Children's and adults' epistemic trust in and impressions of inaccurate informants

In press, Journal of Experimental Child Psychology

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Acknowledgements. A portion of this study was conducted in the Living Laboratory at the Museum of Science, Boston. We appreciate the museum staff and volunteers for their support, and we thank the parents and children for their participation. We also thank Tracy Elizabeth and Lynneth Solis for starring in our video stimuli.

Abstract

As children and adults interact with new individuals, they make and revise inferences about these individuals' traits and intentions; they build and refine psychological profiles. Here, we examine how this ability develops in early childhood and manifests in adulthood, by focusing on the construction of psychological profiles for individuals who have repeatedly provided inaccurate information. Children aged 4–7 years (n = 66) and adults (n = 62) played six rounds of a game in which they had to find a hidden sticker. Each round, an informant made a claim about the sticker's location; then, participants guessed the sticker's location. Each round, after participants' guess, it was revealed that the informant's claim was incorrect. Across trials, children and adults quickly lost trust in the informant's claims. Children's impressions of the informant's smartness, niceness, and intentions became slightly more negative across trials. In contrast, adults' impressions of the informant's smartness increased, while their impressions of the informant's niceness decreased, and adults almost unanimously judged the informant to be purposely (rather than mistakenly) inaccurate. In sum, children and adults track the accuracy of an informant over time and use this information to update their epistemic trust in the informant. However, based on the same data, children and adults end up with different interpretations of the informant's psychological characteristics –their traits and intentions.

Keywords: Testimony; Trait Inferences; Development; Epistemic Trust

Highlights

- We examined children's and adults' epistemic trust in and impressions of inaccurate informants.
- Across trials, children quickly lost trust in the informant's claims. Adults' distrust was more gradual.
- Children's impressions of the informants' traits and intentions were more stable than those of adults and moved in the same direction--they all decreased slightly.
- In contrast, the ratings provided by adults did not cluster in the same manner and proved to be more malleable.
- These data underscore the importance of looking beyond early childhood in studies of epistemic trust and trait inferences.

Children and adults' epistemic trust in and impressions of inaccurate informants

Informants vary considerably in their accuracy. Within a domain, some informants have strong track records of making accurate claims and others are often inaccurate. Thus, to avoid learning from people whose claims are unreliable, learners must be epistemically vigilant (Sperber et al, 2010). By age 4, children are able to track and take into account the relative accuracy of two informants when deciding whose information to endorse (Pasquini, Corriveau, Koenig, & Harris, 2007). Around the same age, young children use explicit information about informants in guiding their epistemic trust. This information includes researcher-provided labels and informant's (often dramatized) overt behavior portraying informants' traits (e.g., nice, mean, smart) and intentions (positive vs. negative) (e.g., Lane, Wellman, & Gelman, 2013; Mascaro & Sperber, 2009; Vanderbilt, Heyman, & Liu, 2018).

In this paper, we take a different approach. Rather than focusing on whether children can use particular explicit, researcher-provided cues to informants' traits or intent to guide their epistemic trust, we explore how learners *independently* construct psychological 'profiles' for novel informants – their impressions of those informants' psychological traits and communicative intentions – and how learners update those profiles through repeated interactions (Harris, 2007; Landrum, Eaves, & Shafto, 2015; Ronfard & Lane, 2018). That is, we investigate how children use information they gather from repeated interactions with an informant to not only decide whether to trust their claims but also to make inferences about what that informant is like – the informant's psychological profile. This is an important topic that extends the ecological validity of research on children's epistemic trust, given that when children and adults meet new people, they are the ones constructing these profiles from scratch; they typically do not

have much background knowledge about those persons' behavioral tendencies and they are not necessarily privy to other people's opinions of new persons' traits or intentions.

Epistemic Trust in Inaccurate Informants

Previous work has documented that young children are attentive to informants' track records and can take these records into account when evaluating informants' claims (for reviews, see Harris, 2012; Harris et al., 2018; Robinson & Einav, 2014). For example, when two informants make competing claims (e.g., about an object's location, or the name of a novel object) preschoolers typically endorse the claim of the informant who has a stronger history of providing accurate claims (e.g., Birch, Vauthier, & Bloom, 2008; Brosseau-Liard & Birch, 2011; Koenig & Harris, 2005; Pasquini, et al., 2007). In their everyday interactions, however, children are rarely forced to choose between two informants' competing claims. Arguably, more ecologically valid studies of epistemic trust examine trust in a *single* informant's claims over time. One common task asks participants to find a token that is hidden in one of two opaque containers. Containers are placed between the participant and an 'informant', who claims that the token is located in one container (e.g., the left one). Then participants are asked either to report where *they* think the token is hidden or to find the token. On the first trial, 3- to 5-year-olds typically report or search in the container that the informant mentioned (Heyman et al., 2013; Jaswal et al., 2010). Age-related differences emerge after the first trial; 3-year-olds typically continue following the informant's claims, whereas 4- to 5-year-olds quickly distrust the informant and accurately choose containers *opposite* to those identified by the informant (there are several theories that account for this shift between 3 and 5 years; see Jaswal & Kondrad, 2016; Jaswal et al., 2014; Lane, 2018; Mills, 2013).

Recent work has revealed that children 4-7 years also *adjust* their epistemic trust in an informant's claims in response to changes in that informant's accuracy over time. In a study by Ronfard and Lane (2018), children's trust in an informant decreased following her inaccurate statements and increased following her accurate statements. Although children 4-7 years demonstrated similar patterns of trust in the informant's claims, important age-related differences emerged in children's inferences about the informant's intent and traits. Following the provision of inaccurate information, older children were more likely to judge that the informant had done so on purpose rather than by mistake and were more likely to downgrade their ratings of the informant's kindness and intelligence. A similar pattern was observed by Ronfard, Nelson, Dunham, and Blake (2018), who found that older children were more likely to attribute negative intentions to an informant who provided incorrect rather than correct information.

In sum, existing data suggest that by the age of four-years children can track an informant's accuracy over time and can use this information to adjust their trust in the informant's claims. However, unlike older children, preschoolers tend to make less use of this accuracy information to update their inferences about the informant's intentions or traits. Here, we directly test this developmental hypothesis by evaluating 4- to 7-year-olds' *and* adults' epistemic trust in *and* impressions of repeatedly inaccurate persons. We focus on repeatedly inaccurate persons because prior research has found that 4- to 5-year-olds quickly distrust the information provided by such informants (Heyman et al., 2013; Jaswal et al., 2010) whereas research on children's trait attributions has found that preschoolers require more behavioral exemplars than older children to make negative trait inferences (Boseovski, Chiu, & Marcovitch, 2013). By having informants repeatedly provide inaccuracies and by continually evaluating participants' epistemic trust in the informant as we well as their impressions of the informant

(her intentions and traits) we can capture differences in the rate of change in participants' epistemic trust and impressions; and we can capture absolute differences in their trust and impressions before and after interacting with this informant. Specifically, we explore how impressions of an informant—her kindness, intelligence, and intent—change as children and adults acquire more information about her inaccuracy, and we test whether the informant's explicit expression of positive intent (in the form of an apology) moderates these impressions. In what follows, we briefly review existing research on these topics and outline hypotheses for the current study.

Most studies that evaluate trust in informants who provide repeated inaccuracies include participants in a limited developmental window; typically children ages 3-5 years (e.g., Heyman et al., 2013; Jaswal et al., 2010; Vanderbilt, Heyman, & Liu, 2014). An assumption behind the focus on this narrow age-range might be that the developmental transition described above marks the beginning and end of the developmental story: 5-year-olds' tendency to quickly distrust informants in this paradigm is "adult like" or "mature". Or it may be assumed that participants older than 5-years will simply perform at ceiling. These assumptions may be correct, but they should be directly tested. We address the protracted development of trust in repeatedly inaccurate informants by using a similar epistemic-trust paradigm with participants ranging from 4-7 years as well as adults. We did not have strong predictions regarding age-related differences, but given that 4-year-old children are quick to distrust such informants, we expected that older children and adults would be as well.

