

Research Report

The Curse of Knowledge in Reasoning About False Beliefs

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ABSTRACT—*Assessing what other people know and believe is critical for accurately understanding human action. Young children find it difficult to reason about false beliefs (i.e., beliefs that conflict with reality). The source of this difficulty is a matter of considerable debate. Here we show that if sensitive-enough measures are used, adults show deficits in a false-belief task similar to one used with young children. In particular, we show a curse-of-knowledge bias in false-belief reasoning. That is, adults' own knowledge of an event's outcome can compromise their ability to reason about another person's beliefs about that event. We also found that adults' perception of the plausibility of an event mediates the extent of this bias. These findings shed light on the factors involved in false-belief reasoning and are discussed in light of their implications for both adults' and children's social cognition.*

Reasoning about what other people believe is often essential for predicting and interpreting human action. A wealth of research has investigated children's appreciation that the mind can misrepresent reality—that is, their appreciation that people can hold false beliefs. Most research on children's false-belief reasoning has utilized some variant of the *displacement task* (e.g., Baron-Cohen, Leslie, & Frith, 1985; Wimmer & Perner, 1983). For example, subjects are told a story about Sally, who puts her candy in a box and leaves the room. In her absence, another character moves the candy to a basket. When Sally returns, where will she look for her candy? The right answer, that she will look in the box, requires attributing a false belief to Sally. Four-year-olds tend to do fairly well at such tasks, but younger children tend to fail (see Wellman, Cross, & Watson's, 2001, meta-analysis). Younger children tend to answer in accord with their own knowledge, saying that Sally will think the candy is in the basket.

The source of children's difficulty is a matter of considerable debate. Some researchers interpret children's difficulties on these tasks as reflecting a conceptual deficit: Perhaps young children lack a concept of belief or a concept of mental representation more generally (e.g., Gopnik, 1993; Perner, Leekam, & Wimmer, 1987; Wellman, 1990; Wellman et al., 2001). An alternative view is that young children's problems are due to more general cognitive factors such as memory and processing limitations, and thus not necessarily indicative of a conceptual limitation (e.g., Fodor, 1992; German & Leslie, 2000; Leslie, 1987; Onishi & Baillargeon, 2005; Roth & Leslie, 1998; Zaitchik, 1990; for a discussion, see Bloom & German, 2000).

According to one version of this alternative, children have the same bias in perspective taking as adults, only to a greater extent. In earlier work (Birch & Bloom, 2003), we showed that 3- and 4-year-olds are more susceptible than 5-year-olds to a cognitive bias found in adults, the *curse of knowledge* (see also Bernstein, Atance, Loftus, & Meltzoff, 2004; Pohl & Haracic, 2005). We adopted this term from Camerer, Loewenstein, and Weber (1989) and use it to refer to the tendency to be biased by one's own current knowledge state when trying to appreciate a more naive perspective, whether that more naive perspective is one's own earlier perspective (as in the hindsight bias) or someone else's perspective (see Birch & Bernstein, 2007, for a discussion).

We proposed (Birch & Bloom, 2003) that the exaggeration of the bias in younger children may partially account for why younger children experience greater difficulty than older children on false-belief tasks (see also Birch, 2005; Birch & Bloom, 2004). If this is correct, then one might expect adults to also experience problems in false-belief reasoning if sensitive-enough measures were used. The logic mimics that of Diamond and Kirkham (2005), who showed that when sensitive measures are used, even adults have difficulty on a problem (the dimensional-change card-sort task) that is particularly difficult for children. We should emphasize, however, that such a finding of adult difficulty in the domain of false-belief reasoning would not prove the conceptual-deficit account false. It is possible, for instance, that children's problems are due to both an exaggerated curse-of-knowledge bias and conceptual limitations.

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There is a well-established literature on this bias in social and cognitive psychology, spurred by the work of Fischhoff (1975) and, more recently, by a growing body of literature linking this bias to children's theory-of-mind deficits (e.g., Bernstein et al., 2004; Keysar, Lin, & Barr, 2003; Royzman, Cassidy, & Baron, 2003). However, it has not yet been tested whether this bias can interfere with false-belief reasoning. The primary goal of the present study was to test whether adults, who undoubtedly do not have a conceptual deficit in belief reasoning, find reasoning about false beliefs harder when they have specific knowledge about the outcome. To test this, we gave adults a displacement task that differed from the standard task in three important ways. First, we used a more sensitive measure than the categorical response that is typically obtained with children. Subjects were asked to report the *probability* that the protagonist would look in each of the containers when she returned. Second, we used four containers, instead of two, so we could manipulate the subjects' knowledge of the outcome. Either subjects were told that the target object (a violin) was moved to a specific container (i.e., the *knowledge* conditions) or they were told that the violin was moved to another container but were not told which one (i.e., the *ignorance* condition).

