

Abstract

An ability to flexibly learn from others while at other times relying upon one's own judgments is an important adaptive human capacity. The present research investigated how others' epistemic states and prior experience of their own independent ability in a given task modulate young children's selective learning. In particular, we asked whether 4-year-old children's judgment concerning the location of a hidden object is modulated both by an informant's knowledge states and by the absence/presence of a prior experience with a particular task. We found that the children were more likely to align their judgment according to the informant's verbal report when the informant was knowledgeable than when she was ignorant – but only when they had explicitly experienced their own incapability to accurately guess an object's location. The findings suggest that 4-year-old children are able to combine their own experience with others' input to make their judgment.

Keywords: belief alignment; prior experience; selective learning

Children's Prior Experiences of Their Successes and Failures Modulate Belief Alignment

We often need to align our beliefs with those of others when they are better informed than ourselves. Belief alignment, however, is challenging because it requires us to selectively adopt others' judgments and opinions – and in comparison to our own. This ability to flexibly and selectively align one's own beliefs with those of others while at other times relying upon one's own judgments is important for human learning. How do young children decide to align their beliefs with others? As will be discussed below, a bulk of developmental studies show that by 4 years of age children are able to selectively trust others' verbal report or advice depending on others' epistemic states (e.g., knowledge, reliability etc.). However, the effect of children's experience of their own independent ability in a given task on their selective trust in others' testimony has not received much attention in prior studies. In the present research, we investigated the combined influence of prior experience of own ability in a particular task and of an informant's knowledge states on children's belief alignment with the informant.

In classical developmental studies of testimony, a predominantly adopted paradigm is the following. Children are presented with two informants one of whom is reliable (by providing accurate labels for familiar objects) whereas the other is unreliable (by providing inaccurate labels for the same familiar objects). After having experienced across trials reliability contrasts between the two informants, children are asked to endorse one of the two conflicting novel labels provided by the two informants for novel objects. The findings are that by 4 years of age children selectively endorse novel information supplied by a previously accurate person over that supplied by a previously inaccurate person. Thus, children selectively learn from others depending on others' epistemic states (Harris, 2012; Mills, 2013 for a review).

Notably, in the existing work on selective trust, children have little clue as to what an object name might be. In other learning cases, however, children are readily able to make their own judgments – based on their own prior (and a related domain of) knowledge, or even guesses. In addition, often times children also come to experience their own ability for a certain task, not just others' ability as in testimony work. Therefore, children should selectively learn from others in comparison to their own independent ability. Overall, independent judgment and learning are as important –if not more important – as other-dependent learning. How do young children decide whether to rely upon their own ability and judgments vs. upon those of others?

Several studies speak to this issue and provide a somewhat mixed picture. Jaswal (2004) demonstrated that 4-year-olds were more likely than 3-year-olds to disregard a verbal report that conflicted with their perception (e.g., a cat-like animal labeled as a dog), but tended to accept the conflicting report when a speaker's communicative intention was made clear. In another study, Lane and Harris (2015) demonstrated that children's developing intuition about what can or cannot happen influences the extent to which children accepted intuitive vs. counter-intuitive claims (about animals or artifacts) made by experts. Robinson and Whitcombe (2003) found that children of ages 3 to 5 trusted others' verbal report that contradicted their own guesses as long as others are better informed than themselves; otherwise they relied upon their own guesses. In their study, for example, children and an experimenter played a "tunnel game" in which either a child or an experimenter had relevant informational access (see vs. feel) to obtain knowledge (color vs. hardness of an object). They then were asked about their judgments which the experimenter contradicted, and asked again about their final judgments. Nurmsoo and Robinson (2009) further demonstrated that children relied upon their own guesses rather than upon a better-informed person's current advice – if they had a reason to doubt the informant's

trustworthiness (i.e., the informant's previous false report occurred despite having full informational access). On the other hand, 3- to 6-year-old children were more likely to align their beliefs even according to an ignorant informant's advice on an animal's diet over one's own judgments (although they did so less frequently compared to a knowledgeable informant's advice) (Rakoczy, Ehrling, Harris, & Schultze, 2015). As in the selective testimony work, children's own capability in these studies could be limited by the nature of knowledge domain being tested (i.e., identity of an object/an animal or an animal diet).

