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Inducing Knowledgeability from Niceness: Children Use Social Features for Making Epistemic Inferences

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In many ways, evaluating informants based on their features is a problem of induction: children rely on the assumption that observable informant characteristics (e.g., traits, behaviors, social categories) will predict unobservable ones (e.g., future behavior, knowledge states, intentions). Yet, to make sensible inferences, children must recognize what informant features are relevant for what types of inferences. The current research investigated whether preschoolers use social features (e.g., niceness) for making epistemic inferences, and conversely, whether they use intellectual features (e.g., expertise) for making social inferences. In the study, 96 preschoolers (M_{age}=4.96 years) were asked to attribute knowledge and behaviors to a mean, a nice, and a neutral informant. Between-subjects, we varied which informant had expertise. We found that, when attributing knowledge, children used both features: attributing more knowledge to nicer informants, but also attributing more knowledge to an informant when he had expertise. In contrast, when making social inferences, children relied primarily on social features.

Key words: Social reasoning; Cognitive Development; Knowledge Attribution; Evaluating Others; Induction

Paramount to determining whether someone can provide accurate information is the ability to determine what that person *knows*. Although what someone else knows is generally unobservable, children will often use observable informant features (e.g., behaviors, social categories) to make inductive inferences about an informant's knowledge (Landrum, Eaves, & Shafto, 2015). For example, even preschool-aged children seem relatively adept at using an informant's prior history of accuracy (e.g., Koenig & Harris, 2005) and expertise category (e.g., doctor, car mechanic, eagle expert; Lutz & Keil, 2002; also see Landrum & Mills, 2015) to make inferences about what that informant might know. However, children may be making inferences from informant features without completely understanding what those features represent. For instance, they may use features relevant to one dimension for inferences along another (e.g., inferring that a classmate who is good at reading will also be good at sharing; Stipek & Daniels, 1990). The current research investigates how children use socially-relevant (i.e., social) features and intellectually-relevant (i.e., intellectual) features for making inferences about informants. In particular, we aimed to examine whether children use social features for epistemic inferences (e.g., inferences about what an informant knows), and conversely, whether they use intellectual features for social inferences (e.g., inferences about how an informant will behave).

Decades of research demonstrate that even preschoolers and kindergarteners (i.e., 4- to 6-year-olds) are capable of making behavioral, dispositional, and trait inferences about other people (e.g., Alvarez, Ruble, & Bolger, 2001; Cain, Heyman, & Walker, 1997; Droege & Stipek, 1993; Feldman & Ruble, 1988; Heyman & Gelman, 1999; Stipek & Daniels, 1990). For example, after hearing a modified version of "Cinderella," preschoolers used what they knew about Cinderella and her stepsister's history of prosocial and antisocial behaviors to make predictions about their future behaviors and abilities, such as whether each character would share a toy with the participant (Cain, Heyman, & Walker, 1997).

Among this body of work, however, are debates about whether young children, particularly preschoolers, truly understand the relationship between observable features and psychological states. For instance, Ruble and Dweck (1995) argue that children do not have a sophisticated understanding of the relationship between traits and behaviors and are actually making global evaluative inferences— qualifying individuals as globally "good" or "bad" and then predicting consistency with that global evaluation when making future inferences (e.g., Ruble & Dweck, 1995). Referring back to the Cinderella example above, in addition to predicting that Cinderella would be more likely than the stepsister to act prosocially, preschoolers predicted that Cinderella was more likely to be "smart" and "athletic" (Cain et al., 1997). For another example, when asked to make predictions about a classmate across four domains (i.e., answering reading questions accurately, doing well on a spatial task, sharing cookies, and jumping hurdles), kindergarteners made all positive predictions about a classmate who they had described with a positive label to (e.g., "smart", or "nice") and all negative predictions about a classmate who they had described with a negative label (e.g., "not smart", or "not nice"; Stipek & Daniels, 1990). In fact, there are situations in which even adults make global evaluative inferences. Work examining halo effects in adults has found that nice, likeable, or attractive individuals are presumed to have positive attributes and less nice, unlikeable, or unattractive individuals are presumed to have negative attributes (e.g., Miller, 1970; see also *Halo effect*, Nisbett & Wilson, 1977; Thorndike, 1920).

Parallel to the trait-behavior literature, research in epistemic trust has shown preschool-aged children making seemingly sophisticated epistemic inferences about a potential informant's trustworthiness—that is, the extent to which an informant is willing and able to provide accurate information (see Mills, 2013, Sobel & Kushnir, 2013; for reviews). From about age 4, children can evaluate an informant's trustworthiness based on a plethora of cues relevant to having accurate knowledge, such as perceptual access (e.g., Pillow, 1989), prior history of accuracy (e.g. Koenig & Harris, 2005); reliability/number of inaccuracies (e.g., Pasquini, Corriveau, Koenig, & Harris, 2007), and expertise (e.g., Landrum, Mills, & Johnston, 2013, Experiment 1). That said, it is unclear whether children really understand the relationship between the observable informant features, or cues, presented and the informants' psychological states, such as knowledgeability and intent. Do children understand, for example, that expertise is indicative of knowledge but not intent and that niceness is indicative of intent but not knowledge? It is possible that when children selectively choose an informant based on a presented feature, they are simply demonstrating that they recognize a valence difference between the informants on the given cue, and they prefer the informant who is more positively-valenced (lending support to the evaluative reasoning theory, Ruble & Dweck, 1995). In fact, selective trust literature has shown that children will choose between informants based on non-epistemic cues; for instance, when informants vary only on attractiveness, 4- and 5-year-old children preferred to trust novel object labels provided by the more attractive informant (Bascandziev & Harris, 2014).

Evaluative reasoning is not the only explanation for why children might use an informant feature that is seemingly irrelevant to the inference being made. It is also possible that children have been led by experimenters to make seemingly irrelevant inferences through pedagogical cues (e.g., exhibiting pedagogical reasoning). Specifically, children may view the experimenter as a helpful and trustworthy source of information and thus view the selection of a particular characteristic as purposeful and inferentially-sufficient (consistent with work on preschool-aged children's understanding of pedagogical intent, e.g., Bonawitz, Shafto, Gweon, Goodman, Spelke, & Schulz, 2011; Shafto & Goodman, 2008). Thus, irrelevant characteristics, when communicated by a presumably knowledgeable experimenter, may support the use of valence-consistent predictions. If children are engaging in such pedagogical reasoning, they may be overriding their own intuitions, making it difficult for researchers to discern whether children believe the characteristic to be relevant to such inferences or whether children are merely cooperating with the task.

