PAPER

Two-year-olds are vigilant of others' non-verbal cues to credibility

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Abstract

Data from three experiments provide the first evidence that children, at least as young as age two, are vigilant of others' non-verbal cues to credibility, and flexibly use these cues to facilitate learning. Experiment 1 revealed that 2- and 3-year-olds prefer to learn about objects from someone who appears, through non-verbal cues, to be confident in performing actions on those objects than from someone who appears uncertain when performing actions on those objects. Experiment 2 revealed that when 2-year-olds observe only one model perform a single action, either confidently or unconfidently, they do not use the model's level of confidence in this single instance to influence their learning. Experiment 3 revealed that 2-year-olds will use a single model's level of confidence to guide their learning if they have observed that the model has a history of being either consistently confident or consistently uncertain. These findings reveal that young children selectively alter their learning based on others' non-verbal cues of credibility, and underscore the importance of an early sensitivity to socio-cognitive cues for human learning and development.

Introduction

Humans acquire a wealth of information from others. This 'social transmission' or 'social learning' is not the only route to knowledge acquisition – one can learn through direct observation, logical reasoning, or trial and error. Yet when it comes to learning many aspects of science, language, history, culture, religion and social relations, often the only option is to rely on others. Indeed, precise imitation of others, imitating the *means* with which an action is performed as opposed to simply emulating the *outcome*, appears specific to humans (Whiten, Horner, Litchfield & Marshall-Pescini, 2004; Tomasello, 1999) and has been argued to be integral to the development of complex human culture (Tomasello, 1999; Meltzoff, 1988; Williamson & Markman, 2006).

Unfortunately, people are fallible: they sometimes act irrationally, perform actions unintentionally, lie and mislead, and convey information even when uncertain about its veracity. Thus, social learning poses unique challenges, and necessitates different skills or learning mechanisms from those required for first-hand learning. Efficient social learning requires being selective in what one chooses to accept. But how do young children sift through all the information available to decide what to learn and what not to learn?

Recent research has shown that young children play a more active role in social learning than previously thought; they will selectively imitate others' actions depending on the apparent rationality of those actions given the situational constraints (Gergely, Bekkering & Kiraly, 2002). Children also selectively imitate others' actions that appear intentional over those that appear accidental (Carpenter, Akhtar & Tomasello, 1998). Still, many human actions are rational and intentional, but not credible. Thus, efficient learning requires *credibility vigilance*. This entails an awareness (even if only tacit) that others may not always be credible, vigilance of potential cues to another's credibility, and the ability to use these cues to facilitate learning.

Fortunately, there are multiple cues that can help learners distinguish between seemingly credible information and information that may be questionable. For instance, one cue a learner can use to determine if someone possesses relevant knowledge is whether that person has had *access* to the target information. A wealth of research has demonstrated that even 3- and 4-year-olds understand various 'information access' cues, such as that looking can lead to knowing (e.g. Pillow, 1989; Pratt & Bryant, 1990), although not surprisingly this understanding becomes more nuanced and sophisticated with age (O'Neill & Chong, 2001; Robinson, 2000).

Even 2-year-olds have at least a rudimentary appreciation of the relationship between knowledge and experience (e.g. Bloom, 2000; O'Neill, 1996; Perner, 1991). At this age they may not understand the nature of the relationship between knowledge and experience at an explicit level, recognize the causal

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nature of this relationship, or understand what *type* of experience is necessary for different kinds of knowledge (e.g. that *seeing* an object, rather than feeling or smelling it, is necessary to know its colour), but they have at least detected the correlation between knowledge and experience. For instance, 2-year-olds provide more communicative gestures about the location of a toy if their mother was absent when the toy was moved than if she was present when it was moved. Children's greater tendency to reference the toy's new location indicates some appreciation that mother's absence made her unable (or less likely) to know this information (O'Neill, 1996).

Two-year-olds' proper name learning also indicates an early appreciation of the relationship between knowledge and experience. In a study by Birch and Bloom (2002), children heard a proper name such as 'Jessie', or a common noun such as 'the dog' used ambiguously in the presence of two potential referents: one was a stuffed animal with whom the speaker was familiar and the other was one she claimed to have seen for the first time. Children as young as two applied the proper name, but not the common noun, to the individual with whom the speaker was familiar. These findings suggest that young children appreciate (in some way) that one cannot know the proper name of an individual with whom one has had no prior experience. More generally, it shows that children at this age can make use of at least some cues indicating what the speaker can and cannot know and capitalize on those cues to foster learning.