Impressions of Inaccurate Informants

A large body of research has revealed how informants' traits can influence learners' epistemic trust (e.g., Fusaro, Corriveau, & Harris, 2011; Heyman et al., 2013; Landrum, Mills, &

Johnston, 2013; Lane, Wellman, & Gelman, 2013; Mascaro & Sperber, 2009). In this study, we instead focus on how an informant's history of providing inaccurate claims influences learners' inferences about that informant's traits. Brosseau-Liard and Birch (2010) began to address this question by presenting preschoolers with two informants--one who provided accurate labels and one who provided inaccurate labels across four episodes. Then, children were asked to identify which of the two informants engages in prosocial behavior (e.g., "Who always shares her toys?"). Five-year-olds (but not 4-year-olds) demonstrated a halo effect--they judged that the more accurate informant was also more prosocial.

In the current study, we *track* whether and how impressions of a single informant *change* in response to that informant's continual inaccuracies. Instead of asking participants to make a prediction about the informant's future behavior only after they have obtained data about the informant's accuracy, we ask participants to evaluate an informant's niceness and smartness before they provide any claims, and then again after one, two, and six inaccurate claims. This allows us to more precisely evaluate how participants *update* their impressions of an informant as they gain behavioral information. Ronfard and Lane (2018) provide initial data on how 4- to 7-year-olds update their impressions of an informant based on her ongoing accuracy. Across three episodes an informant provided accurate information twice and inaccurate information once. Overall, children's impressions of the informant were very positive, but immediately after the informant's single inaccuracy, older children's (6-7 years) evaluations of her niceness and smartness dropped; younger children's (4-5 years) evaluations did not change. These results are consistent with work demonstrating that young children generally hold positive impressions of others (Boseovski & Lee, 2006; Boseovski & Lee, 2008; Heyman, 2009), and that preschoolers require more behavioral exemplars than older children to make negative trait inferences

(Boseovski, Chiu, & Marcovitch, 2013). However, one limitation of Ronfard and Lane (2018) is that they obtained trait ratings following only *one* incorrect claim. Their data reveal how children's inferences about informant's traits change following one inaccurate claim but not how those inferences continue to change as children are provided additional inaccurate claims.

Importantly, the development of trait inferences extends well beyond childhood (e.g., Lockhart, Chang, & Story, 2002). In light of these findings, in the current study we expect that preschoolers' initial evaluations of the informant will be more positive than older children's and adults' evaluations, and we expect that preschoolers' evaluations will drop more slowly across trials (i.e., after the informant has provided more inaccuracies) compared to older children's and adults' evaluations. Importantly, given the protracted development of these abilities, we expected difference even between older children and adults.

Apology's Effect on Trust In and Impressions of Informants

Impressions of an informants' communicative intent can influence children's trust in their claims (Liu, Vanderbilt, & Heyman, 2013). Apologies are one way to signal positive intent and good-will. Children as young as 4-years-old understand that apologies express a transgressor's remorse, and expect that victims will feel better if they are apologized to (Smith, Chen, & Harris, 2010). When children personally receive an apology from a victimizer, they report feeling better and judge the victimizer as remorseful and less mean (Drell & Jaswal, 2016; Oostenbrook & Vaish, 2018; Smith & Harris, 2012). To the extent that an inaccurate informant's apology signals their good will and intention to not repeat their error, an apology following an inaccuracy might mitigate distrust toward that informant. To test this, Ronfard and Lane (2018) manipulated whether 4- to 7-year-olds received an apology from an informant after her single inaccuracy (amidst two other accurate claims) was revealed. Even though children more often reported that

an apologetic (vs. non-apologetic) informant's errors were made "by mistake" (we discuss this in greater detail later), the informant's apology had no measurable influence on children's epistemic trust. Thus, we hypothesize that an informant's apologies in the current study will not influence children's or adults' trust—whether an informant has apologized once or multiple times for their inaccuracies, participants will continually distrust their claims.

How might impressions of a repeatedly-inaccurate informant differ if they apologize for their inaccuracies? In Ronfard and Lane (2018), when an informant apologized (vs. did not apologize) for making a *single* inaccurate claim, children 4-7 years more often inferred that the inaccuracy was unintentional, provided "by mistake." However, these results may not hold when an informant is *repeatedly* inaccurate and *repeatedly* apologizes. It is possible that, when an informant repeatedly errs, apologies no longer convince learners that errors were unintentional. For young children and adults, apologies help to maintain and repair social relationships because they imply that normative or moral violations will *not* be repeated (Darby & Schlenker, 1982; Oostenbrook & Vaish, 2018; Smith & Harris, 2012). But repeated errors violate these implied promises to *not* repeat violations. This may lead children and adults to infer that repeated apologies for the same behavior are disingenuous. Moreover, continuing to provide misleading claims following an apology reveals that the apology itself was misleading; thus, repeated apologies might *compound* the negative influence of inaccuracies—the informant may seem doubly mischievous because their claims and their apologies are both misleading. Thus, we expect that consistently-inaccurate informants will be interpreted as especially unkind when they repeatedly apologize (vs. when they never apologize).

Summary

In sum, the current study addresses three primary research questions. First, we investigate 4- to 7-year-old children's and adults' trajectories of epistemic trust in repeatedly inaccurate informants. Second, we investigate how repeated inaccuracies shape children's and adult's conceptions of these informants (i.e., their intelligence, kindness, and intent). Finally, we investigate whether trust in and conceptions of the informant vary depending on whether she repeatedly apologizes for her inaccuracies.

Method

Participants

Children ranging from 4- to 7-years (n = 66, 29 females) participated individually at a museum in Boston, Massachusetts. For analytic purposes, children were divided into two age groups: 4 to 5.5-years-old (n = 34; 14 females; M_{age} = 4 years, 9 months; *Range* = 4 years - 5 years, 5 months), and 5.5 to 7-years-old (n = 32; 15 females; M_{age} = 6 years, 5 months; *Range* = 5 years, 6 months - 7 years, 9 months). Following prior research on young children's epistemic trust using single informant designs (e.g., Jaswal, 2010), we planned to recruit 16 children per condition within each age group. Thus, we aimed to recruit at least 64 children. Recruitment stopped the day that this goal was reached at our recruitment site. Three additional children were tested but excluded from analyses because they did not complete the study. Most children's families were of middle- to upper-middle socioeconomic status. Children represented a variety of racial and ethnic backgrounds, but were predominately White/European-American. Adults (n = 62) were recruited through Amazon's Mechanical Turk and individually completed a web-based version of the study (M_{age} = 37 years, 9 months, 21-years to 73-years; 36 females), a sample size chosen to be similar to the whole child sample. The study was advertised as a study about

"making decisions based on what you are told". In the description of the study, prospective participants were told that: "The purpose of this study is to understand how children and adult participants make decisions based on what other people tell them". The study was open only to adults who resided in the U.S. state of Massachusetts (the same state from which child participants were recruited). Among these adults, 51 identified as White/European-American, 5 as Asian/Asian-American, 3 as Black/African-American, 1 as both Black/African-American and White/European-American, and 1 as both Black/African-American and Native-American; one participant did not report their racial background. Most adults (n = 52) had completed an associate's or more advanced degree; 9 had most recently graduated high school; and one participant did not report their educational background. Adults were promised compensation of $1, plus bonuses based on their performance (for equity, all adult participants ultimately earned $1.30, regardless of their performance).