Pedagogical reasoning can be ruled out, however, when children are presented with multiple informant characteristics that are in conflict with one another (e.g., each informant is positive on one characteristic and negative on another). In that case, the intent of the person providing the information is unclear. When determining which informant's information to trust in this paradigm, children have to choose which dimension they believe to be more important, at the expense of the other dimension, and then trust the informant who is positive along that dimension. That said, many studies using this design have still found children more heavily weighing non-epistemic cues. For example, studies comparing intellectual features (e.g., expertise, perceptual access) to niceness/meanness (a social feature) have found that preschoolers often choose to trust claims from someone who is positive on the social feature (i.e., niceness), even if that person is negative on the intellectual feature (e.g., expertise: Landrum, et al., 2013; perceptual access: Lane, Wellman, & Gelman, 2013)[1].

This prioritizing of the social cues may be indicative of children using the social dimension (and not the intellectual one) for making global evaluations or of children misunderstanding the importance of knowledgeability to providing accurate information. However, there is another alternative: it is also possible that children are aptly recognizing the importance of the social dimension to evaluations of *trustworthiness*. Evaluating an informant's trustworthiness—choosing whose claims to trust or choosing whom to ask for new information— is different than simply evaluating whether an informant has knowledge. To be evaluated as trustworthy, an informant should be judged as *both* knowledgeable and helpful (e.g., Shafto, Eaves, Navarro, & Perfors, 2012; see also "competent" and "benevolent"; e.g., Landrum et al., 2013; Mascaro & Sperber, 2009). After all, it would be difficult to learn accurate information from someone who does not have the ability

[1] Although this is not always the case (see Johnston, Mills, & Landrum, 2015).

to teach it or intends to mislead the learner. Therefore, such social features are arguably as relevant as intellectual ones for trustworthiness evaluations. So, when evaluating trustworthiness, children's prioritization of niceness/meanness over the intellectual cues (e.g., expertise: Landrum et al., 2013; perceptual access: Lane et al., 2013) may be because they are inferring that a nice informant is more likely to have benevolent intentions, whereas a mean informant may be more likely to be deceptive. Adults, too, have been shown to sometimes preferentially weigh social information, such as benevolence or warmth, over intellectual information in trust decisions and credibility ratings (e.g., Abele, Cuddy, Judd, & Yzerbyt, 2008; White, 2005, also see Pornpitakpan, 2004). For knowledgeability evaluations, however, intellectual features of informants are arguably the only relevant ones. After all, just because someone is nice or friendly does not mean that they also have knowledge. Thus, it is an open question whether children will prioritize social information over intellectual information when attributing knowledge.

Current Study

The current study set out to examine how preschool-aged children think about and use social and intellectual features for making social and epistemic inferences. In the study, children were presented with three informants who varied in their relative niceness and meanness (i.e., the social feature) and whether or not they had expertise (i.e., the intellectual feature). Children were asked to attribute knowledge and behaviors to each informant, individually—children did not have to choose between the informants, as is the case in much of the previous literature (e.g., see Mills, 2013 for a review). Then, children explicitly rated the informants on a scale from really mean to really nice.

We had two primary aims. Aim 1 was to examine whether social features (i.e., provided descriptions of niceness and meanness influence children's epistemic inferences (i.e., what children believe informants are likely to know), even in the presence of the intellectual feature (i.e., expertise). Aim 2 was to examine the reverse: whether intellectual features influence children's social inferences (e.g., engagement in nice and mean behaviors and ratings on a scale of meanness to niceness).

Given that children in this preschool age group seem prone to global evaluative reasoning based on trait-like characteristics (e.g., "helpfulness", "goodness", Ruble & Dweck, 1995), it is possible that children would primarily attend to the social dimension and rate more positively-valenced informants as (a) having more knowledge, (b) engaging in more nice behaviors (and less mean ones), and (c) as nicer on the explicit rating scale. However, it was also possible that children would demonstrate a more sophisticated reasoning pattern in which they systematically employ the intellectual feature for the epistemic inference (e.g., attributing more knowledge to experts than non-experts) and the social feature for making social inferences (e.g., attributing more nice behaviors to nice informants).

Method

Participants

Ninety-six preschoolers (M_{age}=4;11, range: 4;0 to 5;11; 45 females) were recruited from preschools in the greater North Dallas area to participate in the study. The sample was predominately white and middle class. Prior to data collection, participants were semi-randomly assigned to one of three between-subjects conditions using a list randomizing program on Random.org. Sample size was determined using G*Power for a repeated-measures ANOVA with between-subject factors and an anticipated medium effect size. We determined that we needed 32 participants in each of our 3 between-subjects conditions.

Procedure

For all conditions, participants first were told that they would hear a short story about three people (i.e., a mean, a nice, and a neutral informant) and would be asked what those people might know and might have done. Then, the participants were introduced to one informant at a time. For each informant, participants were shown an image (see Figure 1) and two features were described: whether the informant was mean, nice, or neutral (i.e., social valence, the social feature) and whether he had bird expertise or not (i.e., expertise, the intellectual feature; see Table 1). Whether participants heard the social or intellectual feature first was counterbalanced between participants.

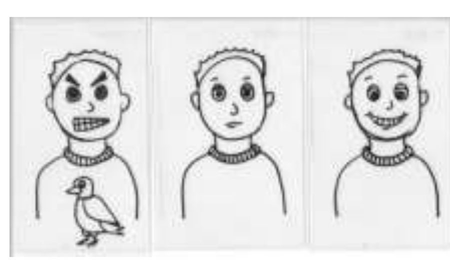

Figure 1. Example image of the three informants. Facial expressions provided visual cues to support the descriptions of niceness/meanness. The presence or absence of the bird on the shirt provided a visual cue to expertise. The image above is from the Mean Expert Condition.

Importantly, the between-subjects expert conditions differed in which informant (the nice, mean, or neutral one) had bird expertise. For each condition, only one informant had bird expertise (i.e., the Mean Expert, Nice Expert, and Neutral Expert conditions). The other informants were described as knowing nothing at all about birds. Informants were introduced one at a time. For each informant, one feature was described and then the other. Whether the social feature or the intellectual feature was described first was counterbalanced between participants.

Moreover, the expert was always introduced before the non-expert as it made more sense to first introduce someone has having bird knowledge before specifying that someone lacks bird knowledge. The descriptions used to describe the informant features (see Table 1) were based upon previous research (e.g., Landrum et al., 2013; Lutz & Keil, 2002). The image depicting the informants showed three virtually identical hand-drawn males that only varied in their facial expressions (which reinforced the social feature) and the presence or absence of a bird on each shirt (which reinforced the intellectual feature; see Figure 1).

Table 1. Descriptions of informant features read to participants. The expert was always introduced before the two non-experts. Whether the social feature description or the intellectual feature description was read first for each informant was counterbalanced between participants.

