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BRIEF REPORT

Preschoolers Use Common Ground in Their Justificatory Reasoning With Peers

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In the context of joint decision-making, we investigated whether preschoolers alter the informativeness of their justifications depending on the common ground that they share with their partner. Pairs of 3- and 5-year-olds ($N = 146$) were introduced to a novel animal with unique characteristics (e.g., eating rocks). In the common ground condition, the children learned about the animal together. In the one-expert condition, one learned about it, the other was naïve. In the two-experts condition, children learned about it separately. Later, the pairs had to decide together on 3 items that the novel animal might need. Both age groups referred to the unique characteristics of the animal in their justifications more in the 2 conditions without common ground than in the common ground condition. Thus, preschoolers begin to use common ground flexibly in their justifications and reason-giving in peer interactions.

Keywords: reasoning, justifications, common ground, peer interactions

In making a joint decision with a partner, individuals not only make proposals but they also justify these proposals to their partner. They provide "reasons" for why their partner should accept their proposal (Mercier & Sperber, 2011; Tomasello, 2014). To be effective, such reasons should be anchored in some assumptions that the partners share in common ground.

In Toulmin's model of argumentation (Toulmin, 1958), there are three main components: a *claim/proposal*; a *fact* providing evidence that attempts to justify the proposal; and a *warrant* or premise that actually turns the fact into a justification for the proposal. For instance, two acquaintances might agree to share a pizza. One says, *Let's not order this pizza* and justifies this proposal with a fact: *There are mushrooms on it*. This fact is meaningful only if the proposer introduces the warrant: *I am allergic to mushrooms*. This warrant may be stated or remain implicit, depending on the "common ground" that the speakers share with one another (Clark, 1996). If these two people are best friends, who both know that one is allergic to mushrooms, the same information can be communicated by saying, *Not this pizza* and pointing to the mushroom icon on the menu. The speaker, knowing that her friend knows about her allergy, does not need to overtly express the fact or the warrant.

In their "Sharing Hypothesis", Moll and Tomasello (2007) argued that children recognize the common ground or their shared experiences with others long before their theory-of-mind understanding. By 14 months, they begin to correctly interpret ambiguous pointing gestures/references based on their shared experiences with particular individuals (Liebal, Behne, Carpenter, & Tomasello, 2009; Moll, Richter, Carpenter, & Tomasello, 2008). By age 2, they point to request a hidden toy more when their parent is ignorant of its new location than when they witnessed its relocation together with their parent (O'Neill, 1996). By age 3–5, as their theory-of-mind understanding emerges, they go beyond the immediate shared experiences and show sensitivity to the cultural common ground—"assumptions that members of the community assume they can take for granted in other members" (Clark, 1996, p.102). Liebal, Carpenter, and Tomasello (2013) showed that 5-year-olds, and 3-year-olds to a lesser extent, assumed that an in-group stranger, whom they just met, would know who Santa Claus is, as he is a part of their cultural common ground; whereas

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they did not assume this stranger to be familiar with novel animal figures.

In contrast to these findings, Birch and Bloom (2003, 2004) argued that preschoolers are prone to a "Curse-of-knowledge" bias—a difficulty to appreciate a more ignorant perspective, but not a more knowledgeable perspective. When preschoolers are introduced to novel facts or "cursed" with knowledge, they tend to overestimate their common knowledge with others and state that others would also know these facts. However when they are ignorant, they accurately estimate others' knowledge states, regardless of whether those others are knowledgeable or ignorant (Birch & Bloom, 2003; Taylor, Esbensen, & Bennett, 1994). By age 5, this bias abates to some degree; however, even older children and adults have difficulty simulating a less knowledgeable perspective (e.g., Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011; Hansen Lagattuta, Sayfan, & Harvey, 2014).

Nonetheless, most of these are comprehension studies about reference disambiguation or children's binary responses to yes or no questions (but see O'Neill, 1996), yielding conflicting findings about how well preschoolers can estimate the common ground that they share with others. There is not much known about how children productively use common ground in more complex communicative acts, for instance in their justifications in collaborative discourse with peers.

