Knowledge and Luck…and Stereotypes?:

Examining the Influence of an Actor's Group Membership on Knowledge Attribution

Kaitlyn Larkin[1], Michael R. Andreychik[1], Sophia Weissgerber[2], Felix Kiunke[2], Hendrik Godbersen[3], Caroline Kolle[2], Anna Kulpe[2], Susana Ruiz-Fernandez[4,8], Kaitlyn M. Werner[5], Raymond Wu[6], & Erin M. Buchanan[7]

[1] Fairfield University

[2] University of Kassel

[3] FOM University of Applied Sciences, Essen, Germany

[4] Brandenburg University of Technology, Cottbus-Senftenberg, Germany

[5] University of Toronto

[6] University of British Columbia

[7] Harrisburg University of Science and Technology

[8] FOM University of Applied Sciences, Essen; Leibniz Institut für Wissensmedien, Tübingen, Germany

Author note: The authors made the following contributions. Kaitlyn Larkin: Conceptualization, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing; Michael R. Andreychik: Conceptualization, Investigation, Methodology, Project administration, Supervision, Writing - original draft, Writing - review & editing; Sophia Weissgerber: Investigation, Software, Supervision, Writing - review & editing; Felix Kiunke:

Data curation, Investigation, Software, Writing - review & editing; Hendrik Godbersen: Investigation, Writing - review & editing; Caroline Kolle: Investigation, Writing - review & editing; Anna Kulpe: Investigation, Writing - review & editing; Susana Ruiz-Fernandez: Investigation, Supervision, Writing - review & editing; Kaitlyn M. Werner: Investigation, Supervision, Writing - review & editing; Raymond Wu: Investigation, Writing - review & editing; Erin M. Buchanan: Data curation, Formal analysis, Software, Validation, Visualization, Writing - original draft, Writing - review & editing.

Correspondence concerning this article should be addressed to Michael Andreychik, E-mail: mandreychik@fairfield.edu

Abstract

According to Justified True Belief Theory, a person can be said to know something if they arrive at true beliefs for justifiable reasons. Philosophers now mostly agree, however, that this account is inadequate because it fails to capture instances in which people arrive at true beliefs for reasons that, while justifiable, are not the real reasons why the belief is true (i.e., people sometimes get lucky). But when ordinary perceivers attribute knowledge, do they really distinguish between being right for the right reasons and being right because one "just got lucky"? Thus far, empirical work on this question has been mixed. And, in focusing almost exclusively on perceivers' (lack of) sensitivity to the particular reasons underlying a person's belief, this work has not yet examined the potential impact of additional aspects of perceiver's beliefs about a protagonist on the process of knowledge attribution. In this preregistered, multi-site study, we contribute to this literature by replicating and extending the influential work of Turri et al. (2015). Our results showed that participants did attribute knowledge more readily to protagonists who were right for the right reasons than to protagonists who were right because they got lucky. Further, this tendency held regardless of the protagonist's level of expertise about the domain of knowledge in question, suggesting that logical considerations about the reasons underlying a protagonist's beliefs may override at least some category-based beliefs about the protagonist.

Keywords: Folk epistemology, Social cognition, Justified True Belief, Multilevel modeling, Multilab, Preregistration, Person perception

Knowledge and Luck…and Stereotypes?: Examining the Influence of an Actor's Group Membership on Knowledge Attribution

People are deeply interested in the contents of others' minds. We regularly seek answers to questions such as "What does she *really* believe?", "Did he mean to do that?", and "How much do they know?". The answers to these questions have profound implications for how we relate to others and navigate our social world (e.g., Malle & Nelson, 2003). In fact, this capacity to reason about the contents of others' minds is seen by many scholars as a key driver of human biological and cultural evolution (e.g., Tomasello, 1996).

Within psychology, the capacity to reason and make inferences about the contents of others' minds is often referred to as Theory of Mind. Work on Theory of Mind, both in various sub-disciplines of psychology and in related disciplines, has been extremely generative (for a review, see Wellman, 2018). But, the interest in understanding how ordinary people figure out what's going on in the minds of others is much older than work on Theory of Mind per se. Philosophers, for example, have grappled with related questions for thousands of years (e.g., Plato, 1997/380 BCE; Reid, 2002/1785; Wittgenstein, 1953).

In this paper, we focus on one specific aspect of understanding others' minds, one that has attracted the attention of psychologists and philosophers alike – how do people decide whether an individual *truly knows* something? At first glance, it might appear that such decisions are quite straightforward: If an individual makes a correct decision or otherwise acts in a correct or adaptive manner, it seems reasonable to assume they must have possessed accurate knowledge about the issue at hand. However, this may not always be the case. For example, the individual may have arrived at the correct answer because they made a lucky guess. But if every decision or action we observe has multiple plausible causes, how then do we decide whether an actor's behavior came from their knowledge of the issue at hand or from a simple (lucky) guess?

Interest in the topic of knowledge attribution has a deep history in philosophy. The most well-known and influential theory to engage with this issue is the Justified True Belief Theory (JTBT), which has its roots in early Platonic thought (e.g., Plato, 1997/280 BCE). The theory holds that there are three conditions that must be met for an actor to possess "true" knowledge. First, the actor must believe something. Second, that thing must actually be true. And third, the reasons the actor has for their belief must be logical. Notice that this third condition says only that the reasons must be *logical,* not that those reasons must be *the real reasons* for why the actor's belief is true. According to the JTBT, then, an actor should be seen as having true knowledge as long as they have logical reasons for believing that something is true, even if those reasons are not the real reasons why that thing is true.

Although a number of scholars have criticized this model of knowledge attribution, the most well-known and influential critique was put forward by Gettier (1963). Gettier argued that it does not make sense to attribute true knowledge to an actor who believes in a true thing for incorrect (although still logical) reasons, and therefore that the JTBT needed to be revised. To illustrate the problem highlighted by Gettier, consider the "Smith case" from Gettier (1963):

> Two men, Smith and Jones, have applied to the same job at the same company. Much to Smith's disappointment, the president of the company has told Smith that Jones will ultimately get the job. Smith then notices that Jones has ten coins in his pocket, coins which Smith counted himself… Smith then infers that the man who gets the job (who he assumes will be Jones) will have ten coins in his pocket… a belief that is well founded by the evidence and therefore justified. However, quite unexpectedly, Smith ends up

> getting the job! And, unbeknownst to himself, Smith coincidentally also has ten coins in his pocket…[Smith's] belief that the man who will get the job will have ten coins in his pocket still turned out to be true, just not for the reason he thought…

Here, although Smith's belief was both true and justified, Gettier argued that people would not judge Smith to have true knowledge in this case because Smith's reasons for holding his belief are not the actual reasons for why the belief is true. In cases like this, where a protagonist is right but for the wrong reasons, Gettier argued that people will fail to attribute knowledge to the protagonist. Such cases are referred to as *Gettier Cases*.

In the wake of Gettier's proposed reformulation of the JTBT, scholars undertook a number of empirical investigations of how people actually reason about Gettier cases. A particularly influential study was conducted by Turri et al. (2015). They found that when presented with a Gettier case containing a noticeable but failed threat to the truth of a belief (such as in the "Smith case" above), people still attributed knowledge to the protagonist. This result suggests that ordinary people do not reason about knowledge in the way Gettier (1963) suggested. Rather, lay people seem to attribute knowledge based only on whether a protagonist's belief is correct and based on logical reasons, even if the reasons why the protagonist holds the belief are not the real reasons for why the belief is true.

Despite the findings of Turri and colleagues (2015), however, the question of how people deal with Gettier cases remains far from settled. Some additional work appears to provide support for Gettier's arguments that people are sensitive to the correctness of the reasons underlying a protagonist's belief when deciding whether to ascribe true knowledge to the protagonist (e.g., Machery et al., 2015; Nagel et al., 2013). Other work seems to provide support for the idea that ordinary perceivers' ascription of true belief to a protagonist depends much more on whether the protagonist's belief is true rather than on the correctness of the reasons underlying that belief (e.g., Starmans & Friedman, 2012). Still other work suggests that whether perceivers attribute true knowledge in Gettier cases depends on factors such as the perceiver's culture (e.g., Weinberg et al., 2001). Add to these inconsistent results the fact that scholars have noted methodological limitations of some of these studies (e.g., underpowered study designs, less-than-ideal experimental manipulations), and a great deal of uncertainty still remains regarding how people reason about Gettier cases.

To help provide some clarity, Hall and colleagues (2023) undertook a large-scale, cross-cultural conceptual replication of Turri and colleagues (2015). In particular, Hall and colleagues (2023) looked at people's reasoning about Gettier and non-Gettier cases across three different experimental vignettes. One of the vignettes was identical to the one used in Turri et al., and two additional vignettes were created to examine the generality of Gettier intuitions across different scenarios. Overall, the findings of Hall and colleagues' supported Gettier's argument that perceivers are sensitive to the correctness of the reasons protagonists use to arrive at their beliefs. Specifically, collapsing across the vignettes, participants were nearly two times more likely to attribute true knowledge to protagonists who arrived at accurate beliefs by applying the reasons that actually made those beliefs true than to protagonists who arrived at accurate beliefs because they applied reasons that, while logical, were not the real reasons that made the beliefs true. However, the size of the difference in true knowledge attribution between the Gettier and non-Gettier conditions varied quite a bit across the three vignettes. On one hand, these results suggest that perceivers are indeed influenced by the logical "facts of the case" when deciding whether to attribute true knowledge to protagonists. On the other hand, the fact that people responded somewhat differently across the three vignettes suggests that factors other than purely logical considerations of the cases contribute to whether true knowledge is attributed to protagonists. But what are these additional factors that contribute to whether protagonists are seen as possessing true knowledge?

