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Children's Developing Ability to Resolve Disagreements by Integrating Perspectives

Jamie Amemiya, Caren M. Walker, and Gail D. Heyman
University of California, San Diego

Children live in a world where disagreement is commonplace. Although disagreement can sometimes be explained by differences in people's reliability, disagreement may also indicate that the referent elicits multiple perspectives. The present studies (total $N = 129$, 5- to 12-year-old ethnically diverse U.S. children, 42% girls) examined children's ability to resolve disagreement among two individuals by identifying referents that integrated the perspectives, and considered the extent to which any age-related change could be explained by epistemological understanding (i.e., acknowledging that two perspectives can be right). Children's age was positively correlated with their ability to integrate perspectives, and children performed at above-chance levels by approximately 10 years of age. Age differences in integrating perspectives were partially accounted for by epistemological understanding.

A fundamental challenge that children and adults face when navigating the world is how to make sense of people's divergent perspectives (Kuhn, 2020). Sometimes, this conflict can be resolved by figuring out which person is more reliable and trustworthy (Bazhydai, Westermann, & Parise, 2020; Harris, Koenig, Corriveau, & Jaswal, 2018; Ronfard & Lane, 2018). However, as highlighted in the literature on epistemological understanding, not all disagreements are best understood in terms of a zero-sum framework where only one person can be right (Barzilai & Ka'adan, 2017; Heiphetz, Spelke, Harris, & Banaji, 2013; Kuhn, 2020; Wainryb, Shaw, Langley, Cottam, & Lewis, 2004; Walker, Wartenberg, & Winner, 2013; see also moral relativism literature, Goodwin & Darley, 2012; Theriault, Waytz, Heiphetz, & Young, 2017). For example, some disagreements can be resolved by recognizing that the *referent* (i.e., the issue or object being discussed) is something that evokes multiple rational perspectives (Dieckmann & Johnson, 2019). The present studies examined children's (5–12 years of age) and adults' fundamental capacities to resolve the disagreement by integrating perspectives in this way.

Taking multiple perspectives seriously, by focusing on the referent, can have a wide range of positive consequences. For example, consider the viral internet dispute in 2015 over whether a photographed dress was blue and black or white and gold (Mahler, 2015). Scientists took interest in how features of the *image itself* elicited different interpretations, and these studies resulted in a greater understanding of individual differences in color perception (e.g., Gegenfurtner, Bloj, & Toscani, 2015; Lafer-Sousa, Hermann, & Conway, 2015; Schlaffke et al., 2015). In other words, focusing on the referent led to the discovery of less obvious truths. This approach may also have interpersonal benefits. For instance, when people perceive aspects of morality as subjective, they are less likely to judge others with differing opinions negatively (Goodwin & Darley, 2012).

One likely correlate of children's developing capacity to integrate perspectives may be their epistemological understanding—specifically, their tendency to acknowledge that multiple perspectives can be right (Heiphetz et al., 2013; Kuhn, 2020; Kuhn, Cheney, & Weinstock, 2000). Indeed, this understanding may motivate children to consider other reasons for disagreement besides the explanation that one perspective is right and the other is wrong.

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Correspondence concerning this article should be addressed to Jamie Amemiya, Department of Psychology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0109. Email: jamemiya@ucsd.edu.

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The ability to consider multiple perspectives begins in early childhood, and becomes increasingly robust across middle childhood (for a review, see Ronfard, Bartz, Cheng, Chen, & Harris, 2018). By 4 years of age, children understand that people may hold conflicting beliefs over various issues (e.g., empirical, moral, or preference; Flavell, Mumme, Green, & Flavell, 1992). By 5 years of age, children begin to understand that, in matters of preferences and ambiguous empirical issues, two people can *both* be right, and this understanding becomes increasingly robust by ages 7–8 (Heiphetz et al., 2013; Kuhn et al., 2000; Wainryb et al., 2004). Similarly, it is around 8 years of age when children reliably acknowledge that two people can interpret the same stimulus differently (Beck, Robinson, Ahmed, & Abid, 2011; Carpendale & Chandler, 1996; see also Moll & Meltzoff, 2011 for evidence that this understanding may emerge earlier).

Age differences in the capacity to integrate perspectives may follow a similar pattern, developing over the period of early to middle childhood. However, this ability may not be particularly robust until later childhood (i.e., after 8 years of age). After all, in order to identify a referent that integrates two perspectives, children must not only consider each individual perspective, but *also* infer something new that is not mentioned by either party. For example, in the case of the dress, scientists needed to consider what kind of image could elicit different perceptions.

In fact, the tendency to integrate multiple perspectives is not particularly common, even among adolescents and adults: When presented with divergent perspectives on empirical issues, adolescents and adults tend to side with one view or the other (Barzilai & Ka'adan, 2017; Brten & Strømsø, 2010; Kuhn, Arvidsson, Lesperance, & Corprew, 2017). However, the tasks in this previous research tend to be particularly complicated; for example, participants were asked to write a report to a policymaker that addresses contrasting claims about the causes of cancer (Kuhn et al., 2017). Thus, open questions remain regarding whether a more fundamental capacity to integrate perspectives emerges in childhood. To address this issue, we designed a less demanding task, the *integrating perspectives paradigm*, in which participants were asked to identify an image of the potential referent of simple disagreements (e.g., about the color of an object).

As a secondary aim, we examined whether children would be more likely to integrate perspectives in relation to preferences than in relation to beliefs. Indeed, children recognize that people can differ in their preferences (e.g., one person can find a food "yummy," while another can find it "yucky") before realizing that people can differ in their beliefs or empirical claims (e.g., one person thinks a box holds a car, while the other thinks it holds a ball; Carpendale & Chandler, 1996; Heiphetz et al., 2013; Kuhn et al., 2000; Peterson & Wellman, 2019; Wellman, 2017; Wellman & Liu, 2004). Thus, children may be more likely to take the next step of integrating perspectives in the preference as compared to the belief domain.

