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Young children update their trust in an informant's claim when experience tells them otherwise

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ABSTRACT

Across two experiments, an adult informant presented 220 preschoolers (34–71 months of age) with either a correct claim or an incorrect claim about how to activate a music box by using one of two toy figures. Children were then prompted to explore the figures and to discover whether the informant's claim was correct or incorrect. Children who discovered the claim to be incorrect no longer endorsed it. Moreover, their predictions regarding a new figure's ability to activate the music box were clearly affected by the reliability of the informant's prior claim. Thus, children reassess an informant's incorrect claim about an object in light of later empirical evidence and transfer their conclusions regarding the validity of that claim to subsequent objects.

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Introduction

When learning about the world, children can use multiple sources of information. Although direct evidence is typically considered an unambiguous source of information, particularly for physical and observable entities, such evidence is not always available. In fact, a large amount of the information that children acquire comes through the testimony of others. Nonetheless, although the testimony of others can provide vital information about less accessible or unobservable phenomena, it can also be faulty. Thus, learning when others' testimony should be given more or less weight than firsthand experience poses a key challenge for children's developing understanding of the world around them.

From a very young age, children appreciate that testimony from other people can be a reliable way to learn, and they appropriately distinguish trustworthy testimony from misleading testimony (Harris, Koenig, Corriveau, & Jaswal, 2018). The development of such "selective trust"—knowing who to trust for information and when—can be observed already in the second year of life (for reviews, see, e.g., Harris & Lane, 2014; Mills, 2013) and improves over the preschool years (Clément, Koenig, & Harris, 2004; Koenig & Harris, 2005). Studies assessing children's ability to judge *who* they should trust for information have generally focused on their judgments in the face of two conflicting and concurrent claims. However, such conflicts may be infrequent in children's everyday lives. By contrast, children may often acquire information at one point and then later gather contradictory information. For example, suppose that an informant shows children a music box and claims to know which of two toy figures makes it work. If children subsequently discover through direct exploration that this claim is either true or false, will they reassess the informant's claim and the informant in light of this empirical evidence? This was the central question in our two experiments. More specifically, in the first experiment, we asked whether 3- to 5-year-old children will reassess an informant's claim when they later acquire conflicting firsthand evidence. In the second experiment, we extended this assessment by asking whether children also reassess an informant's claim about a future event and whether that reassessment affects their predictions about the functioning of a novel object in a subsequent task. Below, we situate these questions in relation to past findings.

Weighing information from conflicting sources

When children receive divergent information from different sources (e.g., a verbal claim contradicted by visible evidence), they must weigh these sources against each other to decide which source to rely on. A source's reliability can be weighed immediately—for example, when a verbal claim is immediately weighed against prior observation. Alternatively, it can be weighed retrospectively—for example, when subsequent visible evidence leads children to reassess a verbal claim they accepted earlier.

Previous studies have shown that preschool children find it challenging to disregard the claim of a single inaccurate informant in light of *prior* counterevidence (Jaswal, 2010; Jaswal et al., 2014; Ma & Ganea, 2010). Given the sense of authority and expertise likely conveyed by an adult informant, the task of disregarding a statement may be challenging even when it appears unlikely in light of prior evidence. This may be especially true when there is no alternative statement from another adult available for direct comparison or when children are uncertain about the prior evidence. By contrast, preschool children may find it easier to weigh counterevidence against an informant's claim when that evidence is acquired *after,* rather than before, the presentation of the claim. Indeed, Scofield and Behrend (2008) showed that some 4-year-olds revised their belief in an informant's labels for novel objects when the informant subsequently provided erroneous labels for familiar objects. This tendency to revise was not found among 3-year-olds. Similar results were obtained by Bridgers, Buchsbaum, Seiver, Griffiths, and Gopnik (2016); in their study, 4- and 5-year-olds who first heard an informant's testimony about the functioning of a music box and then later saw conflicting evidence were subsequently less likely to defer to the informant's testimony in an ongoing task compared with children who had not received such conflicting evidence. Both studies imply that older preschoolers are able to reassess an informant's claim in light of subsequent counterevidence. However, children in the study by Bridgers et al. (2016) were *presented* with counterevidence by a second informant;

they did not need to *seek* this evidence for themselves. Thus, children may have weighed the nonverbal information presented by one informant against the verbal claim made by another informant. Admittedly, children correctly discarded the first informant's claim in light of the second informant's evidence, but it remains an important open question whether they would reach similar conclusions when left to their own devices—notably to acquire the evidence for themselves rather than be presented with it by an adult.

Given that preschoolers realize that empirical evidence should be weighed more heavily than an informant's testimony, as indicated by Bridgers et al.'s (2016) study, it is reasonable to expect that they will do the same when acquiring evidence through their own active exploration. Indeed, earlier work suggests that preschoolers may weigh information even more effectively if they are given the chance to actively engage with the task (Jaswal, 2010; Ma & Ganea, 2010). Moreover, preschoolers show an increased reliance on empirical evidence over testimony with age (Bernard, Harris, Terrier, & Clément, 2015) and show improved learning following evidence they produce themselves over evidence they observed (Kushnir & Gopnik, 2005; Kushnir, Wellman, & Gelman, 2009).

On the other hand, given children's lack of prior experience with a novel experimental task and their general receptivity to adults as useful sources of information, they might consider the counterevidence they acquire themselves as indicating their own incompetence rather than the unreliability of the informant. For example, Vanderbilt, Heyman, and Liu (2014) showed that although 3-year-olds were able to discard an informant's incorrect claim once an alternative claim was readily available, they were not likely to discard it when they needed to seek out relevant information for themselves. Indeed, young preschoolers might not yet realize that they could resolve issues of epistemic uncertainty by seeking further information themselves (see also Ronfard, Chen, & Harris, 2018).

Accordingly, the first experiment was designed to answer two questions. First, are preschoolers able to revise their belief in an informant's claim when they acquire counterevidence through their own direct exploration? Second, when given the chance to actively engage with objects, do 3-year-olds revise their belief in an unreliable informant as much as older children do?

Transferring information across situations

The second experiment examined children's ability to transfer information across situations. Although children appropriately distinguish trustworthy testimony from misleading testimony from an early age when the claims of two informants are directly contrasted (Harris et al., 2018), preschoolers sometimes struggle to use information about a single informant's prior reliability to make inferences about that informant's future reliability. For example, when children must weigh inferences regarding the reliability of a single informant against their own knowledge of gravity, 3-year-olds persistently struggle to disregard the unreliable testimony of that informant (Jaswal, Croft, Setia, & Cole, 2010). Even when they repeatedly saw that an object was located in a different cup than where the informant had told them, 3-year-olds continued to follow the informant's advice, whereas 4- and 5-year-olds were more likely to correctly disregard the informant's claim. Similarly, Bridgers et al. (2016) found that 4- and 5-year-olds who saw that a music box did not function in accordance with an informant's claim were unlikely to follow the informant's claim both when solving the ongoing task and when being provided with a new claim by the same informant in a subsequent task. Scofield and Behrend (2008) showed that 4-year-olds who revised their belief in an informant's labels for novel objects also maintained this shift over time. In sum, these studies show that 4- and 5-year-olds can detect informant inaccuracy and transfer their inferences regarding an informant's reliability from one task to another subsequent task. Accordingly, in Experiment 2, we asked whether children will make such a transfer when they themselves have gathered the counterevidence about one figure and then later are asked about the functioning of a novel untested figure.