Feature	Description
Intellectual feature	
Expertise	See the bird on his shirt? That is because he knows *all about* birds. He knows how many babies they can have, what kinds of food they can eat, and how big they can grow! See, he knows all about birds!
No Expertise	See how he doesn't have a bird on his shirt? That is because he knows *nothing* about birds! He has no idea how many babies they can have or what food they eat; he doesn't even know how big they can grow! See, he knows nothing about birds!
Social feature	
Nice	This guy is really nice. He gives people presents, he always shares, and he really cares about other people's feelings. See, he's really nice!
Neutral	This guy is sometimes nice and sometimes mean. Sometimes he gives presents and sometimes he steals them away; sometimes he shares and sometimes he refuses to share; and sometimes he cares about other people's feelings and sometimes he doesn't care at all. See, he is sometimes nice and sometimes mean!
Mean	This guy is really mean. He steals people's presents, he refuses to share, and he doesn't care at all about other people's feelings. See, he's really mean!

After the descriptions of each informant, participants were asked two practice attribution items to reinforce that it was acceptable to attribute each item to one, two, or all three informants. For the practice attribution items, participants were first told "sometimes people are the same and sometimes they are different. For example, some people have birds on their shirts"— a feature true for only one of the informants. Then, participants were encouraged to respond "yes" or "no" to whether each of the informants had birds on their shirts while the experimenter pointed to each informant, indicating which one was to be assessed. Afterwards, participants were told "some people have short hair"—a feature true of all three informants, and were asked to state "yes" or "no" as to whether each of the informants had short hair.

After the practice items, participants were presented with 16 attribution items: 4 expertise-relevant knowledge items (i.e., bird items), 4 tangential knowledge items (i.e., plant knowledge: items about plants, fruit, and flowers), 4 nice behaviors, and 4 mean behaviors. See Table 2. These items were adapted from the knowledge and behavioral attribution items from Landrum et al. (2013) and the underlying principles knowledge items from Lutz & Keil (2002). These items were not presented to participants in blocks; the expertise-relevant knowledge items, tangential knowledge items, nice behavior items, and mean behavior items were intermixed and randomized into two between-subjects orders using a list randomizing program at Random.org.

Table 2. Attribution items. Items from each of the four categories were intermixed and randomized in two between-subjects orders.

Knowledge attribution items	**Behavior attribution items**
Expertise-Relevant Knowledge	***Nice behaviors***
Some people know a lot about how ducks are able to swim.	Some people might hug their neighbors.
Some people know a lot about how chickens lay eggs.	Some people might act silly so little kids will have fun.
Some people know a lot about how parrots open and close their beaks.	Some people might help others clean their rooms.
Some people know a lot about how many bones turkeys' have in them.	Some people might share their drinks with people who don't have one.
Tangential Knowledge	***Mean behaviors***
Some people know a lot about why plants need sunlight to grow.	Some people might break other people's phones on purpose.
Some people know a lot about why apples are sweet.	Some people might push people down to make them spill their drinks.
Some people know a lot about what makes grass green.	Some people might hit their neighbors in the face.
Some people know a lot about how flowers bloom.	Some people might steal other people's lunch money.

The attribution items were asked in the same format as the practice attribution items: after reading the item, participants were asked whether the statement was true for each informant, and participants were encouraged to respond with "yes" or "no." For example, the experimenter said "Some people how a lot about why plants need sunlight to grow. Does this guy know a lot about why plants need sunlight to grow? Does this guy? How about this last guy—does he know a lot about why plants need sunlight to grow?" Participants' responses were coded as 1 for "yes" or 0 for "no". If participants responded with "maybe", "sometimes", or "I don't know," they were encouraged to respond with yes or no.

After the attribution items, participants were asked to explicitly rate each informant as nice, mean, or somewhere in the middle. If participants said that the informant was nice or mean (as opposed to responding "somewhere in the middle"), then they were asked whether that informant was a little nice (or mean) or really nice (or mean). These ratings were converted to a 5-point Likert scale from "really mean" (1) to "really nice" (5) with "somewhere in the middle" as the midpoint (3)

Results

Aim 1: The influence of social features on epistemic inferences

Our first aim was to determine whether descriptions of an informant's niceness or meanness (the social feature) influence children's epistemic inferences—how children *attribute knowledge* to those informants. We examined this in two knowledge domains: expertise-relevant knowledge (i.e., knowledge about birds) and tangential knowledge (i.e., knowledge about plants). As preliminary analyses showed no significant effects of age or gender, the following analyses are collapsed across those variables.

To examine how children use social and intellectual features for attributing knowledge, we began by conducting a mixed-design ANOVA on the number of knowledge items attributed to an informant of 4. Our within-subjects variables were *social valence* (i.e., whether an informant was nice, neutral, or mean) and *knowledge domain* (i.e., whether the item attributed was from the expertise-relevant knowledge domain or the tangential one). The between-subjects variable was our condition manipulation: *expert condition* (i.e., which informant had expertise: the nice, neutral, or mean informant). The ANOVA revealed the significant effects and interactions listed in Table 3. No other effects were significant. See Figure 2 for expertise-relevant and tangential knowledge attributions to each informant.

Table 3. Significant effects and interactions regarding children's knowledge attributions

Effect	*F*	*p*	η_p^2
Social Valence	31.70	$p < .001$	0.25
Knowledge Domain	4.76	$p = .032$	0.05
Social Valence X Knowledge Domain	3.35	$p = .035$	0.04
Social Valence X Expert Condition	20.83	$p < .001$	0.31
Social Valence X Knowledge Domain X Expert Condition	5.26	$p < .001$	0.10