In two studies, we examined children's developing ability to resolve disagreement by integrating perspectives from early to late childhood (5–12 years). We also included adult participants for comparison. While we had the hypothesis that there would be a positive age-related change in integrating perspectives, these studies were largely exploratory in nature. In both studies, participants were presented with four disagreements about objects behind a curtain and were then shown an array of possible referents (see Figures 1 and 2). Study 1 examined age and domain differences in the tendency to choose the referent that integrated both perspectives. Study 2 aimed to replicate Study 1 with revised materials, and included an additional measure of epistemological understanding to examine whether it accounts for potential age or domain differences.

Study 1

In Study 1, participants completed the *integrating perspectives paradigm*, in which they were presented with four disagreements about an occluded object: One disagreement regarded a preference (whether a painting was beautiful or ugly), whereas the other three presented differing beliefs about an object's properties (whether an object was pink or orange, whether there were two or three blocks, and whether an object was or was not a robot; see Figure 1). In each case, participants were asked to choose from three possible referents of the dispute—one that could only fit the first individual's perspective (e.g., a painting of a rose), one that could only fit the second individual's perspective (e.g., a painting of dirty socks), and a third that could plausibly fit, and thus integrate, both perspectives (e.g., abstract art).

Method

Participants

Participants were $N = 87$ children (40% girls, 59% boys; 55% White, 23% Latinx, 10% Asian, 6%

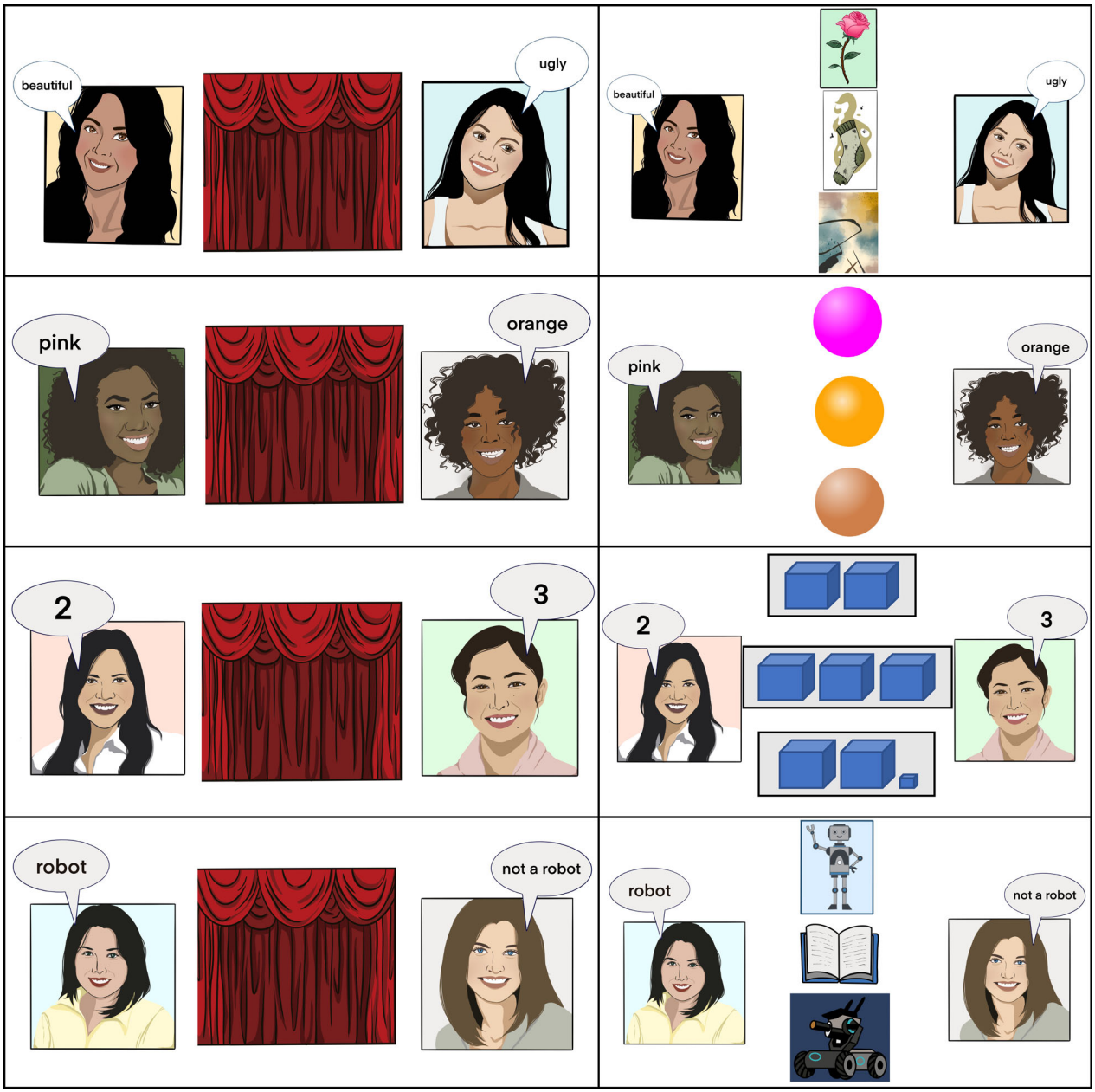

Figure 1. Integrating perspectives paradigm from Study 1. The figure shows an artist's rendition of the task. Participants saw photographs of real faces and real objects (with the exception of the balls and blocks).

