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Young children's developing conception of knowledge and ignorance: work in progress

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ABSTRACT

When do children acquire an understanding of knowledge and ignorance? We analyzed the early development of children's spontaneous references to *knowing* and *not knowing* and conclude that 2-year-olds talk explicitly and cogently about their own knowledge as well as that of an interlocutor. Two-year-olds also admit their own ignorance. Moreover, consistent with their realization that an informant may know what they do not, 2-year-olds ask many information-seeking questions. Finally, we discuss children's receptivity and skepticism, especially toward the counterintuitive claims of an adult. We conclude that children's conception of knowledge and ignorance begins early but undergoes protracted refinement.

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KEYWORDS Knowledge; ignorance; questions; self; other

When do children start to have a concept of knowledge and ignorance? A plausible and widely accepted answer to this question has been based on the experimental analysis of children's emerging theory of mind. Around the age of 3–4 years, children can answer questions about who does and who does not know an observable fact. For example, they are able state that someone who observed an object being put in a box will know what is in the box whereas someone who did not observe that placement will not know what is in the box (Pillow, 1989; Pratt & Bryant, 1990). There is a good deal of evidence showing that children pass such tests of knowledge versus ignorance before they pass standard false belief tasks (Wellman & Liu, 2004). Indeed, this particular task ordering is stable across quite different cultures. It has been found among children growing up in the US, Australia, China and Iran even if the age at which children pass a test of knowledge versus ignorance shows some variation across those cultures (Shahaeian, Nielsen, Peterson, Aboutalebi, & Slaughter, 2014; Wellman, 2014).

Studies of children's spontaneous utterances have also been used as evidence for a similar timetable. In their influential book, *Children talk about the*

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mind, Bartsch and Wellman (1995) found that *know* was the most frequently produced cognitive verb among English-speaking children. Nevertheless, they concluded that references to cognitive states – including references to *know* – flourish only from 3 years of age upward, consistent with the broader claim that children's conception of knowledge and belief, and especially their insight into the difference between true knowledge and false belief, is quite slow to develop.

However, there are various findings that are difficult to reconcile with this relatively slow developmental timetable. First, in a pioneering study, O'Neill (1996) examined young children's sensitivity to the knowledge versus ignorance of an interlocutor. She found that 2½-year-olds produced more acts of communication for their mother about the location of a desirable but out-of-reach toy (e.g., pointing at the toy, naming the toy, stating its location) if she had not witnessed the toy's placement on a high shelf. By implication, the toddlers realized that if their mother had been absent during the toy's placement, she would be ignorant of its whereabouts. Hence, they sought to communicate that information to her.

Reviewing various studies with even younger children, Harris and Lane (2013) concluded that some sensitivity to an interlocutor's ignorance appears to be present in the second year of life. For example, when 12- and 18-month-olds observed an adult searching for an object, expressing puzzlement at its loss, and eventually asking where it was, both age groups tended to respond by pointing to the location of the missing object. Indeed, they often pointed to the object before the adult had explicitly asked about its location (Liszkowski, Carpenter, Striano, & Tomasello, 2006). A follow-up study showed that an interlocutor's ignorance – rather than their expression of puzzlement – led toddlers to provide information via pointing. Twelve-month-olds observed an adult sorting through a variety of objects but from time to time an object would slide onto the floor. If the adult saw this happen and then expressed puzzlement – as if wondering how it had slid to the floor – infants rarely pointed to it. On the other hand, if the adult did not see the object slide to the floor and then expressed puzzlement – as if wondering where it had disappeared – infants were likely to point to the missing object (Liszkowski, Carpenter, & Tomasello, 2008).

Taken together, these various findings highlight an important developmental mystery. If toddlers have some insight into the difference between knowledge and ignorance, arguably at 12 months, why are they so slow to talk about *knowing* and *not knowing* and slow to respond systematically to experimental tests of knowledge versus ignorance? One possible explanation is that the insights displayed by toddlers are only tacit or implicit – unlike the more explicit understanding that can be identified among 3- and 4-year-olds given their talk about *knowing*. However, in the next section, we argue that such an explanation cannot be the whole story because, in fact, 2-year-olds also talk quite cogently about *knowing* and *not knowing*.