Data availability

The data and syntax files for this study are openly available at the Open Science Framework at https://osf.io/u357q/?view_only=386e0d001f054e46a7bd8f42f277cca0.

Procedure

Participants played a game in which they were to find stickers hidden in opaque cups, similar to the game participants played in Ronfard and Lane (2018). The game had three phases: (1) *meeting the players*, (2) *learning the game*, and (3) *playing the game*. For child participants, an experimenter proceeded through the phases using still images and videos presented on a laptop computer; questions were asked verbally. Children could respond to questions verbally or by pointing. For adult participants, identical images and videos were viewed, but they progressed

through the phases by clicking a "Next" button on their web browser-based survey. Adult participants read questions themselves and responded by mouse-clicking their answer.

Meeting the players. Each session began with participants viewing a picture of two women sitting across from one another at a table and were told that the woman facing them (i.e., facing the camera) was named Tracy (the informant) and that the woman facing away from them was named Lynn (the player). Lynn was included in the protocol because participants did not personally interact with Tracy; thus, it made sense for them to watch footage of Tracy's interaction with someone else (Lynn) in-person. Using videos ensured a uniform presentation of stimuli across all participants, and is common practice in research on the development of epistemic trust (e.g., for review, see Harris et al., 2018). After Tracy and Lynn were introduced, child participants were asked to identify each of them (if necessary, children were corrected). Then, both child and adult participants were shown an image of Tracy and were asked to provide *initial* assessments of her *niceness* and her *smartness*: "Do you think Tracy is [nice/smart] or [mean/not smart]?", followed by," Okay. Do you think Tracy is very [nice/smart; mean/not smart] or just a little [nice/smart; mean/not smart]?"

Learning the game. Participants were shown the same image of Tracy and Lynn sitting at a table, but now two cups (one striped and one with dots) were set in front of Tracy. Participants were instructed: "In this game, you and Lynn are going to try to find stickers hidden in cups. For each turn, there will be two cups on the table, and there will be *one* sticker hidden in *one* of the cups. Sometimes the sticker is hidden in the cup on this side and sometimes it's hidden in the cup on this side. You and Lynn won't look in the cups, but Tracy *will* look in the cups. She'll say something, about the sticker, and then you can choose where *you* think the sticker is. You can choose the same cup Tracy says or a different cup. It's up to you. After you

choose, Lynn will choose, and then everyone will get to see what's inside the cups." As small incentives to choose correctly, children earned a point every time they picked the cup with the sticker, and adults earned 5 cents every time they picked the cup with the sticker. To help child participants follow along, the experimenter pointed to Lynn, Tracy, and the cups during the instructions. Participants were then asked whether they were going to try to find as many stickers as they can, and all responded "Yes." They then saw a video of Lynn stating that *she* was going to try to find as many stickers as *she* can.

Playing the game. Participants played six trials of the game, and for each trial the informant provided inaccurate information about a sticker's location. Participants were randomly assigned to either receive or not receive an apology from the informant on each trial, immediately after her inaccuracy was revealed. Trials were presented on videos, shot from the same perspective as the photos and videos previously described, over the shoulder of the player (Lynn) who was sitting at a table across from the informant (Tracy). The video began with an empty table. A third woman, whose face was not visible, placed on the table two different solid-colored cups upright (their contents were not visible to Lynn or to participants). At this point, for child participants only, the video was paused and children were asked to name the color of each cup; corrective feedback was offered if necessary. The video then showed the informant standing up and slowly looking into each cup. Whether the informant looked into the left or right cup first was counterbalanced across trials. The informant then sat down and stated the location of the cup: "The sticker is in the [color] cup". At that point the video was paused and participants were asked: "Where do *you* think the sticker is?" After participants answered, the video resumed and showed Lynn choosing the cup suggested by the informant. Lynn always followed the informant's suggestion in order to create a context where it made sense for the informant to

apologize after her inaccuracy was revealed (among participants in the *Apology* condition). The woman who initially set up the cups returned and tilted each cup towards the camera; first with the empty cup (saying, "It's not in this one"), and then the cup containing the sticker (saying, "It's in this one."). In the *Apology* condition, after the informant's inaccuracy was revealed she looked up and said: "I'm really sorry. I made a mistake." In the *No Apology* condition, the informant looked up without saying anything. Participants were then informed that new cups would be placed on the table, and proceeded to the next trial. Following the first trial and second trial, participants again rated the informant's *niceness* and *smartness*. The actual location of the sticker (left or right cup) was counterbalanced; participants were randomly assigned to one of two mirror-opposite orders for the sticker's location (left, right, right, left, left, right; or right, left, left, right, right, left). Different colored cups were used for each trial.

After participants had completed all six trials of the game, they were asked to rate the niceness and smartness of the informant a fourth, and final time. In sum, participants rated the niceness and the smartness of the informant four times during the experiment: prior to receiving testimony (when the informant was 0-for-0) to measure participants initial impressions of the informant, after the informant was inaccurate just once (0-for-1), after she was inaccurate twice (0-for-2), and at the end of experiment after her sixth inaccuracy (0-for-6) to measure the cumulative impact of having received incorrect information six times in a row. Data from these four time points make it possible to examine whether participants' evaluations of the informant decrease quickly (i.e., after the first and second inaccurate statement) before stabilizing (with small differences between evaluations after second and final inaccurate statements) or whether the decrease is more gradual and linear.

After the final questions about niceness and smartness, participants were also asked about the informant's intent: "Do you think Tracy named that cup *on purpose* or by *mistake*?" (scored 0=Mistake, 1=Purpose). Asking about intent at the end of the experiment makes it possible to assess the cumulative impact of receiving incorrect information from an informant who does or does not apologize for her inaccuracies. This also makes it possible to compare the current participants' intent attributions to prior work in which participants were asked the same question when the informant had only been incorrect once (Ronfard & Lane, 2018).

Results

We first assess how the informant's prior accuracy and provision of apologies influenced participants' trust in her subsequent claims. We then examine participants' evaluations of the informant: their ratings of her niceness and smartness and their judgments of her intent. For each dependent measure, we first test for differences between the younger and older groups of children; when no differences are found, the two child groups are combined.

Influence of the Informant's Accuracy and Apologies on Epistemic Trust

Initial analyses revealed no differences in trust between the two child groups (4- to 5.5-years-old vs. 5.5- to 7-years-old, see supplementary materials). Thus, the two child groups were combined (n = 66), and we compared children's versus adult's trust in the informant's claim at each level of informant accuracy. Initial analyses also revealed no effect of receiving an apology on participants' trust in the informant's claim at each level of the informant's accuracy for each age group (see supplementary materials). Thus, a mixed effects logistic regression model (-xtlogit-, Stata 14) predicted trust in the informant based on the informant's accuracy (i.e., trial), participants' age group, and the interaction between the informant's accuracy and participants' age; see Table 2.

Participants' trust on each trial was equivalent whether or not the informant apologized. Levels of trust were equivalent between children and adults for some trials, and were significantly different for other trials, as indicated by the significant interaction effects in Table 2. As depicted in Figure 1, children and adults trusted the informant's first claim (before they had gained information about her accuracy) at similar rates, and did so significantly above chance (50%; General Linear Hypothesis (GLH) test: Children, $\chi^2(1) = 8.92$, $p < .01$; Adults, $\chi^2(1) = 7.41$, $p < .01$). However, after the informant's first inaccuracy (when she was 0-for-1) children trusted her claim significantly *below* chance, and continued to distrust her subsequent claims (GLH tests: 0-for-1, $\chi^2(1) = 19.27$, $p < .001$; 0-for-2, $\chi^2(1) = 22.81$, $p < .001$; 0-for-3, $\chi^2(1) = 31.48$, $p < .001$; 0-for-4, $\chi^2(1) = 29.29$, $p < .001$; 0-for-5, $\chi^2(1) = 27.84$, $p < .001$). In contrast, when the informant was 0-for-1 and 0-for-2, adults' trust in the informant's claim was at chance (50%; GLH tests: 0-for-1, $\chi^2(1) = .07$, $p = .78$; 0-for-2, $\chi^2(1) = 1.49$, $p = .22$), and adults were significantly more likely to trust her claim than children (0-for-1, OR = 6.30, $z = 2.95$, $p = .003$; OR = 4.96, 0-for-2, $z = 2.51$, $p = .012$). When the informant was 0-for-3, 0-for-4, and 0-for-5 adults and children trusted the informant's claims at similar rates and below chance (GLH test for adults: 0-for-3, $\chi^2(1) = 18.19$, $p < .001$; 0-for-4, $\chi^2(1) = 23.52$, $p < .001$; 0-for-5, $\chi^2(1) = 29.23$, $p < .001$).