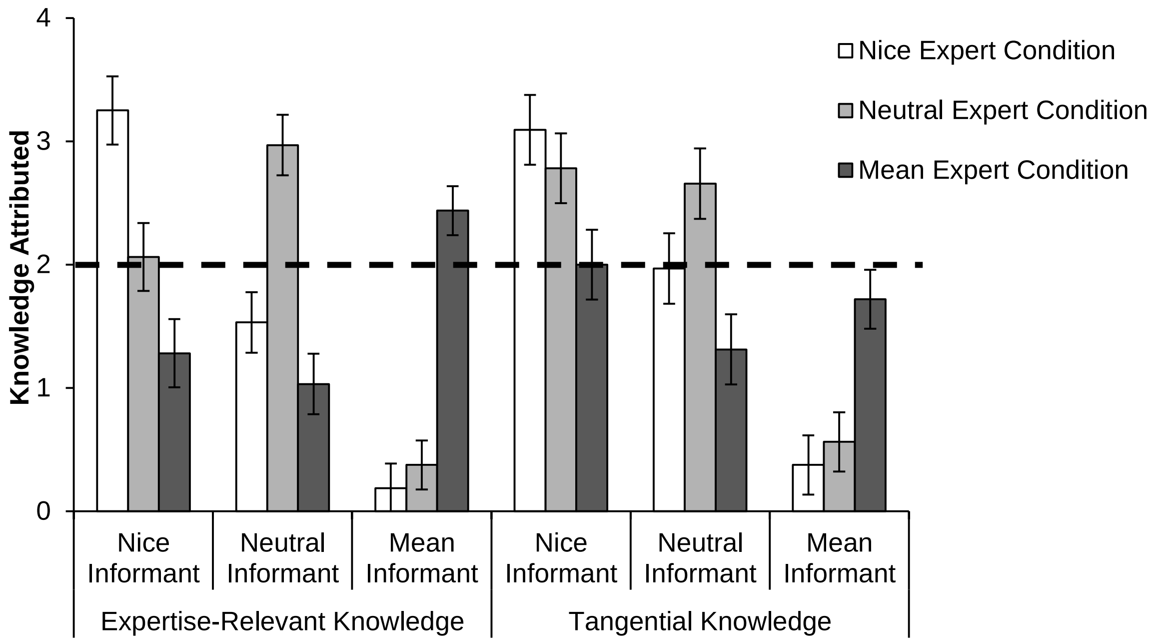

Figure 2. The number of expertise-relevant and tangential knowledge attributions to each informant out of 4 for each of the expert conditions. The dashed line represents chance.

The ANOVA revealed a main effect of social valence. Bonferroni-corrected *t*-tests suggest that, collapsed across all other variables, children attributed more knowledge to the nice informant (*M*=2.41, *SD*=1.52) than to the neutral informant (*M*=1.91, *SD*=1.47, *p*=.008, *d*=0.33), and more knowledge to the neutral informant than to the mean one (*M*=0.94, *SD*=1.36, *p*<.001, *d*=0.68). Thus, children do seem to be using descriptions of niceness and meanness when attributing knowledge.

The ANOVA also revealed a main effect of knowledge domain such that children generally attributed more tangential knowledge (*M*=1.83, *SD*=0.85) than expertise-relevant knowledge (*M*=1.68, *SD*=0.73). In addition, there was a social valence by knowledge domain interaction suggesting that the difference between the amount of tangential knowledge and expertise-relevant knowledge attributed to an informant varied depending on whether the informant was nice, neutral, or mean. Specifically, the difference between tangential knowledge and expertise-relevant knowledge attributed to the nice informant (*MD*=0.43) is significantly greater than the difference between the two knowledge types attributed to the mean informant (*MD*=0.115, *p*=.046).

The ANOVA also revealed an interaction between social valence and expertise condition as well as a three-way interaction of social valence, expertise condition, and knowledge domain. These interactions suggest that how much knowledge children attributed to each socially-valenced informant (nice informant, neutral informant, and mean informant) varied depending on *whom had expertise* and *what type of knowledge* children were attributing. Importantly, we would expect to see interactions of social valence and expertise condition even if children were only using expertise (and *not* social valence) to attribute knowledge—children would attribute more knowledge to a particular informant (e.g., the nice informant) in the condition for which that informant was the expert (e.g., the nice expert condition). However, the main effect of social valence (discussed above) suggests that children are also considering that factor independently of expertise when attributing knowledge. We followed up on the results of the ANOVA in two ways. First, we examined how expertise influenced children's knowledge attributions, keeping social valence constant. Then, we examined to whether social valence influenced children's attributions of knowledge to *experts*.

Given our nested design, the ANOVA cannot provide us with an explicit main effect of expertise to demonstrate whether children are attributing more knowledge to experts than non-experts, over and beyond any effects of social valence. Thus, to proximate this analysis, we held informant social-valence constant and, using Bonferroni-corrected contrasts, compared the amount of knowledge attributed to each informant in the condition for which that informant had expertise to the two conditions for which that informant did not, and we did this for each of the two knowledge types separately (see Table 4). For all of the contrasts (with one exception[2]), children attributed more knowledge to the informant in the condition for which that informant had expertise than in the conditions in which the informant did not have expertise. Thus, children do seem to be using expertise for attributing knowledge, above and beyond information about social valence.

Turning back to effects of social valence, while the main effect of social valence suggests that (collapsed across all other variables) children attributed more knowledge to the nice informant and less to the mean one, we were also interested in whether children attribute more knowledge to nicer informants when expertise is held constant. To examine this, we conducted two Bonferroni-corrected one-way ANOVAs on the amount of knowledge attributed to the expert for each expert condition: one on the amount of expertise-relevant knowledge and one on the amount of tangential knowledge. If children were only using expertise information to attribute knowledge, then they should attribute the same amount of knowledge to an expert, whether that expert is described as nice, mean, or neutral. Then, the follow-up one-way ANOVAs would show no significant effect of expert condition. However, if we did find an effect of expert condition, then children would be demonstrating that they adjust their knowledge attributions based on the social feature.

The first ANOVA focused on the attribution of expertise-relevant knowledge, and it revealed a trend towards an effect of expert condition, $F(2, 93)=2.66$, $p=.076$, $\eta^2=0.05$. Bonferroni-corrected *t*-tests suggest that children who saw a *nice* expert trended towards attributing more expertise-relevant knowledge to the expert ($M=3.25$, $SD=1.46$) than children who saw a *mean* expert ($M=2.44$, $SD=1.59$, $p=.077$, $d=0.55$). No other pairing of informants differed significantly or trended toward doing so. Importantly though, children in the Nice Expert and Neutral Expert conditions attributed knowledge to the expert well above chance levels (Nice Expert: $t(31)=4.846$, $p<.001$, $d=1.74$; Neutral Expert: $M=2.96$, $SD=1.23$, $t(31)=4.452$, $p<.001$, $d=1.03$). Children in the Mean Expert condition, however, did not attribute knowledge to the mean expert above chance, $t(31)=1.561$, $p=.129$, $d=0.56$.

The second ANOVA focused on the attribution of tangential knowledge, and it revealed a significant effect of expert condition, $F(2, 93)=5.96$, $p=.004$, $\eta^2=0.11$. Bonferroni-corrected post-hoc tests reveal that children who saw a *nice* expert attributed more tangential knowledge to the expert ($M=3.09$, $SD=1.32$) than children who saw a *mean* expert ($M=1.72$, $SD=1.94$, $p=.003$, $d=0.84$). In addition, children who saw a neutral expert ($M=2.66$, $SD=1.58$) trended towards attributing more knowledge to the expert than children who saw a mean expert ($p=.070$, $d=0.54$). The amount of knowledge attributed to the neutral and nice experts were comparable ($p=1.00$, $d=0.30$). Moreover, like when attributing expertise-relevant knowledge, children in the Nice Expert and Neutral expert conditions attributed knowledge to the expert above chance levels, and children in the Mean Expert condition did not (Nice Expert: $t(31)=4.657$, $p<.001$, $d=1.67$; Neutral Expert: $t(31)=2.383$, $p=.023$, $d=0.86$; Mean Expert: $t(31)=0.821$, $p=.418$, $d=0.30$). See Figure 3.