Children's use of justifications has been mostly studied in naturalistic interactions with mothers, siblings, and peers (Dunn & Munn, 1987; Eisenberg & Garvey, 1981; Kyratzis, Ross, & Koymen, 2010; Phinney, 1986). It has been suggested that peer-to-peer interactions elicit more justifications than mother–child interactions (Kruger & Tomasello, 1986). Most peer studies have focused on conflict-motivated justifications, showing that children give reasons for their oppositions at ages 2–3 (Eisenberg & Garvey, 1981; Kyratzis & Ervin-Tripp, 1999), and the frequency of justifications increase with age (Phinney, 1986). One gap in this literature is the lack of experimental studies. Children's justifications in naturalistic interactions or conflicts at different ages are unalike and often not comparable, whereas experimental studies allow us to observe children of different ages in similar contexts.

An experimental study by Köymen, Rosenbaum, and Tomasello (2014) investigated how preschool peers appealed to cultural common ground in their justifications, using Toulmin's concepts (Toulmin, 1958)—*proposal*, *fact*, and *warrant*. Pairs of 3- and 5-year-olds were asked to build a zoo with items, which were either *conventional* (e.g., toy animals) or *unconventional* (e.g., piano). When placing conventional items, both age groups used justifications that relied on implicit or unstated warrants. For instance, to justify the proposal for placing the polar bears on ice, they only stated the fact *There is ice*, and assumed that their peer knows the warrant *Polar bears need ice*. When placing unconventional items, they articulated the warrant explicitly to create the necessary common ground. However, in this study the experimental control was still limited. There was no control over what each child knew about zoos or how much of their zoo knowledge overlapped. Moreover, it is still unknown whether children would correctly infer the knowledge state of their peers and use these justifications partner-specifically, for example, if they were interacting with a peer who is unfamiliar with zoos.

In this study, therefore, we took an experimental approach and manipulated the common ground that children had with their peers in three conditions. We introduced a novel animal with unique characteristics (e.g., eating rocks) to pairs of 3- and 5-year-old peers. In the *common ground* condition, both children learned about the animal together so each child knew about the animal and they knew that they shared this knowledge. In the *one-expert* condition, one child learned about the animal while the other was naïve, so the children were ignorant about the knowledge state of one another. In the *two-experts* condition, both children learned about the animal separately so they did not know that they shared this knowledge but could potentially discover it in the course of their conversation. Later, each pair had to decorate a home for the novel animal and jointly decide on three items that the animal might need.

We predicted that both age groups would produce more informative justifications, mentioning the warrant about the animal (e.g., They eat rocks), in the one-expert condition and the two-experts condition, in which children were ignorant of their peers' knowledge states, than in the common ground condition, in which children were aware of their shared knowledge. We expected that children would produce fewer warrants for the later items (after the placement of the first item) in the common ground condition and the two-experts condition, as they would realize that their warrants were redundant, but not in one-expert condition. Finally, we predicted that the difference between the conditions would be greater for the 5-year-olds than the 3-year-olds, because 3-year-olds would be more prone to overestimating their shared knowledge with others than 5-year-olds.

Method

Participants

Seventy-four 3-year-olds (M = 3;8, *range* = 3;4–3;11, 38 girls) and 74 5-year-olds (M = 5;8, *range* = 5;5–5;11, 38 girls) in 74 same-age and same-sex dyads participated in the study. The dyads consisted of children who knew each other based on their teachers' recommendations. One 3-year-old dyad was not included in the analyses, because they were twins. Dyads were randomly assigned to one of the three conditions. There were 36 3-year-old dyads: 12 in each condition; and 37 5-year-old dyads: 13 in the common ground condition, 11 in the one-expert condition, and 13 in the two-experts condition. Children were native speakers of German with various socioeconomic backgrounds.