Research with slightly older children has also revealed that children take advantage of several types of verbal cues to credibility when learning. For instance, 3- and 4-year-old children prefer to learn new words from those who have demonstrated a history of accuracy in word labelling over those who have a history of mislabelling words (Birch, Vauthier & Bloom, 2008; Koenig, Clement & Harris, 2004; Koenig & Harris, 2005; Jaswal & Neely, 2006; Scofield & Behrend, 2008). In addition, preschool children are sensitive to others' explicit verbal markers of their knowledge or certainty (Jaswal & Malone, 2007; Moore & Davidge, 1989). For instance, Sabbagh and Baldwin (2001) demonstrated that preschool children prefer to learn words from someone who offers explicit verbal markers of his knowledge and certainty (e.g. 'I know just which one's her blicket') rather than from someone who offers verbal markers of his ignorance (e.g. 'I don't know what a blicket is').

Compared to the relative wealth of research that has examined children's sensitivity to verbal cues of knowledge and certainty, there has been little research examining children's sensitivity to *non-verbal* cues of knowledge and certainty. This is somewhat surprising, considering how much information is communicated non-verbally, even in brief demonstrations (or 'thin slices') of behaviour (see Ambady & Rosenthal, 1992,

for a review), not to mention its availability to children long before they master verbal language.

The present research expands upon previous literature by addressing whether young children will show selective learning when the cues of their social partners' credibility are presented non-verbally. Are young children sensitive to others' non-verbal cues of confidence or uncertainty when learning new information? Experiment 1 examined whether young children, when faced with two individuals displaying different levels of confidence via non-verbal cues, will prefer to learn from the individual who appears most confident. Experiments 2 and 3 further examined the role of non-verbal cues of confidence in early learning by presenting children with the more common learning situation of being faced with only one potential individual from whom to learn.

Experiment 1

Method

Participants

Thirty-two children (16 males) from middle-class families participated: 16 2-year-olds (M = 32 months; range = 27 to 35 months) and 16 3-year-olds (M = 42 months; range = 37 to 47 months).

Materials and design

The stimuli included two Introductory Videos, six sets of novel objects, and a series of six Test Videos. The Introductory Videos each showed an adult female 'model' standing alone, facing forwards, and waving. One video introduced Jane; a second introduced Courtney.

Each Test Video (mean length = 20 seconds) illustrated a novel task that could be accomplished using one of two objects. One model, the 'Confident Model', performed the task using one object while portraying confidence through non-verbal cues. The non-verbal cues included facial expressions of recognition with the novel objects, upright posture with shoulders back and chin high, and a range of other facial and bodily cues of confidence produced spontaneously by the model (e.g. arm crossing and facial expressions of satisfaction upon completing the action). That is, we simply told the models to act as if they were knowledgeable or ignorant of how to use the objects, rather than specifying the types of nonverbal cues they should use to do so. In contrast, the 'Uncertain Model' selected the opposite object while portraying uncertainty through non-verbal cues. The non-verbal cues included puzzled facial expressions, shoulder shrugging, occasional head tilting, and a range of other facial and bodily cues of uncertainty

produced spontaneously by the model (e.g. the hesitancy with which the model selected the object).

The model who served as the Confident Model, the model who performed the action first, and the object the Confident Model used were counterbalanced across children. The pairs of objects for each task were selected to be equally interesting and equally capable of performing the tasks. The order of the Test Videos was held constant for all subjects. Each model appeared for half the time, and the two models never appeared at the same time. Children watched these videos from a child-sized chair in front of a wall-mounted computer monitor at their eye level.

Procedure

Children were tested individually. Each child was shown a picture of the models side by side and told, 'This is Jane and Courtney. Jane is wearing a brown shirt and Courtney is wearing a black shirt'. The child was then shown the Introductory Videos of Courtney and Jane waving and was encouraged to wave back. At this point the experimenter showed the child the objects that would appear in the next video, stating, 'Look what I have! Jane and Courtney have the same things. One of these is [for making these balls move]. Let's watch and see what [Courtney] does...'. The first half of the video was then played followed by the experimenter saying, 'Now let's watch and see what [Jane] does...', and the second half of the video was played. Immediately following each Test Video the experimenter asked the child to show her what to do (e.g. 'Can you show me how you make the balls move?'). The child's selection was recorded and this procedure repeated for the remaining trials. After the final trial children were asked, 'Who do you think is smarter, who knows more?'