Overview

Across two experiments, we examined whether children reassess an informant's claim in the wake of subsequently acquired counterevidence. In Experiment 1, an informant presented children with a music box and claimed to know which of two figures made it work. Later, children discovered—through

their own direct exploration—that this claim was either true or false. We asked whether preschool children reassess an informant's earlier claim after gathering such empirical evidence and whether their reassessments vary with age. We expected children exposed to the reliable informant to stick to their initial judgment about which figure made the music box play. By contrast, we expected children exposed to the unreliable informant to revise their initial belief in the informant's claim and to endorse the alternative figure instead. We tentatively expected 3-year-olds to revise their belief in an informant's claim, given the opportunity to acquire evidence through firsthand exploration, but to do so less consistently than older children.

Experiment 1

Method

Participants and attrition

Participants were recruited from child-care centers across Oslo, Norway, thereby reflecting the overall diversity of Oslo's population. The final sample consisted of 107 preschool-aged children (3-year-olds: n = 48 [29 girls], M_{age} = 40.98 months, range = 34–47 months; 4-year-olds: n = 59 [28 girls], M_{age} = 52.93 months, range = 48–60). An additional 9 children were tested but excluded from the final analyses. One child did not answer any of the questions. Three children quit after the Introduction Phase. One child experienced some equipment problems. The remaining 4 children answered the first question in the Introduction Phase incorrectly, indicating that they might not have understood the claim made by Informant 1.

Informed consent was obtained from children's parents in advance of testing. In addition, children were asked prior to testing whether they would like to take part, following which 2 children declined. Participating children were tested individually in a quiet room of the child-care center by a research assistant and the first author. The study was approved by the local authorities on data protection.

Materials, design, and experimental task

The study employed a between-participants design, with children randomly assigned to one of two conditions: *Reliable Informant* (R; n = 51) and *Unreliable Informant* (UR; n = 56). Because children are particularly responsive toward testimony from a knowledgeable person (Lane & Harris, 2015), the first informant presented herself as an expert, whereas the second informant presented herself as naïve to the task.

The experiment consisted of four phases played out in a fixed order following a predefined script (see Fig. 1 for an illustration). The Introduction Phase began with Informant 1 taking a seat across the table from the child and introducing the task by saying, "You know what? I am an expert at music boxes like this one, and I've played a lot with this toy," and placing a hand on the music box on the table between them. Informant 1 continued, "The exciting thing about this music box is that it can

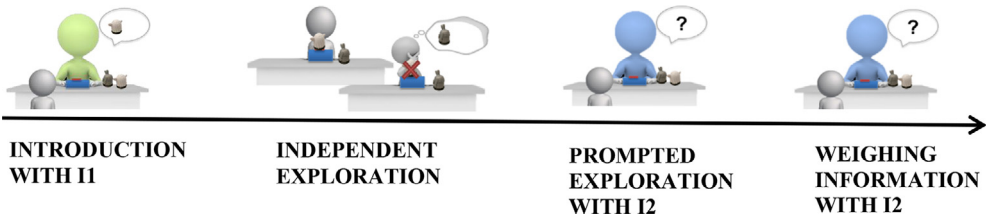

Fig. 1. Illustration of procedure for Experiment 1. In the Introduction Phase, the child met Informant 1 (I1) and was given information about how the music box worked. The child was then left alone for 30 s in the Independent Exploration Phase, providing the child with an opportunity to explore the music box on his or her own. In the Prompted Exploration Phase, Informant 2 (I2) entered the room and prompted the child to demonstrate how the music box worked. In the Weighing Phase, Informant 2 asked the child to weigh the two sources of information against each other.

play music if you put a toy on top of it here [touches the top of the music box]. Because I've played a lot with this music box, I know which one of these toys can make the music box play," and placed a white toy figure and a gray toy figure on the table. Then came the central part of this phase. Informant 1 indicated which figure was the functioning figure: "And it's this figure that can make it play." As the child discovered later in the Independent Exploration Phase or the Prompted Exploration Phase, this claim was either correct or incorrect, showing the informant to be either reliable or unreliable. To ensure that the child had understood the information provided, Informant 1 asked a control question: "Can you point to the figure that can make the music box play?" If the child pointed correctly, Informant 1 offered praise and confirmed the child's response by saying: "Well done, that's correct." However, if the child responded incorrectly, Informant 1 repeated the instructions regarding which figure was the functioning one before restating the question. After the child had provided the correct response, Informant 1 excused herself under the pretense of going to look for a different toy. She assured the child that she would be back in just a little while and informed the child, "Meanwhile, you can try out the toy if you like," and then left the room.

The child was now left alone to explore the music box and the figures for 30 s; this period constituted the Independent Exploration Phase and was videotaped for later coding. Note that during this phase half of the children had the opportunity to discover that what they had been told by Informant 1 was correct (i.e., those in the Reliable Informant condition), whereas the remaining children had the opportunity to discover that what they had been told by Informant 1 was incorrect (i.e., those in the Unreliable Informant condition).

Because previous work has found that children hesitate to test an informant's claim (Ronfard et al., 2018), and because their tendency to explore an object may be lessened when an informant provides a pedagogical instruction (Bonawitz et al., 2011), we were uncertain of the extent to which children would spontaneously test the figures when left alone. Thus, after the child had been alone for 30 s and irrespective of whether children had or had not placed either figure on the music box, Informant 2 entered the room. This naïve second informant was introduced to prompt the child to explore the figures, ensuring that all children had acquired evidence about both figures' ability to make the music box play. The Prompted Exploration Phase began with Informant 2 looking excitedly toward the figures on the table and saying, "Wow, look at that! I've never seen something like that before!" and then lifting them up and inspecting the two figures keenly. Next, Informant 2 prompted the child to demonstrate how the music box functioned by asking, "Can you show me how it works?" When the child placed a figure on the music box, one figure worked and one did not. If the figure that the child chose in response to the prompt from Informant 2 did in fact make the music box play, Informant 2 exclaimed, "Wow! It plays music! What happens if you place the other figure on the box?" The child was thereby prompted to place the other figure on the music box. When this other figure proved to be unable to make the music box work, Informant 2 simply stated, "Hmm ... nothing is happening." If the nonfunctioning figure was placed first on the music box, the order of Informant 2's responses was reversed (i.e., "Hmm ... nothing is happening. What happens if you place the other figure on the box?"). If the child hesitated to place either figure on the box, Informant 2 offered to place a figure on the box and asked the child which figure she should use. These questions and prompts ensured that all children gained empirical feedback about the effectiveness of both figures.