Influence of the Informant's Accuracy and Apologies on Trait Attributions

Participants rated the niceness and the smartness of the informant four times during the experiment: prior to receiving testimony (when the informant was 0-for-0), after the informant was inaccurate once (0-for-1), after she was inaccurate twice (0-for-2), and at the end of experiment after her sixth inaccuracy (0-for-6). Participants' trait ratings were converted to numerical scores and treated as a continuous variable: "very mean / not smart" was scored as 0;

"a little mean / not smart" was scored as .33; "a little nice / smart" was scored as .67; and "very nice / smart" was scored as 1. Initial analyses revealed no differences in the trait attributions (i.e., smartness or niceness) made by the two child age groups, and thus the two child groups were combined (n = 66) (see supplementary materials). Below we describe analyses for ratings of the informant's niceness and smartness.

Niceness Ratings. Variability in niceness ratings was assessed with a mixed effects ANOVA with Apology (2: Apology; No Apology) and Age (2: Children; Adults) as between-subjects-factors and Accuracy (4: 0-for-0; 0-for-1; 0-for-2; 0-for-6) as a within-subjects factor. This analysis revealed an effect of Accuracy, $F(3, 372) = 109.5$, $p < .001$, $\eta^2_p = .47$, an effect of Age, $F(1, 124) = 40.43$, $p < .001$, $\eta^2_p = .34$, and an Accuracy X Age interaction, $F(3, 372) = 29.70$, $p < .001$, $\eta^2_p = .19$. To unpack this interaction, we conducted simple effects tests using a Bonferroni correction for multiple comparisons (adjusted $\alpha = .003$, 16 comparisons). The interaction is depicted in Figure 3.

Children began the experiment by rating the informant as "very nice" (on average) but immediately downgraded their ratings to "a little nice" after she provided one inaccurate claim, $p < .001$. Children's niceness ratings remained fairly constant thereafter. The pattern for adults was different. Adults began the study rating the informant as "a little nice" (on average); significantly lower than children had rated her, $p < .001$. Unlike children, adults' niceness ratings did not drop immediately. Their ratings remained similar after the informant provided one inaccurate claim (p =.18), and then dropped sharply to "a little not nice" after her second inaccurate claim ($p < .001$). Adult's ratings remained at that level thereafter. Thus, by the end of the study, children and adults rated the informant as less nice than at the start of the experiment (Children: $p < .001$; Adults; $p < .001$) with adults providing significantly lower ratings than children, $p < .001$.

Smartness Ratings. Variability in smartness ratings was assessed with a mixed effects ANOVA with Apology and Age as between-subjects factors and Accuracy as a within-subjects factor. This analysis revealed effects of Accuracy, $F(3, 372) = 8.90$, $p < .001$, $\eta^2_p = .067$, Age, $F(1, 124) = 10.02$, $p = .002$, $\eta^2_p = .13$, Apology, $F(1, 124) = 10.02$, $p = .002$, $\eta^2 = .13$, an Accuracy X Age interaction, $F(3, 372) = 49.80$, $p < .001$, $\eta^2_p = .29$, and an Accuracy X Apology interaction, $F(3, 372) = 6.01$, $p = .001$, $\eta^2_p = .046$. To unpack these interactions, we conducted simple effects tests using a Bonferroni correction for multiple comparisons (adjusted $\alpha = .0016$, 32 comparisons).

Figure 4a displays the Accuracy X Age interaction. Children and adults differed in their evaluation of the informant's smartness before she presented any information, $p < .001$. On average, children rated the informant between "a little" and "very" smart, whereas adults rated her between "a little" and "very" *not* smart. After the informant's first inaccuracy, children's and adults' ratings converged. Children's average rating decreased to "a little smart" ($p < .001$), whereas adults' average rating *increased* to "a little smart" ($p < .001$). Child and adult ratings of smartness remained similar thereafter.

Figure 4b depicts the Accuracy X Apology interaction. Children's and adults' average smartness ratings were initially similar, i.e., neutral – between "a little not smart" and "a little smart". Participants who received an apology continued to rate the informant at this level for the duration of the study. In contrast, participants who did *not* receive an apology *increased* their smartness ratings to "a little smart" immediately after the informant's first inaccuracy ($p < .001$) and continued to do so after her second inaccuracy. However, this increase was temporary. By the end of the study, participants who received apologies rated the informant at the same level of smartness they attributed to her at the start of the experiment. Nevertheless, by the end of the

study, participants in the *Apology* condition rated the informant as less smart than participants in the *No Apology* condition, $p < .001$.

Influence of the Informant's Apologies on Intent Attributions

Following the final trial, when the informant was 0-for-6, all participants were asked whether she had provided incorrect information on purpose or by mistake. One child in the younger age group and one child in the older age group did not provide an answer. Initial analyses revealed significant differences in the responses of younger versus older children; thus the two child age-groups were kept separate in these analyses. Figure 5 displays the proportion of participants in each age group and condition who judged that the informant provided inaccurate information on purpose rather than by mistake. A logistic regression model (Table 3, Model 1) predicted participants' judgments (Mistake = 0, Purpose = 1) based on their Age group, whether they received an Apology, and the interaction of Age X Apology. There was no main effect of Apology or interaction between Age and Apology ($\chi^2(3) = 1.25$, $p = .74$). However, rates of intent (i.e., Purpose) attributions differed significantly between the age groups. Younger children attributed intent least often, older children attributed intent more often than younger children ($z = 2.02$, $p = .043$), and adults did so more often than both groups of children (vs. younger children, $z = 4.71$, $p < .001$; vs. older children, $z = 2.83$, $p = .005$) (Table 3, Model 2).

Discussion

As individuals interact with one another, they form impressions of and expectations about the other's behavior, traits, and trustworthiness. We examined trajectories of children's and adults' epistemic trust in and impressions of repeatedly inaccurate informants. Across trials, children 4-7 years quickly distrusted a repeatedly inaccurate informant, whereas adults gradually grew more distrusting. Children's impressions of the informant's smartness, niceness, and

intentions became slightly more negative across trials. In contrast, adults' impressions of the informant's smartness increased, impressions of her niceness decreased, and nearly all adults judged that she purposely (rather than mistakenly) made inaccurate claims. These findings support the hypothesis put forward in the introduction, that the ability to track and use an informant's prior accuracy to decide whether to trust that informant's claims may begin to develop in early childhood (the age-period most commonly studied), but continues to develop well beyond early childhood and indeed may continue to develop well into adulthood. As well, these data reveal how children and adults can be confronted with the same behavioral data and differ substantially in how they *interpret* that behavior—how they construct and update psychological profiles of informants. Thus, these data underscore the importance of looking beyond early childhood in studies of epistemic trust and trait inferences. Next, we discuss these results and their implications in greater detail.