Black), ages 5–12 years (M = 9.15 years, SD = 2.15), recruited from museums and schools in close proximity to the associated university in the southern California area of the United States, and N = 57 adults who were college students at the associated university (47% female, 51% male; 63% Asian, 14% White, 14% Latinx, 5% Multiracial, 2% Middle Eastern or North African). An additional three child participants were excluded due to parental interference (n = 2) and experimenter error (n = 1), and one adult participant was excluded due to failing an attention check. With respect to the key effect of age on integrating perspectives, we expected to detect at least a medium-sized effect (i.e., greater than or equal to r = .40). A power analysis in G*Power (with 80% power) indicated that we needed 46 participants to detect this effect. We decided to aim for a larger sample size (~N = 100) to further increase statistical power but had to stop data collection due to the outbreak of the

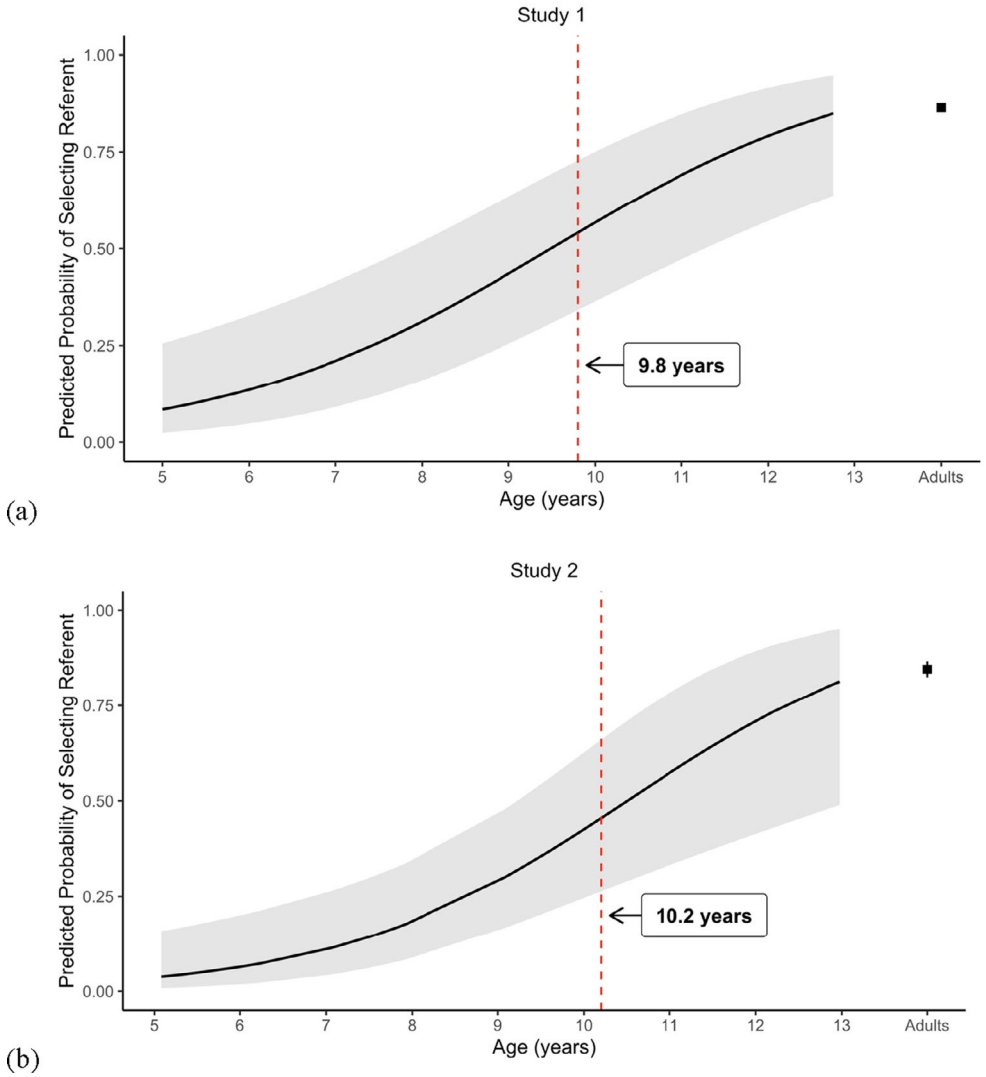

Figure 2. Predicted probability of choosing referent that integrated perspectives across all trials by age in (a) Study 1, and (b) Study 2. *Note*. Predicted probabilities are from mixed-effects logistic regression models that included all trials; gray bars indicate 95% confidence intervals. Red dotted lines indicate children's age at which selecting the referent that integrates perspectives is above chance performance (chance = 33% for Study 1; 25% for Study 2). Adults' mean and standard error of predicted probabilities are graphed (standard error in Study 1 is too small to be visible).

coronavirus pandemic. All procedures were approved by the Institutional Review Board at the associated university and informed consent was obtained for all participants.

Materials and Procedure

Children completed the *integrating perspectives paradigm* one-on-one with an experimenter in museums and schools. The experimenter narrated an animated presentation on a laptop that described four disagreements. Adults completed the study online via Qualtrics in which they read all materials.

To introduce the paradigm, the experimenter said, "Now we're going to play some guessing games, four games all together. I'm going to repeat the directions each time to make sure the questions are clear. In this game, you have to guess what is behind this curtain." Participants were then told, "Before you guess, I will tell you what two adults said is behind the curtain. These two adults each looked at what was behind the curtain. They both looked at the exact same thing." On each of the four trials, participants heard about a specific disagreement. For example, they were told, "*She* (animation emphasized the first adult) said that there is

a beautiful painting. *She* (animation emphasized the second adult) said that there is an ugly painting. So, they disagreed with each other." Recall that the four disagreements were: whether there was a beautiful versus an ugly painting, a pink ball versus an orange ball, two blocks versus three blocks, and a robot versus not a robot. Participants saw the four unique pairs of adults in Figure 1; the pairs of adult characters were each matched in gender (all female), ethnicity (either both Latinx, Black, Asian, or White), age (all looked around mid-thirties), and facial expression (all were smiling). With respect to the order of the disagreements, participants were assigned between subjects to either the *preference first* order (i.e., painting, ball, blocks, robot) or the *belief first* order (i.e., robot, blocks, ball, painting).

After each disagreement scenario, participants were asked two open-ended questions: "Why do you think they disagreed with each other?" and "What do you think was behind the curtain?" Then, at test, they were shown three images of possible referents—one that matched the first adult's perspective (e.g., a beautiful painting of a rose), one that matched the second adult's perspective (e.g., an ugly painting of dirty socks), and one that could plausibly integrate both perspectives (e.g., an abstract painting). Specifically, the test question was: "Of these objects, which do you think was most likely behind the curtain? *This* (animation emphasized the first referent), *this* (animation emphasized the second referent), or *this* (animation emphasized the third, integrative referent)?"