Protagonist Expertise

While Gettier argues that knowledge attributions are based solely on the facts of the situation (e.g., did the protagonist arrive at the right answer for the right reasons?), a wealth of research (especially in social psychology) suggests that attribution can be shaped by a variety of extra-logical factors (see Gilbert, 1998). In the present study, we focus on protagonist-relevant factors as potential contributors to knowledge attribution.

There are good reasons to expect that perceivers' beliefs about protagonists will impact their attributions of knowledge, independent of the objective behaviors that the protagonists engage in or beliefs that they hold. For example, Petty and Cacioppo's influential Elaboration Likelihood Model argues that the perceived credibility of protagonists (e.g., whether protagonists are presented as experts vs. non-experts) shapes how likely perceivers are to be persuaded by the protagonist's arguments (see Petty & Brinol, 2011, for a review). In one classic demonstration of this model, Petty, Cacioppo, and Goldman (1981) presented college student students with arguments in favor of instituting a new comprehensive exam graduation requirement at their university. They varied both the quality of the arguments presented (strong vs. weak) and the source of the arguments (expert vs. non-expert). Regardless of the quality of the arguments, participants showed significantly greater agreement with the arguments when they were made by the expert vs. the non-expert. The effect of source credibility on agreement was especially strong among participants who expected that the policy, if adopted, would not personally impact their own graduation requirements. The authors interpreted this finding as demonstrating that although perceivers always take into account the source of an argument when deciding whether to agree with the argument, they are especially likely to use source characteristics (such as perceived expertise) as a “shortcut” to making a decision when the issue is not especially relevant to them. Although they did not measure knowledge attribution per se, presumably this effect of source credibility on persuasion occurs, at least in part, because participants saw the expert source as more knowledgeable than the non-expert source.

McDonald and Ma (2015) focus more directly on the impact of protagonist factors in shaping knowledge attribution. In one study, they presented 4- and 6-year-olds with photos of two female adults and asked the children which adult they felt was more knowledgeable. The two adults were matched on race, but differed in terms of whether they were dressed formally or casually. Children saw the formally dressed individuals as significantly more knowledgeable than the casually dressed individuals. A second study showed that these knowledge attributions extended to the children’s behavioral intentions as well: Children were significantly more likely to seek out formally vs. casually dressed individuals to help them learn about novel objects and animals.

Taken as a whole, work such as Petty, Cacioppo, and Goldman (1981) and McDonald and Ma (2015) presents a challenge to Gettier’s thinking, as this work suggests that knowledge attributions can be influenced not only by the facts of the situation, but also by people’s perceptions of the protagonist.

Intuitively, this possibility seems quite sensible. Consider the Smith case. Here, Gettier argues that individuals will logically examine the facts of the case and decide that Smith does not possess true knowledge because the reasons for Smith's belief are not the actual reasons for why the belief is true. However, imagine if Smith is described as a highly educated individual, dressed professionally, who has expertise in business management. Would these characteristics lead people to attribute Smith with true knowledge, despite the fact that he was right for the wrong reasons? It seems quite plausible that they would.

The current extension of Turri et al. (2015), therefore, aims to examine the difference in knowledge attribution of Gettier cases when the protagonist is described as an expert vs. a non-expert. Building on prior research, we hypothesized that participants will be more likely to see expert protagonists as possessing knowledge than non-expert protagonists, even in Gettier Cases. Such a result would challenge the notion that knowledge attribution is based purely on a logical examination of the facts. Rather, and consistent with the work stemming from the Elaboration Likelihood Model (e.g., Petty & Cacioppo, 1986) and McDonald and Ma (2015), this result would support the idea that knowledge attribution is a multifaceted process, depending partly on the "objective" facts involved, but also on characteristics of the protagonist being evaluated.

Our primary goal in the current study is to examine the potential impact of protagonist expertise on knowledge attribution. To do this, we created six different versions of the vignette used by Turri et al. (2015). This design allowed us to first test whether participants attributed knowledge differently depending on how a protagonist arrived at their belief: when the protagonist's belief is justified and true (i.e., in the "No Threat" or knowledge condition), when the protagonist's belief is justified but true only because of luck (i.e., in the "Threat" or Gettier condition), and when the protagonist's justified belief is false (i.e., in the "No Detection" or ignorance condition). Additionally, our design allowed us to test whether knowledge attribution across the three belief conditions differed depending on whether the protagonist was presented as an expert or a non-expert.

Disclosures

Preregistration

This study was preregistered on the Open Science Framework prior to data collection (https://osf.io/pgync/registrations).

Data, Materials, and Online Resources

Study materials, de-identified raw data, de-identified data with exclusions, and analysis code and output are available on our master OSF page (https://osf.io/abqsm/).

Reporting

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study (see Simmons et al., 2011).

Ethical Approval

All contributing project teams were required to submit their local institutional ethics approval (if applicable) prior to data collection as part of their pre-registration and Collaborative Replication and Education Project review process (discussed below).

Method

Participants

The study was conducted as part of a larger replication attempt conducted by Hall and colleagues (2023), which implemented the model of the Collaborative Replications and Education Project (CREP; Grahe et al., 2014; Wagge et al., 2019). The purpose of the CREP is to provide experiential learning opportunities for psychology students while addressing the need for direct replication work in the field of psychology by using the collective power of student research projects. As part of this larger project, five research teams administered additional measures and materials to test our proposed research questions. Each student-led project team prepared a study protocol for approval by a CREP reviewer to ensure quality control. Teams could not contribute to data collection until their protocol was approved.

Among this sample, participants (n = 2106 participants) were generally female (*n* = 1234) or male (*n* = 576), with all other data on gender identity missing or marked as other. Participants were mostly White (*n* = 1554), Black (*n* = 74), Asian (*n* = 90), Southeast Asian (*n* = 48), or Latinx (*n* = 38), though participants could identify as multiple identities. The survey was completed in German (*n* = 1198), English (*n* = 907), and Turkish (*n* = 1) in Germany, Canada (*n* = 529), the United States (*n* = 377), and Turkey (*n* = 2).

Several pre-registered exclusion criteria were used in this study. Participants were excluded if they met any one of the following exclusion criteria: a) did not meet the minimum age of 18 (*n* = 296), b) marked their language skills for the language of the study as “not well at all” or “not very well” on a 1 to 5 self-assessment (*n* = 295), c) provided an answer on a suspicion check item that indicated they understood the purpose of the study (*n* = 34), d) said they had previously participated in the study (*n* = 52), or e) did not answer the attention check question about the Darrel vignette correctly (*n* = 181). A total of 492 participants were excluded, leaving 1614 for final analysis in the Knowledge (*n* = 538), Gettier (*n* = 479), and Ignorance (*n* = 597) conditions. See Hall and colleagues (2023) for more information on the larger study and exclusion information.

Materials

Vignettes

Participants were presented with one of six different versions of the “Darrel the

Ecologist" vignette used in Turri et al. (2015). These versions varied, first, in terms of the basis for the protagonist's belief. In the "No Threat" or knowledge condition, the protagonist's belief was both justified and true. In the "Threat" or Gettier condition, the protagonist's belief was justified but true only because of luck. In the "No Detection" or ignorance condition, the protagonist's justified belief was false.

Knowledge condition:

> Ecologists are/ Darrel is unaware that a complex network of aquifers recently began drying up in parts of the park. These aquifers carry vital nutrients to the trees and other forms of plant life that support the squirrels. And the aquifers in the river valley running through Zone 3 are no exception. The animal Darrel is looking at is indeed a thirsty red speckled ground squirrel.

Gettier condition:

> Ecologists are/ Darrel is unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. Still, the animal Darrel is looking at is indeed a red speckled ground squirrel.

Ignorance condition:

> Ecologists are/ Darrel is unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. And, the animal Darrel is looking at is indeed one of the prairie dogs.

Additionally, the vignettes varied in terms of whether the protagonist was presented as a professional ecologist (expert condition) or as an amateur citizen scientist (non-expert condition).

Expert conditions:

> Darrel is an ecologist collecting data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3. While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, "At least one red speckled ground squirrel in Zone 3 today."

Non-expert conditions:

> Darrel is a citizen scientist who has received basic training on cataloging animals. Citizen scientists like Darrel are amateur scientists; people who do not have any formal scientific training but who volunteer their time to help with scientific research. Today, he is volunteering to collect data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3….

The knowledge variable and the expertise variable were fully crossed to create a three (knowledge condition: knowledge vs. Gettier vs. ignorance) by two (Expertise condition: expert protagonist vs. non-expert protagonist) design.

Dependent Measures

Participants were asked to respond to six questions about the vignette. The questions measured comprehension of the passage, protagonist knowledge attribution, perceived reasonability of the protagonist's brief, and luckiness of the protagonist (i.e., did the protagonist arrive at the correct answer, but for the wrong reasons?). These questions used a combination of visual analog scales and forced choice response options as in Hall et al. (2023).

Procedure

Participants took the study individually and online using a single SocSci Survey link. Upon beginning the study, the participants were given an informed consent form where they were told they were going to participate in a study that involved thinking about human behavior. After providing consent, participants were taken to an instruction screen that told them they would read a passage and would answer some questions about what they read.

Participants were then randomly directed to one of the six experimental conditions. Once the participants read the passage about Darrel, they were asked to respond to the six dependent measures. As per the Turri et al. (2015) study and the Hall et al. (2023) registered replication, participants were not able to return to previous pages to reread or change their answers.

Once all of the questions for the vignette were answered, participants were then asked to answer a set of demographic questions (e.g., race, years of education, age, country of residence, gender) and suspicion check questions (e.g., “What do you think was the purpose of this study?”, “Have you ever participated in a similar study?”) as per Turri et al. (2015). Responses to these questions were used to evaluate participant awareness of the hypotheses of the study for purposes of exclusion.

After completing the demographic and suspicion check questions, participants were taken to the final debriefing screen that explained the goals and hypotheses of the study.