[2] Although children also attributed a descriptively larger amount of tangential knowledge to the nice informant when he had expertise ($M=3.09$, $SD=1.33$) than when he did not have expertise ($M=2.39$, $SD=1.75$), the difference did not cross the significance threshold after Bonferroni-correction (prior to Bonferroni-correction $p=0.045$, $d=0.46$).

Table 4. Contrasts for amount of knowledge attributed to each informant between the condition for which that informant had expertise and the other two conditions

Contrasts		Expertise-Relevant		Tangential	
		MD	*p*	*MD*	*p*
Nice Expert	Nice Non-Expert	1.58	*p*<.0001	0.70	*p*=.136
Neutral Expert	Neutral Non-Expert	1.69	*p*<.0001	1.02	*p*=.013
Mean Expert	Mean Non-Expert	2.16	*p*<.0001	1.25	*p*<.0001

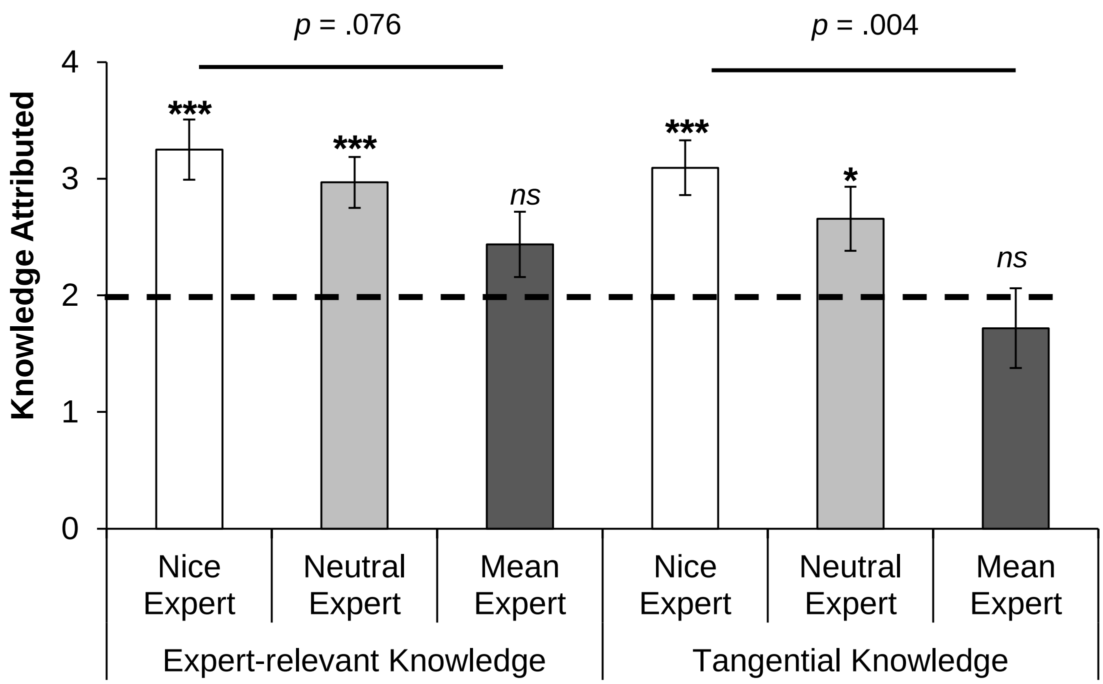

Figure 3. Amount of expertise-relevant and tangential knowledge attributed to each of the experts in each of the conditions. Asterisks denote differences from chance (indicated by dashed line).

Aim 1 summary. How do expertise and niceness and meanness information influence children's *knowledge* attributions? Results from our experiment support the hypothesis that children are systematically attending to and using both intellectual and the social informant features when attributing knowledge to those informants. Encouragingly, children were influenced by intellectual features when attributing knowledge, generally attributing more expertise-relevant and tangential knowledge to experts than to non-experts. However, these knowledge attributions were also influenced by the presence of the social feature. Depending on knowledge domain, children either trended toward attributing (expertise-relevant domain) or actually attributed (tangential domain) more knowledge to a nice expert than to a mean one, even though both were described as having expertise. In addition, children attributed knowledge to a nice expert and neutral expert above chance levels, but were only at chance for the mean expert.

Aim 2: Influence of intellectual features on social behavior inferences

Our second aim was to determine whether descriptions of an informant's expertise (or lack thereof; i.e., the intellectual feature) influences children's social inferences—how children (a) attribute social behaviors to those informants and how children (b) explicitly evaluate those informants' niceness/meanness (i.e., social ratings). First, we discuss the findings related to the attributions of social behaviors. Then, we discuss the findings related to the social ratings.

Social behavior attributions. In addition to attributing expertise-relevant and tangential knowledge, children were also asked to attribute nice and mean behaviors during the attribution task. As preliminary analyses showed no significant effects of age or gender, the following analyses are collapsed across those variables.

To examine how children used social and intellectual features for attributing behaviors, we conducted a mixed-design ANOVA on the number of behaviors attributed to an informant of 4. Our within-subjects variables were *social valence* (i.e., whether the informant was nice, neutral, or mean) and *behavior type* (i.e., nice behaviors, mean behaviors). The between-subjects variable was our condition manipulation: *expert condition* (i.e., which informant had expertise: the nice, neutral, or mean informant). See Figure 4 for nice and mean behaviors attributed to each of the informants by expert condition.

