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Young children heed advice selectively

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ABSTRACT

A rational strategy to update and revise one's uncertain beliefs is to take advice by other agents who are better informed. Adults routinely engage in such advice taking in systematic and selective ways depending on relevant characteristics such as reliability of advisors. The current study merged research in social and developmental psychology to examine whether children also adjust their initial judgment to varying degrees depending on the characteristics of their advisors. Participants aged 3 to 6 years played a game in which they made initial judgments, received advice, and subsequently made final judgments. They systematically revised their judgments in light of the advice, and they did so selectively as a function of advisor expertise. They made greater adjustments to their initial judgment when advised by an apparently knowledgeable informant. This suggests that the pattern of advice taking studied in social psychology has its roots in early development.

Introduction

To be successful agents, we need to make accurate judgments. However, the world is complex and uncertain, and we have only limited resources—both temporal and cognitive—to explore it. If we based our judgments solely on our own knowledge and experience, they would, in most cases, be overly simplistic and ultimately insufficient. A powerful means to circumvent this problem is what Deutsch and Gerard (1955) termed *informational social influence*—making use of the knowledge of others. In their framework, Deutsch and Gerard differentiated between *informational social influence* and *normative*

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social influence. The former (sometime also termed *conversion*; Jaswal, Lima, & Small, 2009) means adopting the views of others because they are perceived to be more accurate; that is, informational influence is the result of an epistemic motive. In contrast, normative influence (sometimes termed *compliance*; Jaswal et al., 2009) means that one publicly (but not privately) adopts the views of others in order to be liked by them. Several fields of research have investigated how we use social information to make more accurate judgments. The current article integrates two of these lines of research: social psychological research on advice taking in adults and developmental research on selective trust in children. We do so by drawing on adult social psychology and modifying the experimental paradigm used in research on advice taking in order to develop a task format for testing advice taking in young children. In this way, we aim to reduce the divide between the two research programs with regard to the scope and sophistication of early selective trust and the ontogeny of advice taking.

Children's selective trust in some (but not all) information gained from other agents has been the focus of much recent work in cognitive development. Studies in this area have shown that the capacity to systematically and selectively acquire new knowledge by testimony develops during the course of the preschool years. From around 3 or 4 years of age, children learn novel words and facts from informants selectively as a function of their individual characteristics, for example, preferring knowledgeable over ignorant, confident over unconfident, previously reliable over unreliable, and adult over peer informants (e.g., Jaswal & Neely, 2006; Koenig & Harris, 2005a, 2005b; for review, see Harris, 2012). Thus, when young children are ignorant about some matter (e.g., not knowing the name or function of a novel object), they selectively accept information from others.

But accepting new knowledge is something different from—and arguably less complex than—revising one's prior judgments. So, a central question is the following: Do children selectively accept information from others in cases where they have made a judgment, and in particular how far do they selectively revise their judgments in light of the advice provided by others? Young children are generally capable of weighting what they have perceived against information provided by adults. For example, when confronted with a perceptually ambiguous object such as a flying fish looking more like a fish than a bird, children from 2 years of age who are left to their own devices tend to call the creature a fish and claim that it lives in a lake, whereas children who hear an adult call it a bird tend to call it a bird and claim that it lives in a nest (Jaswal, 2004; Jaswal & Markman, 2007). A related line of research has shown that young children give up their initial uncertain beliefs about the identity of an object in response to another agent's advice if this agent evidently had perceptual access to the object (Robinson & Whitcombe, 2003).

However, what remains unclear from such studies is whether young children engage in selective belief revision in response to advice in more systematic ways. Do they differentiate between good and bad informants not just on the basis of their perceptual access but also on the basis of other epistemically relevant attributes such as their track record and reliability? Do they engage not just in categorical belief revision (replacing one belief [e.g., that the object in question is an X] with another belief [that the object is a Y]) but also in more fine-grained adjustments, for example, of quantified beliefs?

From a different line of research, we know that preschoolers engage in Asch-style, conformity-based revisions of their public judgments in light of judgments publicly expressed by a consensus. Thus, when children first needed to judge which of several lines was the longest ("A" was the obviously correct answer) and then heard a consensus publicly judge "B", they often conformed to the consensus in their public judgment (Corriveau & Harris, 2010; Corriveau, Kim, Song, & Harris, 2013; Haun & Tomasello, 2011). However, conformity in such contexts is typically due to a *normative* influence rather than an *informational* influence (Deutsch & Gerard, 1955). Control experiments made it very clear that children did not actually revise their *beliefs* in this situation; they only revised their *public pronouncements.*

In sum, we know that children accept information from others selectively in situations where they lack any information themselves, that they adapt their publicly expressed judgments in light of others' social influence, and that they revise some of their categorical beliefs in light of advisers with better perceptual access. However, we do not know whether children revise their judgments on the basis of more general types of social information in a rational and selective fashion. In particular, we do not know whether children revise their initial judgments to a greater or lesser extent depending on the apparent competence of an advisor.

This type of graded revision has been studied extensively by social psychologists using the so-called "judge–advisor system" (JAS; Sniezek & Buckley, 1995). In the JAS, an adult decision maker first makes an initial judgment about a certain matter, then receives advice from another person, and subsequently makes a final decision or judgment. Advice is typically provided in the form of the judgment and decision another participant made when tasked with the same problem. The extent to which the decision maker's final judgment shifts toward that of the advisor can then be calculated. More specifically, decision makers may stick with their initial judgment, move partially toward the judgment proferred by the advisor (e.g., by averaging the two judgments), or fully endorse the advisor's judgment. A study by Soll and Larrick (2009) further showed that some of these advice-taking strategies are more prevalent among adult decision makers than others; specifically, adults have a strong preference for a choosing strategy, sticking to their initial opinion in approximately 40% of the cases and adopting the advice in approximately 10% of the cases. Adults are somewhat inclined to average the two opinions (approximately 20% of the cases), and the remaining 30% of the cases comprise various weighted averages with a tendency for judges to place more weight on their own judgments.

Although the advisor is anonymous in some studies, other studies provide information about the advisor via cues about the advisor's expertise or intentions (e.g., Gino, Brooks, & Schweitzer, 2012; Harvey & Fischer, 1997). In most studies on adult advice taking, participants make their initial and final judgments or decisions in private. This procedure allows us to attribute the revision of participants' opinions to informational influence rather than normative influence.

There are two central findings that generalize to the wide range of tasks and contexts in which adult advice taking has been studied. First, adults generally heed advice, and this leads to more accurate judgments and decisions; that is, error scores, such as absolute deviations from the true target values, are usually lower for the final judgment than for the initial judgment (for reviews, see Bonaccio & Dalal, 2006; Yaniv, 2004b). Second (and this is the most robust finding in the advice-taking literature), advice taking is not perfectly rational because adults weight advice insufficiently, a phenomenon called *egocentric advice discounting* (EAD; Yaniv, 2004a; Yaniv & Kleinberger, 2000). For example, when the decision maker and advisor are equally competent at a task, normative rationality dictates that the advice should be weighted by 50% in order to produce the most accurate revised estimate (Harvey & Fischer, 1997; Soll & Larrick, 2009). However, adults only weight such advice by an average of approximately 30% (Soll & Larrick, 2009).