Dependent Measure

The key-dependent measure was whether participants selected the referent that integrated perspectives—specifically, the abstract painting, coral ball, two large blocks and one small block, and the ambiguous machine. For simplicity, we will refer to selecting the referent that integrated perspectives as "integrating perspectives" in our results.

To further ensure that participants integrated perspectives, as opposed to choosing any third option, we analyzed children's open-ended responses that they gave before they saw the options. Recall that participants were asked why the adults disagreed and what was behind the curtain. We examined their answers across these questions and two coders coded each disagreement trial as inferring either: (a) a *single perspective referent*: the child only mentioned a referent that reflected one of the perspectives (e.g., "a pink ball"; "two blocks"; Cohen's $\kappa = .87$); (b) an *underspecified or random referent*: the child guessed an underspecified or random referent that did not integrate the perspectives (e.g., "a ball"; "cheetah"; Cohen's $\kappa = .86$); or (c) an *integrative referent*: the child mentioned something that could account for both perspectives (e.g., "they could have disagreed because [the ball] is a mixture of pink and orange"; "a messy painting that one thought was beautiful and one [thought was] ugly"; Cohen's $\kappa = .75$). Disagreements were resolved via discussion between the coders.

Results

Age Analyses

As shown in the first row of results presented in Table 1, we found that for three of the four items, children who integrated perspectives were significantly older than those who did not (the fourth robot item followed the same directional trend, but was not statistically significant). Regarding *sum scores* across the four items, we similarly found that children's age was positively correlated with the number of times children integrated perspectives, $r = .46$, $p < .001$. We conducted our main analysis, a mixed-effects logistic regression model with crossed random intercepts for subjects and items and a fixed effect of children's age. We also found a robust effect of children's age with this approach, $B = .53$, $p < .001$, see Table 2, Model 1.

We used the mixed-effects logistic regression model to generate predicted probabilities of integrating perspectives by children's age; these results are shown in Figure 2a. For the adult data, we specified the same model, but without the effect of age. Adults' mean predicted value and standard error of the mean are also included in Figure 2a (standard error is < .01 and is not visible). Figure 2a reveals that, by adulthood, participants robustly integrated perspectives. For children, it was not until 9.8 years of age that they integrated perspectives at above-chance levels (i.e., the confidence interval did not include 33%).

Validity check. As a validity check of our dependent measure (i.e., selecting referents that integrated perspectives), we analyzed whether it correlated with children's open-ended responses. In line with our expectations, we found that there was a strong, positive correlation between *selecting* the referents that integrated perspectives and spontaneously *mentioning* referents that integrated perspectives, $r = .60$, $p < .001$. Moreover, selecting the

Table 1
Percent of Participants Selecting Referent That Integrated Perspectives (Studies 1 and 2) or Saying Both Can be Right (Study 2)

	Study 1							
	Painting (preference)		Blocks (belief)		Color (belief)		Robot (belief)	
Trial	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value
Children	61%	4.48***	51%	4.93***	47%	2.51*	32%	1.72†
Adults	96%	n/a	91%	n/a	68%	n/a	88%	n/a

	Study 2							
	Painting (preference)		Food (preference)		Color (belief)		Robot (belief)	
Trial	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value	% selected referent	Age diff *t*-value
Children	31%	2.91**	43%	2.61*	31%	3.81***	31%	2.45*
Adults	89%	n/a	83%	n/a	85%	n/a	78%	n/a
	% said both right	Age diff *t*-value	% said both right	Age diff *t*-value	% said both right	Age diff *t*-value	% said both right	Age diff *t*-value
Children	60%	3.33**	60%	5.53***	48%	0.28	31%	1.34
Adults	98%	n/a	96%	n/a	70%	n/a	46%	n/a

Note. Age diff = age difference between children who selected the referent that integrated perspectives (or said both can be right) versus children who did not. Positive, significant *t*-values indicate that children who selected the referent that integrated perspectives (or said both can be right) were significantly older than children who did not.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2
Mixed-Effects Logistic Regression Models Predicting Children's Selection of the Referent that Integrated Perspectives

	Model 1: Study 1—Age Only		Model 2: Study 2—Age Only		Model 3: Study 2—Epistemic (individual level)		Model 4: Study 2—Epistemic (trial level)	
Predictor	*B* (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*
Age	**.53 (.12)**	**< .001**	**.60 (.17)**	**<.001**	**.41 (.17)**	**.02**	**.53 (.19)**	**.004**
Epistemic	—	—	—	—	.60 (.32)	.06	.32 (.29)	.27
Preference (vs. belief) trial	—	—	—	—	—	—	.10 (.26)	.69
Epistemic × Preference Trial	—	—	—	—	—	—	**.62 (.27)**	**.03**

Note. Bolded text indicates a significant effect at $p < .05$. Children's age has been mean-centered. Epistemic understanding at the individual level (i.e., sum score) was mean-centered. Epistemic understanding at the trial level (dichotomous) and preference (vs. belief) trial (dichotomous) were coded as 1 = yes and −1 = no.

referents that integrated perspectives was negatively correlated with mentioning referents that reflected a single perspective, $r = -.63$, $p < .001$. Mentioning underspecified or random referents was not associated with selections, $r = .16$, $p = .15$.

Finally, in follow-up mixed-effects models, we tested if any of these open-ended measures explained the age-related change in integrating perspectives. In these models, all variables (i.e., children's age and explanation sum scores) were mean-centered. We found that *only* mentioning referents that integrated perspectives (but not simple or random referents) reduced the age effect to a nonsignificant effect (in this model, main effect of age: $B = .22$, $p = .053$, main effect of mentioning integrative referents: $B = .91$, $p < .001$). Taken together,

these results confirmed that the selection questions tapped children's ability to infer unmentioned referents that *integrated* divergent perspectives.