Data Analysis

Participants completed the study using either the visual analog scale (n = 1260) or the forced choice response option (n = 354). All analyses were conducted using the *lme4* package in *R* (Bates et al., 2015). Because each research lab was also tied to a specific country and study language, we did not include these variables as random intercepts because they were unique and non-nested. The dependent variables in each model were the ratings of knowledge, reasonableness, and luck in the visual analog scale or the forced choice response option. The independent variables were the Knowledge condition (Knowledge, Gettier, and Ignorance) and the Expertise condition (expert, non-expert)[1].

First, a model with only the random intercept of the research lab was analyzed as a baseline comparison. The interaction of condition and expertise was then added to the model, and the Akaike Information Criterion (AIC) was used to determine if the addition of the fixed effects predictors was useful. Models with AIC values at least two points lower than their

[1] Multilevel models are regression models that control for correlated error in the data and are often used in repeated measures designs because each participant is tested multiple times. Random intercepts allow variability within a selected variable by calculating a separate intercept for each group. For example, in a study using response latencies, participants are often used as random intercepts because each individual will have a different average response latency just due to natural differences in processing speed. In this study, we used the research lab as a random intercept to control for average country and language level differences.

comparison are considered better. The individual predictors were then examined using $p < .05$ as a criterion for significance. The overall pseudo-R^2 effect size was calculated with the *MuMIn* library for random and fixed effects (Barton, 2009).

The forced choice response data were modeled with a multilevel binary logistic regression. The visual analog scale data were modeled with a multilevel linear regression model; however, these results indicated a severe violation of normality, homoscedasticity, and linearity. Therefore, we also provide an analysis combining the visual analog scale data with the forced choice response data by dichotomizing the data (>= 55 and <= 45 for each choice). The split of the data was chosen to lessen data loss, but not split directly in the middle of the data (*n* values provided below). While dichotomization is generally not recommended (MacCallum et al., 2002; Maxwell & Delaney, 1993), we believe that this model can confirm if results are better suited as a dichotomous model.

Data and code for this analysis can be found at https://osf.io/abqsm/.

Results

VAS Analysis

Knowledge VAS Analysis

First, a model of the “knowledgeable” visual analog scale (VAS) was analyzed with only the random intercept of the research team (AIC = 12933.89). The addition of the interaction of condition and expertise predicting knowledge VAS ratings improved the overall model (AIC = 12649.96, $R^2_{fixed} = .193$). As shown in Table 1, only the main effect of the condition was found, where participants rated the Gettier condition lower (i.e., closer to believes as opposed to knows) than the Knowledge condition and higher (i.e., more knows) than the Ignorance condition. Figure 1 displays the means and the 95% confidence interval for the knowledge ratings.

Reasonable VAS Analysis

For "reasonable" judgments, the interaction improved the model (AIC = 11450.23, R^2_{fixed} = .006) over the intercept-only model with the random intercept of the research lab (AIC = 11463.23). However, as shown in Table 2, no individual coefficients were significant predictors of reasonable ratings using the VAS, likely due to the ceiling effect found in the data (see Figure 2).

Luck VAS Analysis

The intercept-only model (AIC = 12826.43) was improved by adding the interaction of expertise and condition (AIC = 12777.80, R^2_{fixed} = .029). In this model, participants rated the Gettier condition overall as more lucky than both the Knowledge and Ignorance conditions (see Table 3). Additionally, a main effect of expertise was found such that experts were rated lower (more ability) than naive protagonists (more luck). No interaction of condition and expertise was found.

Forced Choice Analysis

The forced choice models were analyzed using logistic regression, given the dichotomous outcome. These models show less power than the VAS models, as their sample size is smaller. Each model was first checked for large enough sample sizes in each cell of expert by condition by answer choice. The reasonable choice showed the same ceiling effect in which very few participants chose unreasonable as the answer choice. Therefore, this model was not analyzed.

Knowledge Forced Choice Analysis

The "knowledgeable" model with the interaction (AIC = 415.73, R^2_{fixed} = .252) showed a better fit than the intercept-only model (AIC = 477.42). Unlike the VAS model, the Gettier condition was only different from the Ignorance condition, with more "knows" chosen in the Gettier condition (see Table 4 and Figure 4). The Gettier and Knowledge condition answer selections were not significantly different. No other effects were found.

Luck Forced Choice Analysis

While the interaction model (AIC = 442.42, R^2_{fixed} = .105) fit better than the intercept-only model (AIC = 454.65), Table 5 indicates that no coefficient was a significant predictor of the choice between ability and luck (see Figure 5).

Combined Analyses

As noted earlier, the linear models for the VAS did not meet the assumptions of linear regression. In these analyses, we dichotomized each choice by putting choices higher than 55 and lower than 45 into the binned categories. Given the added data, the reasonable model does meet the minimum cell size requirements, but still shows a heavy ceiling effect.

Knowledge Combined Analysis

The intercept-only model (AIC = 2167.22) was improved by adding the interaction of expertise and condition (AIC = 1893.65, R^2_{fixed} = .214). As shown in Table 6 and Figure 6, these results converge on previous findings for forced-choice data, showing that the Gettier condition was not different from the Knowledge condition but did show more selection of "knows" than the Ignorance condition. The difference in the results from the VAS model may show that the VAS is slightly more sensitive to the difference between the Gettier and the Knowledge conditions; however, it is important to remember that the data are mostly bimodal and non-linear in the VAS data.

Reasonable Combined Analysis

In this model, we find that the interaction model (AIC = 704.46, R^2_{fixed} = .018) does not improve model fit over the intercept-only model (AIC = 699.66). Figure 7 illustrates that very few individuals select unreasonable, thus making it difficult to predict the difference in category selection.

Luck Combined Analysis

Mimicking results from the previous luck models, the interaction model (AIC = 2057.65, R^2_{fixed} = .041) was a better fit than the intercept-only model (AIC = 2094.66). In these results, the participants in the Gettier condition were more likely to choose luck than knowledge, but no differences between Gettier and Ignorance conditions were found. Figure 8 and Table 7 show the coefficient results and data. Again, we see that the VAS results may potentially be sensitive to very small differences in expertise and ignorance, with the caveat that these results are also bimodal and non-linear.

Discussion

Reasoning about others' mental states plays a central role in human social life, underlying social activities ranging from deception detection to effective gift-giving. Here we focus on one particular aspect of mental state reasoning, that of knowledge attribution. We engage, in particular, with an ongoing debate about the conditions under which people will attribute true knowledge to others. On one hand, the Justified True Belief Theory (JTBT) suggests that people will attribute true knowledge to protagonists any time those protagonists apply logical reasoning to arrive at a correct conclusion, even if the protagonists' reasons are not the real reasons for why the conclusion is correct. On the other hand, Gettier (1963) argues that people will distinguish between protagonists who are correct because they applied the real causal processes underlying an outcome from protagonists who are correct because they applied causal reasoning that, while logical, does not capture the real reasons underlying the outcome (i.e., protagonists who just got lucky in their correct answer).

Providing some support for Gettier's argument, recent work by Turri et al., (2015) and, even more convincingly, Hall et al. (2023), shows that people are indeed somewhat sensitive to the reasons why protagonists arrive at correct answers when deciding whether to attribute true knowledge to them. People are much more likely to attribute true knowledge to protagonists who are right for the correct reasons ("she *knew* the answer!") than to protagonists who are right for the wrong reasons ("she just got lucky!").

While the data of Turri et al. (2015) and Hall et al. (2023) contribute meaningfully to debates about the Justified True Belief Theory and Gettier intuitions, they are also limited in the sense that they focus specifically on the logical considerations people undertake when deciding whether to attribute true knowledge to protagonists. Given the rich history of scholarship in psychology highlighting the many ways in which (knowledge) attribution can be shaped by extra-logical factors such as the attractiveness (Berscheid & Walster, 1974; Feingold, 1982), dress (Behling & Williams, 1991; Dayani et al., 2022), and group memberships (Mahmud & Swami, 2010; Tran et al., 2023) of the actors involved, in our international, multisite study we sought to examine whether other protagonist-related factors might also shape people's willingness to attribute true knowledge. We focused in particular on protagonist expertise, and asked whether a protagonist's perceived pre-existing knowledge about an issue would affect how likely people would be to attribute true knowledge to the protagonist when they provided a correct answer to a question relating to that issue for the right vs. the wrong reasons.

Several findings were indicated among the VAS analyses. First, we found a main effect of

Knowledge condition on knowledge attribution. Participants saw protagonists in the Gettier condition as less knowledgeable than protagonists in the Knowledge condition, but more knowledgeable than protagonists in the Ignorance condition. This same pattern was found both by Turri et al. (2015) and Hall et al. (2023). We did not find a significant effect of Expertise condition on knowledge attribution (though, at a descriptive level, expert protagonists were seen as slightly more knowledgeable than non-expert protagonists), nor did we find an interaction between Knowledge condition and Expertise condition.

Like Turri et al. (2015), participants' reasonableness ratings did not differ by Knowledge condition or by Expertise condition, although, as mentioned above, it is likely these findings result from a ceiling effect on the reasonableness variable. This result is sensible given that the vignettes were constructed specifically so that each vignette presented a situation where it was quite reasonable for protagonists to arrive at the correct answer (even if they did so for the wrong reasons).

As for attributions of skill vs. luck, participants rated protagonists in the Gettier condition as more lucky than those in both the Knowledge and Ignorance conditions. We also observed a main effect of Expertise condition on skill vs. luck attributions, such that participants rated experts as arriving at the correct answer more because of skill than non-experts, whom they rated as luckier. Given that this effect of the Expertise condition on skill vs. luck attributions did not emerge in the forced-choice response data, however, these may suggest that the VAS is better equipped than the forced-choice scale to identify very small effects of protagonist expertise. That said, because the VAS data violated the linear regression assumptions of normality, homoscedasticity, and linearity, these findings should be interpreted with caution.

