# 3- to 6-Year-Old Children's Epistemic Trust in Intelligent Voice Assistants Across Different Domains

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## Abstract

Based on a dual-informant experimental paradigm, this study examined the epistemic trust of children aged 3–6 years and adults in Digital Voice Assistants (DVAs) and verified the role of accuracy in their trust. In Experiment 1, we manipulated informant type (DVAs vs. humans) and knowledge domain (natural vs. social). The results showed that, compared with humans, both children and adults exhibited stronger epistemic trust in DVAs. The level of trust in DVAs was higher among 6-year-olds than among 4- and 5-year-olds, and higher among adults than among children. Compared with the social domain, both children and adults were more inclined to ask DVAs questions in the natural domain. Building on Experiment 1, Experiment 2 manipulated the accuracy conditions of testimony provided by the two informants. The results revealed that when DVAs were inaccurate, both children and adults no longer trusted their testimony, and 3-year-old children showed lower sensitivity to accuracy. The findings indicate that informant type, knowledge domain, and testimony accuracy all influence children's epistemic trust, and accuracy is an important criterion for evaluating the reliability of DVAs.

## Full Text

## Preamble

### The Epistemic Trust of 3- to 6-Year-Olds in Digital Voice Assistants in Various Domains

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**Abstract:**
[Objective] A new generation of interactive models, called digital voice assistants (DVAs), can respond to young children's speech requests automatically and interact with them by voice. Research on the development of young children's epistemic trust in DVAs is scarce. Previous research has concentrated on the development and influencing factors of young children's epistemic trust in human informants or traditional electronic media (e.g., computers, webpages, internet). The semisocial nature of these devices determines the specific theoretical and practical value of investigating young children's epistemic trust in DVAs. Based on this, the purpose of the current study was to investigate the epistemic trust of young children (aged 3-6) and adults in DVAs in various domains and to confirm the significance of accuracy in their trust. [Methods] The paradigm of dual-informant sources was employed in both experiments.

A sample size of 88 children was required for an effect size of w = 0.30, $1–\beta = 0.8$, $\alpha = 0.05$, according to G*Power 3.1. In Experiment 1, 30 adults and 90 children aged 4-6 were given testimony from distinct information sources (DVAs vs. humans) in either the natural or social domain to investigate the children's willingness to ask questions, explicit trust judgments, and final endorsements. Whereas the natural domain involved a task to label novel things, the social domain involved inquiry into social customs. The accuracy of the informants was manipulated in Experiment 2, which was based on Experiment 1, and 90 children aged 3-5 and 30 adults were exposed to various informants. [Results] The research participants were asked questions about their willingness to ask, explicit trust judgments, and final endorsements. The results of Experiment 1 showed that the children preferred to ask the DVAs questions about the natural domain rather than the social domain, with the DVAs being preferred overall. Moreover, the 6-year-old children preferred the DVAs as the information source more than the 4- to 5-year-old children. The adults were more likely to trust the DVAs than the young children. The results of Experiment 2 revealed that the children of all ages and adults were more likely to accept correct informant testimony in both the natural and social domains. In other words, the children were more likely to use the current accuracy of informants as a cue to assess and decide which informant to trust, and when the DVAs lost their accuracy, the children's preference disappeared along with their intellectual trust. The preference for accurate informants was more obvious in the adults and 4- to 5-year-olds than in the 3-year-olds, with the 3-year-olds being less sensitive to accuracy. Accuracy was an essential indicator of the DVAs' dependability. [Limitations] This study did not include attribution tasks and the experimental material lacked some ecological properties. Conclusions Our study is the first to investigate the development of epistemic trust in DVAs among children aged 3-6 in China. The results show that children can use DVAs as a source of

information and knowledge. Young children become more likely to believe the testimonies of DVAs as they grow older. Children are more likely to trust DVAs in the natural domain than in the social domain. Furthermore, young children are more likely to accept the testimony of reliable informants. The results of this study may contribute to our understanding of the usability and utility of human interaction with technological systems and offer suggestions for the use of DVAs in homes and classrooms to support early learning.

**Keywords:** 3- to 6-year-olds; epistemic trust; digital voice assistants (DVAs); accuracy; domain specificity

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In recent years, advances in intelligent voice technology and the proliferation of these products have substantially increased children's opportunities and time to interact with various digital voice assistants (also known as digital language assistants, conversational robots, intelligent personal assistants, virtual robots, etc.) (Digital Voice Assistants, DVAs). A 2020 report from Common Sense Media on children's electronic media usage revealed that 41% of American children aged 0-8 have smart voice devices at home [**?**], compared to only 9% in 2017 [**?**]. Additionally, according to incomplete statistics, by the end of 2020, the total number of devices supporting intelligent voice interaction had exceeded 4 billion and is expected to surpass the world's population by 2024 [**?**]. DVAs can automatically recognize young children's spoken inquiries and interact with them via voice, avoiding the prerequisite of literacy required for web-based searches [**?**] and facilitating earlier interaction and learning with DVAs. The natural human-computer interaction mode and convenient knowledge acquisition pattern of DVAs may transform how young children learn [**?**]. Research indicates that although children can utilize extended functions of DVAs, such as listening to music for entertainment, their frequency of using these functions is far lower than using DVAs to obtain information; children primarily treat DVAs as information sources rather than entertainment tools [**?**].