Third, the containers were rearranged following displacement to allow us to manipulate the plausibility that the protagonist would look in each of the containers. This manipulation was included because our second objective was to determine how the perceived plausibility of the protagonist's actions (from the subject's perspective) might influence false-belief reasoning. Previous research has demonstrated that plausibility can mediate the magnitude of the curse of knowledge (see Pohl, 1998; see also Pezzo, 2003, for a discussion of the mediating role of surprise). For instance, adults are more biased by their outcome knowledge when the outcome is brought about because of a plausibly foreseeable reason than when the outcome occurs because of a less foreseeable reason. For example, Wasserman, Lempert, and Hastie (1990) told some subjects that the British-Gurka war was won by the British because of the superior discipline of the British troops (i.e., plausibly foreseeable), but told other subjects that a sudden unseasonal rainstorm led to the British victory (i.e., less foreseeable). The magnitude of the bias (i.e., subjects' estimates of the probability they would have assigned to the outcome had they not known the British won) was greater in the plausibly foreseeable condition. To the best of our knowledge, no one has systematically explored the influence of plausibility in false-belief reasoning.

In the present experiment, we manipulated the perceived plausibility of the outcome as follows: In the *knowledge-plausible* condition, subjects were told that the violin was moved to a different container that, following rearrangement, was in the same physical location as the violin had been originally; thus, it would be reasonable to assume that the character might look there by mistake. In the *knowledge-improbable* condition, subjects were told that the violin was moved to a different

container that, following rearrangement, was in a different location than where the violin had been originally. We predicted that the curse of knowledge would be stronger for adults if they could conceive of a plausible rationale for their biased response than if they could not.

EXPERIMENT

Method

Subjects

One hundred fifty-five students (69 male, 82 female, 4 unspecified) enrolled in an introductory psychology course at Yale University in New Haven, CT, participated. Subjects completed the single-page questionnaire as part of a larger packet of questionnaires.

Materials and Procedure

Subjects were randomly assigned to one of three conditions: ignorance, knowledge-plausible, and knowledge-improbable. All subjects received the same stimuli—a color version of Figure 1 (without the color-word labels). The first picture depicted a girl who was holding a violin and standing by a sofa and four containers. Each container was a different color: blue, purple, red, and green. Beneath the first picture was an image of a different girl holding a violin; in this picture, the same four containers were rearranged.

Subjects in all conditions read, "This is Vicki. She finishes playing her violin and puts it in the blue container. Then she goes outside to play. While Vicki is outside playing, her sister, Denise . . ." At this point, the conditions differed:

Ignorance: "moves the violin to another container."

Knowledge-plausible: "moves the violin to the red container."

Knowledge-improbable: "moves the violin to the purple container."

All subjects then read, "Then, Denise rearranges the containers in the room until the room looks like the picture below." This was followed by, "When Vicki returns, she wants to play her violin. What are the chances Vicki will first look for her violin in each of the above containers? Write your answers in percentages in the spaces provided under each container."

Results

In the ignorance condition, subjects gave a mean probability rating of 71% to the blue container, where Vicki originally placed the violin, and a mean probability rating of 23% to the red container, the container that, after the boxes were moved, occupied the location that the blue container had originally occupied. They gave the other two containers a combined probability rating of 5%. That is, as we suspected, subjects who did not know the final location of the violin believed it was relatively plausible (23%) that Vicki would first look in the red container, which occupied the location of the original container,