An important factor that might play a role in children's belief alignment is their experience about their own independent ability. It has been shown that toddlers' confidence about their initial belief can influence later belief alignment when faced with unexpected testimony (Jaswal, 2010). Additionally, while 3-year-olds easily accept a false verbal report that conflicted with their observation, confidence about their own direct observation leads them to disregard the conflicting verbal report (Ma & Ganea, 2010). In the present study we investigate one such factor – prior experience about one's own successes and failures in a specific task. Although experiences of own successes/failures plays an important role in how likely we are to trust others (instead of following our own intuitions), very little developmental research has investigated the two factors (experiences of one's own ability together with those of others' ability) in a single experiment – let alone the role of children's experiences of their own ability on their selective trust.

An exception is a study by Palmquist, Jaswal, and Rutherford (2016) in which 4- and 5-year-old children were tested for their selective trust of a previously helpful vs. a previously unhelpful informant as a function of their prior experience of success in retrieving a hidden toy. Children did not prefer either the previously helpful person or the previously unhelpful person

when they previously experienced success of locating the toy in all trials. By contrast, when they experienced some failure they preferred to ask the previously helpful informant. The authors concluded that children develop a sense of “illusory control” when they only experience success.

While this study makes an important first step in the exploration of this topic, it does not give a conclusive answer as to how children's experiences with a specific task that is uniquely their own – especially experiences of their own ability independently of those of others' ability – affect their selective belief alignment. In the study, it is questionable whether children's experience with the task was unambiguously their own given that they first experienced the task together with the informants during the familiarization trials. Children's independent experience with the task is important because it is likely to provide them with their own sense of the task difficulty level. In particular, during the familiarization trials in Palmquist et al. (2016), in some trials, children's experience of success/failure based on their own guessing was possible (in the unhelpful informant trials in Study 1 and in the no informant trials in Study 2), but in other trials, they made their guesses and the helpful informant also offered information. Thus, even those successful outcomes aided by the helpful informant – especially given that the helpful and the unhelpful trials were intermixed during the testing – could have been attributed to their own independent guess. Note also that children had to choose between the two informants to ask about the location of the hidden object, thus depriving children of a chance to disregard an informant's verbal report. Given these considerations, children's lack of preference for the helpful informant over the unhelpful informant (in Study 1) or the stranger (in Study 2) when they experience success in all trials may indicate that they prefer to rely upon their own guess rather than upon anyone.

In the present research, we tested the combined influence of the presence/absence of prior experiences of own ability and another person's epistemic status on children's belief alignment. The question will contribute to a theoretical debate on the coordination of other-dependent learning and own independent learning in young children (e.g., Harris, 2012; Landrum, Eaves, & Shafto, 2015; Sobel & Kushnir, 2013). Does experience of their successes and failures in a given task provide them confidence or lack of confidence to rely upon their own independent vs. other-dependent learning? Specifically, we manipulated two factors: 1) the knowledge states of the informant who provides a verbal report and 2) the absence or presence of children's prior experiences of their difficulty to accurately guess where a sticker is and to successfully retrieve it. In our study, 4-year-old children received a sticker finding game. We predicted the combined effect of the knowledge states of others' testimony and of the prior experience of own difficulty on children's belief alignment. Specifically, we hypothesized that children's prior experience that reduces their confidence about their independent ability and judgment would lead children to be more alert to others' knowledge status. Thus, children would align their belief according to another person's advice more frequently when the person is knowledgeable as compared to when s/he is ignorant – and given the findings of Palmquist et al. (2016), this effect would be specific to children with prior experience of a difficulty to accurately guess the location of the hidden sticker and successfully retrieve it. We decided to investigate children's belief alignment in a context of the sticker finding game because we wanted to choose a task where children are readily able to form their own judgment (via guessing) – unlike expert knowledge such as animal diet or conventional knowledge such as labels of novel objects. Unlike aforementioned prior studies in which an informant provided a verbal report that contradicted children's own observation or initial judgments, children in our study did not explicitly hear a contradicting