Domain analyses

In Table 1, we report the percentage of participants who integrated perspectives for each trial. As shown in the first and second rows, children and adults were most likely to integrate perspectives when reasoning about the painting disagreement. However, these domain differences reached statistical significance only in comparison to the color disagreement (children: $t[86] = 2.32$, $p = .02$; adults: $t[56] = 4.67$, $p < .001$) and the robot disagreement for children ($t[86] = 4.71$, $p < .001$), and not for the blocks disagreement.

Next, we examined whether children would be more likely to integrate perspectives pertaining to the *belief* disagreements if they first reasoned about the preference disagreement (i.e., painting). To do so, we ran a mixed-effects logistic regression model, with crossed random intercepts for subjects and items, and fixed effects for children's age, order (i.e., preference first vs. preference last), and the interaction between age and order. In this model, only *belief* items (i.e., selections for the color, block, and robot disagreements) were included as dependent measures. Children's age was mean-centered, and order was coded as 1 = preference first, −1 = preference last. There was a significant interaction between age and order ($B = .24$, $p = .04$), with a significant main effect of age ($B = .49$, $p < .001$) and no main effect of order ($B = .46$, $p = .05$). We plot this interaction in Figure 3, which suggests that reasoning about preferences first benefits older but not younger children. Regarding the *painting* trial as the outcome, we did not find a significant main effect of order, or interaction between age and order, suggesting that this scaffolding effect of presentation order was unique to belief trials. All models that were run in relation to order effects are included in Supporting Information.

Discussion

Study 1 supported our key hypothesis that the capacity to resolve disagreements by integrating perspectives would be later developing (i.e., after 8 years of age); indeed, children did not perform above chance levels until approximately 10 years of age. Also as expected, adults showed a robust capacity to integrate perspectives in this task, which was less demanding than tasks in the previous literature (Barzilai & Ka'adan, 2017; Bråten & Strømsø, 2010; Kuhn et al., 2017). There was some support for the hypothesized domain differences between preferences and beliefs: Both children and adults integrated perspectives most often in the preference disagreement, but this was only significantly more often than some of the belief trials (e.g., color and robot, but not blocks for children). We also found evidence to suggest that reasoning

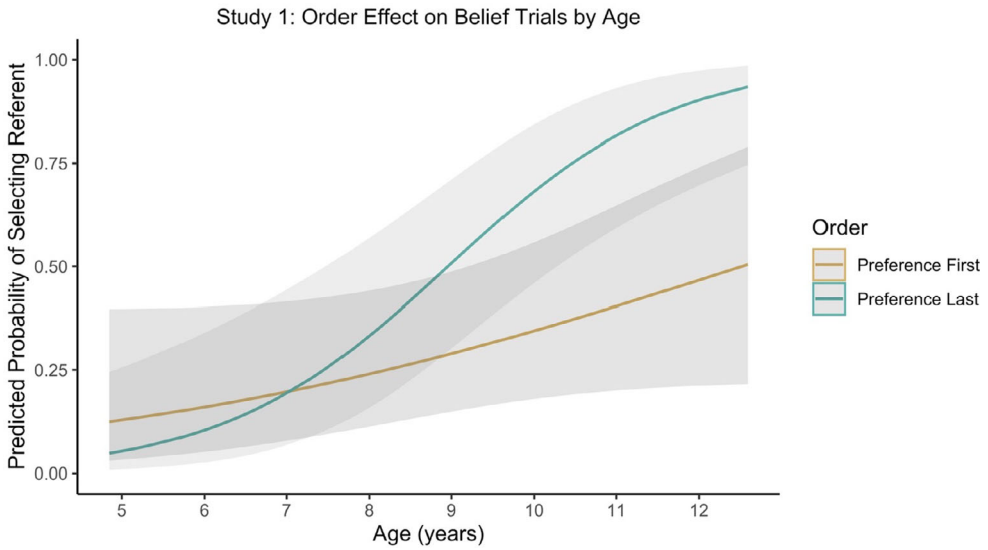

Figure 3. Predicted probability of choosing the referent that integrated perspectives across belief trials by age and order in Study 1.
Note. Predicted probabilities are from a mixed-effects logistic regression model that included only the belief trials; gray bars indicate 95% confidence intervals.

about the preference disagreement first may boost older, but not younger, children's capacity to integrate perspectives in the belief domain. One explanation for why this might have uniquely benefited older children is that, in combination with their ability to understand the preference disagreement, they could reason pragmatically to figure out the purpose of the experiment. Specifically, they may have figured out that they were being tasked to identify referents that accounted for why two individuals disagreed, and then applied this rule to the belief trials (see related literature on analogical transfer; Brown, Kane, & Echols, 1986).

Study 2

In Study 2, our first aim was to determine whether the age and domain differences found in Study 1 would replicate with a revised version of the *integrating perspectives paradigm*, which we describe in further detail below. The second aim was to examine epistemological understanding—specifically, children's endorsement that the two adults with different perspectives could both be right—as a potential mechanism to explain the observed age and domain differences in selecting referents that integrate perspectives.

Method

Participants

Participants were $N = 42$ children (45% girls, 55% boys; 40% White, 26% Latinx, 17% Asian, 14% mixed race or ethnicity), ages 5–12 years ($M = 8.51$ years, $SD = 2.40$), recruited from social media and ChildrenHelpingScience.com (all participants were located in the United States), and $N = 46$ adults who were college students at the associated university (76% female, 24% male; 72% Asian, 13% Latinx, 6% mixed race or ethnicity, 4% Middle Eastern or North African, 4% White); two adults were dropped due to failing an attention check. We chose the sample size of child participants based on the effect size from Study 1, which was the bivariate correlation between age and integrating perspectives, $r = .46$. A power analysis in G*Power (with 80% power) indicated that we needed 34 participants to detect this effect. We aimed for a slightly larger ($\sim N = 40$) sample size given that we were interested in testing additional effects. All procedures were approved by the Institutional Review Board at the associated university and informed consent was obtained for all participants.