Materials

There were three sets of materials. Set 1, for the warm-up, included a three-room dollhouse: A bathroom with a bathtub and a sink; a kitchen with a sink and an oven; and a bedroom with a bed and a closet. There was a bin and a set of three drawers on top of each other. Each drawer had two items: one that typically belonged to one room (a toilet, a fridge, and a cradle) and one that could belong to any room (a lamp, two tables). Children had to place one item from each drawer in the dollhouse, and the other in the bin.

Set 2, for the teaching phase, included a bag with the novel animal (called a selk), a picture book, and three objects that selks need (a rock, a purple soda, and a lake). The first page of the book depicted selks on an island. The next three pages were about selks' unique characteristics: eating rocks, drinking purple soda, and sleeping in water (see Appendix A). The book had three versions; each with a

different order of pages to counterbalance the presentation order of the characteristics.

Set 3, for the experimental phase, included two selks, a piece of cloth (home for selks), a box, three drawers on top of each other, and a bin. The box and each drawer had two items: one correct item to be placed in the home, the other in the bin (see Appendix B). The box was for the experimenter to demonstrate the game and was taken away after the demonstration. The correct item in the top drawer was on the second page (if the second page depicted eating rocks, the top drawer had the rock), the correct item in the middle drawer was on the third page, and the correct item in the bottom drawer was on the last page.

Procedure

The study took place in the nursery schools of a German city. All sessions were videotaped. After the two children and the two experimenters (E1 and E2) played a game outside, E1 and the children entered the room for the warm-up. E1 introduced the dollhouse and asked the children to label the first room and the furniture ("A bathroom with a bathtub and a sink"). She told them to open the top drawer with a toilet and a lamp and to choose one to place in the bathroom, the other in the bin. E1 asked "why" to encourage children to give reasons for their decisions. If children did not answer, E1 provided a reason ("Because one needs a toilet in the bathroom"). Then children did the same thing for the other two drawers. At the end, E1 showed a photo of the correctly furnished house and said, "You did it all correctly" or "You did not pick the right item for this room, but you were right for the rest" to highlight that there is a correct choice in the game. Then, E1 asked the children to help her clean up the dollhouse. This was followed by the teaching phase, which was different in each condition.

In the *common ground* condition, as E1 and the children were cleaning, E1 accidentally found a bag (with a selk, the book and the three items). She pulled out the selk and said: "Look what I found! This is a selk. Here's a book about selks. Let's take a look." For the first page, E1 said, "Selks live on an island far away." On the second page, E1 said, "Selks eat rocks like this one [pulling the rock out of the bag]; they eat only rocks, nothing else." On the third page, E1 said, "Selks drink purple soda, like this one [showing the soda], they drink only purple soda, nothing else." On the last page, E1 said, "Selks sleep in water like this [pulling the lake]; they sleep only in water, nowhere else."

In the *one-expert* condition, as E1 and the children were cleaning, E2 entered the room and asked one child (randomly chosen), Child A, to play with her outside. Without Child A in the room, E1 introduced the other child, Child B, the selks. After the teaching phase, E1 asked Child A to come back in.

In the *two-experts* condition, the beginning of the procedure was identical to the one-expert condition. While Child A was outside playing with E2, Child B was inside with E1 learning about selks. Then, Child B went outside to play with E2, while Child A learned about selks. At the end, E1 asked Child B to come back in.

In the experimental phase, E1 said, "Now we will play a zoo game. Today selks are coming to our zoo. They will live here [placing two selks on the cloth]. In each of these three drawers there is one item that selks need. You place one in their home and the other in the bin. I will start. The box has a tree and a piano. The selks need a tree so I put the tree in their home, the piano in the bin. Now it is your turn: the top drawer first, the middle drawer next, and the bottom drawer last." Then E1 left the room and intervened only when the children started with the wrong drawer or when they got distracted and stopped playing the game. The order of the correct items in the drawers (top to bottom) were counterbalanced and corresponded to the order in the book.