Results and discussion

The dependent measure was the number of trials in which the children selected the object chosen by the Confident Model. These were converted to percentages for ease of interpretation. A 2 (Age) × 2 (Gender) × 2 (Model Order) ANOVA revealed no significant main effects or interactions (all ps > .10), and thus the data were collapsed across these variables.

A single-samples t-test revealed that children preferred to learn from the Confident Model more often than chance ($M = 63\%$, $SD = 26\%$), t (31) = 2.871, $p < .05$, $d = .51$. Moreover, when asked who they thought was smarter, or who knew more, a significant majority ($M = 69\%$) indicated the model who was the most confident, t (31) = 2.252, $p < .05$.

These results demonstrate that children as young as age 2 are sensitive to others' non-verbal cues of confidence and prefer to learn about objects from others who appear confident in their actions on those objects than from those who appear uncertain.

In this experiment, however, children had a choice to learn *either* from someone who appeared confident *or* from someone who appeared uncertain. In everyday life, children will not typically have the luxury of choosing between two sources of information at any one time. Instead, children are typically offered information from one individual and either accept or reject that information. Thus, we wondered what children would do if they were only provided with information from a single informant who was uncertain, in comparison to children who were provided with information from a single informant who was confident. Will children still use the model's non-verbal cues to be selective in what they learn, even if they do not have the choice to learn from a different informant?

Experiment 2

Method

Participants

Thirty-two 2-year-olds (17 males; $M = 31$ months, range = 26 to 35 months) from middle-class families participated.

Materials and design

The stimuli included two Introductory Videos and two Test Videos. The Introductory Videos each showed an adult female model standing alone, facing forwards, and waving. One video introduced Cherie; a second introduced Emily. Critically, the Test Videos (Length = 11 seconds) only presented the Confident *or* the Uncertain Model. That is, half of the children observed a single Test Video in which a model intentionally used her forehead to turn on a tabletop push-light while displaying non-verbal cues of confidence; the remaining children observed a single Test Video in which a model intentionally used her forehead to turn on a tabletop push-light while displaying non-verbal cues of uncertainty.

Procedure

Children were introduced to the models in the same manner as in Experiment 1. The child then observed the Test Video of *either* the Confident *or* the Uncertain Model intentionally using her forehead to turn on the light. The light was then placed in front of the child, and the experimenter asked, 'Can you show me what you do with this?' Children's first action on the light was coded.

Results and discussion

When given the opportunity to interact with the light, all children successfully turned on the light. Most children

(75%) chose to turn the light on with their hand rather than imitating the head action. Children were somewhat more likely to imitate the head action if they had observed the Confident Model (31%) than if they had observed the Uncertain Model (19%), although this comparison was not significantly different, $\chi^2(1, 32) = .667$, $p = .414$.

It is unclear from these results whether 2-year-olds are relatively indiscriminate in learning from confident versus uncertain models when only one potential 'informant' is available, or whether they require more evidence of the model's credibility than that provided in a single 11-second instance. Experiment 3 tested this latter possibility by establishing that the model also had an *enduring history* of being either confident or uncertain across an array of novel tasks – undoubtedly a better cue to one's credibility. Here, 2-year-olds observed pairs of videos in which one model portrayed non-verbal cues of confidence when acting upon or labelling novel objects and the other portrayed non-verbal cues of uncertainty when acting upon or labelling novel objects. The children had no way of knowing whether the model's actions and labels were *actually* correct because all objects and labels were novel; rather, the model's history of repeatedly being either confident or uncertain could serve as a proxy for, or cue to, one's credibility. The children then observed the test video from Experiment 2 in which the model, who was *either* the previously confident *or* the previously uncertain model, used her forehead to turn on a push-light.

Experiment 3

Method

Participants

Thirty-two 2-year-olds (16 males; $M = 30$ months, range = 25 to 36 months) from middle-class families participated.