verbal report, but were asked to make decisions only after hearing the informant's verbal advice. This paradigm allowed us to examine children's belief alignment in the first place when, as in selective testimony studies, they do not have a direct informational access, but in a domain in which children can experience their own independent ability. The present research is different from Palmquist et al. (2016) in several important ways. In the present research, children did not encounter any informants prior to the testing phase, but only experienced their guessing outcomes. This allowed us to examine the role of children's own ability in their belief alignment independently of the role of informants, as discussed above. In addition, we used a single informant paradigm, allowing children to disregard an informant's verbal report. We thus examined whether or not children align their belief with the informant and compared their belief alignment across different conditions instead of measuring children's preferential belief alignment. Moreover, half of the children were entirely deprived of this prior experience. This is important because this informs us about whether any specific kinds of prior experience, either failure or success, have an effect over and beyond the baseline belief alignment. Finally, informants differed in terms of knowledge states rather than in terms of the helpfulness of their prior pointing. Doing so, therefore, the present paradigm allowed us to examine how children's inference and perception of their own independent ability (of guessing) leads them to accept or reject information offered by an informant and to differentially attend to a new person's knowledge states. Aligning one's beliefs with those of others, however, can occur merely due to social influences such as compliance; because we were interested in children's accurate belief formation, in order to minimize such social influences, we motivated children to be accurate by telling them that they would gain as many stickers as they could accurately locate. We tested 4-year-olds given that this is the age at which children reliably display selective trust in testimony

depending on others' epistemic status (e.g., Koenig & Harris, 2005) and also begin to be able to reject deceptive verbal advice (Heyman, Sritanyaratana, & Vanderbilt, 2013; Mascaro & Sperber, 2009).

Method

Participants. Participants were a total of 79 4-year-old (38 boys, 39 girls, $M = 4.51$ Range = 4.03 ~ 4.96) native German children. Three additional children were tested but excluded from the final data analyses due to an experimenter error ($n = 1$), language problems ($n = 1$), and parent intervention (telling where the sticker was) ($n = 1$). Children participated in one of the four experimental conditions: Prior experience-Knowledgeable speaker condition ($N = 21$, 11 boys, 10 girls, $M = 4.5$); Prior experience-Ignorant speaker condition ($N = 19$, 8 boys, 11 girls, $M = 4.5$); No prior experience-Knowledgeable speaker condition ($N = 20$, 9 boys, 11 girls, $M = 4.5$); No prior experience-Ignorant speaker condition ($N = 20$, 10 boys, 10 girls, $M = 4.5$). Children were all native speakers and largely from middle or upper middle class families. All children were of White European descent. The sample size was determined based on prior research (e.g., Koenig & Harris, 2005; Palmquist et al., 2016).

Design and procedure. Individual children were brought into a laboratory room at [a university name masked for a blind review] and introduced to a main experimenter (E 1) who sat at a table across a child participant. E1 greeted children and said they were going to play a sticker finding game. Children were randomly assigned to one of four conditions. Those children in the Prior experience conditions first received four trials in the "prior experience phase" (described below), in which they experienced the difficulty of accurately guessing the final location of a sticker, followed by four test trials in the "test phase". Children in the No

prior experience condition participated only in the Test Phase, thus they received only four test trials. See Table 1 for the summary of the design.

Prior Experience phase. E1 first presented two different colored boxes (red and blue) and placed them on a table each at an equal distance from the children. The two boxes were otherwise identical. The location of the two boxes was maintained across participants. E1 placed a sticker in a red box and closed both boxes with lids, saying “Look! I’m going to put this sticker in this box.” The sticker was always placed in the red box. Then, E 1 introduced a screen and placed it in front of a child to block the child’s view to the boxes, saying “Now I’m going to put this screen here.” The E1 looked down at the table, and made some rattling noise with the boxes but children could not tell what the experimenter was doing behind the screen (about 5 seconds). Immediately thereafter, E 1 removed the screen and asked children where they thought the sticker was, “Okay, where do you think the sticker is?” After children indicated their responses verbally or by pointing, the experimenter opened the lids of the two boxes revealing the location of the sticker. Children received the sticker each time they made an accurate guess. In order for children to experience uncertainty about the location of a sticker, across four trials, two times the final location of the sticker was not changed (in the original red box) and the other two times it was changed (in the other, blue, box). This did not allow us to directly manipulate the success rate of guessing that each child experiences, but we reasoned that this would generate some variation of the successful guessing among children. The order of the four trials – whether the sticker stayed in the original red box (no switch- N) or moved to the other, blue box (switch- S) - was NSSN or SNNS. Half of the children received the four trials in a NSSN order and, the other half, in the other order.