Despite the general tendency to underuse advice, advice taking is, to some degree, systematic and selective. Adults are sensitive to a wide range of cues related to advice quality. For example, decision makers follow advice more when their advisor is labeled as an expert by the experimenter (Harvey & Fischer, 1997), performed well in past trials of the experiment (Yaniv & Kleinberger, 2000), or has more life experience (Feng & MacGeorge, 2006). Decision makers also use advice more when they have limited expertise (Yaniv, 2004a) or when the task is difficult (Gino & Moore, 2007). Interpersonal trust plays a crucial role here because it reflects decision makers' belief in the good intentions and expertise of an advisor (Bonaccio & Dalal, 2010). Accordingly, higher trust in an advisor leads to more advice taking and—assuming that the advisor does not have an ulterior motive—to greater judgmental accuracy (Sniezek & Van Swol, 2001). More important, trust in an advisor has been found to mediate the relation between situational cues such as the advisor's current mood and advice taking (Gino & Schweitzer, 2008; Van Swol, 2011). That is, situational variables change the degree of advice taking because they lead to increased or decreased trust in the advisor. In essence, the acceptance of information from some advisors rather than others is the result of selective trust in their competence and good intentions.

Although such systematic and (boundedly) rational advice taking is well documented in adults, little is known about these forms of socially induced judgment revision in children. Therefore, the current study brings together developmental research on selective trust and social psychological research on advice taking by combining the methods of each field in order to study the development of selective advice taking. In this way, we can contribute to closing two gaps in the literature. First, by investigating situations in which it is appropriate to revise a prior judgment on the basis of social information, we can gain a better understanding of how flexible and sophisticated early selective trust is. Second, by comparing the magnitude of children's belief revision with that typically found in adults, we can shed some light on the ontogeny of the type of advice taking that has been established in adults.

In the two experiments described in this article, children were presented with a task that implemented the basic structure of advice taking in a format suitable for young children. In this task, children had some (but clearly limited) information on which they could base their initial judgment (regarding the amount of food that a given animal would need). One of several informants who differed in their expertise then made a judgment that diverged from the children's judgment. Finally, children were given the chance to revise their original judgment.

In Experiment 1, children were introduced to two informants. In the case of a familiar animal, both informants named it correctly. However, in the case of an exotic animal that was unfamiliar to the children, one informant provided a name, whereas the other informant acknowledged ignorance. Past research has shown that children prefer to accept new information from apparently knowledgeable informants rather than from those who acknowledge ignorance (Koenig & Harris, 2005a, 2005b; Sabbagh & Baldwin, 2001). We anticipated, therefore, that children might also be more willing to revise their original judgment when given advice by the apparently knowledgeable informant rather than the ignorant informant.

Experiment 1

Method

Participants

A total of 41 3- to 6-year-old children from mixed socioeconomic backgrounds were recruited from visitors to the Living Lab of the Boston Museum of Science in the northeastern United States. Their parents had previously given consent to their participation. Two children lost interest in the study early on, so we could not gather data on these children's advice-taking behavior. The remaining 39 children were aged 40 to 77 months (M = 59 months), and 18 of them were female. We did not aim for a specific sample size in Experiment 1. Rather, the second author, who gathered the data, was granted a 3-week timeframe for conducting the experiment in the Living Lab, and we aimed to gather as much data as we could within that timeframe.

Design and procedure

Expertise manipulation phase. Two advisors (Mr. Blue and Mr. Red) were introduced in short animations on a single slide within a computerized game. The introduction of both advisors started when children touched the screen. A second touch on Mr. Blue or Mr. Red started the audio message. Both advisors were standardized, unanimated male adult cartoon characters that differed only in the color of their shirts and trousers (blue or red) (see Fig. 1). In two trials with familiar animals (a dog and a pig), both advisors named the animal correctly. Again a touch on Mr. Blue or Mr. Red started the audio tape. In two subsequent unfamiliar animal trials, the knowledgeable advisor named the animal correctly (e.g., "This is an axolotl"), whereas the ignorant advisor claimed ignorance ("I don't know the name of this animal. I haven't seen an animal like this before").

To ensure that children understood that the knowledgeable advisor was accurate when naming the unfamiliar animals, the experimenter confirmed the statement of the knowledgeable advisor (e.g., "This is right. The name of this animal is axolotl"). In each trial, the advisors labeled the animals consecutively. After both of them had named (or failed to name) the animal, children were asked, "Did Mr. Red know what this animal is called? And did Mr. Blue know what this animal is called?" We counterbalanced whether Mr. Red or Mr. Blue was the knowledgeable advisor, the order of their appearance, and the order of the two questions regarding the advisors' knowledge of the animal's name.

Test phase. Children then played a computerized game in which they were to assign the right amount of food to unfamiliar animals (tapir, platypus, naked mole rat, and Komodo dragon). In each of four trials, children were shown the picture of an unfamiliar animal and asked to choose the right amount of food for that animal. It was made clear to children that both feeding too little ("then the animal remains hungry") and feeding too much ("then the animal gets a stomach ache") would have negative consequences for the animal. Children could always choose from a range of 1 to 5 units of

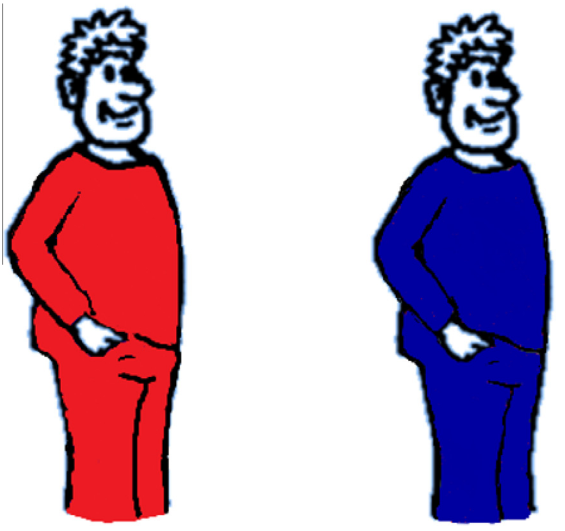

Fig. 1. Mr. Red and Mr. Blue (standardized unanimated male adult cartoon characters used in Experiment 1). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

food (e.g., 1–5 piles of hay). After they made their initial judgment by touching one of the choices on the screen, children received advice from one of the advisors (each advisor provided advice on two consecutive trials). Regardless of the expertise of the advisor, a fixed algorithm calibrated the advice so that it always deviated by two steps from the child's initial judgment. For example, if the child chose 1 unit of food, the advisor chose 3 units, and if the child chose 3 units of food, the advisor randomly chose either 1 unit or 5 units. This procedure ensured that children could engage in the two advice-taking strategies most prominent in adults, averaging the two judgments and choosing between the two judgments (Soll & Larrick, 2009) on each individual trial.