Over the past two decades, developmental psychology research has demonstrated that epistemic trust is a crucial pathway for children to acquire knowledge [**?**]. The manner in which children learn through information provided by sources is termed epistemic trust, or selective trust, also known as selective social learning. The process of children asking DVAs questions and obtaining information from their voice output to complete learning can be considered children's epistemic trust in DVAs [**?**]. Within this framework, children's learning process with DVAs can be conceptualized as a process of judging, selecting, and accepting DVA testimony [**?**, **?**].

Girouard-Hallam and Danovitch [**?**] investigated the epistemic trust of 4-5-year-old children and 7-8-year-old children in DVAs, finding that as age increased, children became more inclined to seek factual information from DVAs. However, this study is currently the only research on children's epistemic trust in DVAs and suffers from multiple limitations, making further investigation necessary.

First, the age span of participants was large, creating a degree of discontinuity and incompleteness. Considering existing research based on human informants has found that children under 4 may exhibit a bias to believe—that is, indiscriminately believing information provided by others (even when obvious evidence indicates the testimony is false) [**?**, **?**, **?**]—it is necessary to continuously examine age differences in children's epistemic trust in DVAs across the 3-6 age range. Second, in Experiment 1 of their study, DVAs and humans provided identical answers to the same question, after which children judged the correctness of both testimonies. This method would greatly affect the study's validity, as young children might indiscriminately endorse responses from different informants [**?**] or exhibit a tendency to say "yes" [**?**]. Third, although the researchers modified Experiment 2 to have children choose which informant (DVA or human) could provide correct answers, in fact neither provided actual testimony, and children did not engage in effective learning interactions with the information sources during the experiment, making the examination of children's epistemic trust incomplete. Finally, Experiment 2 only included questions about epistemic trust ("Who can give us the right answer?"), but previous research has found that "willingness to ask" is not a reliable indicator of epistemic trust [**?**]. Neglecting children's selection and endorsement processes of DVA testimony would greatly weaken the study's validity. Therefore, subsequent research should add explicit trust judgment and final endorsement tasks to comprehensively examine 3-6-year-old children's evaluation and endorsement of DVA testimony.

The key to children's epistemic trust in DVAs may be the accuracy of DVAs. On one hand, although children can evaluate verbal testimony using multiple criteria—such as considering informants' expertise and accuracy [**?**, **?**, **?**], good intentions and motives [**?**, **?**, **?**, **?**], and familiarity of social relationships [**?**, **?**]—these criteria are rarely applicable to assessing the reliability of DVAs. Because DVAs lack moral and motivational attributes, in principle only one criterion may apply to DVAs: accuracy. Existing research has found that accuracy may affect children's epistemic trust in DVAs; for instance, one study showed that children require DVAs to demonstrate their accuracy before answering questions [**?**]. On the other hand, children can base their epistemic trust in electronic media sources on accuracy and may apply this accuracy criterion to DVAs. Danovitch and Alzahabi found that 3-5-year-old children, when answering questions about unfamiliar things, tended to trust information from previously accurate computers rather than inaccurate ones [**?**]. A recent study found that 8-10-year-old children could distinguish webpage accuracy under typographical error conditions and 倾向于从准确的网页获取信息 [**?**]. However, considering that DVAs can interact with children via voice, providing interactive learning Q&A and emotional communication, they may be more attractive to children than traditional electronic media (computers and webpages). Some studies have even found that over half of 3-10-year-old children attribute partial mental properties (e.g., intelligent) (92.80%), moral properties (e.g., can be friends with "me") (65.00%), and social properties (e.g., can teach "me" knowledge) (89%) to DVAs [**?**, **?**, **?**]. DVAs are semisocial media possessing both social attributes (e.g., can communi-

cate with humans using language) and nonsocial attributes (e.g., lack nonverbal cues: nodding, facial expressions, etc.) [**?**] and do not belong to any existing ontological category [**?**]. Thus, a question worth exploring is: if the accuracy of DVAs is manipulated, will children still trust information provided by inaccurate DVAs? The results will verify whether children's epistemic trust in DVAs depends on their accuracy. The unique semisocial properties of DVAs determine that investigating children's epistemic trust in DVAs has distinctive theoretical and practical value.