Among the forced choice response analyses, we found a main effect of Knowledge condition on knowledge attribution, such that the Gettier condition differed significantly only from the Ignorance Condition, and not from the Knowledge condition. We did not find a significant effect of the Expertise condition on knowledge attribution though, as with the VAS analyses, we again found that at a descriptive level, expert protagonists were seen as slightly more knowledgeable than non-expert protagonists. Unlike the VAS analyses, none of the coefficients were found to be a significant predictor of participants' skill vs. luck ratings. The reasonableness model was not analyzed given the aforementioned ceiling effect found in the data.

In the combined analyses, similar results were found. In line with the forced choice analyses, we found a significant effect of the Knowledge condition on knowledge attribution, such that the Gettier condition differed significantly only from the Ignorance condition and not from the Knowledge condition. We did not find a significant effect of Expertise condition on knowledge attribution, nor did we find an interaction between the Knowledge and Expertise conditions.

The findings of the reasonableness model were inconclusive given the limitations of the reasonableness variable. In the skill vs. luck analyses, participants were more likely to rate protagonists as luckier in the Gettier condition than in the Knowledge condition. In addition, expertise was not found to be a significant predictor of participants' luck ratings in the combined analyses.

Taken together, these results have several important implications. First, they support the findings of Turri et al. (2015) and Hall et al. (2023) that a salient but failed threat to the truth of a judgment (a Gettier case) does not significantly affect whether the protagonist is viewed as having knowledge. When an individual may have just gotten lucky by being right (e.g., is right for the wrong reasons), people still tend to see them as knowledgeable.

The findings regarding protagonist expertise are more equivocal. At a descriptive level, expert protagonists were consistently seen as more knowledgeable and as having arrived at the right answer more because of skill than luck than were non-expert protagonists. However, the size (and statistical significance) of these differences varied across the VAS and the forced-choice response scales. Although these findings do align to some extent with research showing that perceived protagonist expertise can influence how knowledgeable protagonists are seen to be (e.g., McDonald & Ma, 2015), they also suggest that any differences in knowledge and skill attribution to experts vs. non-experts are likely to be relatively small, and may only be captured on measures that allow for fine distinctions in knowledge and skill attribution.

This study included a few limitations that should be considered. Primarily, the interpretation of the VAS analyses, and the findings regarding expertise should be done with caution given the bimodality and non-linearity of the data. In addition, this study utilized only one Gettier case vignette. Although Hall et al. (2023) showed that the same general pattern of findings emerged across three separate Gettier cases, because our study used only the Darrel vignette, we can't be sure just how generalizable our findings are to other knowledge attribution scenarios. Lastly, we only tested forced choice and visual analog scale operationalizations of the dependent variables. Perhaps there are more sensitive (e.g., Likert scales) and/or more ecologically valid (e.g., behavioral intentions) ways to measure these dependent variables.

With the aforementioned limitations in mind, there are a few potential future directions for this research. First, researchers should consider testing the effects of expertise in Gettier conditions utilizing additional vignettes to evaluate if the findings of this study are unique to the

Darrel vignette or generalizable to other Gettier cases. Because this was (to our knowledge) the first study to examine the potential effects of protagonist expertise on knowledge attribution in Gettier cases, we deliberately focused on a single vignette, the same vignette employed by Turri et al. (2015). But, given the findings of Hall et al. (2023) showing that knowledge attribution in Gettier cases differs depending on the specific content of the vignettes used, future research utilizing a wider range of vignettes is needed. Second, due to the fact that we found differences in results between the forced choice responses and the visual analog scales, this study suggests exploring different scales such as the Likert scale to test how various operationalizations of the dependent variables can influence results.

Conclusion

In conclusion, the results of this study replicated the key findings of Turri et al. (2015) and those of Hall et al. (2023) and also explored the potential influence of expertise on knowledge attributions. The replication findings of this study allow researchers to be more confident in the finding of Turri et al. (2015) that individuals do not attribute knowledge in Gettier cases the way Gettier suggested. Rather, lay people seem to attribute knowledge even when protagonists' beliefs are correct simply because they were lucky. Beyond replicating this existing work, we found that knowledge attribution in the types of cases that Gettier (1963) described and that Turri and colleagues tested does not seem to be impacted very much by the perceived expertise of protagonists. Given the wealth of work in psychology highlighting the influence of protagonist-level variables on the process of attribution (e.g., McDonald & Ma, 2015; Salmeron, Gómez, & Fajardo, 2016), however, future work is needed to more fully examine the potential influence of protagonist characteristics on what we suspect is a multifaceted process of knowledge attribution. This study adds important findings to the existing field of literature on this subject and provides meaningful directions for future research.

References

Barton, K. (2009) Mu-MIn: Multi-model inference. *R Package Version* 0.12.2/r18. http://R-Forge.R-project.org/projects/mumin/

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1–48. doi:10.18637/jss.v067.i01.

Behling, D. U., & Williams, E. A. (1991). Influence of Dress on Perception of Intelligence and Expectations of Scholastic Achievement. *Clothing and Textiles Research Journal, 9*(4), 1–7. https://doi.org/10.1177/0887302X9100900401

Berscheid, E., & Walster, E. (1974). Physical Attractiveness. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 7, pp. 157–215). Academic Press. https://doi.org/10.1016/S0065-2601(08)60037-4

Dayani, F., Thawanyarat, K., Mirmanesh, M., Spargo, T., Saia, W., & Nazerali, R. (2022). Dress to Impress: Public Perception of Plastic Surgeon Attire. *Aesthetic Surgery Journal*, *42*(6), 697-706. https://doi.org/10.1093/asj/sjab408

Feingold, A. (1982). Physical attractiveness and intelligence. *The Journal of Social Psychology, 118*(2), 283–284. https://doi.org/10.1080/00224545.1982.9922810

Gettier, E. L. (1963). Is justified true belief knowledge? *Analysis*, *23,* 121–123. https://doi.org/10.2307/3326922

Gilbert, D. T. (1998). Ordinary personology. *The handbook of social psychology*, *2*, 89-150.

Grahe, J., Brandt, M., IJzerman, H., & Cohoon, and J. (2014). Replication Education. *APS Observer*, *27*. https://www.psychologicalscience.org/observer/replication-education

Hall, B. F., Schmidt, K., Wagge, J. R., Lewis, S. C., Weissgerber, S. C., Kiunke, F., … Buchanan, E. M. (2023). Registered Replication Report: A Large Multilab Cross-Cultural

Conceptual Replication of Turri, Buckwalter, & Blouw (2015). https://doi.org/10.31234/osf.io/zeux9

MacCallum, R. C., Zhang, S., Preacher, K. J., & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods*, *7*(1), 19-40. https://doi.org/10.1037/1082-989x.7.1.19

Machery, E., Stich, S., Rose, D., Chatterjee, A., Karasawa. K., Struchiner, N., Sirker, S., Usui, N., & Hashimoto, T. (2015). Gettier across cultures. *NOÛS, 51*(3) 645-654. https://doi.org/10.1111/nous.12110

Mahmud, Y., & Swami, V. (2010). The influence of the hijab (Islamic head-cover) on perceptions of women's attractiveness and intelligence. *Body Image*, *7*(1), 90–93. https://doi.org/10.1016/j.bodyim.2009.09.003

Malle, B. F., & Nelson, S. E. (2003). Judging mens rea: The tension between folk concepts and legal concepts of intentionality. *Behavioral Sciences & the Law, 21*, 563–580. https://doi.org/10.1002/bsl.554

Maxwell, S. E., & Delaney, H. D. (1993). Bivariate median splits and spurious statistical significance. *Psychological Bulletin, 113*(1), 181-190. https://doi.org/10.1037/0033-2909.113.1.181

Mcdonald, K. P., & Ma, L. (2015). Dress nicer = know more? young children's knowledge attribution and selective learning based on how others dress. *PLoS One, 10*(12), 41–13. https://doi.org/10.1371/journal.pone.0144424

Nagel, J., Juan, V. S., & Mar, R. A. (2013). Lay denial of knowledge for justified true beliefs. *Cognition*, *129*(3), 652–661. https://doi.org/10.1016/j.cognition.2013.02.008

Petty, R. E., & Cacioppo, J. T. (1986). The Elaboration Likelihood Model of Persuasion. In L.

Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 19, pp. 123–205). Academic Press. https://doi.org/10.1016/S0065-2601(08)60214-2

Petty, R. E., Cacioppo, J. T., & Goldman, R. (1981). Personal involvement as a determinant of argument-based persuasion. *Journal of personality and social psychology*, *41*(5), 84.

Plato. (1997/380 BCE). *The Republic.* G. M. A. Grube & C. D. C. Reeve (Trans.). In J. M. Cooper (Ed.), *Plato, Complete Works.* Indianapolis: Hackett. https://doi.org/10.1037/13728-007

Reid, T. (2002/1785). *Essays on the intellectual powers of man* (D. Brookes, Ed.). University Park: Pennsylvania State University Press..

Salmerón, L., Gómez, M., & Fajardo, I. (2016). How Students with Intellectual Disabilities Evaluate Recommendations from Internet Forums. *Reading and Writing: An Interdisciplinary Journal, 29*(8), 1653–1675. https://doi.org/10.1007/s11145-016-9621-4

Starmans, C., & Friedman, O. (2012). The folk conception of knowledge. *Cognition*, *124*(3), 272–283. https://doi.org/10.1016/j.cognition.2012.05.017

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant. *Psychological Science*, *22*(11), 1359–1366. https://doi.org/10.1177/0956797611417632

Tomasello, M. (1996). The cultural roots of language. In *Communicating meaning: The evolution and development of language* (pp. 275–307). Lawrence Erlbaum Associates, Inc.