As an illustration, if children chose to feed the tapir with two piles of hay, they were presented with a slide showing them their own initial estimation along with a question mark and the experimenter said, "Okay, you chose two piles of hay. Now, if you touch the question mark, Mr. Red/Mr. Blue will appear." As mentioned, regardless of the competence of the advisor, children always received advice that deviated by two steps from their initial judgment. However, if children received advice from the ignorant advisor, they were told, "This animal needs four piles of hay every day," whereas if there were given advice by the knowledgeable advisor, they were told the correct name of the animal, for example, "This tapir needs four piles of hay every day." After the children received advice, they were invited to make their final decision. They were presented with the same slide they saw at the beginning of the trial, and the instructor said, "Now you can make your final choice." To help children remember their own choice and the advice, the instructor asked, "What did you choose at first, and what did Mr. Blue/Mr. Red say?" If children remembered incorrectly, they were shown the slide with their own initial judgment and the advice again. Furthermore, children were explicitly reminded that they could always choose from the full range of 1 to 5 food units again ("Now you can choose again. Maybe you choose your own opinion or you choose what Mr. Red/Mr. Blue told you or something in between or any other possible option. It's up to you"). The trial was completed with children's final, possibly revised judgment. Children did not receive feedback or any other further information.

The dependent measures were as follows:

- *Competence rating:* After the first and last trials, children assessed their own expertise and the current advisor's expertise (the knowledgeable advisor on one trial and the ignorant advisor on the other trial) with regard to feeding animals on a 4-point scale (ranging from *certainly bad* to *certainly good*).

- *Advisor preference:* After the last trial, children were asked which advisor they would prefer to ask for advice if they were to feed another animal.
- *Advice taking:* The crucial dependent measure was advice taking (AT; Harvey & Fischer, 1997), which is defined as [(final estimate − initial estimate)/(advice − initial estimate)] × 100%. The AT, therefore, represents the percentage weight of advice. An AT score of 0% means that the child did not revise his or her initial judgment after receiving advice, fully adopting the advice when making the final judgment means an AT score of 100%, and AT scores between 0% and 100% represent gradual adjustments toward the advice, with 50% representing equal weights assigned to the initial judgment and the advice. An AT score below 0% means that the participant adjusted a judgment in the opposite direction of the advice, and if the participant adjusted in the direction of the advice but went even beyond the advice, the respective AT score is greater than 100%. Although the AT measure is theoretically unbounded on both its high and low sides, the vast majority of the AT values are in the range between 0% and 100% (e.g., Soll & Larrick, 2009). Thus, when judges revise their initial judgment, they typically move toward the judgment made by the advisor to varying degrees; they rarely move away from or beyond the advisor's judgment.

Results

We confirm that we report all independent variables or manipulations of Experiment 1, whether successful or failed. Following the recommendation of Cumming (2014), we report 95% confidence intervals and effect sizes for our statistical tests. In the case of comparisons of group means these confidence intervals refer to the observed mean difference, whereas in the case of regression models they relate to the estimated regression parameters.

As can be seen in Fig. 2A, children appropriately perceived the knowledgeable advisor as more competent ($M = 3.51$, $SD = 0.96$) than the ignorant advisor ($M = 2.01$, $SD = 1.04$), $t(36) = 5.95$, $p < .001$, 95% *CI* [0.979, 1.993], $d = 0.98$. (It should be noted that analyses were run with pairwise deletion of

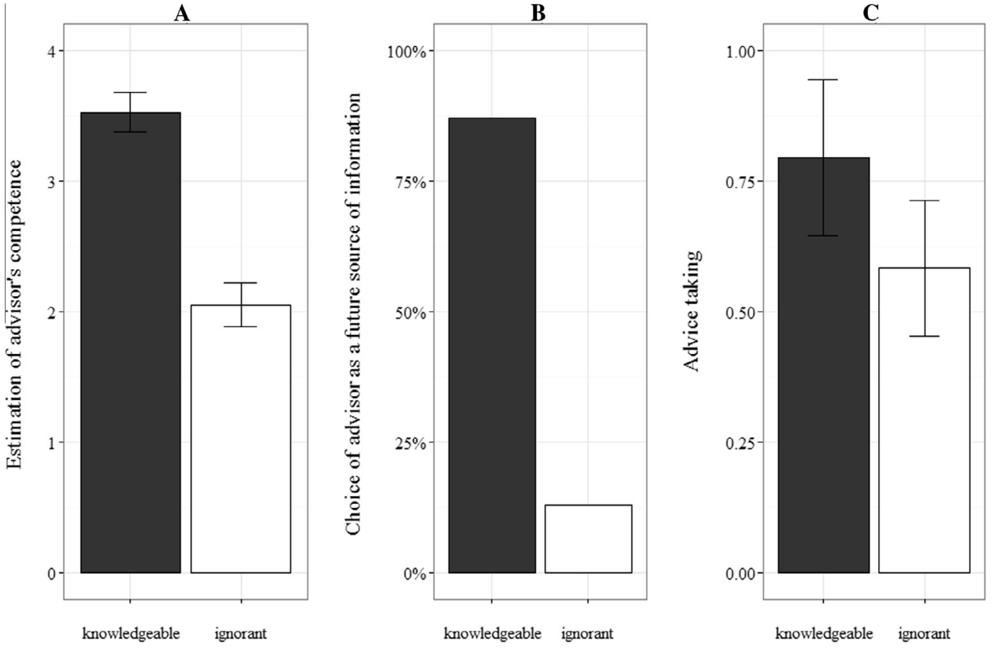

Fig. 2. Children's evaluation of the advisors in Study 1: (A) assessment of the advisor's competence; (B) preference for each advisor as a future source of information; (C) advice taking (AT) from each advisor. Error bars represent the 95% CIs.

missing cases. Therefore, the means and standard deviations computed are based on all available data for each variable for the specific test. Hence, means and standard deviations of one variable were sometimes slightly different across different tests.) Children rated themselves as more competent than the ignorant advisor ($M = 2.71$, $SD = 1.29$ vs. $M = 1.97$, $SD = 1.06$), $t(33) = 2.48$, $p = .018$, 95% CI [0.132, 1.338], $d = 0.43$, but not as differentially competent than the knowledgeable advisor ($M = 3.08$, $SD = 1.23$ vs. $M = 3.50$, $SD = 0.97$), $t(35) = -1.46$, $p = .153$, 95% CI [−0.996, 0.163], $d = 0.24$. Note that the contrast pairs were analyzed separately because children rated themselves as slightly more competent when they were presented with the knowledgeable advisor ($M = 3.09$, $SD = 1.21$) rather than the ignorant advisor ($M = 2.73$, $SD = 1.31$), $t(32) = -1.48$, $p = .148$, 95% CI [−0.136, 0.864], $d = 0.26$. In line with these assessments, children preferred the knowledgeable advisor as a future source of information when asked about feeding another animal (87% vs. 13%), $\chi^2(1, N = 39) = 20.63$, $p < .001$, $d = 0.73$ (see Fig. 2B).