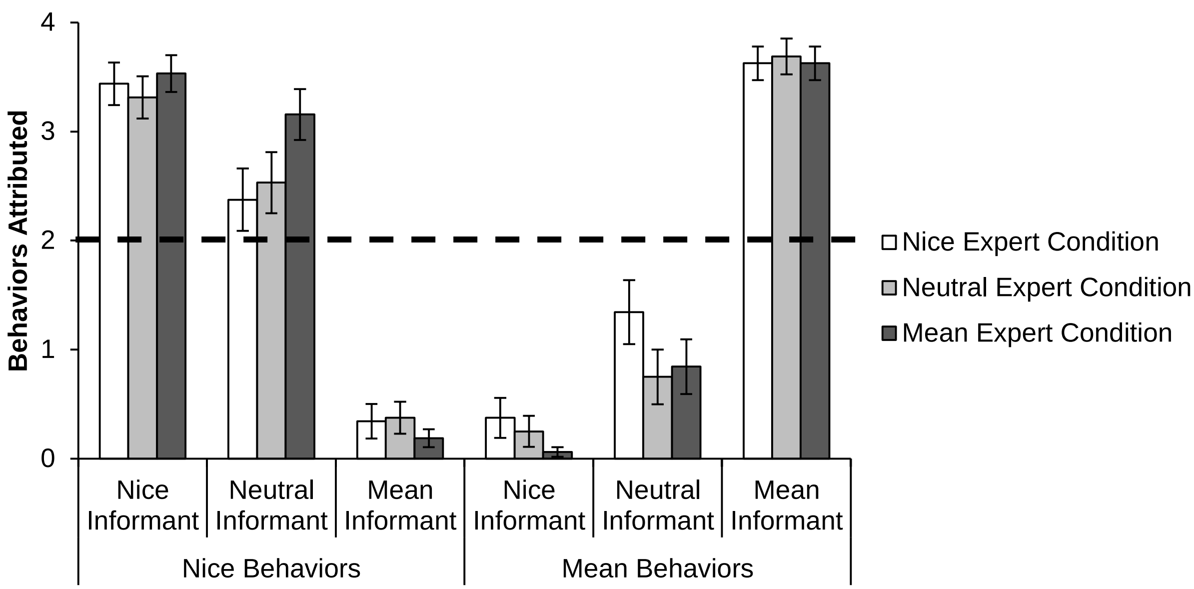

Figure 4. Attributions of nice and mean behaviors to each of the informants out of 4 in the three conditions. The dashed line represents chance.

The ANOVA revealed only two significant effects. First, the ANOVA showed a main effect of behavior, $F(1, 93)=39.06$, $p<.001$, $\eta_p^2=0.28$, such that children generally attributed more nice behaviors ($M=2.14$, $SD=0.66$) than mean ones ($M=1.62$, $SD=0.58$). In addition, the ANOVA revealed an expected interaction of behavior and social valence, $F(2, 186)=332.02$, $p<.001$, $\eta_p^2=0.78$. Follow-up tests confirm that children attributed more nice than mean behaviors to the nice informant and to the neutral informant (Nice informant: $MD=3.20$, $SD=1.47$, $p<.001$, $d=3.48$; Neutral informant: $MD=1.71$, $SD=2.31$, $p<.001$, $d=1.12$), and they attributed more mean behaviors than nice behaviors to the mean informant ($MD=3.34$, $SD=1.28$, $p<.001$, $d=4.08$). Moreover, children attributed more nice behaviors to the nice informant ($M=3.43$, $SD=2.04$) than to the neutral informant ($M=2.69$, $SD=1.54$, $p<.001$, $d=0.56$), and they attributed more nice behaviors to the neutral informant than to the mean informant ($M=0.30$, $SD=0.76$, $p<.001$, $d=1.97$). Similarly, children attributed more mean behaviors to the mean informant ($M=3.65$, $SD=0.88$) than to the neutral informant ($M=0.98$, $SD=1.51$, $p<.001$, $d=2.16$), and they attributed more mean behaviors to the neutral informant than to the nice informant ($M=0.23$, $SD=0.77$, $p<.001$, $d=0.63$). See Figure 5.

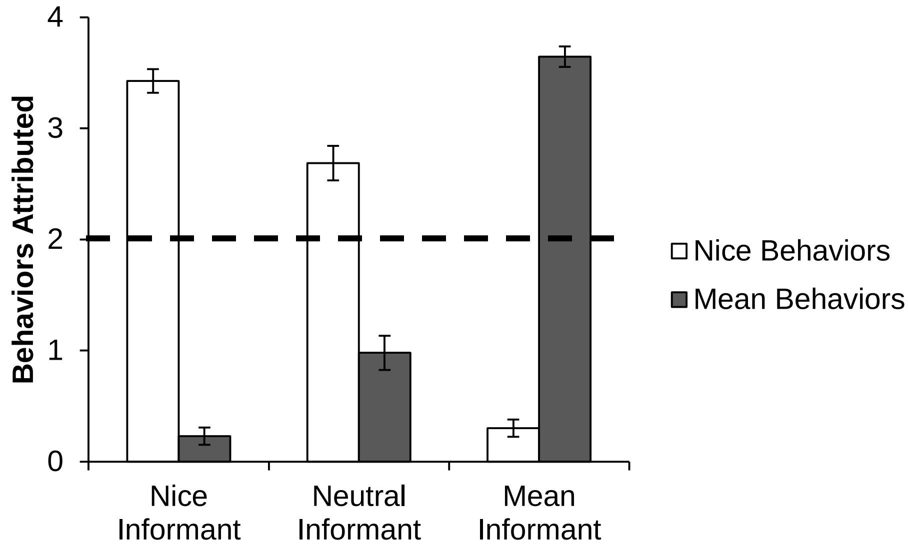

Figure 5. Behavior type by social valence interaction: the number of attributions of nice and mean behaviors to each of the three informants collapsed across expert condition. The dotted line represents chance. All means differ from chance (represented by the dotted line) with all *p*s<.001.

It is clear from the above that children were using social valence for attributing social behaviors. In contrast, the lack of effects related to expert condition suggests that behavior attributions were not varying based on whether the informant had expertise. If children were adjusting how they attributed behaviors to an informant based upon whether or not he had expertise, we would have seen a social valence by expert condition interaction.

As stated in the analysis for Aim 1, because of the nested design of our study, the ANOVA cannot not examine expertise separate from social valence to determine if children are attributing behaviors differently to experts versus non-experts. Thus, to double check that children were not using expertise when attributing behaviors, we conducted Bonferroni-corrected contrasts comparing the number of nice and mean behaviors attributed to an informant in the condition for which that informant was an expert versus the conditions for which that informant was not an expert (similarly to the analysis for Aim 1). If children were using expertise to adjust their behavioral attributions, we would likely see an increase in the attribution of nice behaviors (and a decrease in the attribution of mean ones) in the condition for which an informant had expertise versus the ones for which he did not. See Table 5. As none of these differences were significant, it does not appear likely that expertise influences social behavior attributions.

Table 5. Contrasts for attributing nice and mean behaviors to each informant between the condition for which that informant had expertise and the other two conditions

Contrasts		**Nice Behaviors**		**Mean Behaviors**	
		MD	*p*	*MD*	*p*
Nice Expert	Nice Non-Expert	0.02	*p*=1.00	0.22	*p*= .581
Neutral Expert	Neutral Non-Expert	-0.23	*p*=1.00	-0.34	*p*= .878
Mean Expert	Mean Non-Expert	-0.17	*p*= .895	-0.03	*p*=1.00

Social Ratings. As a reminder, after the attribution task, participants were asked to explicitly rate each informant as nice, mean, or somewhere in the middle. If participants said that the informant was nice or mean (as opposed to "somewhere in the middle"), then they were asked whether that informant was a little nice (or mean) or really nice (or mean). These ratings were converted to a 5-point Likert scale from "really mean" (1) to "really nice" (5) with "somewhere in the middle" as the midpoint (3).

