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Knowledge Attributions and Behavioral Predictions

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Abstract

Recent work has shown that knowledge attributions affect how people think others should behave, more so than belief attributions do. This paper reports two experiments providing evidence that (a) knowledge attributions also affect behavioral predictions more strongly than belief attributions do, and (b) knowledge attributions facilitate faster behavioral predictions than belief attributions do. Thus, knowledge attributions play multiple critical roles in social cognition, guiding judgments about how people *should* and *will* behave.

Keywords: Social cognition; Knowledge; Belief; Prediction; Theory of mind

1. Introduction

Knowledge attributions affect how we think others should behave. For instance, suppose that the water at Metro Beach was recently tested and declared unsafe for swimming. Anyone entering the beach encounters a garish sign warning that the water is unsafe. But the health department botched the test and, as a matter of fact, the water is perfectly safe for swimming. Alicia is at Metro Beach with her children. She examines the water and concludes that it is safe for swimming. Should Alicia allow her children to go swimming? Researchers found that people's response to this question depends on whether Alicia "knows," "thinks," or "is certain" of her conclusion. When she "thinks" or "is certain," people disagreed that she should allow her children to go swimming. But when she "knows," people tended to agree (Turri, Friedman, & Keefner, 2016; see also Turri, 2016a). Relatedly, knowledge attributions strongly influence which decisions we think others should make and which beliefs they should form (Turri, 2015a). Another series of studies showed that knowledge attributions affect who we think should be trusted. For instance, if one person "knows" that an object of interest is in the red box, whereas another person "thinks" the object is in

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the blue box, people are more likely to look in the red box (Furrow & Moore, 1990; Moore, Pure, & Furrow, 1990). Researchers have also found that when someone is judged knowledgeable about an outcome, it increases people's willingness to hold him responsible for negative outcomes (Schroeder & Linder, 1976; Yuill & Perner, 1988). Finally, researchers have found that knowledge attributions are a uniquely powerful indicator of when we think other people should make an assertion, which is an indispensable tool for sharing information and coordinating behavior (Turri, 2015b,c, 2016b).

But do knowledge attributions affect how we think others will behave? A dominant perspective in cognitive science is that belief attributions, not knowledge attributions, play this role in social cognition. "Accurately predicting what others will do is mediated by our understanding that their actions are driven," researchers write, "by what they think and believe" (Southgate & Vernetti, 2014, p. 1). Another team of researchers remarks, "The concept BELIEF ... together with the concept DESIRE plays a key role in interpreting and predicting behavior" (Leslie, German, & Polizzi, 2005, p. 46; see also Perner & Roessler, 2012, p. 521; Rakoczy, 2009, p. 648; Wellman, 1990, p. 10). We predict, for example, that Donald will take his umbrella because we attribute to him the belief that it will rain and the desire to stay dry. With the desire and belief in place, action is predicted; there is nothing left for knowledge to do.

The present research tests the potential role of knowledge attributions in predicting behavior. In the first experiment, people read a brief text about an agent and then made a belief attribution, knowledge attribution, and behavioral prediction. Knowledge attributions predicted behavioral predictions more strongly than belief attributions did. In the second experiment, people read brief texts that attributed either knowledge or belief to an agent. Then they predicted the agent's behavior as quickly as they could. I collected reaction-time data for these behavioral predictions. Behavioral predictions were reliably faster following a knowledge attribution rather than a belief attribution.

Taken together, the results from these two experiments make a novel contribution to our understanding of human social cognition. In particular, they demonstrate an important and previously undocumented role for knowledge attributions in predicting behavior. The experiments accomplish this in two importantly different ways. On the one hand, the connection is demonstrated when people themselves make the knowledge attributions, which are then used to predict their behavioral predictions (Experiment 1). On the other hand, the connection is demonstrated when people are given information about knowledge, which then facilitates faster behavioral predictions (Experiment 2).

2. Experiment 1

2.1. Method

2.1.1. Participants

Four hundred and three participants were tested (aged 18–70, M_{age} = 31 years; 150 female; 96% reporting English as a native language). Participants were U.S. residents, recruited and tested online using Amazon Mechanical Turk (AMT) and Qualtrics, and compensated $0.40 for approximately 2 min of their time. Repeat participation was prevented (by AMT worker ID). The number of participants per condition (=50) was determined in advance based on previous work on knowledge attributions and behavioral evaluations, which included 25–50 participants per condition (see Turri, 2015b,c).

2.1.2. Materials and procedure

Participants were randomly assigned to one of eight conditions in a 2 (informational access: not accessed, accessed) × 4 (information type: vision, hearing, evidence, clues) between-subjects design. The purpose of the information-access factor was to create variance in the dependent measures, the expectation being that scores would be lower when the information had not been accessed. I had no expectations for the information-type factor and included it mainly to determine whether a similar pattern emerged across a range of different informational sources. All participants read a simple story, responded to three test statements, then completed a brief demographic questionnaire.