Tran, A. G. T. T., Holzapfel, J., Lam, C. K., & Eustice, K. L. (2023). Race and student-athlete status: Peer appraisals of academic skills, intelligence, and favorability. *Journal of Diversity in Higher Education*, *16*(3), 346–355. https://doi.org/10.1037/dhe0000339

Turri, J., Buckwalter, W., & Blouw, P. (2015). Knowledge and luck. *Psychonomic Bulletin and*

Review, *22,* 378–390. https://doi.org/10.3758/s13423-014-0683-5

Wagge, J. R., Brandt, M. J., Lazarevic, L. B., Legate, N., Christopherson, C., Wiggins, B., & Grahe,

J. E. (2019). Publishing Research With Undergraduate Students via Replication Work: The Collaborative Replications and Education Project. *Frontiers in Psychology*, *10*. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00247

Wellman, H. M. (2018). Theory of mind across the lifespan? *Zeitschrift Für Psychologie*, *226*(2), 136–138. https://doi.org/10.1027/2151-2604/a000330

Weinberg, J. M., Nichols, S., & Stich, S. (2001). Normativity and Epistemic Intuitions. *Philosophical Topics*, *29*(1/2), 429–460.

Wittgenstein, L. (1953). *Philosophical investigations.* New York: Blackwell.

Table 1: Knowledge VAS Coefficient Table

Term	*b*	*SE*	*t*	*df*	*p*
Intercept	49.65	3.25	15.27	13.90	< .001
Condition: Knowledge	7.96	3.59	2.22	1,252.00	.027
Condition: Ignorance	-29.24	3.58	-8.16	1,252.14	< .001
Expertise: Expert	4.88	3.65	1.33	1,251.99	.182
Interaction: Knowledge X Expert	3.16	5.12	0.62	1,252.38	.538
Interaction: Ignorance X Expert	-5.27	5.08	-1.04	1,251.86	.300
SD: Intercept	3.94				
SD: Observation	36.75				

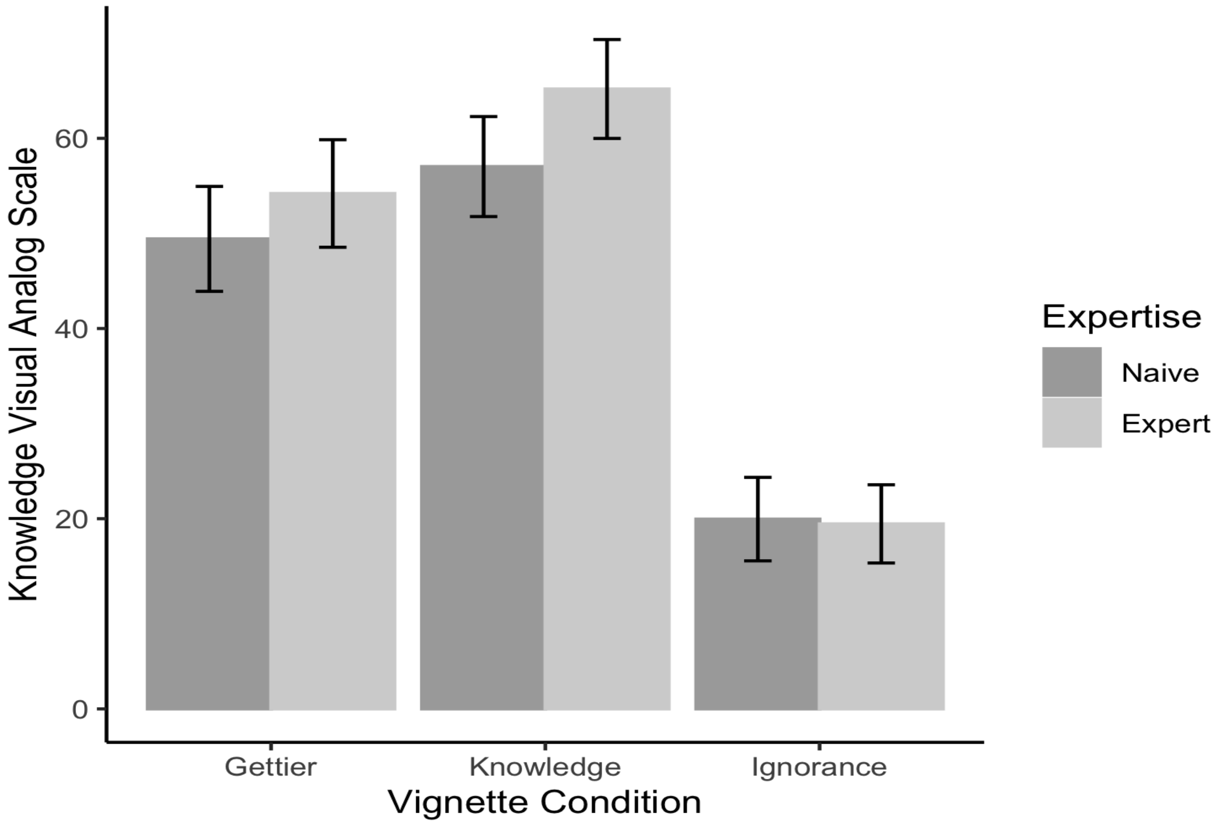

Figure 1. Average visual analog scores for the rating of Believes (0) to Knows (100) for each condition and expertise grouping. Error bars indicate 95% confidence interval of the mean.

Table 2: Reasonable VAS Coefficient Table

Term	*b*	*SE*	*t*	*df*	*p*
Intercept	86.14	1.92	44.87	15.13	< .001
Condition: Knowledge	-0.18	2.22	-0.08	1,251.90	.937
Condition: Ignorance	-1.68	2.22	-0.76	1,252.01	.449
Expertise: Expert	1.91	2.27	0.84	1,251.84	.400
Interaction: Knowledge X Expert	-2.19	3.18	-0.69	1,252.34	.491

Term	*b*	*SE*	*t*	*df*	*p*
Interaction: Ignorance X Expert	-4.05	3.15	-1.29	1,251.66	.198
SD: Intercept	2.12				
SD: Observation	22.78				

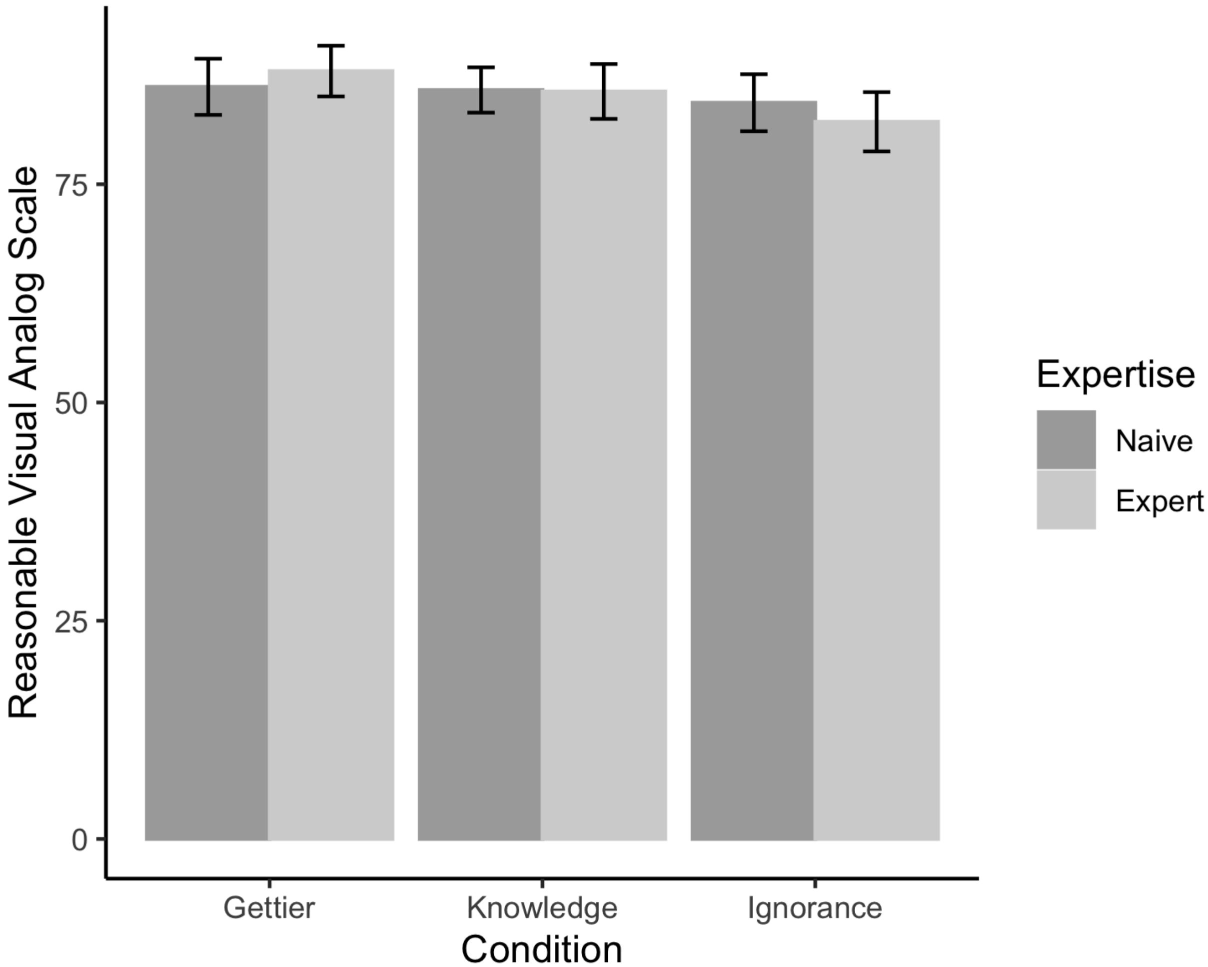

Figure 2. Average visual analog scores for the rating of Unreasonable (0) to Reasonable (100) for each condition and expertise grouping. Error bars represent 95% confidence interval of the mean.