Finally, Informant 2 initiated the Weighing Phase by asking, "When you tried the figures just now, which one was it that could make the music box play?" If the child hesitated to point to either figure, the informant continued by saying, "Was it this one? Or was it this one?" pointing first to the white figure and then to the gray figure. Next, she asked, "The other lady who was here, did she tell you which figure it was that could make the music box play?" Again, if the child hesitated to point, the informant continued by saying, "Did she say that it was this one? Or did she say it was this one?" pointing first to the white figure and then to the gray figure.

Statistical analyses

In the following analyses, we examine (a) children's initial acceptance of the claim made by Informant 1, (b) children's independent exploration following that claim, (c) children's initial judgment of Informant 1′s claim, and (d) children's "post-evidence" replies in the Weighing Phase.

The experimental session was coded by a research assistant blind to the hypotheses of the study and by the first author. Overall reliability was estimated at 96.9%. Following the reliability assessment, discrepancies due to coding errors were corrected and discrepancies due to coder disagreement were resolved through discussion or, if they could not be resolved, the coding of the research assistant was used.

All analyses were performed using SPSS Statistics Version 25 (IBM Corp., Armonk, NY, USA). Details of nonsignificant statistical effects can be found in the online supplementary material.

Results

Children's initial acceptance of Informant 1′s claim (Introduction Phase)

When asked by Informant 1 to indicate which of the two figures was the functional one, immediately after Informant 1 had made her claim, the majority of children pointed to the named figure (overall: n = 90, 84.1%; R: n = 42, 82.4%; UR: n = 48, 85.7%), signaling that they accepted Informant 1′s claim whether or not it would subsequently prove to be reliable. Some children did not point correctly at first and were provided with a restatement of the claim and had the question repeated before they also pointed to the endorsed figure (overall: n = 17, 15.9%; R: n = 9, 17.6%; UR: n = 8, 14.3%). Unsurprisingly, at this initial stage, there was no difference between the two conditions in children's level of acceptance of the claim made by Informant 1, $\chi^2(1, 107) = 0.23$, $p = .635$.

Children's independent exploration (Independent Exploration Phase)

We first coded whether children tested the effect of the figures by placing the endorsed figure, the unendorsed figure, or both figures on the music box. Children's overall pattern of exploration was quite similar across the two conditions, with only a minority of children in each condition spontaneously testing one or more figures (overall: n = 12, 11.2%; R: n = 4, 7.8%; UR: n = 8, 14.3%), $\chi^2(1, 107) = 1.11$, $p = .292$. The lack of difference between the two informant conditions in testing behaviors implies that children appraised the two figures similarly regardless of condition.

Children's initial judgment of Informant 1′s claim (Prompted Exploration Phase)

Because we were uncertain whether all children would spontaneously test the figures when left alone, the second (naïve) informant prompted all children to test them by asking, "Can you show me how it works?" For children who did not want to test the figures themselves (n = 28, 26.2%), the informant provided the children with a demonstration of the two figures but made sure to ask the children which figure they should use first.

Not surprisingly, especially given the paucity of testing behaviors in the Independent Exploration Phase, the majority of children in both conditions initially demonstrated with, or asked Informant 2 to initially demonstrate with, the figure that Informant 1 had originally identified as the effective figure (overall: n = 91, 85.5%; R: n = 44, 86.3%; UR: n = 47, 83.9%). Thus, the majority of children maintained their initial acceptance of the testimony that had been provided by Informant 1 in the Introduction Phase. Importantly, the rate of acceptance did not differ across the two conditions, $\chi^2(1, 107) < 0.01$, $p = .934$. Following the initial demonstration, all children were prompted to also test the alternative figure. Throughout this testing, children in the Reliable Informant condition continued to receive information consistent with Informant 1′s original testimony—that only the endorsed figure makes the music box play. However, children in the Unreliable Informant condition now learned that it is in fact the alternative figure that can make the music box play. Thus, from their exploration of the figures and the music box, children gathered either confirming or disconfirming evidence regarding the testimony of Informant 1.

Children's post-evidence judgment of Informant 1′s claim (Weighing Phase)

To assess whether the newly acquired evidence would alter children's endorsement of Informant 1′s earlier testimony, Informant 2 asked children which of the figures was the functional one (i.e., to elicit children's post-evidence judgment). Children's responses to this question were first coded in terms of which figure they pointed to (i.e., the functioning figure, the nonfunctioning figure, both figures, or the music box). Four children did not respond to this first question appropriately (3 children indicated that both figures worked and 1 child said "I don't know") and therefore were excluded from

further analyses. Next, to ensure that children still remembered the first informant's testimony, and to check whether children had in fact made a *shift* in judgment, the final sample included only those children who had originally endorsed the informant's testimony when prompted to explore the figures as well as correctly remembered the endorsement when later questioned about it at the end of the Weighing Phase, yielding a final sample of 72 for the following analysis (R: n = 36; UR: n = 36).

After being asked by Informant 2, which of the figures was the functional one, nearly all children in the Reliable Informant condition correctly pointed to the functional figure (n = 33, 91.7%). Thus, as shown in Fig. 2, most children in the Reliable Informant condition continued, unsurprisingly, to make the same judgment as they had made before receiving empirical evidence regarding the functioning of the figures. Importantly, however, most children in the Unreliable Informant condition also pointed to the functional figure (n = 29, 80.6%). That is, following empirical evidence that conflicted with the earlier claim made by Informant 1, the majority now shifted their judgment and identified the figure they had not previously endorsed as the functional one (i.e., an increase from 16.1% to 80.6%). Thus, a greater proportion of children shifted their judgment in the Unreliable Informant condition as compared with the Reliable Informant condition, $\chi^2(1, 72) = 38.03$, $p < .001$. Similar shifting behavior was observed among 3-year-olds, $\chi^2(1, 28) = 12.25$, $p = .001$, and 4-year-olds, $\chi^2(1, 44) = 26.26$, $p < .001$.

Although we initially intended for all children to acquire evidence through their own active exploration in the Prompted Exploration Phase, we found that a proportion of children did not want to do so, thereby creating a divide between active (albeit prompted) explorers (n = 51, 70.8%) and passive observers (n = 21, 29.2%). Post hoc analyses revealed that shifting behavior was similarly affected by the reliability of Informant 1 both for prompted explorers (R shift: n = 3, 11.5%; UR shift: n = 19, 76%), $\chi^2(1, 51) = 21.59$, $p < .001$, and for passive observers (R shift: n = 0, 0%; UR shift: n = 10, 90.9%), $\chi^2(1, 21) = 17.36$, $p < .001$.