Materials and design

The stimuli included two Introductory Videos, six 'History Videos' and two Test Videos. The Introductory Videos each showed an adult female model standing alone, facing forwards, and waving. One video introduced Cherie; a second introduced Emily. The History Videos (Mean length = 16 seconds) each depicted a Confident Model and an Uncertain Model appearing for half of the time. Three History Videos (i.e. Action Videos) illustrated a novel tool that could be used in one of two ways. One model, the Confident Model, used the tool to perform Action A; the 'Uncertain Model' used the tool to perform Action B. Three History Videos (i.e. Labelling Videos) illustrated a novel object that was given a different label by each model. The Confident Model gave the novel label (e.g. 'bappy') to Object A using confident non-verbal cues (e.g. She said, 'Oh, a bappy! That's a bappy!', with a

confident vocal intonation accompanying her other non-verbal cues of confidence). In contrast, the Uncertain Model provided the same label to the other novel object (Object B) using the same wording but with non-verbal cues of uncertainty (e.g. She said, 'Oh…a bappy? That's a…bappy?', with a questioning vocal intonation and decreased rate of speech accompanying her other non-verbal cues of uncertainty). Each child received all six History Videos, counterbalanced such that half of the children received the Action Videos first and the remainder received the Labelling Videos first. The model who served as the Confident Model, the model who appeared first, and the objects the Confident Model chose during the History Phase were counterbalanced across children.

Critically, the Test Videos (Length = 11 seconds) only presented the Confident *or* the Uncertain Model, as in Experiment 2. Here, the model intentionally used her forehead to turn on a tabletop push-light while displaying non-verbal cues of confidence or uncertainty, respectively.

Procedure

The experiment was divided into two phases: the 'History Phase' and the 'Test Phase'. During the History Phase, children were introduced to the models and the objects that would appear in the videos in the same manner as in Experiment 1 (e.g. 'Look what I have! Emily and Cherie have the same things! Let's see what [Cherie] does…Now, let's see what [Emily] does.').

The child then observed the Test Video of *either* the Confident *or* the Uncertain Model intentionally using her forehead to turn on the light. The light was then placed before the child and the experimenter asked, 'Can you show me what you do with this?'.

Results and discussion

When given the opportunity to interact with the light, most children (60%) chose to turn the light on with their hand rather than imitating the head action. However, whether they chose to use their hand or to imitate the means the model used (i.e. using her forehead) varied significantly by the confidence of the model. Fifty-six per cent of those who witnessed the Confident Model imitated her head action, whereas only 13% of those who witnessed the Uncertain Model imitated this action, $\chi^2(1, 32) = 6.788$, $p < .01$. See Figure 1.

All but two children successfully turned on the light: one of the children used her head after witnessing the Confident Model and the other used her hand after witnessing the Unconfident Model, but both of these children failed to press sufficiently hard to trigger the light. Regardless of whether their attempts were successful, children's *first* action on the light was recorded. Only two children followed their first action with a second action. In both cases, the child's first action was to use their head and their second action was to use their hand. One of these
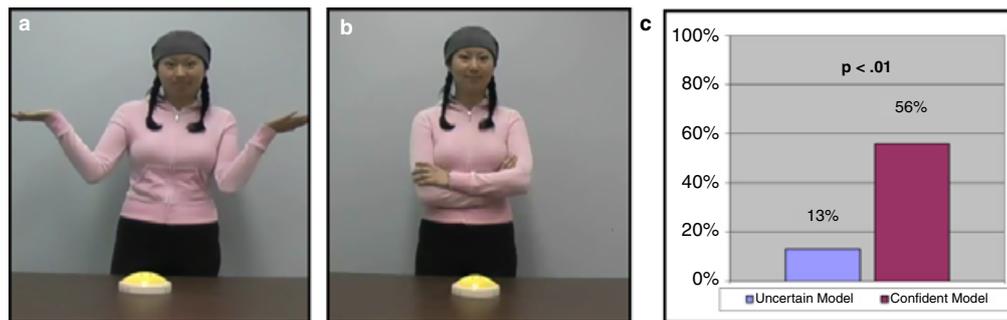
Figure 1 *Comparison of the percentage of 2-year-olds in Experiment 3 who imitated the means the model used to turn on the light (i.e. using her forehead) when the model was (a) uncertain (n = 16) versus when the model was (b) confident (n = 16). (a) and (b) are representative still shots taken from the test videos after the model had used her head to turn on the light.*

children was the child mentioned above who failed to trigger the light by pressing it with her head (she followed this failed attempt with a second touch using her hand). Even if these two children are excluded from the sample (because, unlike the others, they performed both head and hand actions), the finding that more children imitated the head action if they witnessed the Confident Model still holds, $\chi^2(1, 30) = 5.000$, $p < .05$.