Materials and Procedure

Due to the coronavirus pandemic, Study 2's child data collection was conducted completely online over Zoom in live, one-on-one sessions. Adult data were again collected via Qualtrics. The *integrating perspectives paradigm* was similar to the one used Study 1, in that participants were presented four disagreements about occluded objects and prompted to choose the referent (see Figure 4) and the order of these disagreements was counterbalanced (preference disagreements came either first or last). However, we revised the paradigm from Study 1 in several ways to examine the robustness of our findings. First, we included an additional distractor referent that was unrelated to either perspective (e.g., a yellow circle for the pink vs. orange disagreement). This helped to ensure that participants were choosing an option that integrated perspectives, rather than any random referent. Second, to further reduce cognitive load, we removed the question that asked why the adults disagreed, and only asked the open-ended question about what was behind the curtain. Third, we reworded the close-ended test question to be more straightforward: "Only one of these was behind the curtain. Which one do you think it was?" Fourth, we counterbalanced the order of the adult characters (which differed by race); there was no effect of character order. Finally, to assess whether preference effects generalized beyond the painting trial, we replaced the blocks trial with a second preference trial, specifically, something being described as both "yummy" and "yucky." As such, we had two preference trials (painting and food) and two belief trials (color and robot).

Critically, we also assessed epistemological understanding, specifically participants' tolerance of multiple perspectives, with questions adapted from prior research (Heiphetz et al., 2013). This set of questions was asked after participants completed the *integrating perspectives paradigm*. Specifically, we reminded participants about the disagreements that they had just heard previously, this time with just the curtain in the middle of the adults, and asked whether only one adult or both could be right in each of the disagreements, for example, "Remember, in this one, *this* adult (animation emphasized the first adult) said that there is a beautiful painting, and *this* adult (animation emphasized the second adult) said that there is an ugly painting. Can

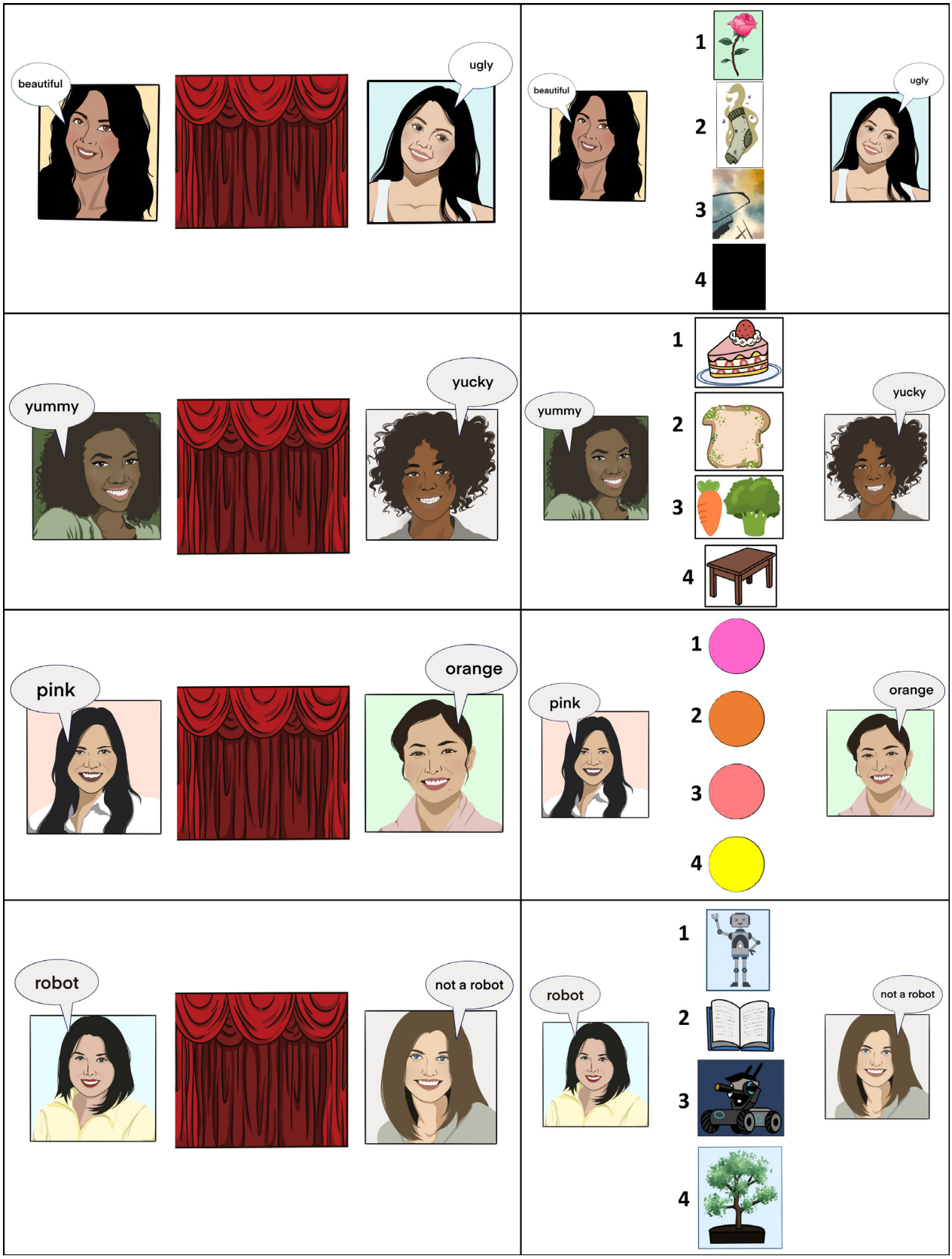

Figure 4. Integrating perspectives paradigm from Study 2. The figure shows an artist's rendition of the task. Participants saw photographs of real faces and real objects (with the exception of the circles).

only one of these adults be right or can both be right?" Following prior studies, we counterbalanced whether "only one" or "both" came first in the question (Heiphetz et al., 2013).