Epistemic Trust in the Informant

Children's and adults' initial and final levels of trust in the informant were nearly identical. However, there were significant differences in the rate at which participants grew to distrust the informant—children did so quickly (typically after the first trial), whereas adults did so gradually. Children's rapid distrust in the informant's claims is consistent with prior work with 4- and 5-year-old children (e.g., Heyman et al., 2013; Jaswal et al., 2010). However, adults' more gradual distrust across trials was not expected. One post-hoc explanation is that this pattern reflects their richer experience with others; adults have stronger expectations that an informant (even a generally poor informant) would not be *repeatedly* inaccurate; thus, adults required more behavioral evidence to counter their strong expectations. Additional work can help to identify the specific reason why we have found these intriguing age-related differences. On any account,

these findings suggest that we should be hesitant to conclude that the epistemic trust of 4-5-year-olds (an age so often targeted in research on this topic) is synonymous with 'mature' or 'adult-like' epistemic trust.

Neither children's nor adults' trust was influenced by the informant's apologies following her inaccurate claims. This finding replicates Ronfard and Lane's (2018) findings with children, and extends it to adult participants. Perhaps apologies would be more effective at shaping epistemic trust in cases when individuals are more uncertain about an informant's intentions because it is possible for the informant to have been mistaken. For example, an apology might be more effective in cases where it is difficult for the informant to gain information about the location of the stickers because it is difficult to see in the cups. However, even in such cases, apologies might influence trust only immediately after the first time they are used. Indeed, as we discuss next, repeated apologies for repeated mistakes are more often seen as intentionally misleading.

Impressions of the Informant

As expected, children provided higher ratings of the informant's niceness and smartness than adults (see also Lockhart et al., 2002). As well, approximately half of the children judged that the informant's six inaccuracies were unintentional, made by mistake; whereas almost all adults interpreted them as intentional, made on purpose. Thus, children generally had more positive impressions of the informant, both before and after her multiple inaccuracies. Children's initially high ratings were also more stable than those of the adults. Indeed, despite having an informant provide them with inaccurate information 6 times in a row, children typically maintained relatively positive assessments of the informant – they judged that she was a little nice, and a little smart. Given that repeated questioning may lead to instability in children's

responses, as children will sometimes change their answers to "please" the experimenter (Siegal, Waters, Dinwiddy, 1988), the relative stability of children's trait ratings over four instances of questioning that coincided with increases in the informants' inaccuracy is remarkable. Of note, despite being relatively stable, all three measures of children's impressions of the informant moved in the same direction--they all decreased slightly. In contrast, the ratings provided by adults did not cluster in the same manner and proved to be more malleable – by the end of the study, adults typically judged that the informant was *not* nice, and *somewhat* smart (ratings were between a little smart and a little not smart). Taken together, the trait ratings and the intent judgments are consistent with patterns observed in prior work demonstrating that with increasing age, individuals need fewer exemplars to make inferences about actors' mental states and dispositions (Boseovski, et al., 2013; Heyman, 2009) and become increasingly likely to attribute negative qualities to others (Boseovski & Lee, 2008). The observed age-related increase in participants' inferences that the informant intentionally provided incorrect information is consistent with that previously observed pattern. Indeed, part of what makes someone mean as opposed to nice is the negative or malicious intent behind their actions.

An important implication of these results is that there appears to be important differences in how children and adults construct psychological profiles of informants, with children being less apt than adults to adjust their profiles across multiple interactions. Children's developing ability to use accuracy information to simultaneously make decisions about whether to trust an informants' claims and to update their psychological profile of the informant may lead to important differences in epistemic trust (relative to adults) over time. Specifically, whereas children may be quick to distrust an inaccurate informant, they may also be quick to trust her again if she starts to provide accurate claims. In contrast, for adults, the informant's increasing

accuracy will be considered in conjunction with a more negative and robust psychological profile for that informant, and this may lead adults to be more distrustful of the informant even if she is now consistently accurate. Thus, adults might be slower to regain trust in the informant, requiring that she provide many more accurate claims before overturning their negative impressions.

We had hypothesized that repeatedly-inaccurate informants who repeatedly apologize would be interpreted as particularly unkind and deceptive, relative to equally inaccurate informants who had not apologized. Our results do not support this hypothesis. The informant's apologies did not influence children's judgements about the informant's niceness or attributions of negative intent at the end of the experiment. Children's evaluation of an informant who apologized after repeated inaccuracies intriguingly contrasts their evaluations of an informant who apologized for just a single inaccuracy—children more often judge that the latter informant's inaccuracy was a mistake (Ronfard & Lane, 2018). Thus, even for young children, the effectiveness of others' apologies varies depending upon when and how frequently apologies are made. This suggest that by 4-years-old children not only understand that apologies express blameworthiness and regret (Drell & Jaswal, 2016; Oostenbrook & Vaish, 2018; Smith & Harris, 2012) they also understand that apologies express a commitment not to repeat one's transgression (Darby & Schlenker, 1982). Repeated apologies for the same behavior reveal that the apologies are not genuine and, as a result, those apologies no longer confer a benefit to the person who apologized.

Adults' ratings of the informant's smartness increased dramatically after her first inaccuracy, and both children's and adults' ratings of her smartness increased somewhat when she did *not* apologize after her first inaccuracy. One plausible explanation for this pattern is that

participants, especially adults, thought that the informant was savvy in providing inaccurate information on the first trial. They might have felt as if they had been "tricked". Indeed, older participants, especially adults, stated that the informant had provided them with inaccurate information on *purpose*. Adults' increasingly positive evaluation of the informant's smartness may also stem from the fact that adults began the experiment with relatively low impressions of her smartness; thus, there was substantial room for their impressions to increase over the course of the experiment. We did not expect adults to begin the experiment with such low assessments of the informants' smartness, and we do not have a good explanation for this finding, so were are hesitant to speculate on its meaning.

It is worth noting a potential limitation of this study: The paradigm we used was developed for young children so that we could closely compare the current findings against prior developmental work (e.g., Heyman et al., 2013; Jaswal et al., 2010; Ronfard & Lane, 2018). As a result, adult participants were faced with a somewhat simplistic social situation. Adult participants were not aware that they were completing a task initially designed for children, and all actors in the videos and photographs were adults themselves. Nevertheless, it will be important to conduct additional research on this topic using a different paradigm. This will help clarify whether the results we obtained with adults generalize to more complex interactions with repeatedly inaccurate informants. Additional research with adults may also help clarify why adult participants began the experiment with favorable views of the informants' niceness but not of the informant's smartness.

Conclusions

Effectively learning from other people is not easy. Individual informants might differ dramatically in their behavior, traits, and trustworthiness. To navigate this complex social world,

individuals interpret the behavioral data from new informants in light their past experiences with other informants (Landrum et al., 2015). We find that children and adults both eventually distrust someone who consistently provides inaccurate information, however, adults' distrust is more gradual than that of children. This pattern highlights the importance of studying the development of epistemic trust across the lifespan and provides additional evidence that the development of epistemic trust from early childhood to adulthood is not simply a matter of increased skepticism (Lane, 2018). Moreover, when individuals interact with informants, they are making inferences beyond whether someone is trustworthy. Indeed, we uncover intriguing age-related difference in children and adults' construction of informants' psychological profiles.

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Table 1

Sample make-up by age group and condition.

	Age Group		
	4 to 5.5 years	5.5 to 7 years	Adults
No Apology	n = 18 (5 female) M_{age} = 4 years, 9 months SD_{age} = 5 months	n = 16 (8 female) M_{age} = 6 years, 5 months SD_{age} = 9 months	n = 30 (18 female) M_{age} = 39 years, 3 months SD_{age} = 14 years, 3 months
Apology	n = 16 (9 female) M_{age} = 4 years, 9 months SD_{age} = 5 months	n = 16 (7 female) M_{age} = 6 years, 5 months SD_{age} = 8 months	n = 32 (18 female) M_{age} = 36 years, 4 months SD_{age} = 13 years, 5 months

Table 2

Mixed-effects logistic regression comparing participants' trust in the informant's claims following each of her inaccuracies (with 0-for-0 as the reference category) for children and adults (with children as the reference category).