To examine how the informants' social and intellectual features may have influenced children's explicit ratings of the informants, we began by conducting a mixed-design ANOVA on the informant ratings described above. Our within-subjects variable was *social valence* (i.e., whether the informant was described as nice, neutral, or mean). The between-subjects variables were *age group* (4-year-olds, 5-year-olds) and *expert condition* (our condition manipulation, which informant had expertise). Significant main effects and interactions are listed in Table 6. See Figure 6 for children's ratings of the informants across the three conditions broken down by age.

Table 6. Significant effects and interactions regarding children's knowledge attributions

Effect	***F***	***p***	η_p^2
Social Valence	472.82	$p < .001$	.840
Social Valence X Expert Condition	3.63	$p = .007$	.075
Social Valence X Age Group	5.02	$p = .008$	.053
Social Valence X Expert Condition X Age Group	4.26	$p = .003$	.087

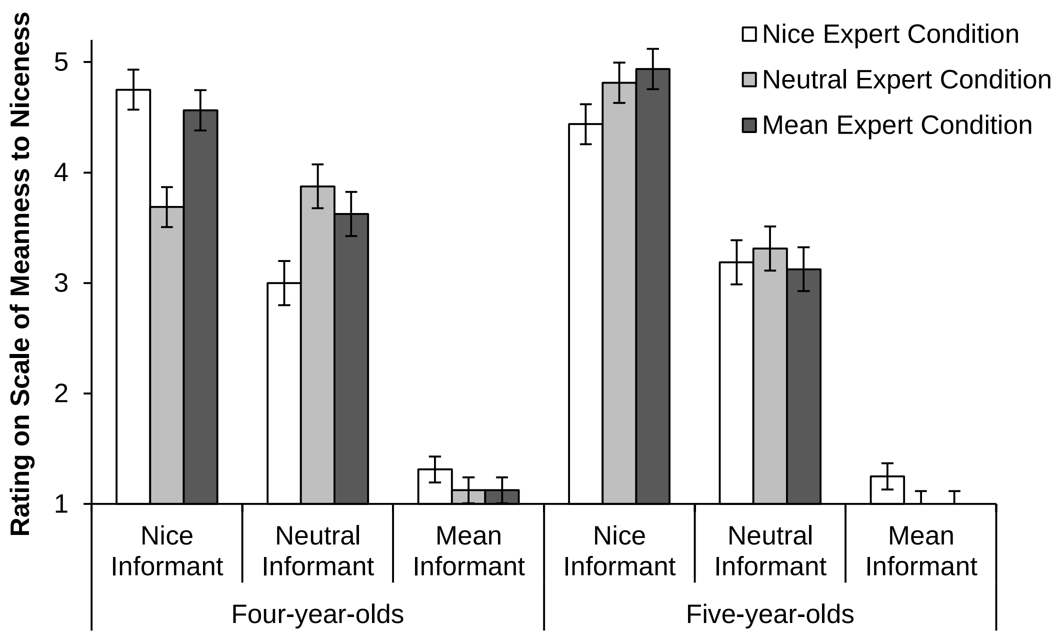

Figure 6. Ratings of informants on a scale from really mean (1) to really nice (5) with 3 representing "somewhere in the middle."

As expected, the ANOVA revealed a main effect of social valence. Bonferroni-corrected comparisons suggest that children rated the nice informant (*M*=4.53, *SD*=0.82) as nicer than the neutral informant (*M*=3.35, *SD*=0.83, *p*<.001, *d*=1.43), and they rated the neutral informant as nicer than the mean informant (*M*=1.14, *SD*=0.47, *p*<.001, *d*=3.27). In addition, there was an interaction effect of social valence and age group. Bonferroni-corrected post-hoc tests revealed that 5-year-olds (*M*=4.73, *SD*=0.64) rated the nice informant as nicer than the 4-year-old did (*M*=4.33, *SD*=0.93, *p*=.017, *d*=0.50). There was a trend towards 4-year-olds (*M*=3.50, *SD*=0.90) rating the neutral informant as nicer than the 5-year-olds did (*M*=3.21, *SD*=0.74, *p*=.086, *d*=0.35). There was no age difference in the ratings of the mean informant.

Like with the social behavior attributions, it is clear that children are using the niceness/meanness information for their social ratings. However, unlike with the social behavior attributions, the ANOVA revealed effects related to *expert condition*, suggesting that children's social ratings indeed may be influenced by which informant had expertise. In fact, the ANOVA revealed an interaction between social valence and expert condition as well as a three-way interaction with social valence, expert condition, and age group (see Table 3 and Figure 4). To follow-up on this effect, we conducted Bonferroni-corrected contrasts to examine whether the rating of each informant varied between the condition for which the informant had expertise and the other two conditions (parallel with the knowledge attributions in Aim 1 and the social behavior attributions in Aim 2). Also, given that this effect varied by age, we looked at each age group separately. See Table 7.

Table 7. Comparing social ratings attributed to each informant between the condition for which that informant had expertise and the other two conditions.

Contrasts		**4-year-olds**		**5-year-olds**	
		MD	*p*	*MD*	*p*
Nice Expert	Nice Non-Expert	0.63	p=.050	-0.44	p=.079
Neutral Expert	Neutral Non-Expert	0.56	p=.100	0.16	p=1.00
Mean Expert	Mean Non-Expert	-0.09	p=1.00	-0.13	p=.918

In this case, we did see some differences between the conditions. There was a marginal effect in which 4-year-olds who saw a nice expert (i.e., Nice Expert condition) rated the nice informant as nicer than 4-year-olds who saw a nice non-expert. Five-year-olds, on the other hand, showed a trend regarding the effect of expert condition on the ratings of the nice informant, but not in the predicted direction: 5-year-olds who saw a nice expert trended towards rating that informant as *less* nice than 5-year-olds who saw a nice-non-expert. Importantly, though, 5-year-olds still rated the nice expert as nicer than the other two informants they saw (neutral informant: p=.004; mean informant: p<.001)[3]. Thus, at least when explicitly evaluating the informants on a scale of meanness to niceness, 4-year-olds seemed to use expertise to bolster their impressions of niceness for the nice informant. Five-year-olds, on the other hand, did not show this same pattern.