Coding

Children's conversations in the experimental phase were transcribed verbatim. For each item (henceforth trial), we first coded whether children placed the correct item, which had four possibilities: placing (a) the "correct" item, (b) the "incorrect" item; (c) "both" items; or (d) "none" of the items.

For each trial, we coded how children reached joint decisions. There were four strategies ranking from the most informative to the least:

- *Warrants* indicated if a child used a justification informing their peer about the unique characteristics of selks, regardless of whether the other child mentioned it. The warrants had to have one of the key verbs (e.g., *eat*) or nouns (e.g., *food*) for the respective item (Table 1 for examples).
- *Other Justifications* comprised of uninformative justifications, wrong justifications for the correct item, and justifications for the incorrect item.
- *Proposals* indicated where the items should go.
- *Nonverbal agreements* indicated trials in which children did not talk.

If a dyad produced two or more strategies within a trial, that trial received the code of the most informative strategy. We did not differentiate the individuals within a dyad because the observations from each child were not independent: the informativeness of what one child said was influenced by what his or her partner said earlier.

A second coder recoded 25% of the transcripts (three dyads from each age group and condition) for the correctness of the item and for the strategy for the joint decision. The agreement was $\kappa = 1$ and $\kappa = .85$, respectively.

Results

In 179 trials (82%) out of 219 trials, the children chose the correct item or both items. As Table 2 suggests, 5-year-olds overall placed the

Table 1
The Coding Scheme

Category	Examples
Warrants	*They eat this/rocks.* *This is their food.*
Other justifications	
Uninformative justifications	*They need this.*
Wrong justifications for the correct item	*They can drink from the lake.*
Justifications for the incorrect item	*They eat bananas.*
Proposals	*The rock goes here.* *The banana goes to trash.* *The rock.* *This.*
Nonverbal agreements	(No talk)

Table 2
The Percentages of Strategies for Joint Decisions Across Age Groups and Conditions

	Correct	Incorrect	Both	None	Total
3-Year-olds					
Common ground condition					
Warrant	5.56%	.00%	.00%	.00%	5.56%
Justification	22.22%	5.56%	5.56%	2.78%	36.11%
Proposal	25.00%	11.11%	8.33%	5.56%	50.00%
Nonverbal	2.78%	.00%	.00%	5.56%	8.33%
One-expert condition					
Warrant	13.89%	5.56%	11.11%	.00%	30.56%
Justification	5.56%	11.11%	5.56%	.00%	22.22%
Proposal	8.33%	19.44%	5.56%	13.89%	47.22%
Nonverbal	.00%	.00%	.00%	.00%	.00%
Two-experts condition					
Warrant	50.00%	.00%	8.33%	.00%	58.33%
Justification	.00%	.00%	5.56%	.00%	5.56%
Proposal	16.67%	5.56%	.00%	2.78%	25.00%
Nonverbal	.00%	5.56%	2.78%	2.78%	11.11%
5-Year-olds					
Common ground condition					
Warrant	10.26%	.00%	.00%	.00%	10.26%
Justification	23.08%	.00%	.00%	.00%	23.08%
Proposal	53.85%	.00%	.00%	.00%	53.85%
Nonverbal	12.82%	.00%	.00%	.00%	12.82%
One-expert condition					
Warrant	45.45%	.00%	.00%	.00%	45.45%
Justification	12.12%	6.06%	.00%	.00%	18.18%
Proposal	27.27%	9.09%	.00%	.00%	36.36%
Nonverbal	.00%	.00%	.00%	.00%	.00%
Two-experts condition					
Warrant	46.15%	.00%	.00%	.00%	46.15%
Justification	7.69%	.00%	.00%	.00%	7.69%
Proposal	41.03%	.00%	2.56%	.00%	43.59%
Nonverbal	2.56%	.00%	.00%	.00%	2.56%

correct item, whereas 3-year-olds especially in the one-expert condition chose the correct item half of the time (36% of the trials the wrong item; 14% of the trials none), especially when the naïve child was the more dominant child and did not let the expert child talk. In 71 (32%) out of 219 trials, children mentioned the warrant. When they did not mention the warrant, children relied mostly on proposals and to some degree on justifications other than the warrant.