Children's epistemic trust may exhibit domain specificity, manifested as differences in epistemic trust toward DVAs providing testimony in different domains. Many researchers have proposed that children's epistemic trust in testimony from different domains varies. Zhang et al. found that in situations with conflicting cues, children's epistemic trust in natural and social domain knowledge shows different developmental characteristics across ages [**?**]. Girouard-Hallam and Danovitch found that for questions involving the past or present, 7-10-year-old children were more willing to trust information provided by Google, whereas for questions about the future, children believed neither humans nor Google could provide accurate answers [**?**]. Recently, Girouard-Hallam and Danovitch categorized research questions into three dimensions—stable factual information, transient factual information, and personal information—and found that as age increased, children showed greater trust in stable and transient factual information provided by DVAs, while preferring humans for personal information; 7-8-year-old children almost universally considered humans to be better informants for personal information questions [**?**]. However, considering the limitations of participant selection in Girouard-Hallam and Danovitch's study, whether domain differences exist in children's epistemic trust in DVAs during early childhood remains worth further exploration. Additionally, the reason for this domain specificity may be that children recognize different informants have different domain expertise. Research shows that children exhibit stronger trust preferences toward informants with professional knowledge; for example, children are more willing to endorse testimony about animals from zookeepers [**?**] and value information about medicine and disease causes from doctors more highly [**?**]. Therefore, this study will control the testimony provided by DVAs regarding questions in different domains (natural vs. social) to verify whether domain specificity exists in children's epistemic trust in DVAs.

In summary, as an information source in the digital age, the development and characteristics of children's epistemic trust in DVAs is a question worth exploring. Based on limitations of previous research, this study will focus on examining the following issues:

First, when facing different informants (DVAs vs. humans), can children of different age groups regard DVAs as reliable information sources equal to humans and trust their testimony? Second, does children's epistemic trust in DVAs depend on their accuracy? In Experiment 2, we manipulated the accuracy conditions of informants to explore whether children still choose to trust information pro-

vided by DVAs when they lack accuracy. We predicted that accuracy is a core criterion affecting children's epistemic trust in DVAs; that is, when DVAs are no longer accurate, children's trust preferences for them will disappear. Third, does children's epistemic trust in DVAs differ across domains? This study divided testimony content into natural and social domains to explore domain specificity in children's epistemic trust in DVAs. We predicted that in the social domain, children might 倾向于选择更具有社会属性的人类作为询问和采信的对象.

## Experiment 1

### 2.1 Participants

Using G*Power 3.1, we calculated that with a significance level of $\alpha = 0.05$ and effect size w = 0.30, a minimum sample of 88 participants was required to achieve 80% statistical power. This experiment selected 90 children from three age groups at a kindergarten and 30 adult participants (half male, half female). Specifically, the 4-year-old group included 30 children (mean age M = 53.33 months, SD = 3.06); the 5-year-old group included 30 children (M = 65.70 months, SD = 2.80); the 6-year-old group included 30 children (M = 75.60 months, SD = 1.72); and the adult group included 30 participants (mean age M = 21.85 years, SD = 7.22). This experiment was approved by the ethics committee of the affiliated institution and received consent from the kindergarten. The kindergarten communicated with the children's guardians, and informed consent was obtained from all guardians.

### 2.2 Experimental Materials

A DVA (Xiaomi speaker)—"Xiaoai" and a female adult—"Yuanyuan" served as different types of informants [Figure 1: see original paper]. The process of informants providing testimony was presented through pre-recorded videos, during which the experimenter controlled video playback timing and content to make it appear as if the two informants could respond to participants' questions in real time. Natural domain experimental materials consisted of researcher-created pictures of novel objects , with names being meaningless reduplicated pseudo-words. The familiarity and preference for experimental materials were pre-assessed by asking 30 children who did not participate in the experiment to ensure they did not recognize the pictures and had no preference for either the images or the artificial names. Experimental materials were ultimately presented to participants via PowerPoint.

Social domain tasks involved customs scenario stories, adapted from materials used in Clément et al. [**?**], as shown in . The experimenter first introduced the scenario background: "This is our good friend Dingding, but this child is from the bongbonglolo ethnic group, and his lifestyle habits are very different from ours. He wants to invite you to attend a bongbonglolo festival." Participants were then asked to answer four social domain questions, such as "What special clothing should you wear to attend this festival?" [Figure 2: see original paper].

Questions and answers are presented in .

### 2.3 Procedure

The experiment was conducted in a quiet room at the kindergarten, with the experimenter working one-on-one with each child for approximately 10 minutes. The research process is illustrated in [Figure 3: see original paper].

**Warm-up phase:** The experimenter engaged in simple interactions with the child, such as discussing favorite cartoons, friends, sports, etc., to help the child relax. The child was then introduced to the game and informed that the human "Yuanyuan" and DVA "Xiaoai" would complete the following game together.