Dependent Measures

As in Study 1, the key-dependent measure was whether participants chose the referent that integrated perspectives—specifically, the abstract painting, vegetables, coral circle, and ambiguous machine. Although not planned initially, we also scored participants as integrating perspectives when they chose the black image in the painting disagreement, as it seemed reasonable to assume this color also could evoke polarizing reactions. Notably, about the same number of children chose the black image (6 children) as the abstract painting (7 children), whereas many more adults chose the abstract painting (40 adults) than the black image (1 adult). For the epistemological understanding measure, we scored whether participants endorsed that both adults, as opposed to only one, could be right in each disagreement trial.

Results

Age Analyses (Replication)

The age-related change in integrating perspectives observed in Study 1 replicated in Study 2. As reported in Table 1 (see first row under Study 2), there were significant age differences across each of the four disagreements, such that children who integrated perspectives were older than those who did not. We also found a robust correlation between children's age and the total number of times they integrated perspectives, $r = .54$, $p < .001$. Our mixed-effects logistic regression model results found an effect similar to that of Study 1, $B = .60$, $p < .001$, see Table 2, Model 2. Finally, we plotted the predicted values from the child and adult models in Figure 2b, and found again that adults robustly integrated perspectives, whereas children were at above-chance levels (25% in this study) in later childhood, by 10.2 years of age.

Domain Analyses (Replication)

We did not replicate the domain differences found in Study 1, see Table 1. There were no significant differences between any of the trials for either children or adults. We also examined again whether children would integrate perspectives more in the *belief* trials if they reasoned about the preference disagreements first. The direction of the effects was similar to Study 1, but none were statistically significant. Regarding the *preference* disagreements, we again did not find a main effect of order or significant age by order interaction. All models that were run in relation to order effects are included in Supporting Information.

Epistemological Understanding Analyses

Children's and adults' rates of endorsing that both people could be right in each disagreement are reported in the bottom two rows of Table 1. There were significant age differences in children's epistemological understanding for *preference* disagreements, such that children who endorsed both perspectives as being correct were significantly older. There were no age differences in epistemological understanding for *belief* disagreements.

With respect to *domain* differences, among both children and adults, endorsing both views as correct was significantly higher when participants reasoned about preference disagreements compared to the robot disagreement (painting vs. robot: children, $t[41] = 3.11$, $p = .003$; adults, $t[45] = 7.01$, $p < .001$; vegetables vs. robot: children, $t[41] = 3.34$, $p = .002$; adults, $t[45] = 6.19$, $p < .001$). Among adults only, epistemological understanding was also greater for preference disagreements than the color disagreement (painting vs. color: $t[45] = 3.82$, $p < .001$; vegetables vs. color: $t[45] = 3.99$, $p < .001$).

Next, we examined the associations between epistemological understanding and integrating perspectives. We used chi-square tests to examine this association for each disagreement. Among children, this association was significant for each of the preference disagreements (painting: $\chi^2[1] = 10.49$, $p = .001$, food: $\chi^2[1] = 5.78$, $p = .016$). For the painting disagreement, 52% of children who said both could be right integrated perspectives, whereas 0% of children who said that only one could be right integrated perspectives. For the food disagreement, 60% of children who said both could be right integrated perspectives, as compared to 18% who said only one could be right. There was no significant association between epistemological understanding and integrating perspectives for either the color or robot disagreement.

Notably, the adult results followed a similar pattern. While we did not find this association for the painting disagreement (98% of adults agreed with both perspectives being right, resulting in virtually no variability), we found this association for the

food disagreement, $\chi^2(1) = 4.83$, $p = .03$, such that 86% of adults who said both could be right integrated perspectives, whereas 0% of adults who said only one could be right did so. Also, like the child sample, we did not find significant associations between the epistemological understanding item and integrating perspectives for the belief disagreements.

Finally, we were interested in whether epistemological understanding accounted for the age effect on integrating perspectives. We ran two mixed-effects logistic regression models, see Table 2, Models 3 and 4. Both models added to Model 2, which included crossed random intercepts of trial and subject and a fixed effect of mean-centered age. In Model 3, we added a fixed effect of the *sum score* of epistemological reasoning at the individual level (mean-centered), which was the number of times a child said both adults could be right. We found that this was associated with integrating perspectives, though it did not reach conventional levels of significance ($p = .06$), and accounted for some of the age-related change (i.e., the effect of age was reduced from Model 2). In Model 4, we included a fixed effect of the *trial-level* scores of epistemological reasoning (1 = both can be right, −1 = only one can be right). Given the apparent moderation by domain, we also added a fixed effect of domain (*preference* vs. *belief* trial, coded as 1 and −1, respectively) and the interaction between epistemological understanding and domain type. This model confirmed that, for preference trials only, epistemological understanding was associated with integrating perspectives. Of note, the effect of age again remained even after partialling out epistemological reasoning at the trial level.

Discussion

In Study 2, which was conducted with revised materials and via an online platform, we found strong evidence of age-related increases in the tendency to integrate perspectives to resolve disagreement, replicating the age effects found in Study 1. We also replicated the finding that children are at above-chance levels by approximately 10 years of age. We did not, however, replicate the domain differences found in Study 1; participants were no more likely to integrate perspectives when reasoning about preference disagreements compared to belief disagreements. One possibility is that having only three referents (in Study 1), as opposed to four referents (in Study 2), helped to draw children's attention to the referent that combined the perspectives. This constrained hypothesis space may have been especially beneficial in the painting disagreement, in which children may have had the strongest inclination to consider multiple perspectives. Prior research has demonstrated that providing children with relevant alternatives (or in our case, constraining alternatives) improves reasoning on a variety of tasks (Gweon & Asaba, 2018; Skordos & Papafragou, 2016). Finally, we found that epistemological understanding explained some of the variation in integrating perspectives—for preference, but not belief disagreements—and that this understanding accounted for some of the age-related change.

General Discussion

The present studies examined children's and adults' ability to resolve disagreement by identifying referents that integrated the two perspectives. Across both studies, we find that this capacity develops slowly across childhood, such that integrating perspectives was not highly robust until 10 years of age. We find that adults robustly integrate perspectives, which contrasts with prior findings using more complex paradigms which show that adults have a low tendency to do so. Finally, we found correlational evidence that suggests epistemological understanding—that is, tolerance of multiple perspectives—may be part of the mechanism that explains age-related change in integrating perspectives to resolve disagreement.