Discussion

There were two aims of Experiment 1. First, we asked whether children would reassess an informant's claim following the acquisition of conflicting empirical evidence through firsthand exploration. We found that most children initially accepted the claim made by Informant 1. However, once children had tested the figures and gained evidence that either confirmed or conflicted with the claim made by Informant 1, the majority of children in the Unreliable Informant condition changed their judgment regarding the functioning of the figures. Moreover, children who acquired conflicting evidence through their own active (albeit prompted) exploration were just as likely to reject the first

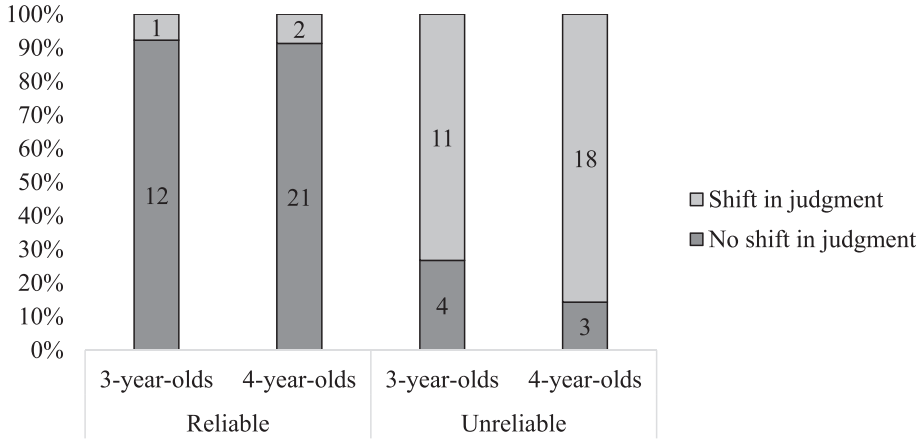

Fig. 2. Percentages and numbers (inside the bars) of children who did and did not shift their judgment regarding the functional figure following empirical evidence in the Reliable Informant and Unreliable Informant conditions.

informant's claim as those who passively observed the naïve informant's demonstration. Second, we asked whether children's age contributed to variation in their belief revisions. As expected, 3- and 4-year-olds were equally able to revise their belief in the first informant's claim, placing greater weight on empirical evidence as compared with a testimonial claim when given the chance to actively engage with objects.

It is worth noting that most children in both conditions remembered what Informant 1 had said even after acquiring direct counterevidence and after having responded to the question of which figure was the functional one—because they correctly identified the figure initially endorsed by Informant 1. This is important because it shows that the majority of children held both pieces of information in mind while weighing their subsequent empirical experience against the informant's initial claim. Thus, it was not the case that children forgot what the informant had said in the wake of empirical evidence. They remembered what the informant had said but discounted it in favor of the empirical evidence.

However, there is a reasonable objection to the conclusion that children reassessed their belief in the claim made by Informant 1. Recall that Informant 2 asked children which of the figures *was* functioning when they tried them out *just now.* Thus, it is unclear whether children were simply observing and accurately reporting on what they had observed or whether, despite remembering what Informant 1 had originally claimed, they also now recognized that claim to be false, including with respect to any future placement of the figures. Thus, one aim of Experiment 2 was to assess whether children would come to similar conclusions when questioned about a future placement.

Another central aim of Experiment 2 was to investigate whether children's judgments about the reliability of the informant's claim would affect their later inferences regarding its applicability to similar situations, and whether this would vary depending on the specificity of the claim. That is, when asking children to make inferences about a future event, it is relevant to consider whether the claim actually implicates future relevance. If the claim is framed to focus very specifically on a certain object (e.g., "*this* white figure can make the music box play") and this claim turns out to be wrong, there is little reason for children to think that the claim will be true when a second identical-looking figure is presented. On the other hand, if the claim is framed more generically (e.g., "white figures like *these* can make the music box play"), it is reasonable for children to think that a similar-looking figure might work even if the first one did not. As shown in Experiment 1, even a single counterinstance can reduce children's belief in a specific claim. However, it might not necessarily give children good reason to stop trusting a more generic claim, particularly when presented with a novel yet identical-looking and untested figure in a subsequent task. As a secondary aim, we also asked whether children's age would affect children's transfer of inferences. Given the findings of Experiment 1, and given the opportunity to actively gather evidence through direct exploration, we expected that 3-year-olds' ability to transfer inferences across tasks would be similar to that of older children. Given that such generalizations may be slightly more challenging than inferring from information within the initial task situation, and with prior studies mainly focusing on 4- and 5-year-olds, Experiment 2 also included a group of 5-year-olds in addition to 3- and 4-year-olds.

To summarize, Experiment 2 further investigated children's weighing of information from conflicting sources by asking whether children are able to (a) truly reassess the accuracy of an informant's claim following subsequent counterevidence acquired through firsthand exploration (i.e., accurately remember that claim and also anticipate that it will be incorrect in a future instance) and (b) transfer inferences regarding the reliability of the claim across situations. Finally, we asked whether (c) these processes are affected by children's age.

Experiment 2

Method

Participants and attrition

Participants were recruited from child-care centers across Oslo and nearby areas, with the final sample of Experiment 2 consisting of 113 preschool-aged children (3-year-olds: n = 28 [19 girls],

M_{age} = 41.23 months, range = 35–47; 4-year-olds: n = 36 [18 girls], M_{age} = 54.03 months, range = 48–59; 5-year-olds: n = 49 [28 girls], M_{age} = 64.39 months, range = 60–71). An additional 10 children were tested but excluded from the final analyses. One child wanted to quit after the Introduction Phase. Two children seemed to have a language problem given that none of their responses during any phase of the experiment demonstrated an understanding of the task. One child answered the first question in the Introduction Phase incorrectly, indicating a lack of understanding of the first informant's initial claim. The remaining 6 cases were excluded due to equipment problems.

Testing and procedures for informed consent were otherwise equivalent to those in Experiment 1. The study was approved by the local authorities on data protection.

Materials, design, and experimental task

Using a between-participants design, children were first randomly assigned to one of four conditions depending on the reliability of the informant (i.e., reliable vs. unreliable) and the format specificity of the informant's claim (i.e., generic vs. specific). However, because our data revealed no difference in children's behavior depending on the format of the testimony, below we collapse across format and focus on the two informant conditions: *Reliable Informant* (R; n = 53) and *Unreliable Informant* (UR; n = 60).