**Willingness to ask questions:** In the natural domain task, the experimenter presented 4 pictures of novel objects (created by the researchers) and asked the child, "Do you know what this is?" In the social domain task, the experimenter introduced the scenario and asked relevant questions , such as "Do you know what you should…?" After the child expressed not knowing the answer, the experimenter asked, "Both Yuanyuan and Xiaoai know the answer to this question. Who do you want to ask?" Choosing "Xiaoai" was scored as "1" and choosing "Yuanyuan" as "0."

**Testimony provision:** The experiment employed a conflicting informants paradigm [**?**, **?**]. "Yuanyuan" and "Xiaoai" served as informants, providing children with names for 4 novel objects or suggestions for what to do in 4 scenarios . The order of picture presentation, sequence of social scenario tasks, positions of informants, testimony provided by informants, and order of testimony delivery were all counterbalanced in advance.

**Explicit trust question:** The experimenter asked the child, "Who do you think is right? Who do you trust?" If the child did not answer or make a clear judgment, the experimenter repeated both informants' testimony and asked the child to choose to trust either Yuanyuan's or Xiaoai's testimony. Choosing "Xiaoai" was scored as "1" and choosing "Yuanyuan" as "0."

**Final judgment question:** The experimenter asked the child, "Now, what do you think this object is?/What do you think you should do?" The experimenter recorded the child's response. Cognitive judgments consistent with Xiaoai's testimony were scored as "1" and those consistent with Yuanyuan's as "0."

**Debriefing phase:** The experimenter briefly explained the research purpose, thanked the child, gave a gift, and escorted the child back.

### 2.4 Experimental Design

The experiment employed a 4 (age: 4-year-olds/5-year-olds/6-year-olds/adults) $\times$ 2 (informant: human vs. DVA) $\times$ 2 (question domain: natural vs. social) three-factor mixed design, with age and question domain as between-subjects variables and informant as a within-subjects variable. The dependent variables

were participants' choice of which informant to ask, choice of testimony, and whether their final judgment aligned with which informant (DVA vs. human).

### 2.5 Statistical Analysis

In this study, the dependent variables were repeated-measures categorical data (children's willingness to ask, explicit trust, and final judgment), following a binomial distribution. Therefore, we used the glmer function with the BOBYQA optimizer from the lme4 package in R version 4.2.2 to establish generalized linear mixed models (GLMM) for statistical analysis.

### 2.6 Results and Discussion

#### (1) Participants' willingness to ask informants for testimony

Analysis of children's and adults' average willingness to ask DVAs in natural and social domains revealed the pattern shown in [Figure 4: see original paper]. Using children's epistemic trust in DVAs (willingness to ask) across domains (natural vs. social) as the dependent variable, the full GLMM included the following fixed effects: age, domain, and the age × domain interaction, with random factors including participant ID and trial. Random slopes and intercepts were reduced one by one through principal component analysis. The final model showed a significant main effect of domain ( $^2$ = 3.85, df = 1, p = 0.050), a significant main effect of age ( $^2$ = 60.12, df = 3, p < 0.001), and a nonsignificant age × domain interaction ( $^2$ = 3.85, df = 3, p = 0.084). Post-hoc comparisons for domain revealed that children were significantly less willing to ask DVAs questions in the social domain than in the natural domain (t = 2.19, p = 0.029 < 0.05, d = 0.14). Post-hoc comparisons for age showed that adults were more willing than children to ask DVAs (adult–4-year-olds: t = 9.39, p < 0.001, d = 0.93; adult–5-year-olds: t = 7.10, p < 0.001, d = 0.72; adult–6-year-olds: t = 5.11, p < 0.001, d = 0.54), and older children were more inclined to ask DVAs (5-year-olds–4-year-olds: t = 2.30, p = 0.022 < 0.05, d = 0.19; 6-year-olds–4-year-olds: t = 4.28, p < 0.001, d = 0.36; 6-year-olds–5-year-olds: t = 1.98, p = 0.048 < 0.05, d = 0.17).

These results indicate that both adults' and children's initial trust preferences for DVAs are influenced by question domain; compared to social domain questions, both adults and children prefer to ask DVAs about natural domain questions in initial inquiries. Additionally, adults are more willing than children to ask DVAs in initial inquiries, and older children are more inclined to ask DVAs.