Aim 2 summary. How do expertise and niceness and meanness information influence children's behavior attributions and social ratings? Results from our experiment support the theory that children are primarily using social features for social inferences. When it comes to attributing nice and mean behaviors, children only seem to be using social information—attributing similar amounts of each behavior to an informant (e.g., nice informant) whether or not he has expertise (e.g., nice expert or nice non-expert). However, there is some influence that children may be influenced by expertise, at least when explicitly rating the informants. Although 4-year-olds seemed to adjust their explicit evaluations of the nice informant based on who had expertise, no other comparisons reached significance.

Discussion

The present study investigated whether preschool-aged children use social features, specifically descriptions of niceness and meanness, for making epistemic inferences (Aim 1), and conversely, whether they use intellectual features, specifically descriptions of expertise, for making social inferences (Aim 2). Regarding the first aim, although we found that children did seem to be using expertise in that they attributed more knowledge to an informant in the condition in which he had expertise than in the other two conditions, children also adjusted their attributions based on the social feature. Not only did children attribute more knowledge to the nice informant generally, but they only attributed knowledge to an expert above chance levels when that expert was also nice or neutral (and not when the expert was mean).

Importantly, these findings indicate that children have a complex view of the relationships between observable informant features and informant mental states, at least when evaluating informant *knowledge*. If children were simply using the most relevant cue for a given inference, they would have attributed similar amounts of knowledge to experts, no matter their social valence. Alternatively, children could have been focused on social features, attributing more knowledge to nice informants than mean ones, regardless of expertise.

[3] This was also true for 4-year-olds (both ps<.001).

However, in our study, children's knowledge attributes were affected by both the intellectual information and the niceness/meanness information. Additionally, children's knowledge attributions seemed to be sensitive to the domain of the knowledge being attributed. For instance, although children attributed similar amounts of *tangential* knowledge to the nice informant whether he had expertise or not, when it came to attributing *expertise-relevant knowledge*, children attributed more knowledge to an informant when he had expertise. This was not true for the neutral and mean informants, however. For both the neutral and mean informants, children attributed more of both types of knowledge to informants when they had expertise and less of both types of knowledge when they did not.

Although children utilized both social and intellectual features for both expertise-relevant and tangential epistemic inferences, they did not do so for social inferences. When attributing social behaviors, children's attributions varied *only* by whether the informant was described as mean, nice, or neutral (social valence) and not by whether an informant had expertise (expertise condition). When explicitly rating the informants on a scale of meanness to niceness, however, we found a small developmental difference. Four-year-old children's ratings were sometimes affected by expertise: when rating the nice informant, 4-year-olds who saw a nice expert rated the nice informant as marginally nicer than children who saw a nice non-expert. Five-year-olds did not show this pattern (if anything, they trended in the opposite direction). Children were not influenced by expertise when rating neutral and mean informants.

In reflecting on the fact that only for one age group for one type of question were influenced by intellectual features when making social inferences, it is important to note the difference between the social behavior attribution items and the social rating scale. The behavior attribution items were constructed parallel to the knowledge attribution items, in which children were asked whether each informant engaged in specific behaviors. In contrast, the social rating scale asked children to qualify an informant as really nice, sort of nice, somewhere in the middle, sort of mean, or really mean. It is possible that this final item was capturing a more explicit global value judgment of informants as opposed to a social inference for which only the social information was relevant. Still, generally speaking, for the vast majority of the social inferences and ratings, children seem to be primarily relying on the most relevant informant features—descriptions of niceness and meanness.

Taken together, our research shows that when given both social and intellectual features, children make broader inferences from social features (influencing both epistemic and social inferences), but narrow inferences from intellectual features (influencing primarily for epistemic inferences). One potential reason for why children made broader inferences from the social feature than from the intellectual feature may have to do with whether children conceptualize the given features as personality traits (e.g., Ajzen, 1987). Specifically, children may be more inclined to make broader (or even cross-domain) inferences based on what they perceive as stable and enduring personality traits (see Lane, Gelman, & Wellman, 2013, for a similar discussion). In the current study, children may have been using the descriptions of niceness and meanness to make an initial trait inference about each informant as nice or mean[4] (which was bolstered by our labeling). Then, when asked to make later inferences about the informants, children may have been using the trait to make valence-consistent predictions (see Liu, Gelman, & Wellman, 2007, for a discussion on behavior to trait and trait to behavior inferences;), while still taking into consideration information provided by the intellectual features.

In contrast, our descriptions of expertise (and label of "expert" and "non-expert") likely were not interpreted as personality traits and so they were not perceived as stable and generalizable across domains. Although it is certainly the case that some intellectual features could be interpreted as stable traits ("smart" or "not smart;" e.g., Stipek & Daniels, 1990), expertise is more likely to be interpreted as domain-specific and not as generalizable as traits are required to be. In addition, there is evidence that young children differ from older children in that they do not conceptualize intellectual features as indicative of stable and enduring traits: some research suggests that whereas older children (e.g., high schoolers) see intelligence as stable and long lasting, elementary school children see intelligence as fluid (e.g., Ablard & Mills, 1996).

Even if traits are more likely to lead to accurate inductive inferences because of their stability, it does not follow that one could use traits to make *any* type of inference. It is important for children to recognize that while social features (including social *traits*) can be useful for predicting whether someone will be nice or pleasant, such features offer no insight into whether a person will be *knowledgeable*. Because knowledgeability is based on someone's domain of

[4] Given our results, it seems likely that children perceived the neutral informant as nice, but just less nice than the nice informant.

expertise, someone can be very knowledgeable about one topic and much less knowledgeable about another. This makes it difficult to make more global evaluations about someone as "smart" or "not smart" and use these to predict domain-specific knowledgeability. Even if children are using the social dimension for making epistemic inferences in some cases, it is encouraging that children are not relying *only* on the social dimension. Prior research finding that children sometimes focus on social information when making epistemic inferences has pitted two informants against each other (e.g., children preferred to endorse claims by a nice non-expert over a mean expert; Landrum et al., 2013). The current findings suggest that children do seem to attend to the intellectual dimension and recognize its importance to having knowledge.

In sum, evaluating potential informants is a problem of induction where observable information (e.g., traits, behaviors, social categories) can be used to make predictions about the unobservable (e.g., future behavior, knowledge states). For instance, children understand that an informant with a previous history of accuracy is likely to continue to be accurate (e.g., Koenig & Harris, 2005) and an informant known to be nice is likely to be nice in the future (e.g., Boseovski & Lee, 2006; Cain, Heyman, & Walker, 1997). However, while niceness is a stable trait supporting generalizations to new situations, children recognize that expertise is not and children's generalizations are more conservative when based on this feature. Understanding how children encode and use these informant features is important for understanding both how children learn from others and how they make sense of their social world (Alvarez et al., 2001). Our research provides evidence that not only are children able to attend to and remember both accuracy and niceness features, but they can combine these features to sensibly navigate the problem of induction.

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