	Odds-Ratios	z scores	95% CI
Adults	.92	.18	.36, 2.32
0-for-1	.07***	5.62	.03, .18
0-for-2	.05***	5.91	.02, .14
0-for-3	.02***	6.53	.01, .07
0-for-4	.03***	6.38	.01, .09
0-for-5	.04***	6.28	.01, .10
Adults X 0-for-1	6.30**	2.95	1.85, 2.32
Adults X 0-for-2	4.96*	2.51	1.42, 21.42
Adults X 0-for-3	3.91~	1.85	.92, 17.30
Adults X 0-for-4	1.81	.83	.44, 7.38
Adults X 0-for-5	.78	.33	.18, 3.41
Constant	2.72**	2.99	1.41, 5.26
Ln(Random Effects Variance)	.32		-.26, .91
Wald X^2		63.21 ***	
Model df		12	

Note. ~ $p < .10$, * $p < .05$. ** $p < .01$, *** $p < .001$. Participants = 128, Observations = 768

Table 3

Logistic regression predicting judgments that information was provided on purpose, as a function of age (4- to 5.5-year-old is the reference category) and whether participants received an apology (not receiving an apology is the reference category).

	Model 1			Model 2		
	OR	**z scores**	**95% CI**	**OR**	**z scores**	**95% CI**
5.5- to 7-years-old	3.38	1.61	.77, 14.81	2.89*	2.02	1.03, 8.11
Adults	15.75**	3.14	2.81, 88.12	16.19***	4.71	5.08, 51.55
Apology	.68	.55	.17, 2.70	.61	1.07	.25, 1.51
5.5 to 7 X Apology	.74	.28	.09, 5.86			
Adults X Apology	1.02	.02	.10, 10.45			
Constant	.89	.24	.34, 2.30	.93	.17	.41, 2.10
Pseudo R2		.20			.20	
X^2		29.47***			29.37***	
Model df		5			3	

Note. ~ $p < .10$, * $p < .05$. ** $p < .01$, *** $p < .001$. $N = 126$.

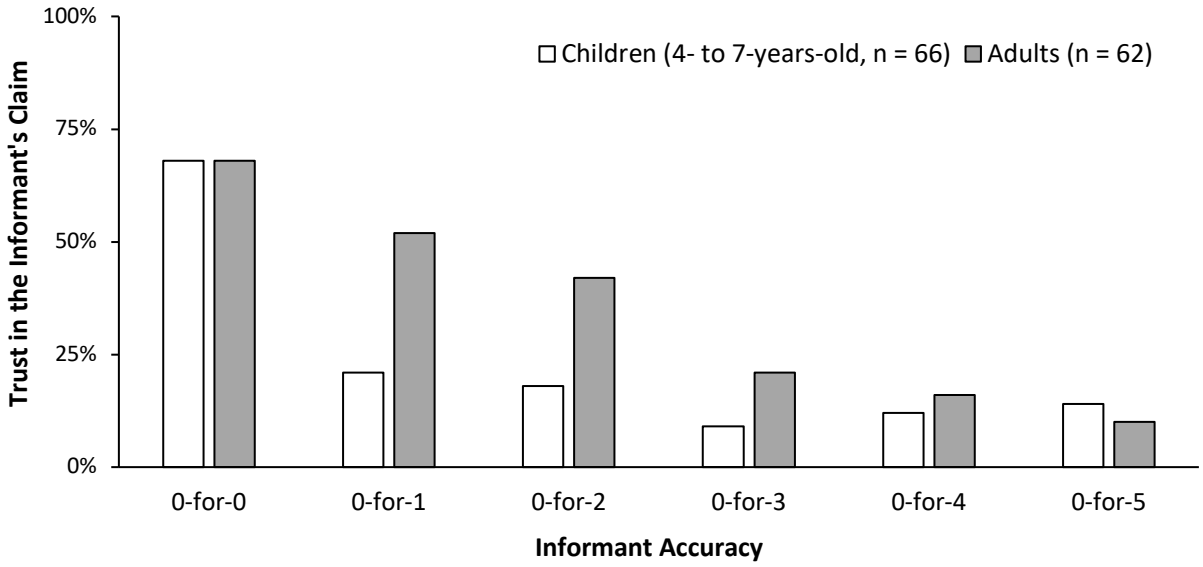


Figure 1. Proportion of children and adults who trusted the informant as a function of her prior accuracy: Trial 1 = 0-for-0, Trial 2 = 0-for-1, Trial 3 = 0-for-2, Trial 4 = 0-for-3, Trial 5 = 0-for-4, Trial 6 = 0-for-5.

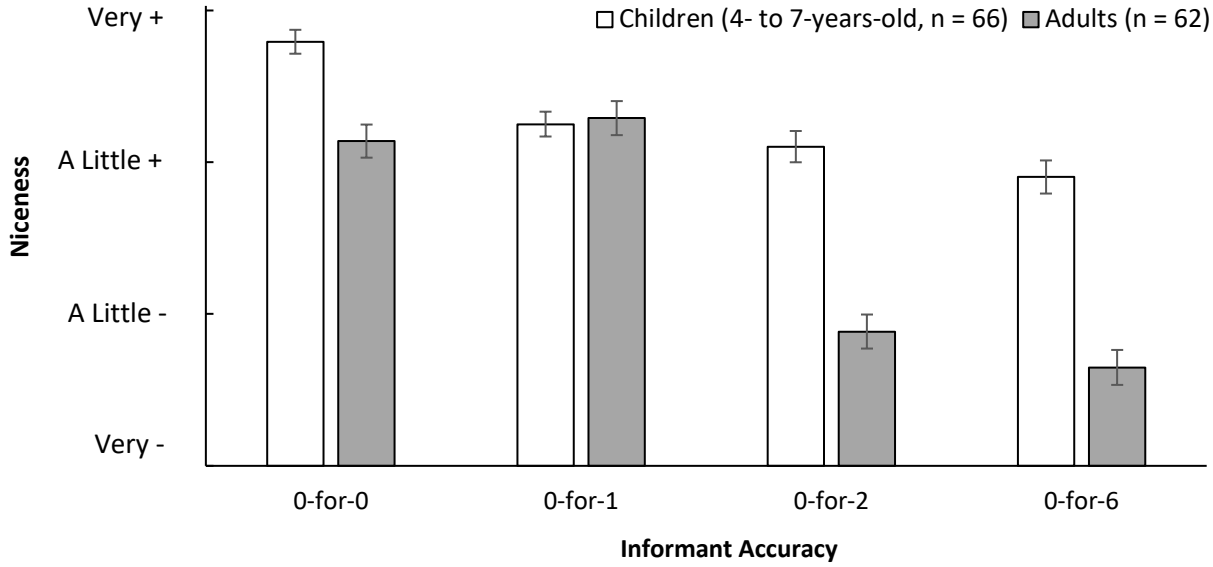
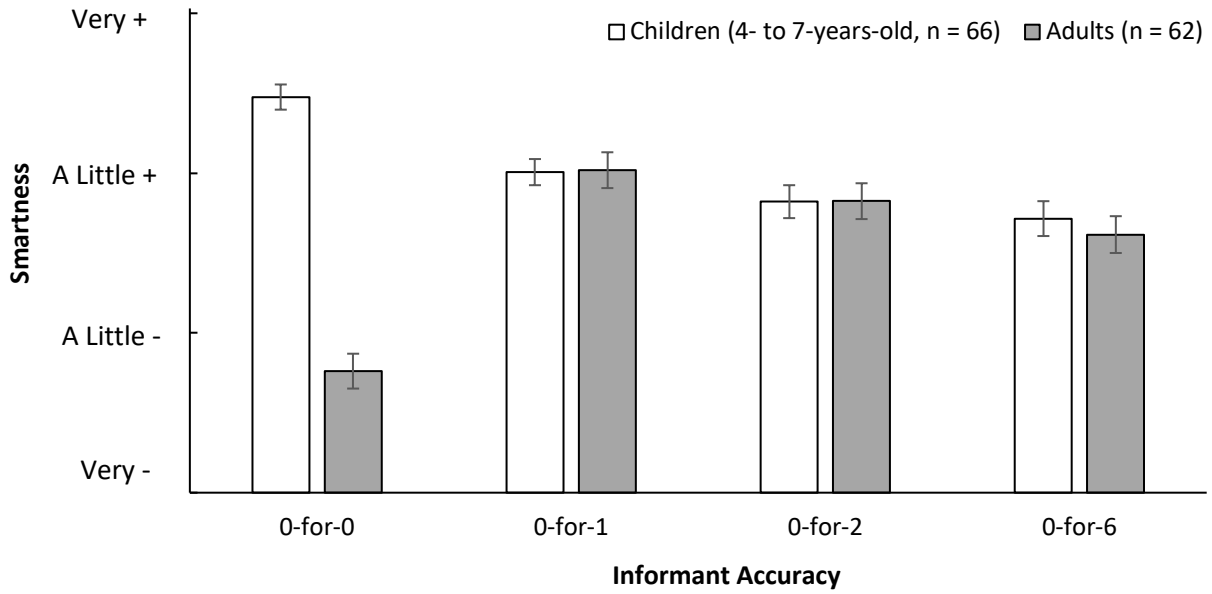