#### (2) Participants' explicit trust in informants

Analysis of children's and adults' average explicit trust in DVAs in natural and social domains is shown in [Figure 5: see original paper]. Using children's epistemic trust in DVAs (explicit trust) across domains as the dependent variable, the full GLMM included fixed effects of age, domain, and their interaction, with random factors of participant ID and trial. After reducing random slopes and

intercepts, the final model showed a nonsignificant main effect of domain ( $^2$ = 0.45, df = 1, p = 0.502), a significant main effect of age ( $^2$ = 32.37, df = 3, p < 0.001), and a nonsignificant age × domain interaction ( $^2$ = 2.68, df = 3, p = 0.443). Post-hoc comparisons for age revealed that adults were more willing than children to trust DVAs (adult–4-year-olds: t = 10.48, p < 0.001, d = 1.12; adult–5-year-olds: t = 10.59, p < 0.001, d = 1.13; adult–6-year-olds: t = 6.62, p < 0.001, d = 0.79), and 6-year-olds were more willing than 4- and 5-year-olds to trust DVAs (6-year-olds–4-year-olds: t = 3.86, p < 0.001, d = 0.31; 6-year-olds–5-year-olds: t = 3.97, p < 0.001, d = 0.32).

These results indicate that adults are more willing than children to trust DVAs, and 6-year-olds are more willing than 4- and 5-year-olds to trust DVAs.

**(3) Participants' final judgments**

Analysis of children's and adults' average final judgments regarding DVAs in natural and social domains is shown in [Figure 6: see original paper]. Using children's epistemic trust in DVAs (final judgment) across domains as the dependent variable, the full GLMM included fixed effects of age, domain, and their interaction, with random factors of participant ID and trial. After reducing random slopes and intercepts, the final model showed a nonsignificant main effect of domain ( $^2$ = 1.81, df = 1, p = 0.178), a significant main effect of age ( $^2$ = 33.49, df = 3, p < 0.001), and a nonsignificant age × domain interaction ( $^2$ = 0.20, df = 3, p = 0.978). Post-hoc comparisons for age revealed that adults were more willing than children to ultimately trust DVAs (adult–4-year-olds: t = 10.67, p < 0.001, d = 1.15; adult–5-year-olds: t = 10.46, p < 0.001, d = 1.13; adult–6-year-olds: t = 7.41, p < 0.001, d = 0.86), and 6-year-olds were more willing than 4- and 5-year-olds to ultimately trust DVAs (6-year-olds–4-year-olds: t = 3.27, p = 0.001, d = 0.26; 6-year-olds–5-year-olds: t = 3.05, p = 0.002 < 0.01, d = 0.25).

These results indicate that adults are more willing than children to ultimately accept DVA testimony, and 6-year-olds' final judgments align with their explicit trust; compared to 4- and 5-year-olds, 6-year-olds are more willing to ultimately accept DVA testimony.

Overall, these results show that as age increases, all children show increasing trust in DVAs, with 6-year-olds trusting DVAs more than 4- and 5-year-olds; adults trust DVAs more than children. This result aligns with expectations, suggesting that as age and social experience increase, children increasingly believe DVAs can better provide information. Compared to social domain questions, both adults and children prefer to ask DVAs about natural domain questions in initial inquiries, consistent with previous findings that children's epistemic trust in natural and social domain testimony differs [**?**, **?**, **?**, **?**]. Additionally, previous research has found that young children (3-year-olds) already understand that knowledge is domain-specific and that informants' knowledge represents a division of cognitive labor [**?**]. Children may believe that in the natural domain, DVAs and their underlying internet and artificial intelligence have greater

professional authority than humans. Considering that DVAs may also provide incorrect and untrue testimony, if children's core criterion for judging DVA reliability is accuracy, then a question worth verifying is whether children still consider DVAs trustworthy when they lose accuracy. Therefore, Experiment 2 will manipulate the accuracy of DVAs and humans to verify whether accuracy is the core criterion children use to evaluate DVA credibility. Given that Experiment 1 results showed 4-year-olds already possess rational epistemic trust decision-making abilities similar to older children and adults, while previous research found children under 4 may be more prone to a bias to believe [**?**, **?**], it is necessary to extend the age range downward to 3-year-olds to investigate the developmental trajectory of children's epistemic trust in DVAs. Based on this, Experiment 2 expanded the participant age range to include 3-year-olds to explore younger children's epistemic trust in DVAs.

## Experiment 2

### 3.1 Participants

Using G*Power 3.1, we calculated that with a significance level of $\alpha = 0.05$ and effect size w = 0.30, a minimum sample of 88 participants was required to achieve 80% statistical power. This experiment selected 90 children from three age groups at a kindergarten and 30 adult participants (half male, half female). Specifically, the 3-year-old group included 30 children (mean age M = 44.77 months, SD = 2.57); the 4-year-old group included 30 children (M = 56.43 months, SD = 3.57); the 5-year-old group included 30 children (M = 65.60 months, SD = 3.56); and the adult group included 30 participants (mean age M = 21.70 years, SD = 7.11). No participants had taken part in Experiment 1. This experiment was approved by the ethics committee of the affiliated institution and received consent from the kindergarten. The kindergarten communicated with the children's guardians, and informed consent was obtained from all guardians.