Table 3: Luck VAS Coefficient Table

Term	*b*	*SE*	*t*	*df*	*p*
Intercept	49.76	2.71	18.34	91.71	< .001
Condition: Knowledge	-13.28	3.78	-3.51	1,253.63	< .001
Condition: Ignorance	-6.87	3.78	-1.82	1,253.17	.069
Expertise: Expert	-8.37	3.85	-2.17	1,253.03	.030
Interaction: Knowledge X Expert	0.01	5.40	0.00	1,253.61	.999
Interaction: Ignorance X Expert	9.58	5.35	1.79	1,252.82	.073
SD: Intercept	0.73				
SD: Observation	38.73				

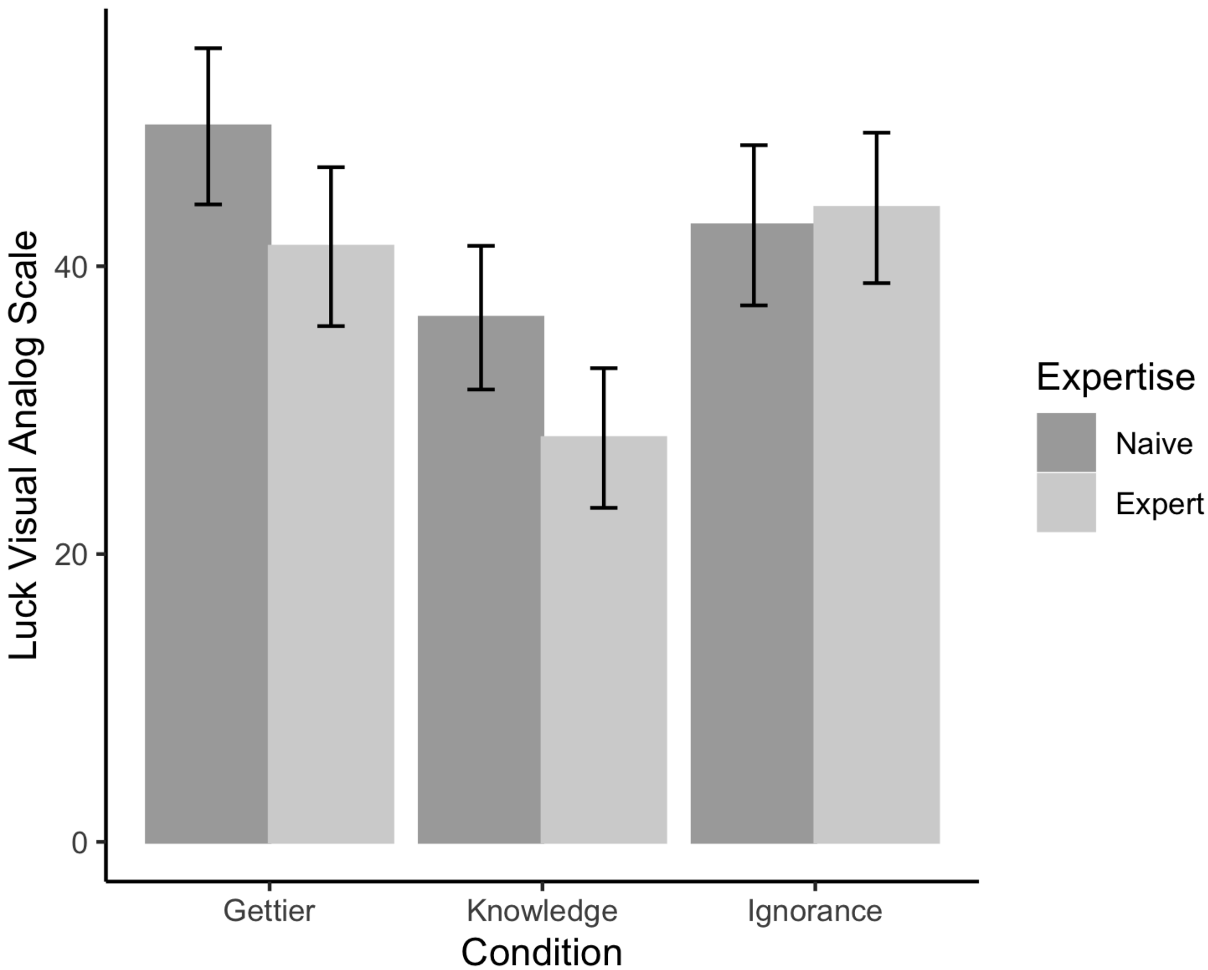

Figure 3. Average visual analog scores for the rating of Ability (0) to Luck (100) for each condition and expertise grouping. Error bars represent 95% confidence interval of the mean.

Table 4: Knowledge Forced Choice Coefficient Table

Term	*b*	*SE*	*Z*	*p*
Intercept	-0.12	0.28	-0.42	.675
Condition: Knowledge	0.15	0.38	0.40	.692
Condition: Ignorance	2.08	0.47	4.42	< .001

Term	*b*	*SE*	*Z*	*p*
Expertise: Expert	-0.01	0.41	-0.02	.980
Interaction: Knowledge X Expert	-0.60	0.55	-1.09	.278
Interaction: Ignorance X Expert	-0.06	0.66	-0.09	.932
SD: Intercept	0.00			

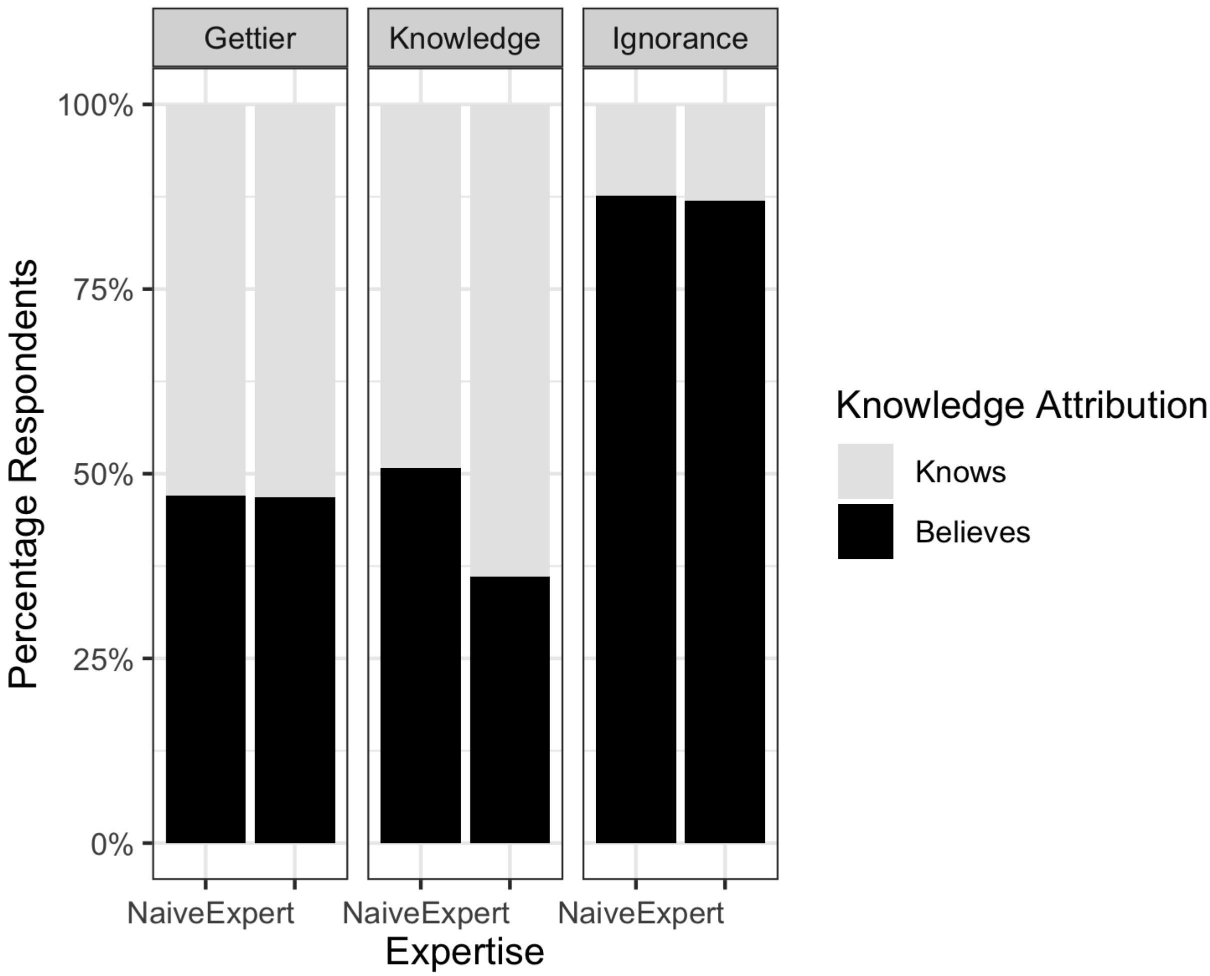

Figure 4. Selection of knows versus believes in the forced choice task.