We analyzed advice taking using multilevel modeling (for an introduction to multilevel modeling, see Nezlek, 2008). We started the analysis with a baseline or null model that included only the intercept and buildup on this model, adding one predictor at a time (for further information, see Field, Miles, & Field, 2012). To account for the dependencies in the data, we modeled the intercept as a random effect varying by participants. We then added the following predictors as fixed effects: advisor's expertise (Model 1), children's age (Model 2), and interaction of the two variables (Model 3). We assessed the general fit of the models using Schwarz's Bayesian information criterion (BIC). The BIC is a conservative goodness-of-fit measure that is corrected for model complexity; lower values indicate a better model fit. The comparative fit of our nested multilevel models was further tested using a likelihood ratio test. The likelihood ratio follows an approximate chi-square distribution with degrees of freedom equivalent to the difference of the number of parameters of the models to be compared (i.e., the models' respective degrees of freedom). A significant likelihood ratio indicates that adding additional predictors to a model increases the model's explanatory power. Both the BIC and the result of the likelihood ratio test indicate that Model 2 provides the best fit to the data (see Table 1).

In line with children's stated preferences, children used advice from the knowledgeable advisor more than they used advice from the ignorant advisor ($M = 0.80$, $SD = 0.46$ vs. $M = 0.58$, $SD = 0.40$) (see Fig. 2C). Nevertheless, separate t tests against zero showed that children used the advice from both advisors (knowledgeable: $t(38) = 10.75$, $p < .001$, CI [0.645, 0.945], $d = 1.72$; ignorant: $t(38) = 9.14$, $p < .001$, CI [0.454, 0.713], $d = 1.46$). Furthermore, the model suggests slightly higher degrees of advice utilization for older children (see Table 2).

Finally, we tested whether the effect of the advisor's expertise on advice taking was mediated by children's assessment of the advisor's competence. A mediation analysis consists of three steps (Baron & Kenny, 1986). The first step is to test for a significant influence of the independent variable on the dependent variable that we did in Model 2, showing a significant effect of advisor expertise on advice taking. The next step is to test for a significant effect of the independent variable on the mediating variable. In our case, the mediator is children's assessment of advisor expertise. A multilevel model analogous to Model 2 but with children's assessment of advisor competence revealed a significant effect of advisor expertise ($B = 0.60$, $SE = 0.09$), $t(36) = 6.46$, $p < .001$, CI [0.41, 0.78], whereas children's age was not significantly related to the competence ratings. The third step is to predict the dependent variable from both the independent variable and the mediator. Mediation is established if (a) the explanatory power of the independent variable is reduced by entering the mediator in the model and (b) the mediator is a significant predictor of the dependent variable. Entering children's

Table 1
Summary of multilevel model comparison for Experiment 1.

Model	BIC	logL	Test	χ^2	p
Baseline	235.14	−108.86	–	–	–
Model 1	232.89	−105.55	Baseline vs. 1	6.61	.010
Model 2[a]	232.86	−103.36	1 vs. 2	4.39	.036
Model 3	235.75	−102.63	2 vs. 3	1.46	.226

[a] Best fitting model.

Table 2
Parameter estimates for the best fitting multilevel model predicting advice taking in Experiment 1 ($N = 39$).

Variable	*B*	*SE*	*df*	*t*	*p*	*CI*
Model 2	–	–	–	–	–	
Intercept	0	0.13	38	–	–	
Advisor expertise	0.24	0.09	38	2.63	.012	[0.045, 0.412]
Age	0.26	0.12	37	2.11	.041	[0.016, 0.510]

Note: All variables were centered at their means.

assessment of advisor competence as an additional predictor in Model 2 showed this exact pattern. Compared with Model 2, the effect of advisor expertise was strongly reduced and no longer statistically significant ($B = 0.02$, $SE = 0.12$), $t(35) = 0.17$, $p = .863$, CI [−0.21, 0.25], whereas children's assessment of advisor competence was significantly related to advice taking ($B = 0.36$, $SE = 0.12$), $t(35) = 2.94$, $p = .006$, CI [0.12, 0.61].

Finally, we tested whether the indirect effect of advisor expertise (which is equivalent to the reduction of the explanatory power of the independent variable) via the competence assessment was significantly different from zero using the bootstrapping method of Preacher and Hayes (2008). Using 20,000 bootstrap samples and bias-corrected and accelerated confidence intervals (BCa CIs), the results revealed that children's assessment of advisor expertise was indeed a significant mediator. The indirect effect was estimated at 0.217, and the 95% BCa CI [0.099, 0.438] excluded zero. This analysis suggests that children followed advice from the knowledgeable advisor more precisely because they perceived this advisor to be more competent.

In summary, children systematically revised their judgments when presented with advice. They did so selectively, however, making a greater adjustment to their initial judgment following advice from the more knowledgeable advisor. However, Study 1 used only a very coarse-grained contrast between a clearly knowledgeable model and a strikingly ignorant model. Given this contrast, any differential advice taking might have been merely driven by the negative information concerning the ignorant model rather than by a relative contrast in competence. In Study 2, therefore, we used a more differentiated, systematic, and stringent manipulation of model competence. There were two contrasts—between a highly competent model and a neutral basic-level model (performing on the level of the child) and between the latter and a clearly incompetent model—such that one and the same model (the basic-level model) performed on the same absolute level but performed relatively worse or better than another model, respectively, in the two contrasts. If children really base their selective advice taking on the perceived relative competence of models, they should prefer the competent advisor over the basic-level advisor and should prefer the basic-level advisor over the incompetent advisor.

Experiment 2

Method

Participants

In Experiment 2, we aimed for a sample size of 95 children based on a power analysis. The basis for this analysis was the age effect observed in Experiment 1 ($r = .32$). We chose the age effect as a basis for the power analysis because it was the weakest effect observed in Experiment 1. Given a Type I error of 5% and a desired test power of .90, the power analysis suggested a sample size of 95 children. All children who took part in Experiment 2 were recruited in Göttingen, Germany, from a database of children whose parents had previously given consent to experimental participation. Children were tested in separate rooms in various kindergartens.

We gathered data from 97 3- to 6-year-old children from mixed socioeconomic backgrounds, but 2 children lost interest in the experiment and did not provide data on the advice-taking trials. Later analysis of the data revealed that 2 children provided wrong answers on the manipulation checks (see below) and, therefore, were also excluded from the analysis (the pattern of results and reported statistical tests do not change substantially when these children are included in the analysis, and including them slightly shifts the results in favor of our hypotheses). The remaining 93 children were aged 37 to 73 months ($M = 56.6$ months), and 39 of them were female.

Design and procedure

Expertise manipulation phase. The procedure paralleled that of Experiment 1 with the following exceptions. First, instead of two advisors, one knowledgeable and one ignorant, there were three advisors: a knowledgeable advisor, a basic-level advisor, and an ignorant advisor. As in Experiment 1, we used standardized male adult cartoon characters that differed only in the color of their shirts and trousers (white, red, and green). Advisor expertise was established by advisors naming eight animals typically known to children: pig, dog, fish, ape, guinea pig, cat, butterfly, and chicken. On four trials, the knowledgeable and basic-level advisors appeared. The former gave the full name of the specific species (e.g., "humphead wrasse"), whereas the latter named the animal with its basic-level category name (e.g., "fish"). As in Experiment 1, the experimenter confirmed the statements of the knowledgeable advisor. The other four trials featured the basic-level and ignorant advisors. The former again called the animals by their basic-level category name, whereas the latter gave a wrong label (e.g., "duck" in response to a fish). After each pair of four trials introducing two advisors, children were asked to state which of these advisors was better at naming animals. This question served as a manipulation check. If a child did not provide the correct answer, the advice-taking trials for this advisor dyad were excluded from the analysis. This led to the exclusion of 2 children from the analysis (see above).