Figure 3. Mean trait ratings (Standard Errors) for the informant's niceness as a function of participants' age and the informant's accuracy. Trial 1 = 0-for-0, Trial 2 = 0-for-1, Trial 3 = 0-for-2, After Trial 6 = 0-for-6.

(a)



(b)

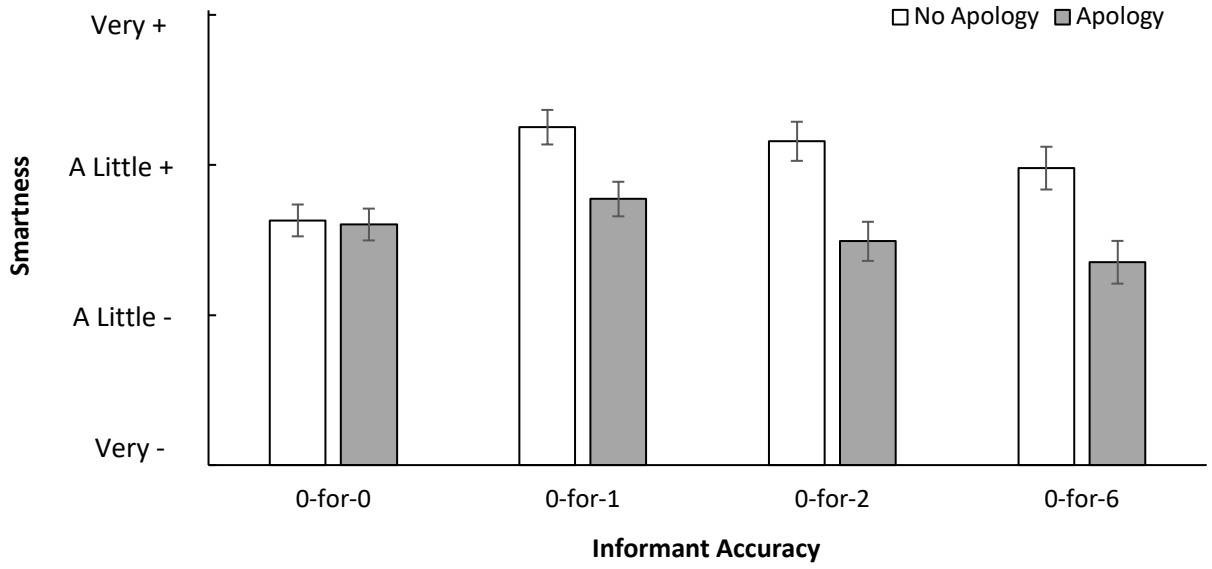


Figure 4. Mean trait ratings (Standard Errors) for the informant's smartness as a function of (a) the informant's accuracy and participants' age, and (b) the informant's accuracy and provision of an apology. Trial 1 = 0-for-0, Trial 2 = 0-for-1, Trial 3 = 0-for-2, After Trial 6 = 0-for-6.

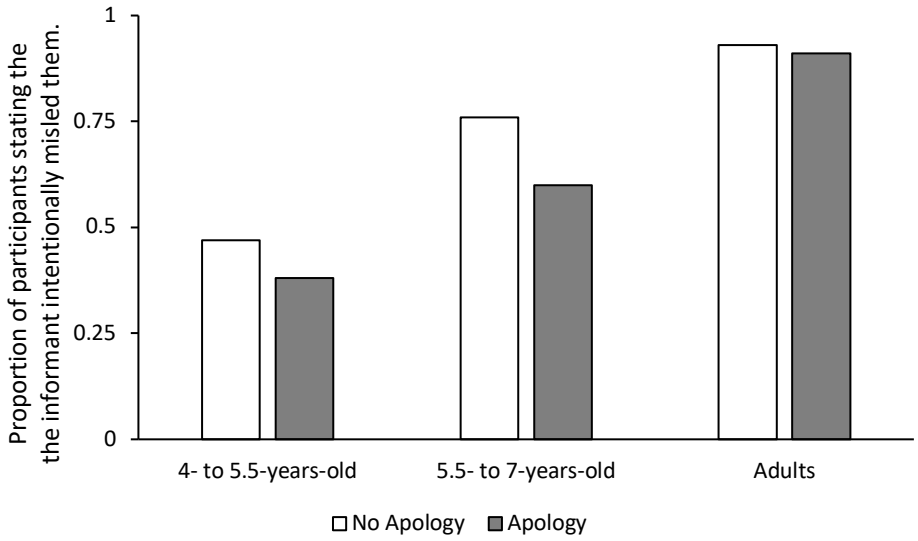


Figure 5. Proportion of participants in each age group and condition who judged that the informant purposely rather than mistakenly provided inaccurate information.

SUPPLEMENTARY MATERIALS

Overall influence of prior accuracy on trust in the informant's recommendation.