Table 5: Luck Forced Choice Coefficient Table

Term	*b*	*SE*	*Z*	*p*
Intercept	0.12	0.28	0.42	.675
Condition: Knowledge	0.68	0.39	1.71	.086
Condition: Ignorance	0.29	0.38	0.76	.446
Expertise: Expert	0.27	0.41	0.66	.509
Interaction: Knowledge X Expert	0.98	0.64	1.54	.124
Interaction: Ignorance X Expert	0.02	0.54	0.03	.974
SD: Intercept	0.00			

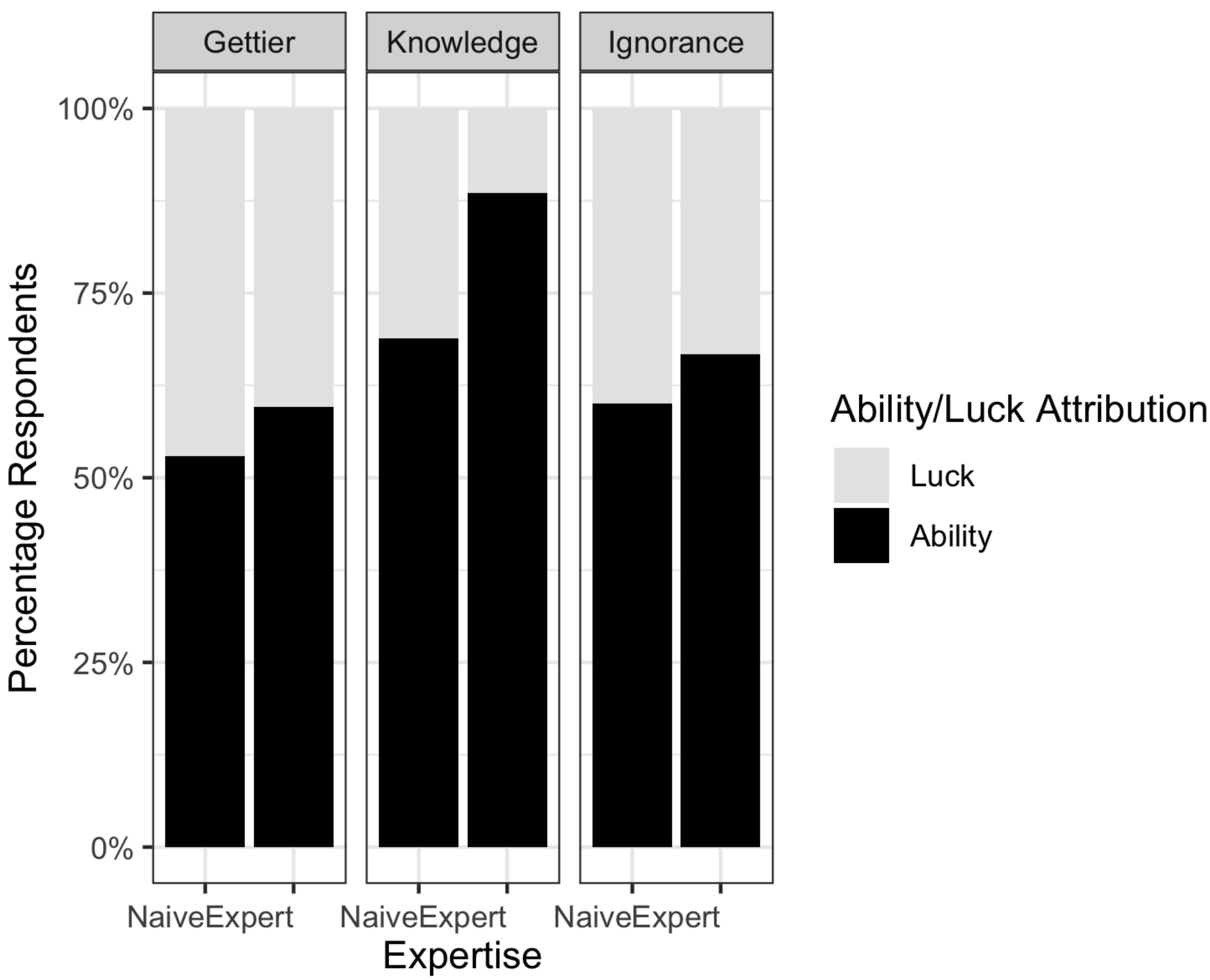

Figure 5. Selection of luck versus ability in the forced choice task.

Table 6: Luck Forced Choice Coefficient Table

Term	*b*	*SE*	*Z*	*p*
Intercept	0.03	0.16	0.21	.833
Condition: Knowledge	0.21	0.18	1.22	.222
Condition: Ignorance	-1.64	0.21	-7.97	< .001
Expertise: Expert	0.19	0.18	1.07	.284
Interaction: Knowledge X Expert	0.31	0.26	1.22	.223
Interaction: Ignorance X Expert	-0.22	0.29	-0.74	.459
SD: Intercept	0.19			

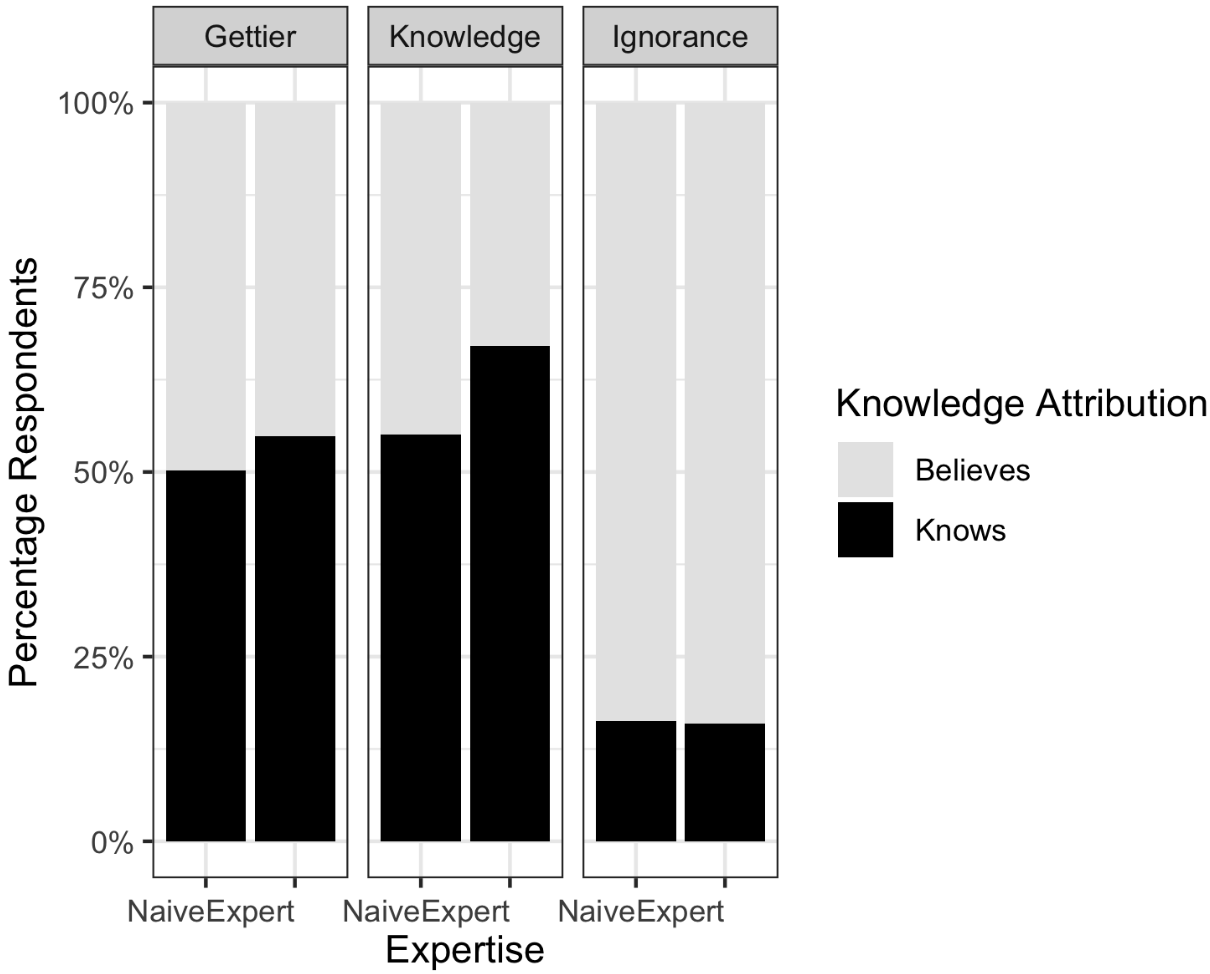

Figure 6. Selection of know versus believes in the combined data.