The basic story was about an agent (Laurie) who is tracking someone (Josh). The conditions differed in whether the agent accessed information (informational access) and which sort of information it was (information type). A supplemental file contains the complete text of all stories. Here is the story for the vision condition (informational access manipulation bracketed):

> Laurie is tracking Josh. On a crowded city street, Josh quickly turns into an alley and enters apartment 16E. Laurie's view of the alley is completely [blocked/clear]. The next moment, Laurie's partner calls and asks her, "Where is Josh staying?"
>
> Beneath the story were three test statements in a question matrix:
>
> Laurie will say that Josh is in apartment 16E. ("behavioral prediction")
>
> Laurie thinks that Josh is in apartment 16E. ("belief attribution")
>
> Laurie knows that Josh is in apartment 16E. ("knowledge attribution")

Responses were collected on a standard 7-point Likert scale, 1 "strongly disagree"-7 "strongly agree," left-to-right on the participant's screen. The order of test statements was randomized. Participants then advanced to a new screen and completed a demographic questionnaire.

2.2. Results

A supplemental file contains descriptive statistics for the dependent measures in all the conditions. I conducted a preliminary analysis of variance with behavioral predictions as the dependent variable, informational access as a fixed factor, belief attributions and knowledge attributions as covariates, and information type as a random factor. The analysis revealed that behavioral predictions were unaffected by information type, $F < 1$, so I omitted that factor from the subsequent regression analysis. Multiple linear regression revealed that knowledge attributions were the strongest predictor of behavioral predictions (see Table 1). For the regression analysis, I entered behavioral predictions as the outcome variable and access type (reference class: not accessed), belief attributions, and knowledge attributions as predictor variables. The model explained over 80% of the variance in behavioral predictions ($R^2 = .808$).

2.3. Discussion

The results from this experiment demonstrate that, at least in some ordinary contexts, knowledge attributions guide behavioral predictions in human social cognition. Knowledge attributions were more predictive than belief attributions.

3. Experiment 2

3.1. Method

3.1.1. Participants

Eighty participants were recruited and tested online using AMT and Qualtrics. Seventy-eight completed the experiment (aged 18–61, $M_{age} = 35$; 24 female; 95% reporting English as a native language). Participants were compensated $4.00 for approximately 24 min of their time. Repeat participation was prevented.

3.1.2. Materials and procedure

Participants first completed a lexical decision task to familiarize them with giving speeded responses (see the supplemental file for further information on the lexical decision task and analyses). Participants then performed a narrative evaluation task. This task began with six warmup trials (order randomized), followed by 32 experimental and 30 filler trials (order randomized). A trial started with participants reading a brief text about a situation. After participants read and understood the text, they pressed the spacebar to

Table 1
Multiple linear regressions predicting behavioral predictions[a]

Predictor	B	$SE(B)$	β	t	p
Access	0.447	.135	0.100	3.31	.001
Belief attribution	0.363	.034	0.357	10.83	<.001
Knowledge attribution	0.529	.034	0.532	15.34	<.001
Constant	0.294	.115		2.56	.011

Note. [a]$F(3, 399) = 558.81$, $p < .001$, $R^2 = .808$. Reference class for access: not accessed.

proceed. The next screen contained a partial sentence (horizontally centered) missing its final word, which remained on the screen for 3,000 ms. Next a fixation cross (horizontally centered) appeared for 1,500 ms, followed immediately by a word (horizontally centered) that completed the sentence. The task was to decide ("as quickly as you can") whether the completed sentence accurately described the situation. Participants pressed the f-key to answer "no" and the j-key to answer "yes." The next trial started immediately after the response.

The experimental trials took the form of a 2 (State: thinks, knows) × 2 (Fit: incongruent, congruent) within-subjects design. The state factor manipulated whether the agent in the story "thinks" or "knows" a certain proposition. The sentence that participants evaluated on experimental trials was always a behavioral prediction. The fit factor manipulated whether the prediction was congruent or incongruent with the attributed mental state's content. If it was congruent, the correct response to the prediction was "yes," whereas if it was incongruent, the correct response was "no." Here is an example illustrating all four treatments for a single scenario:

(Text) A woman is driving to her destination. An intersection is coming up.

The woman [thinks/knows] that her destination is to the south.

(Prediction) The woman will turn [south/north].

A supplemental file includes all stimuli used in this experiment.

3.2. Results

Apparently, two participants reversed the response keys (9% and 18% correct) and four others answered randomly (56%, 51%, 51%, and 44% correct). I removed data from these participants. Thus, the analyses below included 72 participants.

I analyzed error rates and RTs from the experimental trials with 2 × 2 repeated measure analyses of variance. Each analysis used State (think, know) and Fit (incongruent, congruent) as within-subjects factors.