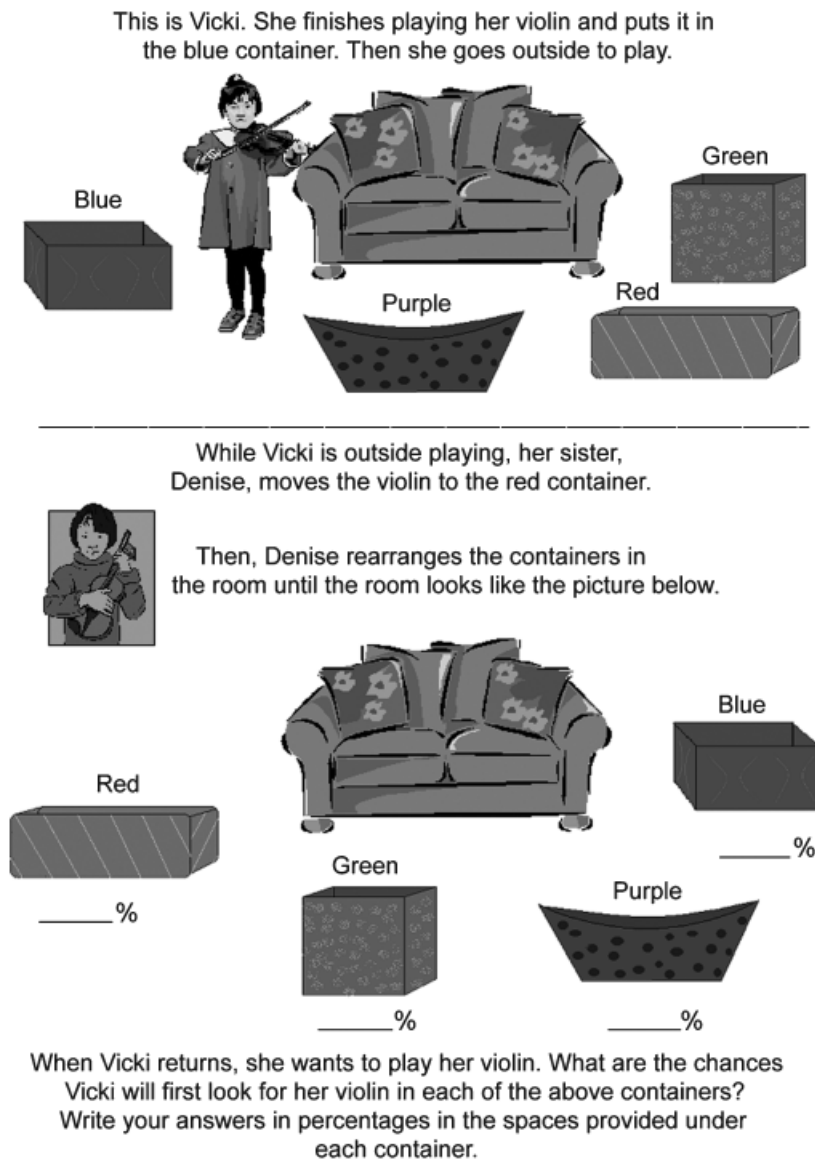


Fig. 1. The knowledge-plausible version of the task.

and believed it was relatively implausible (2%) that Vicki would first look in the purple container. Hence, our plausibility manipulation appears valid.

Subjects in the knowledge-plausible condition, who were told that the violin was moved to the red container, which was in a location where Vicki might plausibly look, assigned significantly higher probabilities to the red container than did subjects in the ignorance condition, $t(105) = -2.42, p_{\text{rep}} = .95, d = 0.472$. Furthermore, subjects in the knowledge-plausible condition assigned significantly lower probabilities to the blue container than did subjects in the ignorance condition, $t(105) = 2.35, p_{\text{rep}} = .95, d = 0.459$. That is, their own knowledge of the location of the violin influenced their predictions of whether Vicki would behave in accord with a false belief. They knew that Vicki was absent when the violin was moved to the red container and hence should not know this information, yet their judgments

of the probability that she would look in the red container were significantly higher than the judgments of adults who did not possess specific knowledge of the violin's location. Similarly, their judgments of the probability that she would act according to a false belief were significantly lower than those of adults in the ignorance condition.