Similar to Experiment 1, Experiment 2 consisted of several phases, each played out in the same order following a predefined script (see Fig. 3). However, in the wake of questions arising from the first experiment, some notable changes were introduced. First, in the Introduction Phase, half of the children heard the informant's claim formulated as a specific claim (i.e., "It's *this white figure* that can make it play"), whereas the other half heard the claim formulated as a generic claim (i.e., "It's white figures *like these* that can make it play"). As in Experiment 1, Informant 1 asked a control question to ensure that children had understood the information provided, "Can you point to the figure that can make the music box play?" If the child responded incorrectly, Informant 1 repeated the instructions regarding which figure was the functioning one before restating the question. Second, because very few children had spontaneously explored in Experiment 1, and to streamline the procedure, children in Experiment 2 were left alone for only about 5 s in order for the experimenters to change places. Spontaneous exploration of the figures by children was prevented by placing the figures inside a transparent box. Thus, all children now explored the material together with Informant 2 in the Prompted Exploration Phase. Third, to better determine whether children simply remembered what happened when they tested the music box or truly reassessed the informant's claim, we changed the wording of the control questions in the Weighing Phase. That is, Informant 2 now asked the following three questions: (a) "If I wanted to make the music box play *one more time,* which figure *should* I use?"; (b) "The other lady who was here, did she tell you which figure could make the music box work?"; and (c) "Was what she said right or wrong?" No feedback was provided for any of these questions. In addition, we added a final Generalization Phase in which we introduced a generalization task to

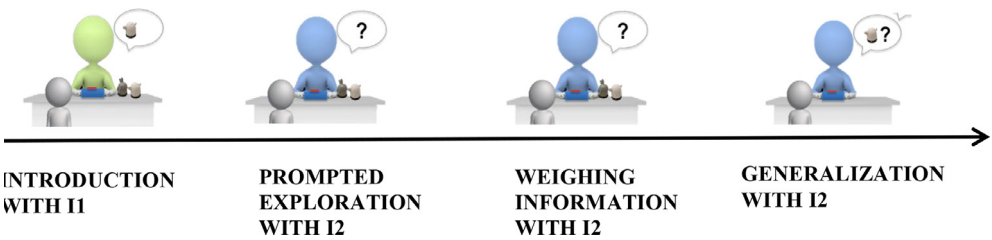

Fig. 3. Illustration of procedure for Experiment 2. In the Introduction Phase, the child met Informant 1 (I1) and was told how the music box worked. The child was left alone for 5 s while the experimenters changed places. In the Prompted Exploration Phase, Informant 2 (I2) entered the room and prompted the child to demonstrate how the music box worked. In the Weighing Phase, Informant 2 asked three test questions prompting the child to weigh information from the two sources. Finally, in the Generalization Phase, Informant 2 brought out a new figure and asked the child whether he or she thought it could make the music box play.

examine whether children transferred their inferences about the first informant's claim to a subsequent task. More specifically, Informant 2 continued to the Generalization Phase by stating, "Oh! Look at this, I have another figure in my bag. Maybe you can tell me if it will work." She then took out a new figure looking identical to the originally endorsed figure, placed it on the table, and asked, "Do you think that this one will make the music box work?" No feedback was given after children's responses to these questions. However, if children answered something other than "yes," "no," "maybe," or "I don't know," the question was repeated.

Statistical analyses

In the following analyses, we examine (a) children's initial acceptance of the claim made by Informant 1, (b) children's "pre-evidence" judgment of Informant 1's claim, (c) children's "post-evidence" judgment of Informant 1's claim, (d) children's post-evidence reliability evaluation of Informant 1 as a provider of information, and (e) children's transfer of inferences regarding the validity of the claim to a new task.

The experimental session was coded by a research assistant blind to the hypotheses of the study and by the first author. Overall reliability was estimated as 98.8%. All analyses were performed using SPSS Statistics Version 25. Details of nonsignificant statistical effects can be found in the supplementary material.

Results

Children's initial acceptance of Informant 1′s claim (Introduction Phase)

When initially asked by Informant 1 to indicate which of the two figures was the functional one, the majority of children pointed to the named figure (overall: n = 100, 87.7%; R: n = 46, 86.8%; UR: n = 54, 90%), signaling that they accepted Informant 1′s claim. Some children did not point correctly at first and were provided with a restatement of that claim and had the question repeated before they also pointed to the endorsed figure (overall: n = 13, 11.4%; R: n = 7, 13.2%; UR: n = 6, 10%). As expected, there was no difference in level of acceptance between the two reliability conditions, $\chi^2(1, 113) = 0.28$, $p = .594$.

Children's pre-evidence judgment of Informant 1′s claim (Prompted Exploration Phase)

To ensure that all children gained empirical evidence regarding the functioning of the music box, children were prompted to test the figures by Informant 2 asking, "Can you show me how it works?" A majority of the children demonstrated the functioning of the music box themselves (n = 84, 74.3%), whereas some children wanted Informant 2 to perform the demonstration and pointed out which figure she should use (n = 28, 24.8%). One child did not wish to either demonstrate or let the informant test out the figure (0.9%); therefore, this child was excluded from further analyses, reducing the sample to 112 children for the remaining analyses.

As in Experiment 1, the majority of children in both conditions initially demonstrated with, or asked Informant 2 to initially demonstrate with, the figure that the first informant had identified as the effective one (overall: n = 109, 97.3%; R: n = 53, 100%; UR: n = 56, 94.9%). Thus, apart from 3 children in the Unreliable Informant condition (5.1%), children displayed an initial acceptance of the testimony that had been provided by Informant 1 in the Introduction Phase. The rate of acceptance did not differ significantly between the two informant conditions, $\chi^2(1, 112) = 2.77$, $p = .096$. Thus, with rare exceptions, children across both conditions initially demonstrated with, or asked Informant 2 to initially demonstrate with, the figure identified by the first informant as the effective figure. Following the initial demonstration, all children were prompted to also test the alternative figure. As in Experiment 1, children in the Reliable Informant condition continued to receive information consistent with Informant 1′s original testimony through this testing, whereas children in the Unreliable Informant condition now learned that it is actually the alternative figure that can make the music box play (see Fig. 3).

Children's post-evidence judgment of Informant 1's claim (Weighing Phase)

To assess whether the newly acquired empirical evidence would alter children's endorsement of Informant 1's earlier testimony, Informant 2 restated her question regarding which of the figures would be the functional one if she wanted to make the music box play one more time. Children who did not respond appropriately to this question were excluded from analysis (n = 4; 2 children said "I don't know" and 2 made a comment that did not fit with the question). Moreover, to analyze children's *shift* in judgment, we included only those children who had originally endorsed the informant's testimony during the Prompted Exploration Phase as well as correctly remembered this endorsement when later questioned about it, leaving a final sample of 89 for the following analysis (R: n = 48; UR: n = 41).

After being asked by Informant 2 which of the figures was the functional one, the majority of children in each condition pointed correctly (overall: n = 72, 80.9%; R: n = 46, 95.8%; UR: n = 26, 63.4%). Thus, as illustrated in Fig. 4, the majority of children in the Reliable Informant condition continued to make the same judgment as they had made before receiving direct evidence regarding the functioning of the figures. However, for children in the Unreliable Informant condition, the acquisition of evidence conflicting with the claim made by Informant 1 led the majority to shift their judgment and identify the figure they had not previously endorsed as the functional one (i.e., an increase from 5.1% to 63.4%).

The proportion of children who shifted their judgment was greater in the Unreliable Informant condition as compared with the Reliable Informant condition, $\chi^2(1, 89) = 35.99$, $p < .001$. A similar shift was observed among 3-, 4-, and 5-year-olds [3-year-olds: $\chi^2(1, 15) = 5.00$, $p = .025$; 4-year-olds: $\chi^2(1, 32) = 12.64$, $p < .001$; 5-year-olds: $\chi^2(1, 42) = 18.83$, $p < .001$]. Moreover, post hoc analyses confirmed that the effect of reliability condition on shifting behavior was similar among prompted explorers (R shift: n = 2, 5.4%; UR shift: n = 21, 70%), $\chi^2(1, 67) = 30.66$, $p < .001$, and passive observers (R shift: n = 0, 0%; UR shift: n = 5, 45.5%), $\chi^2(1, 22) = 6.47$, $p = .011$.