Beginning with error rates, there were no main effects (*p*s ≥ .607), but there was an interaction effect, $F(1, 71) = 7.36$, $p = .008$, $\eta_p^2 = .094$. Follow up paired-samples *t* tests revealed that when the fit was incongruent, accuracy was non-significantly lower on "think" trials ($M = 96.00\%$, $SD = 7.21$) than on "know" trials ($M = 97.49\%$, $SD = 6.61$), $t(71) = -1.46$, $p = .148$. In contrast, when the fit was congruent, accuracy was higher on "think" trials ($M = 97.71\%$, $SD = 5.32$) than on "know" trials ($M = 95.49\%$, $SD = 7.05$), $t(71) = 2.30$, $p = .024$, $MD = 2.23$ [0.30, 4.16], $d = 0.27$.

Moving on to RTs, all erroneous responses (3.26% of the data), responses less than 300 ms (<0.1% of the data), and, to correct for a positive skew in the overall dataset, responses greater than 4,000 ms (0.69% of the data) were eliminated for this analysis. There was a main effect of State, $F(1, 71) = 8.51$, $p = .005$ $\eta_p^2 = .102$, with RTs faster on "know" trials. There was a main effect of Fit, $F(1, 71) = 19.15$, $p < .001$, $\eta_p^2 = .212$, with RTs faster on congruent trials. There was no interaction, $F(1, 71) = 0.15$, $p = .700$, n.s.[1] Overall, mean RT on "know" trials was 57 ms faster than on "think" trials (915 ms compared to 972 ms), $t(71) = -2.92$, $p = .005$, $d = 0.37$.

3.3. Discussion

The results from this experiment provide evidence that, at least for some simple predictive tasks, knowledge attributions facilitate faster behavioral predictions than belief attributions do. People more rapidly predicted an agent's behavior when they were told that the agent knows a relevant proposition than when they were told that the agent believes the same proposition (within-subjects).

4. General discussion

The results from two experiments advance our understanding of social cognition. While previous research has demonstrated a unique role for knowledge attributions in evaluating how people should behave, the present findings demonstrate a role for predicting how people will behave. This was accomplished in two different ways. Experiment 1 provided evidence that knowledge attributions sometimes guide behavioral predictions, and that they do so more reliably than belief attributions. When participants were allowed to make judgments about what an agent knows, believes, and will do, the knowledge judgments more strongly predicted behavioral predictions than belief attributions did. Experiment 2 provided evidence that knowledge attributions facilitate faster behavioral predictions than belief attributions do. Taken together, these findings demonstrate an important connection between knowledge attributions and behavioral predictions.

A possible criticism of these findings is that the experiments were confounded by the relative complexity of the mental state attributions. For instance, it might be suggested that belief comes in degrees, whereas knowledge does not. So participants told that an agent believes something need to decide how strongly the agent believes it before predicting his behavior; in contrast, participants told that an agent knows something do not need to decide how strongly the agent knows it before predicting his behavior. Overall, this could make belief attributions slower and less reliable than knowledge attributions for predicting behavior. In response, first, it is not clear why this is a criticism rather than a possible explanation. If belief attributions are more complex, slower, and less reliable for predicting behavior, then that would naturally lead people to rely, by default, on knowledge attributions instead. Second, the criticism falsely assumes that knowledge does not come in degrees. One can know things better or worse and this is reflected in ordinary speech, which includes graded and comparative knowledge attributions. For instance, people rate as highly felicitous statements such as "Samantha knows better than Nicole that a circle's diameter is twice as long as its radius" (Myers, under review).

A possible explanation of the present findings builds on recent discoveries about primate social cognition. (I emphasize that this hypothesis is speculative.) Based on a series of findings over the past 15 years, many researchers have concluded that non-human primates attribute knowledge to others and, furthermore, that they use these representations to predict others' behavior (Flombaum & Santos, 2005; Hare, Call, & Tomasello, 2001; Kaminski, Call, & Tomasello, 2008; Marticorena, Ruiz, Mukerji, Goddu, & Santos, 2011; Melis, Call, & Tomasello, 2006; Santos, Nissen, & Ferrugia, 2006; Tomasello, Call, & Hare, 2003). For instance, subordinate chimpanzees keep track of which food items dominant chimpanzees currently or recently saw. Subordinates then use this information to predict a dominant's behavior and decide which food items to retrieve. Nevertheless, primatologists contend, there is no clear evidence that non-human primates attribute beliefs to others. If this emerging consensus in primatology is on the right track, then perhaps humans retain and use elements of the older primate social-cognitive system, which relies on knowledge attributions to predict behavior.

Regardless of whether this speculative hypothesis about primate social cognition is on the right track, the present findings on knowledge attributions contribute to our understanding of human social cognition.

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Note

1. These effects were not due to outliers because I obtained a similar pattern of results when removing all RTs more than three median absolute deviations from the median response per subject (following the procedure of Leys, Ley, Klein, Bernard, & Licata, 2013): State, $F(1, 71) = 3.07$, $p = .042$, $\eta_p^2 = .041$, with responses faster on "know" trials; Fit, $F(1, 71) = 36.26$, $p < .001$, $\eta_p^2 = .338$, with responses faster on congruent trials; no interaction, $F(1, 71) = 0.01$, $p = .470$, n.s.

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Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article:

Data S1. Knowledge Attributions and Behavioral Predictions.