Test phase. The testing phase was the same as the Prior experience phase except for several changes. First, another experimenter (E2), who was either knowledgeable or ignorant, was introduced by E1 in the beginning of the testing phase. "This is [Steffi]. She is also going to play with us." In the Knowledgeable condition, E2 was present during the entire 4 testing trials, standing next to E1; when the screen was placed on the table to block the children's views to the boxes, E2 said, "I'm going to watch what she (E1) is doing." By contrast, in the Ignorant condition, in every trial E2 left the room just before the screen was placed, after saying, "I forgot something in the other room. I will be back soon" and then returned to the room immediately after the screen was removed. Second, the sticker was initially located in the red box in all four trials and E2 always informed that the location of the sticker was changed. Thus, after the screen was removed in both knowledgeable and ignorant conditions, E2 provided a verbal report, "Now the sticker is in the blue box." Then, E1 asked the children where they thought the sticker was. "Now, where do you think the sticker is?" Finally, during the test phase, the final location of the sticker was not revealed but children were told that when the entire game is over, they would receive as many stickers as they had correctly predicted their location. All children were told at the end that they did a good job and received all four stickers.

Results

Confirmatory analyses

Figure 1 presents the number of trials in which children aligned their belief with the informant. We first analyzed children's scores by conducting a Generalized Linear Model with Experience and Speaker knowledge states as predictors. We found a significant interaction effect of Speaker knowledge and Experience ($\beta = 1.346$, $SE = .146$, $p = .042$). A main effect of

Speaker knowledge was not significant ($\beta = .975, SE = .103, p = .808$) nor was a main effect of Experience ($\beta = .919, SE = .104, p = .415$).

Only in the Prior experience-Knowledgeable informant condition, was children's score above chance ($= 2$), $t(19) = 4.466, p < .001$, Cohen's $d = 1.012$; Prior experience-Ignorant informant: $t(18) = .721, p = .480$; No prior-experience-Knowledgeable speaker: $t(19) = 1.406, p = .176$; No prior experience-Ignorant speaker: $t(19) = 1.868, p = .077$. Thus, only in the prior experience-knowledge informant condition, did children reliably align with the informant.

Next, we specifically tested the hypothesis that children with prior experience of their own ability as compared to those without it were more likely to differentially align with the speaker depending on the speaker's knowledge states. In the Prior experience condition, children were more likely to follow the knowledgeable speaker's advice than the ignorant speaker's advice, $t(37) = 2.641, p = .012$, Cohen's $d = .846$, whereas no such effect of speaker knowledge states was found in the No prior experience condition $t(38) = .23, p = .819$.

Exploratory analyses

The previous set of analyses revealed that children's differential belief alignment with the knowledgeable vs. the ignorant informant was limited to the prior experience conditions. In order to examine whether children's performance in the prior experience conditions as compared to the no-prior experience conditions was indeed due to differential experience of success (not merely because of additional practices or experiences), we asked whether children's specific kind of experience of own ability during the prior experience phase had any impact on their belief alignment. Children's overall guess rate ($M = 1.54, SD = .82$) was below chance, $t(38) = 3.505, p = .001, d = 1.137$. We classified children into a high (above average guess rate) vs. a low (below average guess rate) success group. There were 20 children in the low success group

(11 in the knowledgeable and 9 in the ignorant condition) whereas there were 19 children in the high success group (9 in the knowledgeable and 10 in the ignorant condition). Among the low success group, 9 out of 11 children aligned their belief according to the informant in all 4 trials in the knowledgeable condition whereas 2 out of 9 children did so in the ignorant condition ($p = .022$, Fisher's exact test). By contrast, among the high success group, there was no difference between the knowledgeable condition (5 out of 9 children) and the ignorant condition (2 out of 10) ($p = .170$, Fisher's exact test). Thus, those children who experienced their unsuccessful guess differently aligned with the knowledgeable vs. the ignorant speaker whereas those who experienced successful guess did not. See Table 2.

We further asked whether children's experience of the high vs. low success in guessing affected children's belief alignment over and beyond the baseline belief alignment. Thus, we compared across high vs. low vs. no experience group in each knowledgeable and ignorant condition. We first identified those children who consistently aligned their belief according to the informant in all 4 trials. Children's consistent belief alignment in the knowledgeable speaker conditions differed across three experience groups (No experience: 6 out of 20; High success: 5 out of 9; Low success: 9 out of 11) $\chi^2 = 7.77$, $df = 2$, $p = .021$ whereas the groups did not differ in the ignorant speaker conditions (No experience: 7 out of 20; High success: 2 out of 10; Low success: 2 out of 9) $\chi^2 = .95$, $df = 2$, $p = .622$. Further analyses revealed that children's belief alignment in the knowledgeable speaker conditions differed only between the no experience vs. the low success group ($\chi^2 = 5.70$, $df = 1$, $p = .017$); no experience vs. high ($\chi^2 = .81$, $df = 1$, $p = .368$); high vs. low ($\chi^2 = .62$, $df = 1$, $p = .433$). Therefore, children's experience of low success influenced their belief alignment with the knowledgeable informant more than the baseline, no

experience condition. Children's experience type, however, did not have an effect on their belief alignment with the ignorant informant.