Yet knowledge of the outcome per se did not appear to be the sole biasing factor. In the knowledge-implausible condition, subjects knew that the violin was moved to the purple container, but the purple container was an improbable container for Vicki to look in first. Probability judgments that Vicki would look in that container were not significantly higher in this condition than in the ignorance condition, $t(97) = -1.44, p_{\text{rep}} = .95, n.s.$ Moreover, probability judgments that Vicki would act on a false belief were not reduced in the knowledge-implausible condition. In other words, subjects reported similar probabilities for the

TABLE 1
Mean Probability Judgments That Vicki Will Look in Each of the Containers

Container	Condition		
	Ignorance	Knowledge-plausible	Knowledge-implausible
Blue (where the violin was originally)	71% (26%)	59% (27%)	73% (29%)
Red (occupies the location where the violin was originally)	23% (22%)	34% (25%)	19% (21%)
Purple (occupies a location different from where the violin was originally)	2% (5%)	3% (5%)	6% (16%)
Green (occupies a location different from where the violin was originally)	3% (7%)	4% (7%)	3% (5%)

Note. Standard deviations are given in parentheses.

blue container in the knowledge-implausible and ignorance conditions, $t(97) = -0.21$, $p_{\text{rep}} = .95$, n.s. (See Table 1 for a summary of subjects' probability judgments in all three conditions.)

Thus, at least in this task, knowledge was a curse for adults only when they had available a potential explanation for why Vicki might act in accord with their knowledge (instead of her false belief). Note that the potential explanation that subjects could use to justify assigning a higher probability to the red container and a lower probability to the blue container (i.e., that the violin was in the same physical location as it had been originally) was true in all conditions. Thus, it was the subjects' knowledge that the violin was moved to the red container that led to biased responses. Perhaps adults will succumb to the curse of knowledge only when there is a *seemingly* justifiable reason to support such a biased response, or, to put it differently, perhaps knowledge is a curse unless the outcome seems sufficiently *implausible*.

DISCUSSION

Our findings demonstrate that an adult's own knowledge can compromise his or her ability to reason about other people's false beliefs and to make predictions about their actions. Subjects who knew the specific outcome of the displacement event and had available a plausible explanation for Vicki to act in accord with their knowledge were significantly less likely to predict that Vicki would act according to a false belief than were subjects who did not know the specific outcome. Subjects who knew the specific outcome of the displacement event and had available a plausible explanation for Vicki to act in accord with their knowledge were also significantly less likely to predict that Vicki would act according to a false belief than were those who knew the outcome but did not have available a plausible explanation for Vicki to act in accord with their knowledge.

These findings have implications for the study of both adult social cognition and cognitive development. For adults, our findings suggest that knowledge becomes a more potent curse when it can be combined with a rationale (even if only an implicit one) for inflating one's estimates of what others know. We manipulated the plausibility of the protagonist's actions, but this is likely only one of a number of ways subjects may fall prey to

the tandem effects of the curse of knowledge and the presence of an excuse to support their bias.

As for children, given that the curse of knowledge appears to be stronger earlier in development (e.g., Birch & Bloom, 2003; Pohl & Haracic, 2005), it follows that younger children's performance on false-belief tasks would be more compromised than older children's and adults' performance. Note also that although we tested adults' curse-of-knowledge bias only in a displacement task (one of the tasks most commonly used to assess children's false-belief reasoning), the same logic can apply to a number of difficulties in mental-state reasoning when the subject has specific knowledge, such as the difficulties young children experience in unexpected-contents tasks (e.g., Perner et al., 1987), appearance-reality tasks (e.g., Gopnik & Astington, 1988), and source-of-information tasks (e.g., Taylor, Esbensen, & Bennett, 1994). Our findings suggest that allowing children to remain ignorant of the specific outcome of the events in these tasks or manipulating the plausibility of the various outcomes in these tasks could help advance understanding of children's developing theory of mind. If younger children have a less sophisticated understanding of what is, and is not, plausible than older children and adults do, or simply fail to consider the plausibility of the outcome at all, then this may contribute to their greater susceptibility to the curse of knowledge and exacerbate their difficulties with mental-state reasoning. Indeed, young children are often noted to be more gullible and accepting of certain impossibilities, such as those presented in magic tricks, than older children and adults are.

The findings from the present study do not preclude a hybrid account of 3-year-olds' difficulty with false-belief reasoning. It is possible that young children's difficulty on standard false-belief tasks stems from both an exaggerated curse-of-knowledge bias and conceptual limitations. Our findings do show, however, that the curse of knowledge can interfere with false-belief reasoning even in adults, who are less susceptible to the bias and who do not have a conceptual deficit in belief reasoning. In sum, one's own knowledge can be a curse when reasoning about beliefs that differ from one's own. For children, greater susceptibility to this curse may lead to more blatant errors in mental-state attribution, but knowledge can contaminate even adults' ability to reason about other people's actions and beliefs.

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