We investigated whether the use of the warrant changed across conditions and age groups, using a Generalized Linear Mixed Model (GLMM) with binomial error distribution. We ran the statistical analyses in two datasets: the first included all trials and the second included the trials with the correct item including the trials in which children chose both items. We treated placement of both items as correct, because the correct item was still chosen as something that selks needed so the speaker had to justify this, when necessary. The unit of analysis was the trial and the response variable was the binary measure of whether children expressed the warrant in a trial. The full model included the predictors: age group (3 vs. 5), condition (common ground, one-expert, two-experts), their interaction, the order of trials (1–3), and the random factor of dyad (as we had repeated observations from each dyad for each trial). To test the significance of the full model, we compared its fit with that of a null model, which included only the random factor. In the analyses with all trials, the full model improved the fit ($\chi^2 = 34.37$, $df = 6$, $p < .001$). The interaction between age and condition was not significant: the full model did not improve the fit when compared to the reduced model without the interaction term ($\chi^2 = 2.16$, $df = 2$, $p = .34$). Therefore, we dropped the interaction term from the model to get interpretable tests of the main effects. The reduced model revealed two significant main effects of condition[1] and order. As compared with the common ground condition, both age groups mentioned the warrant significantly more in the one-expert condition ($z = 3.36$, $p < .001$) and in the two-experts condition ($z = 4.57$, $p < .001$). There was no significant difference between the one-expert condition and the two-experts condition ($z = 1.46$, $p = .14$; Figure 1a). There was no significant age difference ($z = -0.46$, $p = .65$).

The significant order effect suggested that children were less likely to mention the warrant in the later trials ($z = -2.61$, $p = .01$; Figure 2a). Looking at each condition separately, this was significant only in the common ground condition ($z = -2.06$, $p = .04$) and two-experts condition ($z = -2.80$, $p = .01$), but not in the one-expert condition ($z = 0.41$, $p = .68$). When we ran the same model with the 179 trials (with correct items), the results were the same (Figure 1b, 2b).

Discussion

Our results suggest that during preschool ages young children begin to adapt the informativeness of their justifications according to the common ground that they share with their peers. Children in our study relied on implicit warrants mostly in the common ground condition, in which both children knew about the novel animal and they knew that they shared this knowledge. In the other two conditions, they produced informative justifications, mentioning the warrant, presumably because they did not assume that their

[1] When the reduced model was compared with a model without the main effect of condition, it improved the fit, suggesting a significant main effect of condition ($\chi^2 = 25.88$, $df = 2$, $p < .001$).