Discussion

The present research demonstrates that young children's belief alignment with others is modulated by the combined influences of their prior experiences with a specific task and of an informant's knowledge states. Our findings corroborate current approaches on the nature of children's belief formation and learning as they demonstrate that children flexibly make their decisions guided by both their own experience and others' opinions (Sobel & Kushnir, 2013).

We found that children were more likely to align with the informant's verbally reported belief when the informant was knowledgeable than when she was ignorant: this effect, however, only appeared when children had had the prior experience of failing to accurately guess an actual state of affairs, and of being unable to successfully retrieve an object. In the Prior experience condition, during the experience phase, children immediately observed that they failed at accurately guessing the location of the sticker (on average 38 percent correct). By contrast, in the No-prior experience condition, although children might have reasoned that the experimenter could change the final location of the sticker behind the screen during the test phase, they never saw the final location of the sticker; thus, they lacked the explicit experience that children in the Prior experience conditions had had. It is possible, then, that these prior experiences led children in the Prior experience conditions to be less confident in their own judgment, which in turn led them to carefully attend to the knowledge states of others and align their beliefs accordingly.

One might argue that children in the prior experience conditions simply had more experience of playing the game than children in the no prior experience conditions. Our final sets of analyses, however, reveal that children did not just have more experiences but rather had

differential experiences of whether or not the outcomes are predictable. Note that those children who belonged to the low success group differed in terms of whether they consistently followed the informant's verbal report in all four trials depending on the knowledge states of the informants. By contrast, the high success group did not differ. In addition, children in the low success group (but not the high success group) were more likely than those without experience to align with the knowledgeable informant. Future studies could further address children's differential experience by directly manipulating children's guess rate during the prior experience phase (along with their rating of their own confidence) and examining whether they align their belief accordingly.

A growing number of recent studies of metacognition demonstrates that young children use their (un)certainly to guide their own decisions and behaviors. For example, children as young as 3 years old are less likely to choose to respond to a trial when they are uncertain about the correct answer (Balcomb & Gerken, 2008) and display more information seeking behaviors in such cases (Coughlin, Hembacher, Lyons, & Ghetti, 2015; Goupil, Romand-Monnier & Kouider, 2016 showed that 20-month-old infants seek for help when they are uncertain about their memory). This early emerging metacognitive ability is also documented at a brain-level (Goupil & Kouider, 2016 for 12-month-old infants, see also Filevich et al., in press for 5-year-olds). Additionally, studies point to the effects of one's belief and perception about self-ability on task performance and achievements (e.g., Dweck, Chiu, & Hong, 2009). In the present research, therefore, children's pattern of decisions may be explained in terms of their overall uncertainty of correctly locating the object of interest based on their prior experiences with the task. Future studies should empirically test this idea more systematically, however. To explore

this possibility, one could ask children to rate their own confidence level along with the manipulation of children's guess rate discussed above.

Notably, our study extends research by Palmquist and colleagues (2016). These authors demonstrated that 4- and 5-year-old children displayed selective trust for an informant only when they previously experienced a failure in a task: when they experienced no failure, then they did not show selectivity. We sought to address the limitations of Palmquist et al. (2016) by adopting a single informant paradigm, ensuring that children's experience of their success is unambiguously attributed to their own ability, and including a baseline condition (i.e., no prior experience condition). Our findings are consistent with Palmquist et al. (2016) in that children's prior experience of success vs. failure modulates children's belief alignment. The findings, however, go beyond Palmquist et al. (2016) by documenting the role of *prior experience of independent ability* (in a specific task) that is uniquely their own in their belief alignment with *new informants differing in knowledge states*, and together highlight that children flexibly incorporate both their own experience and others' information into their learning (see Landrum et al., 2015; Sobel & Kushnir, 2013).