Test phase. There were eight trials of the animal-feeding game split into two blocks of four trials (animals to be fed: tapir, platypus, naked mole rat, Komodo dragon, elephant shrews, axolotl, tarsier, and bat). In each block, we contrasted two of the three advisors. In the high-expertise contrast children received advice from the knowledgeable advisor (two trials) and the basic-level advisor (two trials), whereas in the low-expertise contrast they received advice from the basic-level advisor (two trials) and the ignorant advisor (two trials). After both the first and last trials of each block, children estimated their own competence at feeding animals as well as the competence of the advisor from whom they had received advice during those trials. Finally, at the end of each block, children were asked which advisor they would prefer to ask if they needed to feed another animal. We counterbalanced the assignment of the different advisors to the three levels of expertise as well as their order of appearance. The dependent measures were the same as in Experiment 1.

Results

We confirm that we report all independent variables or manipulations of Experiment 2, whether successful or failed. Within each contrast pair, children differentially assessed the advisors' competence; they rated the knowledgeable advisor ($M = 3.70$, $SD = 0.80$) as more competent than the basic-level advisor ($M = 3.00$, $SD = 1.21$), $t(79) = 4.59$, $p < .001$, CI [0.375, 0.950], $d = 0.51$, and rated the basic-level advisor ($M = 3.39$, $SD = 1.05$) as more competent than the ignorant advisor ($M = 2.46$, $SD = 1.32$), $t(83) = 5.41$, $p < .001$, CI [0.587, 1.270], $d = 0.59$ (see Fig. 3A). Note that the contrast pairs were analyzed separately because children rated the basic-level advisor as less competent when he was contrasted with the knowledgeable advisor ($M = 3.09$, $SD = 1.19$) rather than the ignorant advisor ($M = 3.39$, $SD = 1.05$), $t(83) = -2.07$, $p = .041$, CI [0.012, 0.583], $d = 0.23$.

Children rated themselves as more competent than the ignorant advisor ($M = 3.49$, $SD = 0.91$ vs. $M = 2.42$, $SD = 1.32$), $t(83) = 6.91$, $p < .001$, CI [0.763, 1.380], $d = 0.75$, and also as more competent than the basic-level advisor when he was contrasted with the knowledgeable advisor ($M = 3.41$, $SD = 1.07$ vs. $M = 3.06$, $SD = 1.19$), $t(84) = 2.01$, $p = .047$, CI [0.004, 0.701], $d = 0.22$. They rated themselves as no less competent than either the knowledgeable advisor ($M = 3.36$, $SD = 1.07$ vs. $M = 3.68$, $SD = 0.82$), $t(74) = -1.97$, $p = .052$, CI [−0.643, 0.003], $d = 0.23$, or the basic-level advisor when he was contrasted with the ignorant advisor ($M = 3.55$, $SD = 0.96$ vs. $M = 3.38$, $SD = 1.06$), $t(81) = 1.31$, $p = .262$, CI [0.130, 0.471], $d = 0.14$.

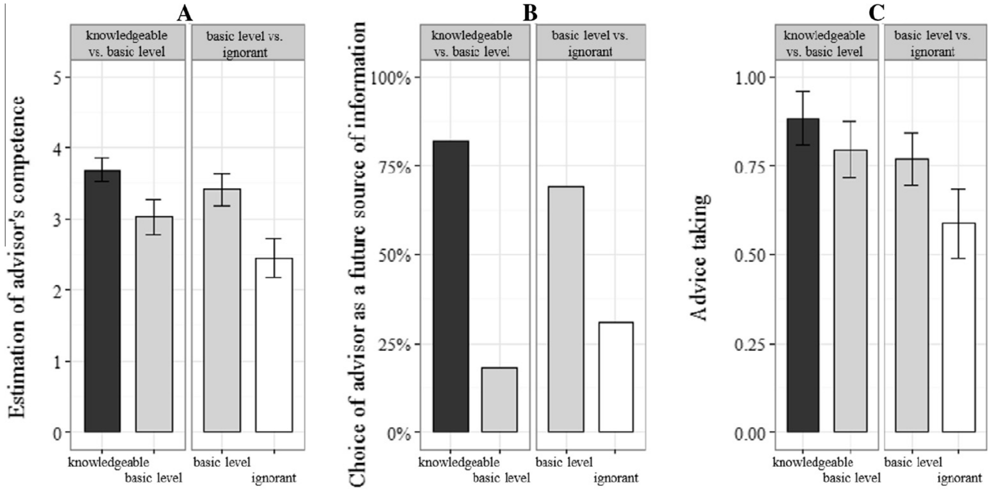

Fig. 3. Children's evaluation of the advisors in Study 2: (A) assessment of the advisor's competence; (B) preference for each advisor as a future source of information; (C) advice taking (AT) from each advisor. Error bars represent the 95% CIs of the continuous measures.

In line with these competence ratings, children preferred the more knowledgeable advisor as a future source of information within each contrast pair (knowledgeable vs. basic level: 82% vs. 18%, $\chi^2(1, N = 92) = 36.55$, $p < .001$, $d = 0.63$; basic level vs. ignorant: 69% vs. 31%, $\chi^2(1, N = 90) = 12.84$, $p < .001$, $d = 0.38$). These results are displayed in Fig. 3B. We again used multilevel modeling to analyze advice taking. We started with a baseline model containing only the intercept, which was allowed to vary by participants as a random effect in order to account for dependencies in the data. We then successively added the independent variables as well as children's age to the model in the following order: advisor expertise between dyads (Model 1), advisor expertise within dyads (Model 2), interaction of the two expertise variables (Model 3), children's age (Model 4), two-way interactions of age with the two expertise variables (Models 5 and 6), and three-way interaction (Model 7). As in Experiment 1, we used the BIC and likelihood ratio tests to determine the best fitting model. Both consistently revealed Model 2 to provide the best fit to the data. Adding children's age did not improve the model, and neither did adding any of the interaction effects (see Table 3).

This means that, using a larger sample, we did not replicate the modest age effect on advice taking observed in Experiment 1. However, fully consistent with the findings of Experiment 1, the best fitting model indicates that children made a greater adjustment to their initial judgment when advised by the dyad with greater expertise and made a greater adjustment when advised by the more expert advisor within each dyad (see Table 4 and Fig. 3C).

Table 3
Summary of multilevel model comparison for Experiment 2.