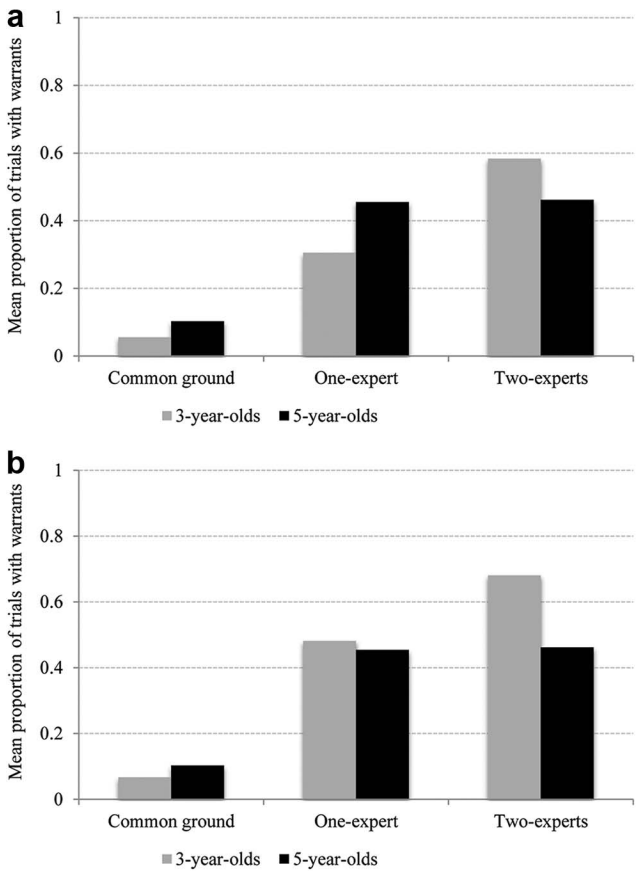

Figure 1. (a) The mean proportion of trials in which children stated the warrant (all trials). (b) The mean proportion of trials in which children stated the warrant (the trials with correct items).

peer shared their knowledge. There was no significant difference between the one-expert condition and the two-experts condition, even if the chances of stating the warrant were twice as high in the two-experts condition (because both children knew) than it was in the one-expert condition. Thus, when there was no shared learning experience, children of both ages treated their peers as ignorant.

These findings are in line with the findings of Köymen and colleagues (2014) showing that preschoolers can estimate what common ground they share with a peer and adjust the informativeness of their justificatory discourse accordingly. However, beyond that study, which might have several interpretations (e.g., children automatically assumed no common ground for unusual situations no matter the partner), the current study manipulated children's experiences with a partner systematically. We were thereby able to establish experimentally that preschoolers use their experience with particular peer partners to determine their common ground with them, and most importantly, that they are able to use this knowledge of common ground flexibly in providing reasons and justifications that their peer, hopefully, will find convincing.

Contrary to our expectations and to the findings of the "curse-of-knowledge" studies (e.g., Birch & Bloom, 2003), there was no significant age difference, although the pattern was much clearer for 5-year-olds. One explanation for the notable performance of 3-year-olds could be the sharp contrast in the *shared*-ness of the learning experience across conditions, as discussed in the "Sharing Hypothesis" of Moll and Tomasello (2007). Learning about the animal together with a peer, in contrast to learning about it alone, could have been an especially salient cue for children to recognize their shared or unshared knowledge. A second explanation could be children's early understanding of knowledge-ignorance. Despite their poor performance in false belief tasks (Gopnik & Astington, 1988; Wimmer & Perner, 1983; Wellman, Cross & Watson, 2001), around age 3–4 children start to perform well in knowledge-ignorance tasks: they appreciate that agents can be unaware of certain facts (e.g., someone who does not have perceptual access to a container would not know what is inside; Hogrefe, Wimmer, and Perner, 1986; Wellman & Liu, 2004). Similarly, in our study, at least some 3-year-olds could appreciate their peers' knowledge-ignorance when they thought that their peer did not see the novel animal.

We should also note that despite the significant difference between the common ground condition and the other conditions, the children produced warrants only around 50% of the trials in the two conditions without the common ground. Especially in the one-expert condition, the 3-year-olds produced warrants only in 30% of the trials as compared with 5-year-olds who produced