Thus, extending the pattern observed in Experiment 1, most children in the Unreliable Informant condition shifted their judgment and identified the figure they had not previously endorsed as the functional one in the wake of empirical evidence conflicting with Informant 1's earlier claim. Only a minority continued to endorse Informant 1's unreliable testimony.

Children's post-evidence judgment of Informant 1 (Weighing Phase)

The first two questions in the Weighing Phase targeted children's endorsement and evaluation of the claim made by Informant 1. With a final question, the second informant prompted children to explicitly evaluate the reliability of the first informant: "Was what she said right or wrong?" Note that for the first 20 children who were tested, the question was phrased using the phrasing "good or bad."

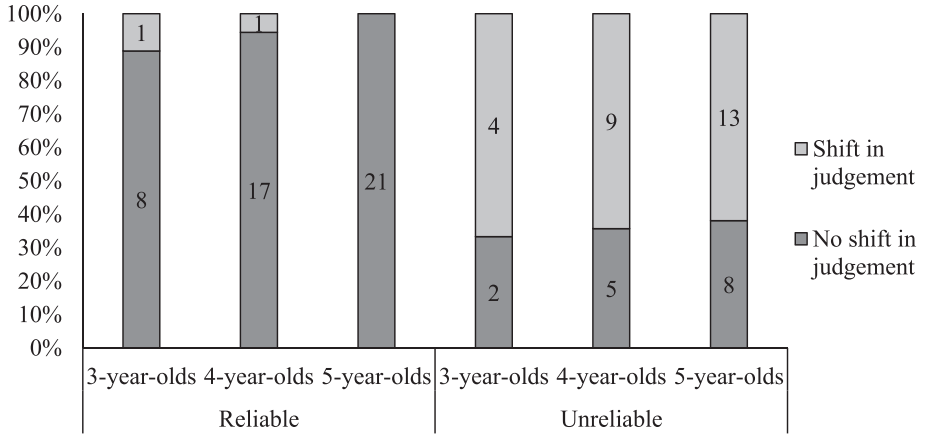

Fig. 4. Percentages and numbers (inside the bars) of children who did and did not change their judgment regarding the functional figure following empirical evidence in the Reliable Informant and Unreliable Informant conditions.

Because this phrasing might be misinterpreted as calling for an evaluation of the informant's performance rather than the content of her claim, we opted to change this phrasing to "right or wrong" for the remaining children. However, because the results remained the same regardless of whether we excluded children who received the questions framed as good/bad compared with right/wrong, all children are included in the analyses presented in the following.

Children's responses were coded in terms of whether they judged the informant positively (right/good) or negatively (wrong/bad). As can be seen in Fig. 5, the majority of children in the Reliable Informant condition rated the informant positively (R: n = 47, 88.7%), whereas the majority of children in the Unreliable Informant condition rated the informant negatively (UR: n = 35, 59.3%). Eight children did not respond to this first question appropriately (3 said "I don't know" and 5 made a comment that did not fit the question) and therefore were excluded from further analyses, leaving a final sample of 104 children for the following analysis (R: n = 48; UR: n = 56).

The rating of the informant was significantly different between the two reliability conditions, $\chi^2(1, 104) = 41.68$, $p < .001$. This difference in informant rating was significant within all age groups [3-year-olds: $\chi^2(1, 24) = 5.93$, $p = .015$; 4-year-olds: $\chi^2(1, 35) = 11.06$, $p = .001$; 5-year-olds: $\chi^2(1, 45) = 26.31$, $p < .001$]. Children's ratings of the unreliable informant became increasingly consistent from 3 to 5 years of age, but this age difference was not statistically significant within either condition [R: $\chi^2(2, 48) = 1.56$, $p = .459$; UR: $\chi^2(2, 56) = 3.82$, $p = .148$].

Children's transfer of inferences (Generalization Phase)

For the final phase of the experiment, children were presented with a novel untested figure that looked identical to the one originally endorsed in the prior phases and asked whether they thought that this figure could make the music box play. Six children responded with uncertainty to this question (i.e., saying "I don't know" [n = 1] or "maybe" [n = 5]) and were excluded from further analyses, leaving a final sample of 107 for the following analysis (R: n = 52; UR: n = 55).

As illustrated in Fig. 6, the majority of children thought that the new but identical-looking figure would work (overall: n = 80, 74.8%; R: n = 48, 92.3%; UR: n = 32, 58.2%). However, there was a significantly higher proportion of children in the Reliable Informant condition who thought so compared with children in the Unreliable Informant condition, $\chi^2(1, 107) = 16.50$, $p < .001$. The effect of reliability on children's predictions was significant within all age groups [3-year-olds: $\chi^2(1, 26) = 5.72$, $p = .017$; 4-year-olds: $\chi^2(1, 34) = 4.05$, $p = .044$; 5-year-olds: $\chi^2(1, 47) = 7.13$, $p = .008$].

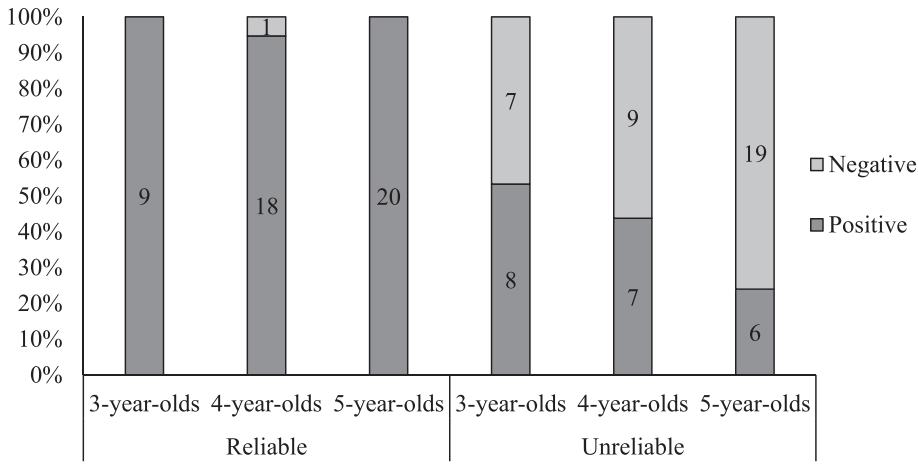

Fig. 5. Percentages and numbers (inside the bars) reflecting children's evaluations of the first informant's original testimony.