Model	BIC	logL	Test	χ^2	p
Baseline	1052.26	−511.37	–	–	–
Model 1	1041.10	−502.84	Baseline vs. 1	17.06	<.0001
Model 2[a]	1033.99	−496.34	1 vs. 2	13.01	<.001
Model 3	1038.31	−495.54	2 vs. 3	1.59	.208
Model 4	1044.21	−495.54	3 vs. 4	0.00	.996
Model 5	1048.66	−494.81	4 vs. 5	1.45	.229
Model 6	1052.96	−494.02	5 vs. 6	1.60	.205
Model 7	1058.71	−493.94	6 vs. 7	0.15	.699

[a] Best fitting model.

Table 4
Parameter estimates for the best fitting multilevel model predicting advice taking in Experiment 2 ($N = 93$).

Variable	*B*	*SE*	*df*	*t*	*p*	*CI*
Model 3	–	–	–	–	–	–
Intercept	−0.35	0.09	179	–	–	–
Expertise between dyads	0.39	0.09	92	4.29	<.001	[0.208, 0.564]
Expertise within dyads	0.33	0.09	179	3.64	<.001	[0.150, 0.504]

Note: All variables were centered at their means.

Additional post hoc analyses revealed no significant difference in advice taking for the basic-level advisor in the two contrast pairs ($M = 0.80$, $SD = 0.39$ vs. $M = 0.77$, $SD = 0.36$), $t(88) = 0.56$, $p = .577$, *CI* [0.071, 0.128], $d = 0.06$. Therefore, we averaged advice taking from the basic-level advisor across the two contrast pairs and tested for the linear effect of advisor expertise (knowledgeable vs. basic level vs. ignorant) on advice taking ($M = 0.88$, $SD = 0.38$ vs. $M = 0.78$, $SD = 0.29$ vs. $M = 0.59$, $SD = 0.47$). A multilevel model with advisor expertise as the predictor and a random effect of participants showed a significant effect of advisor expertise ($B = 0.36$, $SE = 0.06$), $t(272) = 5.63$, $p < .001$, *CI* [0.23, 0.48], indicating stronger advice taking the higher the advisor's expertise. Finally, separate *t* tests against zero showed that children systematically accepted advice in all three conditions (all *t*s > 11.95, all *p*s < .001, all *CI*s [>0.489, >0.684], all *d*s > 1.27).

We again tested whether the effect of advisor expertise on advice taking was mediated by children's rating of advisor competence. Having already established the significant effect of advisor expertise on advice taking, we next tested for its effect on children's assessment of their advisor's competence, finding a significant positive relation ($B = 0.52$, $SE = 0.06$), $t(252) = 8.23$, $p < .001$, *CI* [0.40, 0.65]. We then predicted advice taking from both advisor expertise and children's ratings of advisor competence. In this analysis, the effect of advisor expertise was still significant but less pronounced ($B = 0.25$, $SE = 0.07$), $t(247) = 3.57$, $p < .001$, *CI* [0.11, 0.39], and children's ratings of their advisor's competence were significantly related to advice taking ($B = 0.21$, $SE = 0.06$), $t(247) = 3.82$, $p < .001$, *CI* [0.11, 0.39], suggesting partial mediation of advisor expertise via children's assessment of advisor competence.

Using 20,000 bootstrap samples and bias-corrected and accelerated confidence intervals, we again tested whether this indirect effect was significantly different from zero. The results suggested that children's assessment of advisor competence was a significant mediator given that the indirect effect was estimated at 0.11 and the respective 95% BCa *CI* [0.050, 0.200] excluded zero. As in Experiment 1, children relied more on the more expert advisor because they perceived him to be more competent.

Advice-taking strategies

In both experiments, we consistently found that children placed rather high weights on the advice. Although the degree of advice taking differed as a function of advisor expertise, children generally placed more weight on the advice than on their own initial judgment. This was true even when the advisor was clearly ignorant and, therefore, likely to be less competent at the task than the children. This pattern is in stark contrast to advice taking in adults, who rarely place more weight on advice than on their own initial judgment even when their advisor is demonstrably better at the task (e.g., Harvey & Fischer, 1997; Soll & Larrick, 2009). Our analyses indicate quantitative differences in advice-taking behavior between children and adults (i.e., higher mean AT scores of children compared with the usual level of advice taking observed in adults) (see Bonaccio & Dalal, 2006).

However, there is also the possibility that children and adults might differ qualitatively; that is, they might apply different advice-taking strategies. Soll and Larrick (2009) argued that adult decision makers mainly use two advice-taking strategies: (a) averaging the initial judgment and the advice and (b) choosing the better of these two judgments. Although averaging yields more accurate final judgments in most cases, adults heavily rely on the choosing strategy. In the Soll and Larrick studies, adults used the choosing strategy approximately 50% of the time, whereas averaging accounted for slightly more than 20% of the trials. However, adult decision makers did not use the choosing strategy

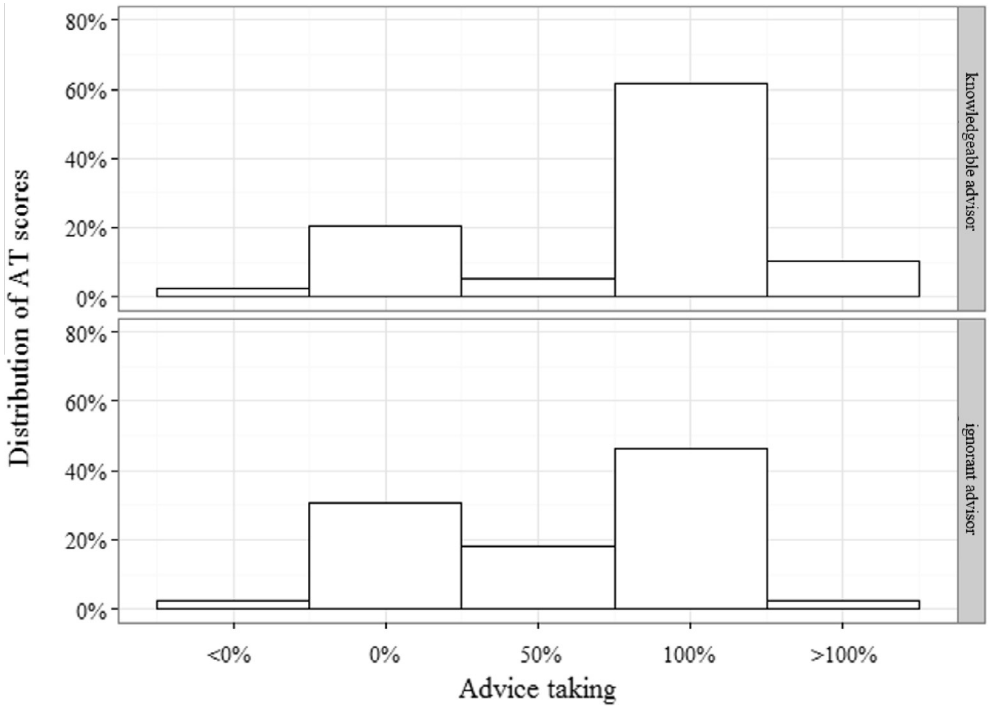

Fig. 4. Frequency distribution of AT scores in Experiment 1 as a function of advisor expertise.

appropriately. Rather, they often chose their own initial estimate even though averaging or choosing the advice estimate would have provided a more accurate final estimate. Adults' preference for choosing their own estimate holds even when they receive unequivocal performance feedback indicating that their advisor is more competent than they are (Soll & Mannes, 2011).