### 3.2 Experimental Materials

The materials were essentially the same as in Experiment 1. Items and their names used in the familiarization phase are shown in .

### 3.3 Procedure

The procedure was essentially the same as in Experiment 1, with the addition of a familiarization phase after the warm-up phase, during which the accuracy history of informants was manipulated [Figure 7: see original paper].

**Warm-up phase:** Same as Experiment 1.

**Familiarization phase:** The experimenter told children they would be shown several pictures, and both "Xiaoai" and "Yuanyuan" would tell them what they were. Children were randomly assigned to either the "Xiaoai inaccurate,

Yuanyuan accurate" or "Xiaoai accurate, Yuanyuan inaccurate" condition. In the "Xiaoai inaccurate, Yuanyuan accurate" condition, the experimenter told children that "Yuanyuan" would always provide "correct" answers, while "Xiaoai" would provide "wrong" answers. Conversely, for children in the "Xiaoai accurate, Yuanyuan inaccurate" condition, "Xiaoai" was the reliable information source.

The experimenter then sequentially presented three pictures of familiar items , and both informants told children the items' names. The accurate informant always answered correctly, while the inaccurate informant always answered incorrectly. For example, when presenting a picture of "pants," the accurate informant identified them as "pants," while the inaccurate informant answered "shoes." The order of picture presentation, positions of informants, informant accuracy, and order of testimony delivery were all counterbalanced in advance.

**Test phase and debriefing phase:** Same as Experiment 1.

### 3.4 Experimental Design

The experiment employed a 4 (age: 3-year-olds/4-year-olds/5-year-olds/adults) $\times$ 2 (accuracy condition: "Xiaoai inaccurate, Yuanyuan accurate" vs. "Xiaoai accurate, Yuanyuan inaccurate") $\times$ 2 (question domain: natural vs. social) three-factor mixed design. The accuracy condition was selected from four possible combinations of 2 accuracy levels (accurate vs. inaccurate) $\times$ 2 informants (human vs. DVA). Considering that this experiment manipulated differences in accuracy between the two information sources, conditions where both humans and DVAs were accurate or both were inaccurate were excluded. Age, accuracy condition, and domain were between-subjects variables. The dependent variables were participants' choice of which informant to ask, choice of testimony, and whether their final judgment (yes vs. no) aligned with the DVA "Xiaoai."

### 3.5 Statistical Analysis

Similar to Experiment 1, this study used the glmer function with the BOBYQA optimizer from the lme4 package in R version 4.2.2 to establish generalized linear mixed models for statistical analysis.

### 3.6 Results and Discussion

#### (1) Participants' willingness to ask informants for testimony

Analysis of children's and adults' average willingness to ask DVAs in natural and social domains under different accuracy conditions is shown in [Figure 8: see original paper]. When DVAs lost their accuracy, the average willingness to ask DVAs decreased across all three age groups of children and adults in both natural and social domains.

Using children's epistemic trust (willingness to ask) toward informants of different accuracy (accurate vs. inaccurate) across domains (natural vs. social) as the

dependent variable, the full GLMM included the following fixed effects: accuracy condition, age, domain, and all two-way interactions, with random factors of participant ID and trial. It should be specifically noted that we attempted to include the three-way interaction of accuracy condition × age × domain in the model, but the model failed to converge, so it was not included in the final model. After reducing random slopes and intercepts, the final model showed a nonsignificant main effect of domain ( $^2 = 0.05$, df = 1, p = 0.815), a nonsignificant main effect of age ( $^2 = 1.55$, df = 3, p = 0.672), a significant main effect of accuracy condition ( $^2 = 97.57$, df = 1, $p < 0.001$), and a significant accuracy condition × age interaction ( $^2 = 25.66$, df = 3, $p < 0.001$). No interactions were found between accuracy condition and domain ( $^2 = 0.11$, df = 1, p = 0.738) or between age and domain ( $^2 = 1.81$, df = 3, p = 0.613). The accuracy condition × age interaction is shown in [Figure 9: see original paper]. Post-hoc comparisons for accuracy condition revealed that children were more willing to ask accurate informants (t = 28.62, $p < 0.001$, d = 1.85), regardless of whether they were human or DVA.

Further simple effects analysis of the accuracy condition × age interaction found that adults and children across all three age groups were more willing to ask accurate informants (adults: $p < 0.001$; 3-year-olds: $p < 0.001$; 4-year-olds: $p < 0.001$; 5-year-olds: $p < 0.001$). Under the "Xiaoai inaccurate, Yuanyuan accurate" condition, adults were more willing than children across all three age groups to ask accurate informants (adult–3-year-olds: p = 0.010; adult–4-year-olds: $p = 0.002 < 0.001$; adult–5-year-olds: $p = 0.033 < 0.05$), with no significant differences among child age groups (3-year-olds–4-year-olds: p = 0.999; 3-year-olds–5-year-olds: p = 0.725; 4-year-olds–5-year-olds: p = 0.606). Under the "Xiaoai accurate, Yuanyuan inaccurate" condition, adults were more willing than 4-year-olds to ask accurate informants ($p < 0.001$), with no significant differences among child age groups (3-year-olds–4-year-olds: p = 0.406; 3-year-olds–5-year-olds: p = 0.999; 4-year-olds–5-year-olds: p = 0.265).