A new look at children's spontaneous utterances

Harris, Yang and Cui (in press), conducted an analysis of the spontaneous utterances of two English-speaking children, Adam, an African-American child of middle class parents, and Sarah, a European-American child of working class parents. The utterances of both children were retrieved from the CHILDES database (MacWhinney & Snow, 1985). For each child, utterances were analyzed from 27 months, the age at which recordings began, until their third birthday. In addition, the utterances of a Mandarin-speaking child, Qiānqian (芊芊), a Han Chinese child of middle class academic parents, were analyzed. Qiānqian's mother (a linguist) had recorded her utterances between 16 and 39 months. The utterances of all three children were recorded when they were at home with a familiar caregiver. None was obviously precocious or delayed in their language development.

Between the ages of 27 and 36 months, Adam and Sarah produced a total of 103 and 56 references respectively to *know*. Over a longer window of 16–39 months (reflecting the start and end of the recording process), Qiānqian produced a total of 43 references to the Mandarin equivalent of *know* (*zhi1dao4*). Like *know that* in English, *zhi1dao4* is an epistemic verb that is used in the context of factual knowledge. For all three children, most of these references were truly spontaneous in the sense that only a modest percentage, between 10 and 30%, depending on the individual child, were repetitions, whether exact or partial, of what the child's interlocutor had just said. Two features of each utterance were coded: (i) whose knowledge the child was talking about – their own knowledge, their interlocutor's knowledge, or the knowledge of a third party; and (ii) the pragmatic function of each utterance – notably, whether it was used to make an affirmation of knowledge (e.g., 'I already know that'), to issue a denial of knowledge (e.g., 'I don't know') or to ask a question about knowledge (e.g., 'Don't you know that?').

References to a third party (such as a sibling, an absent parent, or a pet) were surprisingly rare. The large majority of children's utterances – around 80% – focused on their own knowledge or that of their interlocutor. Accordingly, in a further analysis, the frequency with which children produced an affirmation, a denial, or a question regarding their own knowledge as compared to that of their interlocutor was calculated. A clear pattern emerged. All three children produced references to know that sometimes affirmed their own knowledge (e.g., 'I already know that') and sometimes affirmed the knowledge of their interlocutor (e.g., 'You know that'). Denials and questions were more asymmetric. Children often denied their own knowledge (e.g., 'I don't know') but almost never denied the knowledge of their interlocutor (e.g., 'You don't know that'). Conversely, they often asked a question about their interlocutor's knowledge (e.g., 'Do you know that?') Whereas they never asked a question about their own knowledge (e.g., 'Do I know that?')

Table 1. Details of eight children from the *CHILDES* database.

Child	Corpus	# of *knows*	# of utterances	*Know* utterances per 10,000	Age range (months)
Laura	Braunwald	40	10,534	38	18–36
Lily	Providence	116	17,999	64	18–36
Naima	Providence	83	18,107	46	18–36
Naomi	Sachs	47	12,221	38	18–35
Peter	Bloom	92	21,033	44	21–34
Ross	MacWhinney	43	6327	68	18–36
Violet	Providence	24	6679	36	18–35
William	Providence	20	9799	20	18–36

This asymmetry was quite robust – it emerged in the two English-speaking children, despite their different family backgrounds, and also across two quite different languages – English and Mandarin. However, given the tiny sample, it was difficult to conduct any statistical analysis of the findings. Accordingly, in a follow-up study, Bartz (2016) analyzed the utterances of an additional eight English-speaking children from the CHILDES corpus. These children were chosen because they had transcripts for most of the appropriate age range (notably 18–36 months) and like Adam, Sarah and Qiānqian had been recorded interacting with their families at home. Table 1 provides the name of each child, the name of the corpus from which the child's files were retrieved, the number of utterances that included the word *know*, the number of recorded utterances in the child's files, the number of utterances that included the word *know* per 10,000 utterances, and the age range over which files were retrieved and analyzed.