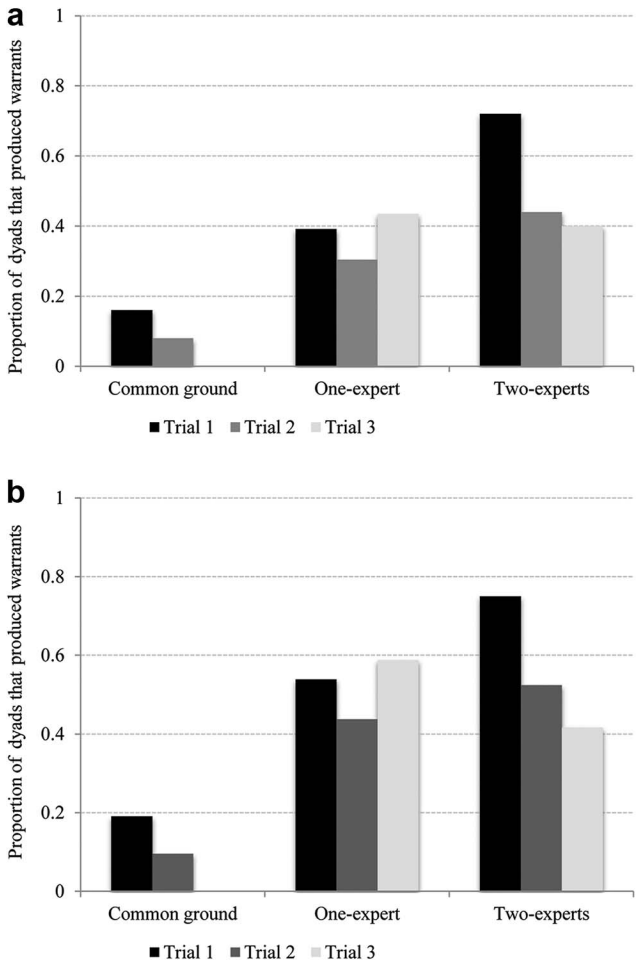

Figure 2. (a) Proportion of dyads who produced warrants across the three trials. (b) Proportion of dyads who produced warrants across the three trials with correct items.

warrants in 45% of the trials. This suggests that some preschoolers, especially 3-year-olds, might still be struggling to infer the knowledge states of others and/or to provide informative justifications based on their peers' knowledge states. Moreover, some motivational reasons such as lack of investment in the task and social reasons such as lack of friendship or closeness between children might have also played a role in the low rates of warrants.

Another finding was that the children were less likely to produce warrants in the later trials of the common ground condition and the two-experts condition. Upon hearing their peers' warrants about the novel animal, children might have realized their shared knowledge and switched to less informative utterances in the later trials especially in the two-experts condition. However, they did not verbally comment on this. Only four pairs mentioned that they heard/knew about the animal earlier. This could be because preschoolers do not spontaneously comment on their own knowledge states, unless asked. Perhaps if children had commented on their knowledge about the animal more, they would have produced even fewer warrants in the later trials of the two-experts condition, resembling the common ground condition.

To conclude, our study supports the view that collaborative reasoning with peers is a complex social skill drawing on many of children's social–cognitive capacities. This may be especially true in the context of joint decision-making. In convincing their partner to accept their proposal, children must present compelling reasons based on their assessment of their common ground knowledge that the two of them share. The current study found that even 3-year-olds have begun to learn how to engage in such reason-based justificatory discourse and to do so in flexible ways adapted for different partners.

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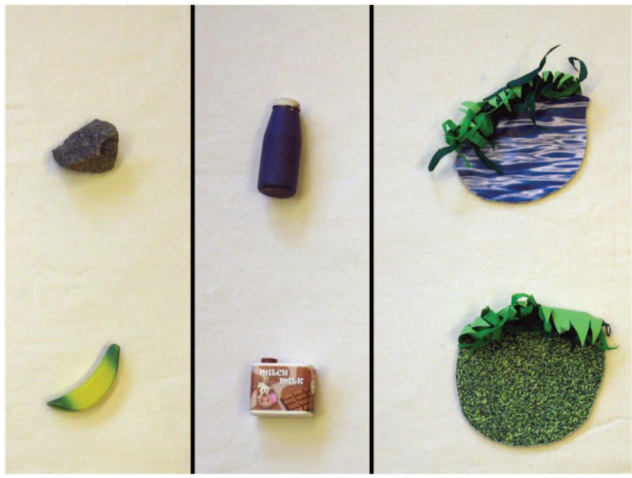
Appendix A

The Picture Book

See the online article for the color version of this figure.

Appendix B

The Items in the Experimental Phase (Top Row: The Correct Items, Bottom Row: The Incorrect Items)



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