These findings seemingly contrast with the non-significant findings from Experiment 2; however, it is not entirely clear what to make of such apparent differences. How much of this difference arises from the role of the additional information regarding the model's history (i.e. that the model was not only confident/unconfident about how to turn on the light but similarly confident/unconfident about the labels and uses of other novel objects)? It might be tempting, for instance, to surmise that this additional information about the model's history led to the more robust effects found in Experiment 3 because the additional information allowed the children to make a more stable, possibly even trait-like, attribution of knowledge or credibility. Tempting as it might be, however, we are not prepared to make this claim for a number of reasons. First, there is the obvious reason: to avoid drawing too many inferences from null results. Although not significant, the findings from Experiment 2 trend in the same direction as those of Experiment 3, and it may be the case that the additional information about the model's level of confidence simply made the children themselves a bit more confident in disregarding the actions of the unconfident model. That is, perhaps almost any additional information about the models (e.g. even just one more instance of her uncertainty) and not necessarily an enduring and always consistent history of uncertainty would have sufficed to produce the differential imitative behaviour seen by the participants in Experiment 3.

Second, and perhaps more interestingly, the addition of the History Phase in Experiment 3 provided the children with an opportunity to see the target model *in contrast* to a second model. The presence of this second model during the history phase may have made the target model's level of confidence more salient because they could compare and contrast the target model's confidence (or lack thereof) with that of the

other model. Another way of thinking about the possible effects of the presence of the second model in the History Phase of Experiment 3 is that these children (who witnessed the unconfident model turn on the light with her head) knew that a more confident, and potentially more credible, source to learn from existed 'out there in the world' (i.e. they saw such a person during the History Phase). In contrast, those children in Experiment 2 who witnessed the unconfident model turn on the light with her head could not be sure that they would ever encounter anyone more knowledgeable about the appropriate way to turn on the light.

A final reason we are reluctant to make too much of the seemingly different findings from Experiments 2 and 3 is that they are not significantly different from one another. A direct comparison of the data from Experiments 2 and 3 informs us that, despite the results of Experiment 2 being non-significant and those of Experiment 3 being significant, there actually is not any statistical significance between the findings of Experiments 2 and 3 (Fisher's exact $p = .603$, *ns*). Thus, all we are prepared to say at this point about the collective findings of Experiments 2 and 3 is that, minimally, these results indicate that 2-year-olds are vigilant of others' non-verbal cues of confidence and are more wary of information provided by someone who appears uncertain and has a history of being uncertain than they are of that provided by someone who appears confident and has a history of being confident. Importantly, this wariness of information from an uncertain source is present not only when they have the option of imitating the actions of a seemingly more credible source (as in Experiment 1) but also even if they are not provided with an alternative means from a more credible source.[1]

General discussion

Social transmission is one of the primary means through which humans learn. Thus, the awareness that others

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[1] Note, of course, that you might posit that the children themselves are 'the more credible source', but this is still importantly different from the 'two external sources' paradigm used in Experiment 1.

may not always provide credible information, the capacity to assess the potential credibility of others, and the vigilance to monitor these cues when learning from others are vital to early learning. Findings from this research suggest that such credibility vigilance is present early in development, at least by age two.

These findings provide the first evidence that young children will selectively alter what they learn from others based on others' non-verbal cues of credibility. When given a choice to learn about novel objects either from someone who displayed non-verbal cues of being confident or from someone who displayed non-verbal cues of being uncertain, 2- and 3-year-olds preferred to learn from the person who appeared more confident (Experiment 1). When they were not given a choice, and instead were faced with *only* one person who displayed cues of either confidence or uncertainty, children who witnessed a model perform an action in a confident manner were not significantly more likely to imitate her action than those who witnessed a model perform the action in an uncertain manner (Experiment 2). However, when the models were shown to have an enduring history of being confident (or not) across several tasks, children were significantly more likely to imitate the actions of the confident model (Experiment 3).