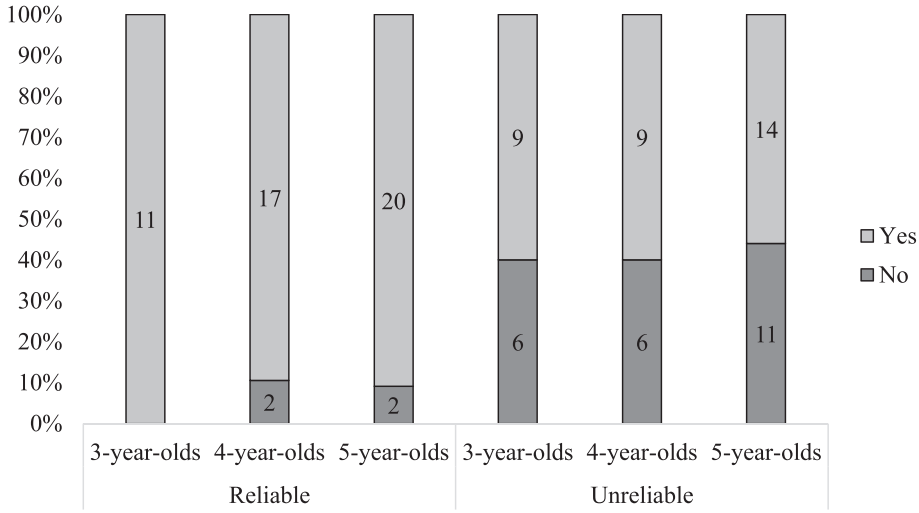

Fig. 6. Percentages and numbers (inside the bars) reflecting children's predictions of whether the novel identical figure would make the music box play.

Discussion

As in Experiment 1, children initially accepted the first informant's claim. Nevertheless, after gathering empirical evidence, children in the Unreliable Informant condition were more likely than children in the Reliable Informant condition to shift in their judgment regarding the functioning of the figure. Given the rephrasing of the control question, this finding indicates that the children in the Unreliable Informant condition of both experiments were reassessing the future validity of the informant's claim and not simply reporting on what they had just experienced. Importantly, although the overall effect of reliability on children's reassessments in this second experiment might have been driven by the inclusion of a slightly older age group, individual assessments within each age group revealed that the effect of informant reliability was indeed stable across all ages. In line with our predictions, the results in the Generalization Phase also revealed a significant effect of prior informant reliability; children in the Unreliable Informant condition were less likely than children in the Reliable Informant condition to think that the new but identical-looking and untested figure would work. Despite less consistency in their evaluations of the informant, 3-year-olds performed similarly to older children when required to transfer their inferences across tasks. A post hoc analysis contrasting shifting by those who actively gathered information themselves (prompted explorers) with those who only observed the second informant's demonstration (passive observers) revealed no effect on children's reliability assessment.

General discussion

In Experiment 1, we asked whether children would revise their belief in an informant's claim following the acquisition of counterevidence through direct exploration. Extending the findings of the first experiment, the second experiment investigated whether children would revise their belief in an informant's claim with respect to a future event and whether their inferences regarding the reliability of the claim would be transferred to a new figure. Finally, both experiments explored whether these processes are affected by children's age. Below, we discuss the findings and implications.

Initial acceptance of an informant's claim

As indicated by the first experiment, children showed a strong initial tendency to encode and accept an informant's claim. When left alone, very few children spontaneously tested the claim. Given that the informant presented herself as an expert and conveyed fairly definite and unsurprising information, children's passive acquiescence toward her claim was not unexpected (Bonawitz et al., 2011; Ronfard et al., 2018). Moreover, in line with the findings of Ronfard et al. (2018), the few children who did go on to test the informant's claim were within the older age range.

Reassessing belief in an informant's claim

Across both experiments, the subsequent acquisition of evidence disconfirming the first informant's initial claim led children to reject that claim as false. Experiment 2 confirmed that children were also able to evaluate the informant as being wrong. This finding supports the proposal that children can assess trustworthiness not only prospectively when selecting between two informants (Koenig & Harris, 2005) but also retrospectively when assessing the testimony of a single informant against subsequent empirical evidence (Bridgers et al., 2016; Luchkina, Corriveau, & Sobel, 2020; Scofield & Behrend, 2008). Thus, extending the findings of Bridgers et al. (2016), the current studies demonstrate that preschoolers are also able to retrospectively revise their belief in a verbal claim when counterevidence is acquired through their own active (albeit prompted) exploration. This indicates that young children's capacity to revise their beliefs is not contingent on the information being acquired in a given format. Rather, young children are able to integrate and align information from different sources (i.e., verbal testimony, actively gathered evidence, and passively observed evidence). Such abilities are particularly useful as children transition from social interaction mainly in their home environment to larger school environments where information is acquired through multiple sources of varying quality and relevance.

One caveat to the current findings is that because all children heard the informant's claim prior to seeing the evidence, it is possible that the ordering of information may have increased children's tendency to weigh the empirical evidence more heavily than the informant's claim (see Hermansen, Ronfard, Zambrana, & Harris, 2020). Also of note, children's rejection rate decreased from Experiment 1 to Experiment 2. This could indicate that the change in the framing of the control question from the past tense to the future tense made the task more challenging. Moreover, although children in the Unreliable Informant condition in the second experiment were less likely to select the endorsed (non-functioning) figure compared with children in the Reliable Informant condition, their rejection rate was not greater than chance. This is surprising given that the informant's claim was either confirmed or disconfirmed through empirical testing, which is an important difference relative to previous work (Luchkina et al., 2020; Scofield & Behrend, 2008). By implication, half of the children found the informant's claim to be unreliable and worth rejecting, whereas the other half thought otherwise. However, it is also possible that children in the Unreliable Informant condition may have become confused by the conflicting information and therefore had no preference for either figure. Future studies are required to tease apart these two interpretations.

Transfer of inferences

The majority of children were able to transfer their inferences regarding the validity of a claim from one task to another. Children in the Reliable Informant condition continued to trust the information they had encountered previously, whereas most children in the Unreliable Informant condition revised their belief in the informant's misleading testimony and continued to maintain this altered perspective in the subsequent task. Moreover, although the current design did not directly target children's learning improvements, it extends the findings of Luchkina et al. (2020) by showing that children display a nuanced learning not only of object labels but also of an object's functioning, depending on the reliability of the informant.

Although previous studies have shown that children appropriately weigh and transfer information from two sources with a similar format (i.e., verbal claim vs. verbal claim), they have struggled to

show whether 3-year-olds are able to transfer their inferences when information is acquired through sources with differing formats (i.e., verbal claim vs. nonverbal evidence) (e.g., Doebel, Rowell, & Koenig, 2016; Fitneva & Dunfield, 2010; Palmquist, Jaswal, & Rutherford, 2016). Hence, it is worth highlighting aspects of the current design that may have helped children to succeed in that transfer. First, the potential relevance of each source was highlighted during the first task. That is, informant reliability was highlighted through explicit questioning (i.e., "Was she right or wrong?"), and the empirical evidence was highlighted through children's active engagement with the task. In addition, our experiment did not require children to actively approach the informant herself as a potential source of information. Instead, children were prompted to use the information they had gained in the previous task regarding the validity of the claim to make a prediction about a new untested figure. Removing the burden of needing to seek new information in the second task, the current design avoids the confounding of children's belief in an informant's claim (as reflected in the degree to which children endorse the previously provided information) and their more overt trust behaviors (as reflected in their choice of whether or not to seek new information from the informant). Note that the latter may be guided as much by social norms of trust as by evidence of prior reliability. In future studies, it will be important to investigate the social factors governing children's decision to use information about prior informant reliability when actively seeking new information without prompting.