Using the same coding system as before, Bartz asked whether these eight children displayed a comparable pattern of asymmetry with respect to denials and questions. The findings were very clear. Six of the eight children produced denials of their own knowledge but none of their interlocutor's knowledge; the remaining two children produced frequent denials of their own knowledge but very few of their interlocutor's knowledge. Conversely, seven of the eight children produced questions about their interlocutor's knowledge but none about their own knowledge; and the remaining child produced more questions about their interlocutor's knowledge than about their own. In summary, all eight children displayed a double asymmetry: all of their denials or the majority of their denials of knowledge targeted the self rather than the interlocutor. By contrast, all of their questions or the majority of their questions about knowledge targeted the interlocutor. Granted that the likelihood of a single child displaying this double asymmetry is 1 in 4, the likelihood of all eight children displaying this double asymmetry by chance is exceedingly small ($p < .000015$).

How should we interpret this asymmetry? It might be quite specific or it might be relatively wide-ranging. Thus, it might be a pattern that is restricted to the verb *to know*. Alternatively, it might be part of a larger pattern associated

with the production of a variety of mental state verbs. Thus, whether they are talking about feeling, seeing, thinking, wanting, or knowing, children might produce more denials about the self ('I don't feel/see/think/want/know …') than about their interlocutor ('You don't feel/see/think/want/know …'). Conversely, they might produce more questions about their interlocutor ('Do you feel/see/think/want/know …') than about the self ('Do I feel/see/think/want/know …'). Yet a third possibility is that the asymmetry is part of a still larger pattern, one that holds for the production of any type of verb. For example, children might show the same asymmetry even when they are talking about the actions of eating, hitting, or pulling – more denials about the self as compared to their interlocutor and more questions about their interlocutor as compared to the self.

Our hunch – and it remains a very tentative hunch at the moment – is that the asymmetry probably extends beyond *know* but is likely to be restricted to mental state verbs. Our intuition is that the asymmetry reflects a deep-seated difference between children's access to the mental states of the self as compared to the mental states of another person, including an interlocutor. More specifically, it is plausible that children have privileged access not just to what they know, but also to what they feel, see, think or want so that self-directed questions about their own mental states are otiose. Conversely, they have no such privileged access to what their interlocutor feels, knows, sees, thinks or wants, so that denials are typically inappropriate. By contrast, in the case of many action verbs, particularly those with a relatively constricted and predictable set of motor movements, any impact of privileged access to the self is likely to be much less potent. For example, even if children have privileged access to their own goals and intentions, they can easily observe the relatively distinct motor actions of eating, hitting, and pulling whether they are carried out by the self or by another person (Huttenlocher, Smiley, & Charney, 1983).

Some theorists have maintained that children deploy the same theory of mind whether they are conceptualizing the mental states of the self or the mental states of another person. In particular, advocates of the theory–theory position have maintained that children's understanding of the mind proceeds in the same way and at the same pace whether the mental states in question belong to self or to another person (Gopnik, 1993). By contrast, advocates of simulation theory have emphasized that children have privileged access to some of their mental sates so that the course of development is likely to display asymmetries between self and other (Harris, 1993). The intense research focus on children's understanding of false belief – a mental state for which no privileged access exists (i.e., we have conscious access only to those of our current beliefs that we take to be true) dampened interest in the potential impact of privileged access. Greater attention to young children's emerging understanding of knowledge versus ignorance, and to asymmetries between self and other, is likely to likely re-activate interest in that issue.

An experimental study of professed ignorance

The findings discussed so far were derived exclusively from analyses of naturalistic language data. In a recent study, Bartz, Rowe, and Harris (2016) devised an experimental investigation of the early expression of ignorance. Children ranging from 16 to 37 months were shown a sequence of pictures. The pictures depicted two types of entity: easy-to-name entities and hard-to-name entities – see Figure 1 for an example of each type.