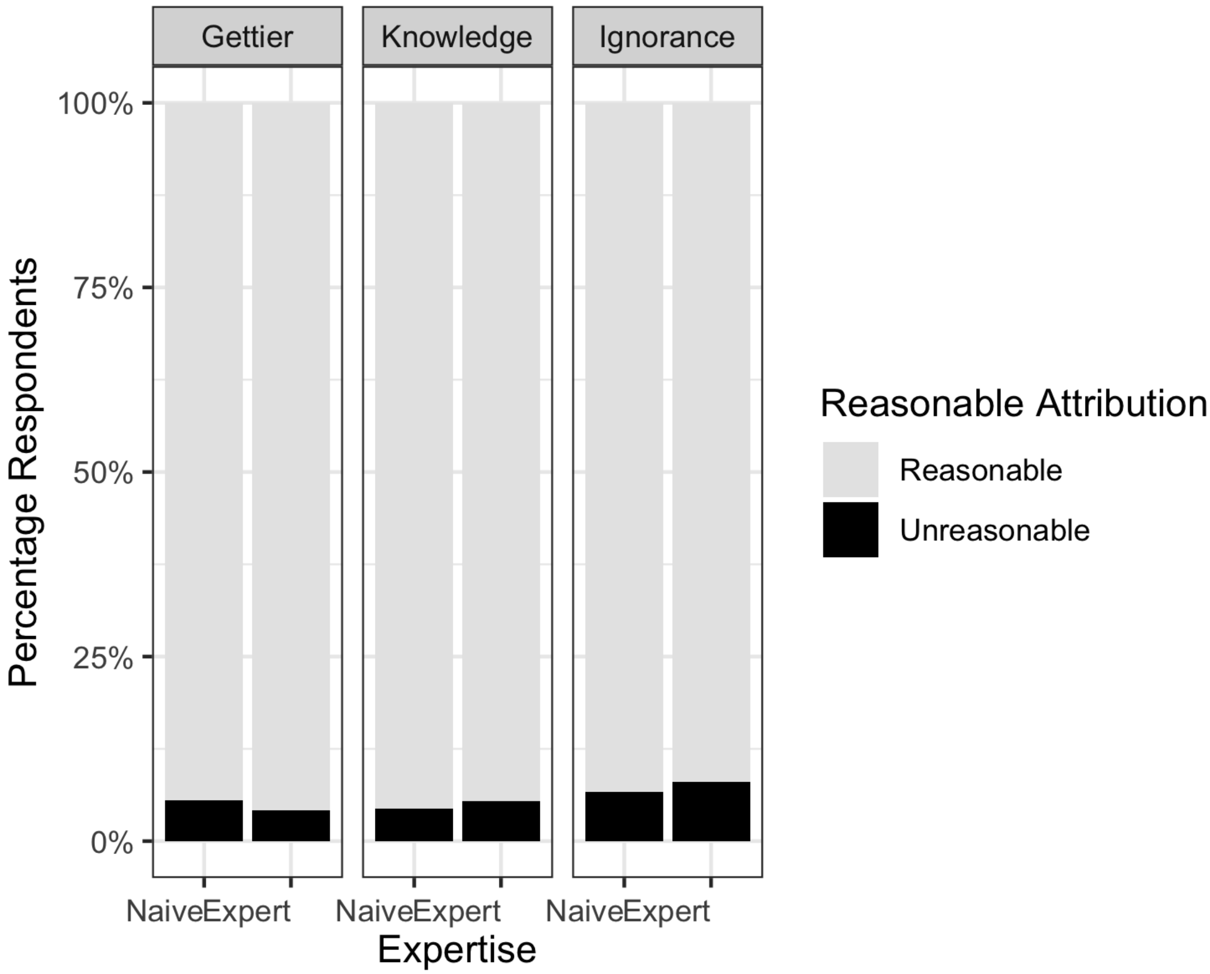

Figure 7. Selection of unreasonable versus reasonable in the combined data.

Table 7: Luck Forced Choice Coefficient Table

Term	b	SE	Z	p
Intercept	-0.11	0.13	-0.88	.380
Condition: Knowledge	-0.61	0.18	-3.37	< .001
Condition: Ignorance	-0.25	0.18	-1.40	.162
Expertise: Expert	-0.25	0.18	-1.38	.168

Term	b	SE	Z	p
Interaction: Knowledge X Expert	-0.32	0.27	-1.18	.237
Interaction: Ignorance X Expert	0.19	0.25	0.76	.448
SD: Intercept	0.00			

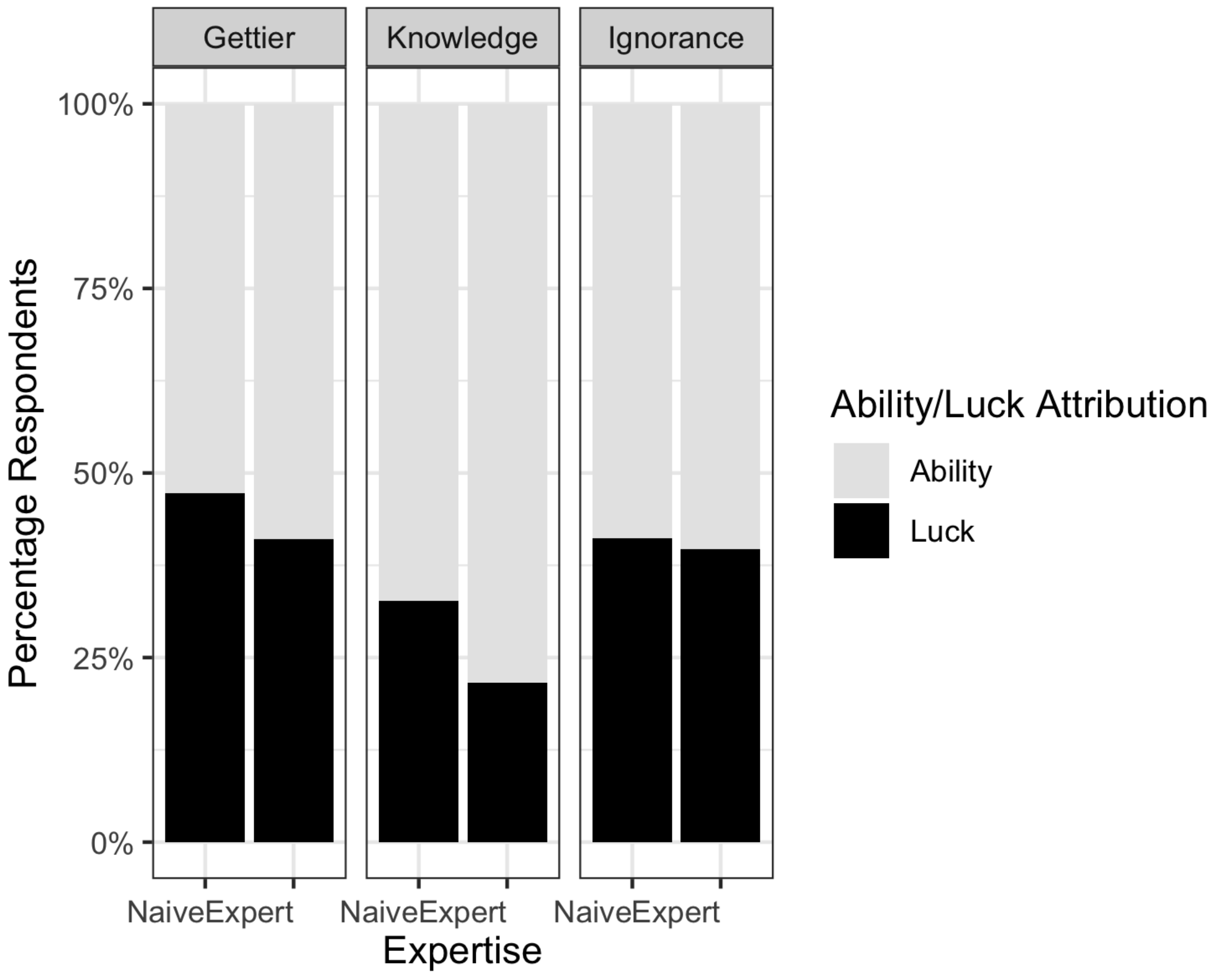

Figure 8. Selection of ability versus luck in the combined data.

Appendix A

Vignette 1 - Original "Darrel" vignette (Turri et al., 2015):

D1 - "Darrel" knowledge control condition:
Darrel is an ecologist collecting data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3. While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, "At least one red speckled ground squirrel in Zone 3 today."

Ecologists are unaware that a complex network of aquifers recently began drying up in parts of the park. These aquifers carry vital nutrients to the trees and other forms of plant life that support the squirrels. And the aquifers in the river valley running through Zone 3 are no exception. The animal Darrel is looking at is indeed a thirsty red speckled ground squirrel.

D2 - "Darrel" Gettier case condition:
Darrel is an ecologist collecting data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3. While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, "At least one red speckled ground squirrel in Zone 3 today."

Ecologists are unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. Still, the animal Darrel is looking at is indeed a red speckled ground squirrel.

D3 - "Darrel" ignorance control condition:
Darrel is an ecologist collecting data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3. While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, "At least one red speckled ground squirrel in Zone 3 today."

Ecologists are unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. And, the animal Darrel is looking at is indeed one of the prairie dogs.

Vignette 2 - "Darrel" Naive Vignette (Turri et al., 2015):

D1 - "Darrel" knowledge control condition:
Darrel is a citizen scientist who has received basic training on cataloging animals. Citizen

scientists like Darrel are amateur scientists; people who do not have any formal scientific training but who volunteer their time to help with scientific research. Today, he is volunteering to collect data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3.

While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, “At least one red speckled ground squirrel in Zone 3 today.”

Darrel is unaware that a complex network of aquifers recently began drying up in parts of the park. These aquifers carry vital nutrients to the trees and other forms of plant life that support the squirrels. And the aquifers in the river valley running through Zone 3 are no exception. The animal Darrel is looking at is indeed a thirsty red speckled ground squirrel.

D2 - “Darrel” Gettier case condition:
Darrel is a citizen scientist who has received basic training on cataloging animals. Citizen scientists like Darrel are amateur scientists; people who do not have any formal scientific training but who volunteer their time to help with scientific research. Today, he is volunteering to collect data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3.

While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, “At least one red speckled ground squirrel in Zone 3 today."

Darrel is unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. Still, the animal Darrel is looking at is indeed a red speckled ground squirrel.

D3 - “Darrel” ignorance control condition:

Darrel is a citizen scientist who has received basic training on cataloging animals. Citizen scientists like Darrel are amateur scientists; people who do not have any formal scientific training but who volunteer their time to help with scientific research. Today, he is volunteering to collect data on red speckled ground squirrels in Canyon Falls national park. The park is divided into ten zones and today Darrel is working in Zone 3.

While scanning the river valley with his binoculars, Darrel sees a small, bushy-tailed creature with distinctive red markings on its chest and belly. The red speckled ground squirrel is the only native species with such markings. Darrel records in his journal, “At least one red speckled ground squirrel in Zone 3 today.”

Darrel is unaware that a non-native species of prairie dog recently began invading the park. These prairie dogs also have red markings on their chest and belly. When these prairie dogs tried to invade Zone 3, the red speckled ground squirrels were unable to completely drive them away. And the animal Darrel is looking at is indeed one of the prairie dogs.