Figs. 4 and 5 suggest that children's advice-taking behavior is both similar to and different from that of adults. Like adults, children favored the choosing strategy. Adoption of the averaging strategy (i.e., an AT sore of 50%) accounted for less than 20% of the trials regardless of the advisor's expertise, whereas children used the choosing strategy (i.e., an AT score of 0% or 100%) on more than 75% of the trials in both Experiments 1 and 2. The crucial difference between children and adults is that children strongly preferred to choose the advice over their own initial judgment. Thus, in Experiment 1, children shifted entirely to the knowledgeable advisor's judgment (obtaining an AT score of 100%) on 63% of the trials. Indeed, shifting to the advisor's judgment occurred on 46% of trials even when the advisor was ignorant. The data of Experiment 2 show a similar pattern. Shifting entirely to the advisor's judgment was the most frequent strategy when the advisor was knowledgeable (69%), when the advisor had basic-level knowledge (65%), and even when the advisor was clearly ignorant (46%).

General discussion

The current study combined methods from developmental research on selective trust and social psychological research on advice taking. In two experiments, we used a child-adapted version of a judge–advisor paradigm and found that young children consistently used advice to revise their initial beliefs in a domain where their knowledge was limited. The extent to which they revised their initial judgment was calibrated to the source of the advice. Thus, children revised their beliefs most in response to advisors who appeared to be experts, less so in response to advisors who displayed neither expertise nor inaccuracy (by either acknowledging ignorance or offering only basic-level information),

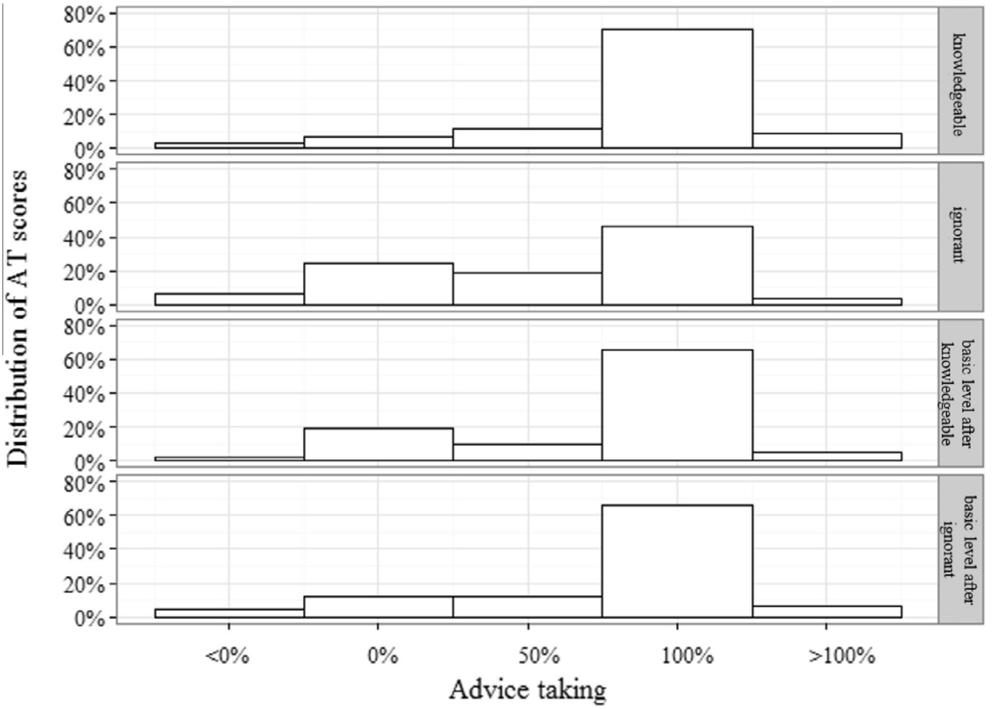

Fig. 5. Frequency distribution of AT scores in Experiment 2 as a function of advisor expertise.

and least in response to inaccurate advisors who made mistakes in naming common objects at a basic level.

These findings contribute to previous work on selective trust in three important ways. First, they add to our understanding of children's differentiation among informants. Second, they show that selective learning from informants is not confined to the differential formation of novel beliefs but is also displayed when earlier judgments are revised. Finally, the findings show that, despite their selective learning from informants, young children are surprisingly receptive to counterclaims even from informants who name common objects inaccurately. We discuss each of these contributions in turn.

In Experiments 1 and 2, we observed that children were more willing to accept information from an apparently knowledgeable informant as compared with an ignorant informant (Koenig & Harris, 2005a, 2005b; Sabbagh & Baldwin, 2001) or an inaccurate informant (Corriveau, Meints, & Harris, 2009; Luu, de Rosnay, & Harris, 2013)—a preference that is consistent with earlier findings. However, Experiment 2 went beyond earlier findings in showing that children's preference for an apparently knowledgeable informant emerges even when the alternative informant offered basic-level names. More specifically, even when the basic-level informant neither acknowledged ignorance nor named the unfamiliar animal inaccurately, children in Study 2 still preferred the knowledgeable informant over the basic-level informant both in their ratings of the informants and in their advice taking.

An important implication of this result is that young children regard an apparently knowledgeable informant as having trustworthy expertise despite their having no autonomous metric with which to empirically check that informant's accuracy. Sobel and Corriveau (2010) documented children's preference for learning from an expert informant, but this informant had earlier made observably correct predictions concerning the class of objects in question. Hence, children could assess this expert informant for themselves. In contrast, in Experiment 2, although the animals presented in the familiarization phase were familiar to children, the specific names provided by the knowledgeable informant were unfamiliar so that children could not verify their accuracy. Admittedly, the names were also endorsed by the experimenter, but children could make no autonomous check on that endorsement. At best, they could simply trust that it was appropriate. Thus, children are willing to invest trust in an informant who is said to be knowledgeable even if they cannot check the informant's knowledge for themselves. Similarly, Koenig and Jaswal (2011) documented children's preference for learning from an informant who had been described as knowing "a lot about dogs." By implication, children trust an informant who is said to have expertise even when they have no way to independently and empirically check that assertion for themselves.

Research on selective trust has often examined the extent to which children's acquisition of new information—for example, learning the name or function of an unfamiliar object—is guided by their selective appraisal of different informants, including knowledgeable informants as compared with ignorant or inaccurate informants (Harris & Corriveau, 2011). Is children's revision of their initial judgment or estimate also guided by their appraisal of informants? We know that young children are willing to revise their spontaneous judgment of the category that an object belongs to in the wake of unexpected testimony from an informant (Jaswal, 2004; Jaswal & Markman, 2007). However, those studies did not assess whether the magnitude of judgment revision varied with the perceived expertise of the informant. We also know that 3- and 4-year-olds are alert to an informant's perceptual access in deciding whether to revise their judgment. For example, 3- and 4-year-olds who had limited perceptual access to an object (e.g., they saw only a small uninformative part of it) were more likely to revise their initial judgment about its identity if they received a counter-suggestion from an informant who was better informed about the object than they were (e.g., has seen the entire object) (Robinson & Whitcombe, 2003; Whitcombe & Robinson, 2000).