Although children's consideration of multiple perspectives emerges in early childhood and is relatively robust by 8 years of age (Beck et al., 2011; Carpendale & Chandler, 1996; Heiphetz et al., 2013), our results suggest that the ability to infer *what* could have evoked two different views emerges later—around 10 years old. It is likely that this inference develops later because it requires coordination of multiple complex inferences (see Kuhn, 2020). We posited that children first need to acknowledge that both individuals may have valid perspectives (Heiphetz et al., 2013; Kuhn et al., 2000; Walker et al., 2013). Indeed, we found evidence to suggest that this kind of epistemological understanding explains part of the age-related change in identifying the referents that integrate perspectives.

Children then need to take an additional step to integrate these perspectives and consider referents that could explain both views. The second step may be particularly challenging, as it requires children

to consider an entirely new referent that was not mentioned by either person. One potential explanation for why older children are more successful at this is that they are more capable of spontaneously generating possible referents. Some support for this possibility comes from the open-ended data in Study 1, in which spontaneously mentioning a referent that integrated the two views explained age-related changes in integrating perspectives. While younger children may also have some capacity to integrate perspectives in this way, they may require much more scaffolding and may only be able to do so when reasoning about concrete issues. For example, children as young as 3 years of age can recognize that an adult will classify a blue object as green when viewed through a yellow screen, but notably, this occurs after a substantial training period about color mixing (Moll & Meltzoff, 2011). We speculate that older children's prior knowledge and increased cognitive flexibility allow them to integrate perspectives more readily across a wider range of issues. Confirming the precise mechanisms that facilitate this capacity in older children will be important in future research.

An unexpected finding was that epistemological understanding was correlated with integrating perspectives of *preference* disagreements, but not *belief* disagreements. We posit that this may be due to the wording of the question in the current task. Recall that the question was, "Can only one of these adults be right or can both be right?" We used this wording because it had been used in previous research with children as young as 5 years of age (Heiphetz et al., 2013), and researchers have noted that other epistemological understanding questions may be confusing for children younger than 10 (Kuhn et al., 2000). Nonetheless, this wording may have been incompatible with the belief disagreements, which were similar to disagreements about empirical facts (Kuhn et al., 2000; Walker et al., 2013). Indeed, it is often the case that in scientific theoretical disputes (e.g., nativism vs. empiricism), neither perspective is completely right, but both perspectives offer some valid claims. Future research should use other variations of this question that better tap the idea that both people may be somewhat correct, for example, a child-friendly version of the item in Kuhn et al. (2000), "Can only one of their views be right, or could both have some rightness?"

One limitation of this research is that our measure of epistemological understanding was always presented at the end, which does not allow us to assess potential order effects. We made this decision because our integrating perspectives measure was of primary interest, and we wanted to ensure that it would not be influenced by our epistemological understanding measure. However, to better interpret the relationship between these measures, it will be important to examine whether there are order effects. Doing so could also provide theoretical insights; for example, it may be that asking children to consider issues related to epistemological understanding (i.e., issues of subjectivity; e.g., see Walker et al. 2013) will help them integrate perspectives. It will also be important to address another limitation of our epistemological understanding task, specifically, that only items about the *same* disagreements used in the integrating perspectives paradigm were included. We did this as a straightforward test of the association between epistemological understanding and integrating perspectives, in that it controlled for any potential variance associated with idiosyncratic aspects of the items. However, future research may also include standardized measures of epistemological understanding to test the robustness of these findings (Heiphetz et al., 2013; Kuhn et al., 2000).

While our study focused on simple disagreements, future research should also examine more complicated topics that are often the subject of debate, including disagreements about causal relations and moral judgments. As noted previously, prior studies with adults and adolescents find that participants rarely integrate perspectives about causal relations (e.g., the causes of climate change or cancer; Barzilai & Ka'adan, 2017; Bŕten & Strømsø, 2010; Kuhn et al., 2017). While this may be due to the complexity of the task, it is also possible that people are more rigid when they think about causality. Indeed, children and adults tend to assume that causal relations are deterministic (Mayrhofer & Waldmann, 2016; Schulz & Sommerville, 2006) and favor simple explanations (Lombrozo, 2016), which may hinder them from integrating two competing causal accounts.

Regarding moral judgments, studies have found that there is variation across individuals and across certain issues as to whether moral claims are construed as objective versus subjective (Goodwin & Darley, 2012; Heiphetz et al., 2013; Theriault et al., 2017). Given our epistemological understanding results, we posit that this variation may predict whether people integrate two divergent moral views in specific situations. For example, imagine a reasoner who hears one person say, "It was wrong to eat meat," but another person say, "It was okay to eat meat." If the reasoner holds an *objective* view

of this moral claim, such that they believe it is always wrong to eat meat, regardless of context, they will likely side with the first person. However, if the reasoner holds a more *subjective* view, they may question whether the situation itself was morally ambiguous; perhaps it was a situation where it was not entirely clear if eating meat was socially appropriate (e.g., when eating out with vegetarian friends).

A related future direction would be to examine whether focusing on the referent of disagreement is associated with the reasoner's perceptions of the disagreeing individuals involved. Specifically, attending to the referent may reflect that the reasoner believes that both people are reasonable and trustworthy. This assumption may be particularly useful when attempting to resolve disagreements in a highly polarized society, as more attention would be paid to the issue at hand, rather than to attacking the opposing group.

In sum, children are tasked with navigating a world with a diverse range of viewpoints that often conflict with one another. The current studies examined whether children are able to look beyond each perspective provided to them directly and consider unmentioned referents that could have given rise to multiple perspectives. Our results indicate that this ability does not become robust until about 10 years of age, and that tolerance of multiple perspectives may partly underscore this age-related change. This research lays the foundation for future investigations on how children make inferences from disagreements as they learn about the world around them.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Appendix S1. Models testing order effects.