These results indicate that under manipulated accuracy conditions, both adults and children prefer to ask accurate informants, with adults showing a stronger preference than children.

**(2) Participants' explicit trust in informants**

Analysis of children's and adults' average explicit trust in DVAs in natural and social domains under different accuracy conditions is shown in [Figure 10: see original paper]. When DVAs lost their accuracy, the average explicit trust in DVAs decreased across all three age groups of children and adults in both natural and social domains.

Using children's epistemic trust (explicit trust) toward informants of different accuracy across domains as the dependent variable, the full GLMM included fixed effects of accuracy condition, age, domain, and all two-way interactions, with random factors of participant ID and trial. After reducing random slopes and intercepts, the final model showed a nonsignificant main effect of domain

( $^2$ = 0.26, df = 1, p = 0.612), a significant main effect of age ( $^2$ = 8.10, df = 3, p = 0.044 < 0.05), a significant main effect of accuracy condition ( $^2$ = 103.29, df = 1, p < 0.001), and no interactions between accuracy condition and age ( $^2$ = 1.29, df = 3, p = 0.731), accuracy condition and domain ( $^2$ = 3.13, df = 1, p = 0.077), or age and domain ( $^2$ = 1.16, df = 3, p = 0.762). Post-hoc comparisons for age revealed that compared to 3-year-olds, 4-year-olds, 5-year-olds, and adults all showed stronger preferences for trusting accurate informants (4-year-olds–3-year-olds: t = 2.85, p = 0.004 < 0.01, d = 0.26; 5-year-olds–3-year-olds: t = 3.95, p < 0.001, d = 0.36; adults–3-year-olds: t = 2.02, p = 0.043 < 0.05, d = 0.18). Post-hoc comparisons for accuracy condition showed that children were more likely to trust accurate informants (t = 41.27, p < 0.001, d = 2.67).

These results indicate that under manipulated accuracy conditions, both adults and children prefer to trust accurate informants, with 4-year-olds, 5-year-olds, and adults showing stronger preferences than 3-year-olds.

**(3) Participants' final endorsement of informants**

Analysis of children's and adults' average final judgments regarding DVAs in natural and social domains under different accuracy conditions is shown in [Figure 11: see original paper]. When DVAs lost their accuracy, the average final judgment aligned with DVAs decreased across all three age groups of children and adults in both natural and social domains.

Using children's epistemic trust (final judgment) toward informants of different accuracy across domains as the dependent variable, the full GLMM included fixed effects of accuracy condition, age, domain, and all two-way interactions, with random factors of participant ID and trial. After reducing random slopes and intercepts, the final model showed a nonsignificant main effect of domain ( $^2$ = 0.19, df = 1, p = 0.662), a nonsignificant main effect of age ( $^2$ = 3.96, df = 3, p = 0.265), a significant main effect of accuracy condition ( $^2$ = 88.39, df = 1, p < 0.001), and no interactions between accuracy condition and age ( $^2$ = 2.81, df = 3, p = 0.422), accuracy condition and domain ( $^2$ = 3.79, df = 1, p = 0.051), or age and domain ( $^2$ = 0.60, df = 3, p = 0.897). Post-hoc comparisons for accuracy condition revealed that children were more likely to ultimately trust accurate informants (t = 42.79, p < 0.001, d = 2.76).

These results indicate that under manipulated accuracy conditions, both adults and children prefer to trust accurate informants.

Building on previous research, this study modified the experimental paradigm and materials, employing a conflicting informants paradigm [**?**, **?**] to examine the development of Chinese 3-6-year-old children's epistemic trust in DVAs across different domains and to investigate the impact of DVA accuracy on children's epistemic trust. The results are largely consistent with our hypotheses.

Children's epistemic trust in DVAs shows age-related differences. Experiment 1 results indicate that children of different ages show different preferences for epis-

temic trust in DVAs, with older children showing greater initial trust in DVAs. This may be because as children grow older, they gain more understanding of DVAs and increasingly view them as more reliable informants. Particularly in explicit trust and final judgment tasks, 6-year-olds were more willing than 4- and 5-year-olds to choose DVAs as informants. Moreover, we can see that 6-year-olds' decision-making is approaching adult levels, becoming more mature. Under conditions manipulating intelligent voice assistant accuracy, Experiment 2 results showed that compared to 3-year-olds, 4-year-olds, 5-year-olds, and adults all showed stronger preferences for trusting accurate DVAs. Under the "Xiaoai inaccurate, Yuanyuan accurate" condition, 5-year-olds' decision-making was already approaching adult levels. These findings align with our hypotheses, suggesting that with age and cognitive development, children in the late preschool stage can rationally judge and choose to trust testimony provided by informants.