Lingering trust or a growing awareness of the usefulness of evidence?

Although several features of the current design may have promoted children's ability to weigh the two types of information against each other, the lack of consistency in children's rejection of the informant's claim across the Weighing Phase and Generalization Phase is interesting and worth reflecting on. That is, whereas children's rejection rates in both phases were significantly higher in the Unreliable Informant condition than in the Reliable Informant condition, children's overall rejection rates in the Unreliable Informant condition decreased slightly from the Weighing Phase to the Generalization Phase, indicating that children might not have rejected the informant's claim as firmly as it might at first seem in the Weighing Phase. Below, we discuss possible explanations for these inconsistencies, focusing on whether children (a) may vary in how firmly they evaluate different sources, (b) are aware of the relevance of seeking further information when uncertain, and (c) may hold ideas of object uniqueness.

One possible explanation for children's inconsistent rejection rates across the two tasks is that children vary in how critically they evaluate different sources. Previous work suggests that although some children initially appear to maintain their trust in an unreliable informant's claim about a hidden object's location when asked explicitly, they disregarded the claim when later prompted to physically locate the object (Clément et al., 2004). Similar tendencies of slow distrust were also reported by Faught, Leslie, and Scofield (2015), who found that although some children trusted the unreliable informant for an original word–object link, they did not maintain this trust when presented with a new novel object. The current study revealed yet another group of children—those who maintained a lingering trust in the informant's claim. Upon receiving counterevidence, these children first rejected Informant 1′s claim before later endorsing it when making a prediction about the novel object in the subsequent task. Although these children may appear to be inconsistent in the extent to which they believe the informant's original claim, an alternative interpretation is that they are more willing to entertain the idea that a claim can be correct under certain conditions and otherwise not correct. Together, these findings indicate that there may be individual or developmental differences in how children monitor other people's errors and that differences in task demands may affect the extent to which such variations are displayed.

A second possible explanation for the lower rejection rates in the Generalization Phase compared with the Weighing Phase is that the mere exposure to information inconsistencies alerted children in the Unreliable Informant condition to the relevance of seeking further information. In the Weighing Phase, children had recent and direct experience with the exact figure they were questioned about. In the Generalization Phase, however, children had no prior experience with the object in question but were required to use information acquired from two different prior sources about a different (albeit identical-looking) object. Thus, although children may maintain their inferences from the Weigh-

ing Phase, the previously inconsistent information may have alerted children to the value of testing a novel object before reaching a conclusion about its functions in the Generalization Phase. Because they were not given the chance to explore the novel object in the Generalization Phase, children may have been equally likely to say that the novel figure will or will not be able to make the music box play.

Finally, although both of the above alternatives are plausible, each alternative assumes that children recognize the similarities between the two figures and situations and entertain the idea that prior information about one figure may also be applicable to a novel figure. An alternative account is that children do not fully recognize the two figures as being similar and therefore see no relevance in the previously acquired information. For example, prior research has suggested that children are prone to treat some objects (notably animated objects or objects they were attached to) as having a unique essence—and found an identical duplicate to be less acceptable than the original (Gelman & Davidson, 2016; Hood & Bloom, 2008). In the current study, the figures were indeed animated and held distinct functional properties, raising the question of whether children may have perceived the objects as more unique than originally intended. However, given that children who received consistent information in the first task did not waver in their conclusions in the second task, this interpretation seems less likely to explain the slight decrease seen in children's tendency to transfer inferences across the two tasks in the second experiment.

Format of testimony

There was no effect of a specific versus generic claim on children's weighing of information from the two different sources. One potential explanation for this may be that children interpreted the specific and generic claims as largely similar because both formats referred to a quite generic quality (i.e., white figures). In addition, children had only a single white figure available to empirically test the validity of the claim, and this may have undermined any focus on the generic testimony as a rule applicable to white figures in general. Alternatively, as discussed above, children may have perceived the figures as more unique than intended, which may have cancelled out some of the expected effect of variation in format specificity. In sum, more research will be needed to draw firm conclusions about the possible impact of testimony format.

Developmental differences

Younger children had more difficulties with the procedural demands of the experiments. In particular, they needed the testimony to be repeated more often. Because the experiments involved a rather broad age range, particularly Experiment 2, one could imagine that the overall effect of reliability on children's reassessments was driven by the inclusion of an older age group. However, independent assessments of the effects of informant reliability on children's reassessments in both experiments show that the ability to revise beliefs is indeed present by the time children are 3 years of age. This ability has not been consistently found among 3-year-olds in prior work (e.g., Scofield & Behrend, 2008). One reason for the observed findings may be that the current design allowed children to directly engage with the objects in question, a factor previously found to increase children's tendency to weigh information from different sources (Jaswal, 2010; Ma & Ganea, 2010).

An interesting point of note, however, is that although 3-year-olds were able to revise their belief in the content of the first informant's claim, they struggled to evaluate the unreliable informant as being "wrong" in Experiment 2. These findings could highlight a developmental difference in children's ability to assess the reliability of the *content* versus *source* of information. That is, because children in the Unreliable Informant condition correctly selected the alternative figure as the functioning one, we can assume that they recognized that the information they acquired through the evidence was more correct or reliable than the information they received through Informant 1's claim. However, even after coming to this conclusion about the figures' functioning, and still remembering what Informant 1 had originally claimed, the majority of 3-year-olds still considered Informant 1 as being correct. This suggests that, compared with older children, younger children were less likely to consistently connect inferences about the figures' functioning to the informant herself. Further research will be required

investigate the extent to which there are developmental differences in children's perception of an incorrect claim versus an unreliable source

Conclusion

The current study showed that children can use empirical evidence acquired through their own active (albeit prompted) exploration to revise their belief in information previously acquired through a verbal claim if that claim proved to be incorrect. They can do so at an earlier age than previously indicated. Moreover, children used this reassessment to guide their predictions regarding the subsequent functioning of a novel but untested object, indicating that the reassessment of an informant's claim applies not just to a claim about a specific object but also to other objects in the same category. These novel findings show that young preschoolers are able to correctly judge the reliability of information acquired from different sources of information and to generalize that judgment to a similar but new object.

There were, however, inconsistencies in children's rejection rates across the different stages of the weighing processes. Such inconsistency may reflect children's uncertainty about what they know, but it may also reflect interesting nuances in their developing sensitivity to, and understanding of, the status of different sources of information. Future studies should further investigate the circumstances that lead children to doubt the information they are provided with when faced with contradictory verbal and nonverbal evidence, their ability to acknowledge that a given source is faulty, and the conditions that lead them to update their beliefs about prior information.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2020.105063.

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