The current study adds to these findings by showing that in revising their initial judgment, children take into account not just an informant's perceptual access to the object or situation that is currently under scrutiny but also the informant's previous epistemic record. Thus, as noted above, children revised their initial judgment to a greater or lesser extent depending on the characteristics of their informant. They made greater adjustments to their initial judgment when advised by an apparently knowledgeable informant.

However, turning to the third notable finding, recall that children sometimes revised their initial judgment when the informant had a poor epistemic record. Thus, even if they received advice from an informant who had proven to be inaccurate in naming common objects, children were prone to revise their initial judgment. One possible explanation is that young children find it difficult to inhibit a normally appropriate bias to believe an informant's testimony. Consistent with this line of explanation, recent findings have shown that 2- and 3-year-olds are especially prone to revise their judgment about which cup an object has fallen into in the wake of an adult's misleading testimony if they have difficulty with an inhibitory control task involving a spatial conflict between the cue and correct response (Jaswal et al., 2014). However, because inhibitory control is likely to improve with age, it would be reasonable to expect older children to be less receptive than younger children to advice from a hitherto inaccurate informant. Yet, we found no reliable indication of such an age change.

Another possible explanation is that children revised their initial judgment simply because they were asked to make the same judgment twice. Previous research using the Piagetian conservation paradigm has shown that children are likely to revise an initial quantity judgment if they are posed two successive questions rather than a single question (Siegal, Waters, & Dinwiddy, 1988). However, it is noteworthy that preschoolers do not alter their quantity judgments if, in between making those judgments, they are not presented with the visible transformation of the array that is standard in Piagetian conservation experiments (Halford & Boyle, 1985). Thus, repetition of a quantity question does not in itself lead young children to alter their judgment (Neilson, Dockrell, & McKechnie, 1983). Still, repeated questioning cannot be entirely ruled out as a factor in the current design because in between the two questions children received the advice, and this might have had an analogous effect to visible transformations in conservation tasks.

However, the most plausible explanation of children's willingness to take advice from an inaccurate informant is that children are prone to trust such an informant in the absence of any conflicting testimony, particularly in a task like the current one where their own prior beliefs are relatively uncertain. This interpretation is strengthened by the recent findings of Vanderbilt, Heyman, and Liu (2014), who reported that preschoolers readily learn the names of unfamiliar objects from an informant with a record of inaccuracy as long as no other informant proposes an alternative. In many past studies of selective trust, children are presented with conflicting testimony from two informants and tend to endorse the claims made by the hitherto more accurate informant. By implication, children regard an inaccurate informant as relatively unreliable—in comparison with an accurate informant—but not as inherently or absolutely unreliable.

With regard to the broader study of advice taking, the current findings extend research in social psychology by adding a developmental dimension. We are, of course, aware that comparisons between child and adult advice-taking behavior are most informative when one compares their behavior using the same task. However, because the aspects of advice taking that we are most interested in here—sensitivity to advisor expertise, choice of advice-taking strategies, and egocentric advice discounting—are robust and largely invariant in adult advice taking, we believe that the current findings may license some (admittedly speculative) conclusions even though we did not investigate adults in our study.

We first discuss the apparent commonalities, starting with the fact that both children and adults are sensitive to differences in advisor expertise. Like adults, children can correctly tell the competent and less competent advisors apart, and their assessment of the advisors' competence influences the degree to which children adjust their opinions toward the advice. Thus, the competence to engage in selective advice taking that has been amply documented in adults (e.g., Harvey & Fischer, 1997; Soll & Mannes, 2011; Yaniv & Kleinberger, 2000) turns out to have deep ontogenetic roots and to reveal considerable developmental continuity from early childhood to adulthood. Additional evidence for a certain degree of developmental continuity stems from, children's choice of advice-taking strategies. Like adults (Soll & Larrick, 2009; Soll & Mannes, 2011), children strongly preferred a choosing strategy, either sticking with their own initial judgment or fully endorsing the advice; partial shifts toward the advisor's judgment were comparatively rare. Moreover, as is the case with adults, children were more likely to endorse knowledgeable informants.

Nevertheless, future research will need to dig deeper to explore how far these continuities go. We showed developmental continuity in a context where children's initial judgment was unlikely to be very firm. But how does the subjective strength of the initial judgment affect the revision process in children, and are these processes relatively stable or do they undergo developmental change? Second, how does the capacity for *selective* belief revision, based on characteristics of the advisor, develop? In the current experiments, advisors clearly differed in expertise and the area of expertise was close to the target domain. But what about cases with more subtle differences in expertise between advisors or cases in which the dimension along which the advisors differ (e.g., knowledge of baseball) is of less or no relevance to the target domain (e.g., how to feed an elephant)? Sophisticated advice taking would track differences between advisors and also the degree to which these differences are relevant to a given problem, weighing both factors appropriately. The nature and development of such processes of information integration in children (and adults) is an important area for future research.

Finally, what is the scope of early advice taking and how deep is the developmental continuity? Our exploratory analysis of advice-taking strategies points toward a potential systematic difference between advice taking in adults and that in young children. Adults reveal systematic limits to rationality due to egocentric advice discounting; even when decision makers are aware that the advice is the optimal solution, they weight it only by 50% instead of fully adopting it (Gardner & Berry, 1995). As we mentioned earlier, these low weightings of advice are mainly because adults prefer to maintain their own initial judgment even when choosing the advice of averaging the two opinions would yield a more accurate judgment (e.g., Soll & Larrick, 2009; Soll & Mannes, 2011). Children in our experiments seemed to commit the opposite error. They frequently chose the advisor's estimate even when they were aware that the advisor was ignorant with regard to the task. Just like relying too much on one's own initial opinion, overweighting advice from an ignorant advisor may be dysfunctional because it can result in a less accurate judgment.

Of course, our results with regard to children potentially overweighting advice should be interpreted with caution until they are replicated with other judgment tasks. However, if they can be generalized, our results provide a unique opportunity to better understand advice-taking behavior and advice discounting in particular. The cognitive processes underlying advice discounting are currently not well understood (Soll & Mannes, 2011). Interestingly, however, one of the few systematic accounts explains advice discounting in terms of complex metacognitive processes. More specifically, it is proposed that adults have a fundamental bias to regard their own opinions as more plausible and to weight them more strongly than those of advisors because of an asymmetry in access to their own reasons for a given judgment as compared with those of others (Yaniv, 2004a).

If this theory were correct, one would expect a developmental paradox; over time, the growth of metacognition would yield less rational advice taking (i.e., more advice discounting). Prima facie, the current data seem to be compatible with such a possibility; children accepted advice much more than is typically found in adult studies (and, therefore, might have been less subject to advice discounting). Systematic future research will need to establish whether there are, in fact, such reliable developmental discontinuities. If so, this would have interesting theoretical implications for explaining the cognitive processes underlying rationality in selective advice taking and its limits.

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