The accuracy of DVAs determines children's epistemic trust in them. Based on Experiment 1, Experiment 2 manipulated the accuracy conditions of DVA and human testimony. The results found that children and adults across all age groups showed stronger preferences for trusting accurate informants in both domains, meaning children 偏向将信息提供者实时的准确性作为线索，判断并选择信任相应的信息提供者，当 DVAs 失去准确性后，幼儿对其的知识性信任偏好也随之消失。This strongly supports our hypothesis that children's epistemic trust in DVAs depends on DVA accuracy. Detailed analysis of the results revealed that compared to 3-year-olds, 4-year-olds, 5-year-olds, and adults showed more pronounced preferences for accurate informants, with 3-year-olds being less sensitive to accuracy. This aligns with Jaswal et al.'s findings [**?**], indicating that as age and cognitive abilities develop, children's ability to judge information accuracy also strengthens. Additionally, ages 3-6 represent a period of rapid development of inhibitory control in children, and in the process of rationally judging information, children must inhibit their trust preferences for DVAs and use accuracy as the judgment criterion. Furthermore, the results show that even 3-year-olds can make epistemic trust judgments based on informant accuracy, which also aligns with Danovitch and Alzahabi's findings [**?**].

Children's epistemic trust in DVAs shows domain specificity. Experiment 1 results showed that compared to the social domain, both adults and children preferred to ask DVAs about natural domain questions, with 5- and 6-year-olds and adults showing higher average willingness to ask, explicit trust, and final judgments for DVAs in the natural domain than in the social domain. This aligns with our hypothesis, suggesting that with age and increased social experience, children can judge who is a better informant. When social domain questions are involved, children gradually recognize that humans with complete social attributes can provide more reasonable answers, or that humans are experts in the social domain. Additionally, the study found that 4-year-olds showed higher average willingness to ask and explicit trust for DVAs in the natural domain than in the social domain, but in final judgments, 4-year-olds showed trust preferences for DVAs in the natural domain. The researchers speculate that this fluctua-

tion may be because social domain tasks are more complex than natural domain tasks, and 4-year-olds' cognitive abilities are insufficient for accurate, rapid judgment of obtained information. This finding also indicates that 4-year-olds can already conduct complex analysis and judgment of obtained information, recognizing that different informants have different domain expertise and selecting informants with higher domain expertise accordingly. Under conditions manipulating DVA and human accuracy, neither adults nor children showed domain specificity in their choices; both preferred to trust accurate informants in both natural and social domains. This further suggests that DVA accuracy may be a prerequisite for children's epistemic trust, with accuracy being the characteristic of good informants that children value more.

Additionally, this study has limitations. First, this study completed experimental design and data collection before the publication of Girouard-Hallam and Danovitch's research, so it did not include the attribution trials used in their study. Instead, it focused on investigating the impact of different domain information and accuracy on children's epistemic trust in DVAs. Future research could ask children about their attributions toward DVAs to further explore this topic. Second, although research shows that children's preferences for informants are unrelated to whether they have DVAs at home [**?**], the researchers believe that studying the development of children's epistemic trust in DVAs should still control for familiarity with both DVAs and humans. This study did not pre-test or post-test whether children had DVAs at home, and relying solely on foreign researchers' data cannot substitute for understanding DVA ownership in Chinese families. Future research could investigate whether participants have DVAs at home. Furthermore, this study used artificially synthesized, nonexistent novel objects as natural domain materials and created fictional ethnic groups and festivals for the social domain, resulting in some lack of ecological validity in the experimental materials.

## Conclusions

(1) Children's epistemic trust in DVAs shows age-related differences; older children are more inclined to trust DVAs. Compared to children, adults are more willing to trust DVAs.

(2) Accuracy is an important criterion for both children and adults in their epistemic trust in DVAs; children and adults only show epistemic trust preferences for accurate DVAs.

(3) Children's and adults' epistemic trust in DVAs shows domain specificity; compared to social domain questions, children and adults are more willing to ask DVAs about natural domain questions.

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LI Zhe: Conducted experiments, analyzed data, wrote manuscript and revised final version;
LIU Zheyu: Designed research protocol, conducted experiments;
MAO Keyu, LI Wanting, LI Jing: Revised final version of manuscript;
LI Tingyu: Designed research protocol, revised final version of manuscript.

*Note: Figure translations are in progress. See original paper for figures.*