The task for the children was simple – when each object was displayed on the screen they were asked by the experimenter to say what it was called. Faced with hard-to-name items, children often produced a word error (a name that was

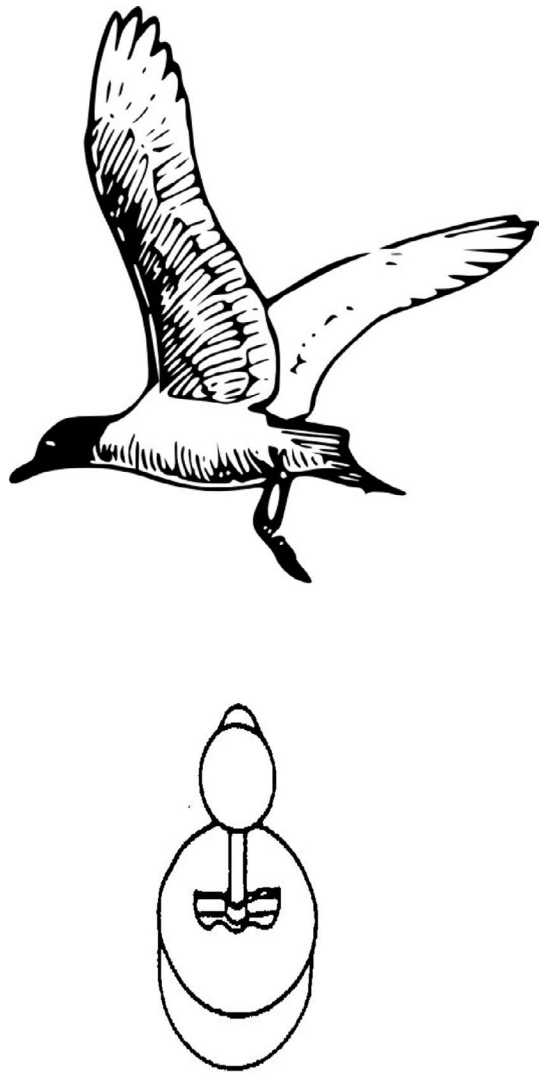

Figure 1. An easy-to-name object and a hard-to-name object.

incorrect) or invented unintelligible words (e.g., 'a starda') something that they did much less often for the easy-to-name items. In addition to such errors, however, children also expressed their ignorance of the hard-to-name items either via implicit responses (e.g., asking an adult for help, and/or producing a filled pause, such as 'um' or 'ah') or via an explicit denial of knowledge ('I don't know'). These expressions of ignorance were rarely produced for easy-to-name items.

Thus, in their second and third year, children may not be able to pass standard experimental tests of the relationship between knowledge and perception but they do begin to express their own ignorance, through vocalization or gesture and sometimes through explicit denial. In future research, we plan to look more systematically at the scope and development of such early expressions of ignorance. We anticipate that toddlers will initially convey their ignorance via vocalizations and non-verbal gestures whereas older children – 2-year-olds – will increasingly supplement or replace such tacit responses with explicit denials of knowledge.

To sum up the argument so far, the standard conclusion that has emerged from research on children's developing theory of mind is that children acquire some conception of knowledge and ignorance around 3–4 years of age. However, analysis of children's naturalistic language as well as their responses gathered under experimental conditions reveals a working conception of knowledge and ignorance among 2-year-olds. Moreover, 2-year-olds talk explicitly but differently about their own knowledge as compared to that of an interlocutor.

Asking questions

When we ask an information-seeking question, two conditions are normally present: we are aware of some gap in our own knowledge but we also entertain the possibility that our interlocutor may not share that state of ignorance and could supply the missing information. The preceding section provides encouraging evidence that 2-year-olds are able to meet both of these conditions. Recall that the spontaneous language data showed that they often assert their own ignorance but rarely that of an interlocutor. Conversely, they acknowledge, via their questions about an interlocutor's knowledge, the possibility that he or she may know a given piece of information. At what point do children begin to capitalize on this perceived difference between self and interlocutor by asking information-seeking questions?