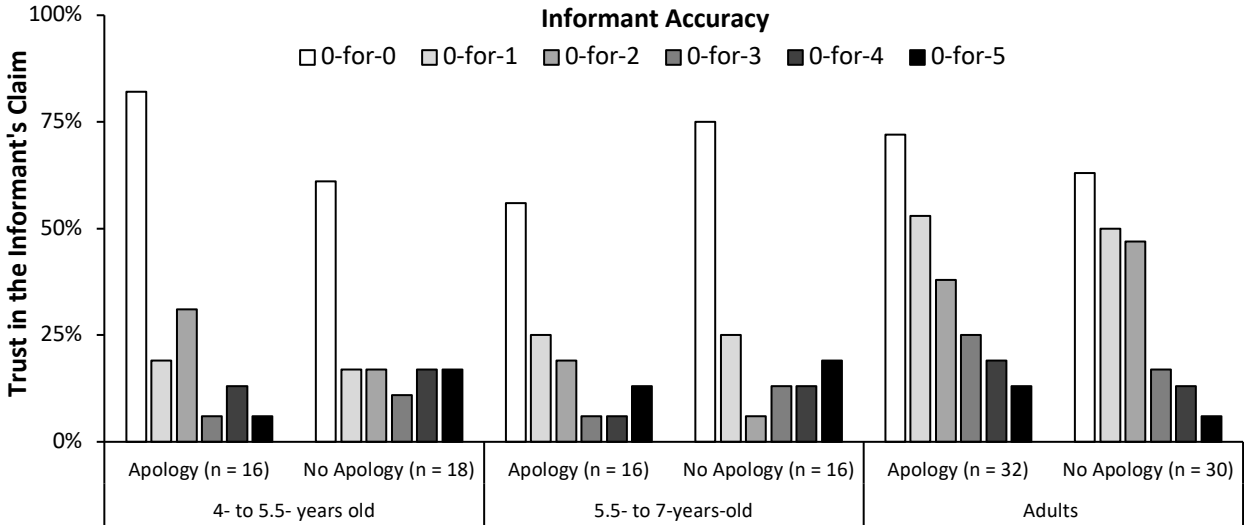


Figure 1. Proportion of participants in each age group who trusted the informant as a function of her prior accuracy and whether she apologized after providing inaccurate information. For each condition (e.g., 0-for-1) the first number reflects the informant's number of accurate claims, and the second number reflects the informant's total number of claims. Note that Trial 1 = 0-for-0, Trial 2 = 0-for-1, Trial 3 = 0-for-2, Trial 4 = 0-for-3, Trial 5 = 0-for-4, Trial 6 = 0-for-5.

Table 1

Mixed-effects logistic regression model comparing 4- to 5.5-year-old children's trust in the information provided by the informant at different ratios of accuracy in the apology and no apology condition, with 0-for-0 as the reference category (Children = 34, Observations = 204).

	Odds-Ratios	**z scores**	**95% CI**
Apology	3.90	1.16	.39, 38.67
0-for-1	.04**	3.00	.004, .32
0-for-2	.04**	3.00	.004, .32
0-for-3	.02**	3.24	.001, .20
0-for-4	.04**	3.00	.004, .32
0-for-5	.04**	3.00	.004, .32
Apology X 0-for-1	.36	.65	.02, 7.57
Apology X 0-for-2	1.02	.01	.05, 18.30
Apology X 0-for-3	.13	1.06	.003, 5.59
Apology X 0-for-4	.18	1.05	.007, 4.40
Apology X 0-for-5	.06	1.51	.002, 2.28
Constant	2.20	1.05	.50, 9.61
Ln(Random Effects Variance)	1.23		.28, 2.18
Wald X^2		34.05***	
Model df		12	

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2

Mixed-effects logistic model comparing 5.5- to 7-year-old children's trust in the information provided by the informant at different ratios of accuracy in the apology and no apology condition, with 0-for-0 as the reference category (Children = 32, Observations = 192).

	Odds-Ratios	**z scores**	**95% CI**
Apology	.22	1.28	.02, 2.24
0-for-1	.03	2.92	.00, .31
0-for-2	.00	3.34	.0001, .08
0-for-3	.01	3.30	.0004, .13
0-for-4	.01	3.30	.0004, .13
0-for-5	.02	3.14	.001, .21
Apology X 0-for-1	5.51	1.16	.31, 99.44
Apology X 0-for-2	45.68	1.91	.91, 2289.13
Apology X 0-for-3	3.19	.61	.08, 130.05
Apology X 0-for-4	3.19	.61	.08, 130.05
Apology X 0-for-5	3.51	.77	.14, 85.45
Constant	6.24	2.01	1.05, 37.19
Ln(Random Effects Variance)	1.19		.01, 2.37
Wald X^2		26.65**	
Model df		12	

** $p < .01$, *** $p < .001$.

Table 3

Mixed-effects logistic model comparing adult's trust in the information provided by the informant at different ratios of accuracy in the apology and no apology condition, with 0-for-0 as the reference category (Adults = 62, Observations = 372).

	Odds-Ratios	**z scores**	**95% CI**
Apology	1.54	.71	0.47, 5.05
0-for-1	0.54	1.1	0.18, 1.62
0-for-2	0.47	1.36	0.16, 1.40
0-for-3	0.09***	3.62	0.02, .33
0-for-4	0.07***	3.82	0.02, .27
0-for-5	0.03***	4.02	0.01, .17
Apology X 0-for-1	0.75	.37	0.16, 3.49
Apology X 0-for-2	0.42	1.08	0.09, 2.02
Apology X 0-for-3	1.14	.14	0.20, 6.40
Apology X 0-for-4	1.01	.01	0.16, 6.27
Apology X 0-for-5	1.36	.28	0.16, 11.65
Constant	1.85	1.45	0.81, 4.24
Ln(Random Effects Variance)	-.61		-1.79, .57
Wald X^2		58.12 ***	
Model df		12	

*** $p < .001$.

Table 4

Mixed-effects logistic model comparing participant's trust in the information provided by the informant at different ratios of accuracy for younger (4-to 5.5.-years-old) and older children (5.5- to 7-years-old), with 0-for-0 as the reference category (Children = 66, Observations = 396).

	Odds-Ratios	**z scores**	**95% CI**
Older Children	0.03***	-4.60	0.006, .13
0-for-1	0.05***	-4.22	0.012, .20
0-for-2	0.01***	-4.97	0.001, .06
0-for-3	0.02***	-4.76	0.004, .10
0-for-4	0.01***	-4.89	0.002, .08
0-for-5	0.69	-0.48	0.15, 3.13
Older Children X 0-for-1	2.82	1.03	0.39, 20.38
Older Children X 0-for-2	0.50	-0.65	0.06, 3.98
Older Children X 0-for-3	1.80	0.47	0.16, 20.70
Older Children X 0-for-4	0.78	-0.22	0.08, 7.58
Older Children X 0-for-5	2.50	0.82	0.28, 22.41
Constant	3.80*	2.43	1.29, 11.20
Ln(Random Effects Variance)	1.08		.36, 1.81
Wald X^2		63.21 ***	
Model df		12	

* $p < .05$, *** $p < .001$.

Differences in younger and older children's Niceness ratings

Age-related differences in younger and older children's Niceness ratings were assessed using a mixed effects ANOVA with Condition (2: Apology, No Apology) and Age (3: 4- to 5.5-years-old; 5.5- to 7-years-old) as between-subjects-factors and Accuracy (4: 0-for-0, 0-for-1, 0-for-2, 0-for-6) as a within-subjects factor. The main effect of Age was not statistically significant, $F(1, 62) = .851$, $p = .36$, $\eta^2_p = .014$. The interaction between Age and Accuracy was not statistically significant, $F(3, 186) = .574$, $p = .63$, $\eta^2_p = .009$. The interaction between Age, Accuracy, and Condition was not statistically significant, $F(3, 186) = .51$, $p = .68$, $\eta^2_p = .008$.

Thus, the two child groups were combined into a single group ($n = 66$) and compared to adults' ratings.

Differences in younger and older children's Smartness ratings

Age-related differences in younger and older children's Smartness ratings were assessed using a mixed effects ANOVA with Condition (2: Apology, No Apology) and Age (3: 4- to 5.5-years-old; 5.5- to 7-years-old) as between-subjects-factors and Accuracy (4: 0-for-0, 0-for-1, 0-for-2, 0-for-6) as a within-subjects factor. The main effect of Age was not statistically significant, $F(1, 62) = .870$, $p = .36$, $\eta^2_p = .014$. The interaction between Age and Accuracy was not statistically significant, $F(3, 186) = .107$, $p = .96$, $\eta^2_p = .002$. The interaction between Age, Accuracy, and Condition was not statistically significant, $F(3, 186) = .694$, $p = .56$, $\eta^2_p = .011$.

Thus, the two child groups were combined into a single group ($n = 66$) and compared to adults' ratings.