Note that in the No-prior experience conditions, even when the informant was knowledgeable, children were no more likely to align their epistemic decision than when the informant was ignorant. At a first glance, the absence of an informant effect in the No-prior experience condition may be puzzling, given a body of evidence showing that young children selectively learn from others (e.g., Koenig & Harris, 2005; Sabbagh & Baldwin, 2001; but see also Kim, Paulus, & Kalish, 2016). However, under closer scrutiny, the picture is not entirely straightforward: at times children selectively learn from others; at other times, they seem to learn indiscriminately (Hermes, Behne, & Rakoczy, 2018; Jaswal & Kondrad, 2016 for reviews). In

our study there are several reasons that might explain why children did not prefer the informant's verbal advice even when she was better informed than the children themselves. First, the informant's intention was not made clear. Children never had a chance to know whether she honestly reported the location of a sticker. Additionally, the informant in our study was a bystander – rather than a collaborator or a helper as in prior studies – who was not introduced to a child in the beginning of the study and did not directly address to the children (see Csibra & Gergely, 2005 on pedagogical cues). Even when s/he was introduced, it was very brief in passing (“she is going to play with us”). Finally, the location of a sticker may be considered as not as important or meaningful to learn as object names (on generalizability: see Csibra & Gergely, 2005). Depending on the learning domain, children's perception about their own capability may vary. Children in the present research could be overconfident about their ability to accurately guess the location of the object, whereas children in prior studies may have been less confident about their own decisions concerning expert knowledge (e.g., animal diets) or conventional knowledge (e.g., object labels). Thus, they may be more prone to others' verbal report when it comes to learning about novel labels or expert knowledge than about the sticker location. Nevertheless, the present findings suggest yet another important modulating factor in children's selective trust in testimony – children's prior experiences of their own (in)capability in a given task.

In the present research we investigated two factors that modulate children's trust in testimony: an informant's knowledge states and presence/absence of children's prior experiences of incapability. However, as discussed above, other factors might affect children's dispositions to selectively align their beliefs with others. Future studies should explore the role of informants, knowledge type, and children's own confidence level. Testing the role of these

additional factors would help us have a fuller picture of the conditions under which children flexibly and accurately form their judgments and beliefs.

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	Experience Phase ----->	Test phase
Prior experience- knowledgeable	Yes	Knowledgeable informant
Prior experience-ignorant	Yes	Ignorant informant
No prior experience-knowledgeable	No	Knowledgeable informant
No prior experience- ignorant	No	Ignorant informant

Table 1. The design of the four conditions

	Low success (n = 20)	High success (n = 19)
Knowledgeable	9 out of 11	5 out of 9
Ignorant	2 out of 9	2 out of 10

Table 2. The number of children who consistently aligned their belief according to the informant's report in all four trials.

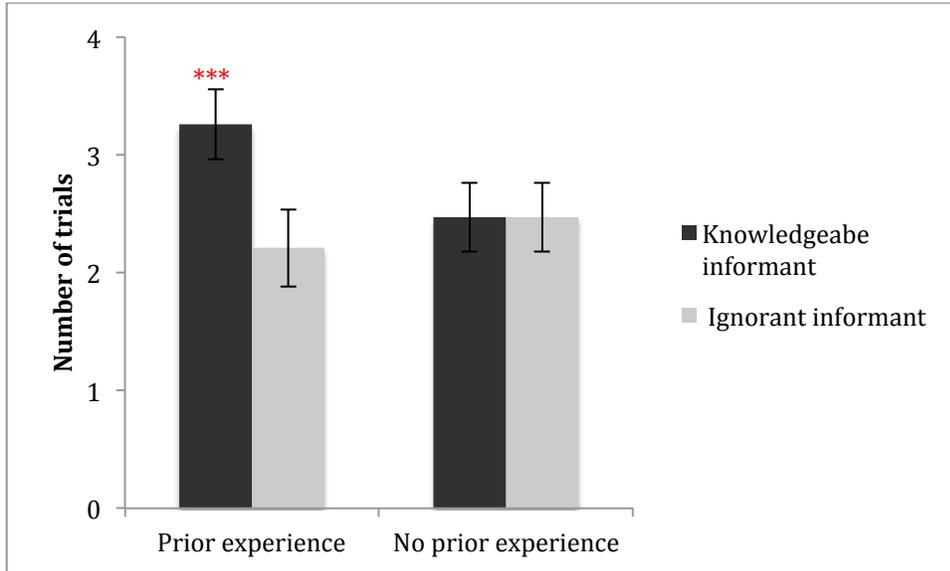


Figure 1. Children's belief alignment as a function of an informant's knowledge state and children's prior experience of own incapability. Error bars indicate Standard Errors. *** $p < .001$