Inspired by the research of Chouinard (2007), we examined the emergence of such questions in Adam, Sarah and Qiānqian. We first identified all the questions in each child's corpus and then classified each question into one of three broad categories: information-seeking, interaction-seeking, or indeterminate. We classified a question as information-seeking if its apparent goal was the elicitation of a piece of information from an interlocutor, for example, information about object identity (e.g., 'What's that?'), location (e.g., 'Where are my scissors?'), about

ongoing activities (e.g., 'What is the kitten doing?') and so forth. We classified a question as interaction-seeking if its apparent goal was to seek a particular form of interaction or social response from the interlocutor, such as help (e.g., 'Can you fix this for me?') or permission (e.g., 'Can I go outside?'). Third, there were a few questions that could not be firmly assigned to either of these two broad categories; these were assigned to the residual category of indeterminate. Three key results emerged (Harris, 2015). First, all three children posed both information- and interaction-seeking questions throughout the age period under study. Second, as children got older, the ratio shifted in favor of information-seeking questions. Third, all three children displayed a predominance of information- over interaction-seeking questions by approximately 30 months of age.

This pattern of development fits well with the conclusions reached in the previous section. In the course of the third year, children talk explicitly about their own ignorance and query the knowledge of their interlocutor. Alongside this metacognitive talk, children increasingly use conversation to extend their knowledge; they pose information-seeking questions to their interlocutor. It is plausible that these two developmental trends are connected. For example, we can imagine that, by virtue of asking information-seeking questions, children become increasingly cognizant of, and articulate about, who does or does not know a given piece of information. On this view, children's questions would drive their metacognitive talk. However, the opposite causal influence is also feasible. Children who are metacognitively aware, as reflected in their explicit talk about knowledge and ignorance, might, as a result of that awareness, be better equipped to pose information-seeking questions. In particular, children who are aware of their own ignorance but alert to the possibility that their interlocutor may know what they do not may be especially prone to ask questions.

A third possibility is that both developmental trends are driven by a fundamental shift in the nature of early communication. Recent longitudinal work has shown that the period from 18 to 42 months is characterized by a sharp increase in the proportion of decontextualized parental talk that is removed from the here and now, i.e., narrative talk, explanatory talk and pretend-based talk. At 18 months, such decontextualized talk amounts to a tiny percentage – just over 2% – of all parental input to the child. In the course of the next 24 months, that percentage is more than quadrupled to reach 9% at 42 months (Rowe, 2012).

When the topic of conversation is displaced from the here and now, the discrepancy between parent and child in knowledge pertinent to that topic is likely to be magnified. After all, when the ongoing topic of conversation is visible to both parent and child, they can, within limits, communicate in terms of an overlapping knowledge base concerning what they concurrently observe. However, in the case of decontextualized conversations about events that are distant in time and space, such as a past birthday celebration, an upcoming visit to the zoo, or a story about a protagonist's fictional adventure, the parent will probably be able to draw on a much richer knowledge base about the

topic, especially if it is one that the parent introduced or elaborates upon. The resultant discrepancy between the knowledge base of the parent and the child is likely to set the scene for greater metacognitive awareness by the child of such discrepancies and to boost the number of information-seeking questions that the child poses.

In sum, future research based on the longitudinal study of parent-child conversations, should throw more light on potential links between three concurrent changes that straddle the third year: (i) the considerable increase in parents' decontextualized utterances; (ii) the emergence of children's explicit metacognitive remarks about self and interlocutor; and (iii) the rise in the proportion of children's questions that are aimed at obtaining information from an interlocutor rather than securing a given type of social interaction.

Doubt and empirical corroboration

Recent research on the role of testimony in children's cognitive development has often focused on the way that children learn from other people, especially in domains, such as history and religion, where it is difficult for children to carry out any empirical checks on what they are told (Harris & Koenig, 2006). For example, when they are told about historical epochs such as the Roman Empire or about someone going to Heaven after they die, it is not obvious that children can carry out any kind of first-hand, empirical investigation to verify – or disprove – what they have been told. At best, by asking questions, they can seek out additional testimony, building on what they have already learnt (Harris, 2000). Nevertheless, a considerable body of evidence has shown that children are ready to trust what they are told in these various domains (Harris, 2012). Indeed, children display considerable trust in what they are told even when the claims that they are presented with run counter to their pre-existing intuitions (Lane & Harris, 2014).

