individual differences. They have also highlighted that there is much we do not know about questions and their impacts on learning. Nevertheless, there seems to be agreement that learning to ask questions happens over time as one is socialized into this practice. More research is needed to understand how this socialization process takes place and how culture shape it. Are there unique cognitive benefits to asking questions or are the benefits that exist simply reflective of the fact that questions like other forms of active learning benefit from a high level of motivation, agency, and deeper processing? In addition to helping answer this question as well as others, we hope that this book will help build bridges between the various disciplines interested in the development of children's question asking. In sum, we hope that this volume, like all good questions, generates interactions, explanations, and more questions!

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