Given the naturally confounded relationship between non-verbal cues of confidence and non-verbal cues of affect, one must consider the possibility that purely affective differences between the models could be driving, or at least contributing to, these effects. We acknowledge this possibility, noting that mental states of uncertainty and lack of confidence are *by their very nature* more unpleasant than states of certainty and confidence. It is possible, then, that the children are picking up on these affective cues and preferring to imitate the models who appear to be having more fun, or that they are having an affective reaction (e.g. 'affective contagion') to the models' affective states. Although we recognize this as a possibility, we believe that the children are using the model's non-verbal cues to make inferences about the model's potential credibility. One reason to favour this account stems from children's responses to the question, 'Who do you think is smarter, who knows more?'. If children were simply responding to their own affective contagion from the models, or merely imitating the model who appeared to be having more fun, one would expect their responses to this question to be at chance. Nonetheless, it may be interesting to consider whether the natural correlation between affect and confidence could facilitate the learning of the socio-cognitive significance of these cues.

The findings from the current research expand upon a host of new findings in child development revealing that 3- and 4-year-olds are sensitive to their social partner's history of credibility and use it to facilitate learning (Birch *et al.*, 2008; Koenig, *et al.*, 2004; Koenig & Harris, 2005; Jaswal & Neely, 2006; Jaswal & Malone, 2007; Scofield & Behrend, 2008). For example, in these earlier studies, preschoolers were shown to prefer to learn new words from someone with a history of correctly labelling common objects over someone with a history of incorrectly labelling those objects. The current findings expand upon this work by showing that children's sensitivity to another's credibility is not limited to cues from the verbal domain. It appears that children as young as two are sensitive to non-verbal cues that may signal whether someone is a potentially credible source. Thus, even before children have mastered verbal language, they use non-verbal cues of credibility to facilitate learning.

One interesting avenue for future research is whether children are equally attentive to, and influenced by, cues to confidence as they are to cues to *a lack* of confidence. That is, it may be that the cues to confidence are largely superfluous because children may assume that people are confident and credible unless they are given evidence to the contrary (e.g. cues of a lack of confidence). An analogous possibility was raised in response to the findings reported above showing that preschoolers prefer to learn from previously accurate labellers over previously inaccurate labellers (e.g. Corriveau, Meints & Harris, 2009). Recent research suggests that younger children may be more attuned to cues indicating a lack of accuracy, whereas older children seem sensitive to both positive and negative evidence of accuracy. Corriveau *et al.* (2009) presented 3- and 4-year-olds with a choice to learn from either a previously inaccurate informant or a neutral informant (i.e. one for which prior accuracy information was not provided) as well as with a choice to learn from either a previously accurate informant or a neutral informant. In the inaccurate-vs.-neutral condition, both age groups were likely to learn from the neutral informant and did so to the same extent. In contrast, in the accurate-vs.-neutral condition, only the 4-year-olds were selective, showing greater preference to learn from the accurate informant. Future research could examine children's differential sensitivity to cues of confidence versus uncertainty by similarly including a neutral model for comparison.

Overall, the present results indicate that 2-year-olds are vigilant of others' non-verbal cues of credibility and can use these cues to facilitate learning. When given a choice between two sources of information they prefer to learn from a source who shows non-verbal cues of confidence, rather than from a source who shows non-verbal cues of uncertainty. They also appear to monitor a source's track record of confidence or uncertainty and to use it to facilitate learning even if only one source is available. That is, they are wary of information provided by someone who has consistently shown non-verbal cues of uncertainty across different tasks even when a more credible source of information is not currently available. Rather than imitating the means with which a consistently uncertain model performed an action, they were more likely to resort to their own means (i.e. using their hands). This tendency to resort to their own means

was much more likely after observing a consistently uncertain model than after observing a consistently confident model.

We believe that the presence of this credibility vigilance early in development is advantageous for novice learners because it can prevent them from learning inaccurate information (or at least decrease the robustness of what is learned) and thereby increase the efficiency of their learning. Thus, in addition to cues about the intentionality and rationality of their social partners' actions, young children can also capitalize on cues about their social partners' potential credibility to facilitate learning. Vigilance of others' non-verbal cues of credibility may be especially fruitful to young learners because such cues are readily available to children before they master verbal language, and thus may provide one of the earliest toeholds to their understanding of the minds of others. In sum, the current results show that young children at least tacitly appreciate that socially transmitted information can be fallible and that others' non-verbal behaviour can be a useful signal of what to learn and what not to learn. Thus, such early credibility vigilance plays an important role in the social and cultural transmission of knowledge.

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