However, there are some contexts in which children can check counter-intuitive claims – not by gathering further testimony but by active observation or experimentation. For example, in the domain of science it may be possible for children to check on unexpected claims. With some adult scaffolding, they can observe for themselves whether water expands when it becomes ice, whether spawn turns into tadpoles, and whether wet raffia will burn. Indeed, some educators have argued that children learn best from such hands-on investigation of their own uncertainties (Isaacs, 1930).

We have begun to examine whether children seize such opportunities or acquiesce to what they are told even when it is unexpected and open to empirical confirmation (Ronfard & Harris, 2016). In an initial study, the experimenter showed children ranging from 3 to 6 years three wooden dolls, all of the same shape but different in size, and asked: 'Which one do you think is the heaviest?' All but two of the 72 children (97%) pointed to the biggest doll. In other

words, almost all the children shared the plausible intuition that weight could be inferred from size. However, in the next stage of the experiment, the experimenter contradicted this intuition: he told children that the largest doll was actually the lightest and that the smallest doll was the heaviest. In fact, his claim was false: the biggest doll was indeed the heaviest and the smallest doll was indeed the lightest. In other words, the weight of the dolls was consistent with what almost all children had inferred even if they could not know this.

Following this unexpected testimony, children were again questioned to see how far they would accept – at least overtly – what they had been told. Thus, the experimenter re-posed his earlier question about which doll was the heaviest. He then left for a brief period (45 s) during which a confederate, who appeared to be busy reading a newspaper, discreetly monitored whether the children investigated the dolls. When the experimenter returned, children had an opportunity to challenge him – on the strength of what they had discovered in his absence. Such challenges were not explicitly invited but the experimenter did give children a chance to voice any doubts they may have had: 'We're done! Is there anything you want to tell me before we go back to the classroom?'

How did children respond to the experimenter's counter-intuitive assertion and did they take the opportunity to conduct an empirical check? On being re-questioned about the weight of the dolls, the majority of the children initially agreed, either fully or partially, with the experimenter's claim that the smallest doll was the heaviest. Moreover, only a minority subsequently took the opportunity to verify that claim by examining the dolls during his absence? Thus, just over a quarter (i.e., 18 of the 70 children who had expressed the intuition that biggest = heaviest) checked the weight of the biggest and lightest dolls by lifting each of them – with this pattern being more common among older children. The remaining children either failed to touch any of the dolls or examined only one. When the experimenter returned, the majority of the children who had conducted an empirical check on the two dolls told the experimenter that the biggest doll was the heaviest – contradicting what he had told them before his departure. By contrast, most of the children who had not conducted an empirical check said nothing to the experimenter about the dolls.

This study was exploratory. We cannot be certain that children picked up the biggest and smallest dolls in order to check the experimenter's unexpected claim – although that seems very likely given the tenor of their remarks on his return. In addition, we do not yet know what distinguishes the empirically oriented children from those who are more acquiescent. Nevertheless, the study confirms that some children in this age range, especially older children, do not accept an adult's counter-intuitive claim. Granted an opportunity to check that claim via hands-on investigation, they take advantage of it and they report on what they have observed. We plan further studies to figure out what prompts some children to check a counter-intuitive claim and others to acquiesce.

Conclusions and implications

Young children have been classically described as egocentric. Especially in the domain of knowledge, they are said to assume that other people will know what they know themselves. The findings reviewed in this paper offer a radically different picture. Even in the second year of life, toddlers display some appreciation – as indexed by the helpful information that they offer to a puzzled adult – that other people may not know what they know. In addition, 2-year-olds comment explicitly on what they do not know but display little indication of projecting that same ignorance onto others. Instead, their information-seeking questions suggest that they readily entertain the possibility that others may know what they do not. Overall, these findings imply that young children have a keen sensitivity to the fact that people differ in what they know and appreciate ways in which such differences can be remedied via communication and the answering of questions. In short, far from being egocentric, children seem well equipped to take their place within a community of knowers. Much less clear at this point is the extent to which children are disposed to act as autonomous experimenters who check on dubious claims. Some children do conduct an empirical investigation but many accept what they are told without demur.

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