LEARNING IN SOCIAL CONTEXT: THE NATURE AND PROFIT OF LIVING IN GROUPS FOR DEVELOPMENT

EDITED BY: Ildikó Király and David Buttelmann
PUBLISHED IN: Frontiers in Psychology

frontiers Research Topics

frontiers

ISSN 1664-8714
ISBN 978-2-88945-182-1
DOI 10.3389/978-2-88945-182-1

About Frontiers

Frontiers is more than just an open-access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

Frontiers Journal Series

The Frontiers Journal Series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the Frontiers Journal Series operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

Dedication to Quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews.
Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view.
By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area! Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office: **researchtopics@frontiersin.org**

LEARNING IN SOCIAL CONTEXT: THE NATURE AND PROFIT OF LIVING IN GROUPS FOR DEVELOPMENT

Topic Editors:
Ildikó Király, Eötvös Loránd University, Hungary
David Buttelmann, University of Bern, Switzerland

Cover image by David Buttelmann

One of the distinctive features of humans is their unique sociality. Humans live in organized societies that are characterized by a high level of interdependence of group members in various aspects of life, ranging from the economic phenomenon of labour division to providing emotional support to others. Under these circumstances, the capacity to track social connections within and between groups has great adaptive value in managing everyday life.

We may understand the importance and adaptive value of tracking the scope of culturally shared knowledge if we consider the importance of cultural norms in guiding behaviour. To become a competent member of their cultural group one must be able to conform to the group's specific behavioural norms and to accumulate culturally shared knowledge. Acquiring this knowledge is essential for successful social interactions.

In contrast to current dominant explanatory theories emphasizing that social category formation is simply rooted in humans' need to belong and affiliate with a group, the aim of this e-book is to provide evidence that, in addition to its affiliative role, children form social categories for epistemic purposes. We show that children use specific cues, like kinship, patterns of resource allocation and consensus to understand group cohesion (Section 1). Once children figured out who is in-group and who is out-group, they show a significant in-group bias in attention, acting and learning (Section 2). Yet, this in-group bias can be attenuated by induced synchronous behavior (Section 3).

Citation: Király, I., Buttelmann, D., eds. (2017). Learning in Social Context: The Nature and Profit of Living in Groups for Development. Lausanne: Frontiers Media. doi: 10.3389/978-2-88945-182-1

Table of Contents

frontiers in Psychology

EDITORIAL
published: 09 March 2017
doi: 10.3389/fpsyg.2017.00336

Editorial: Learning in Social Context: The Nature and Profit of Living in Groups for Development

Ildikó Király[1]* *and David Buttelmann*[2]

[1] Cognitive Psychology Department, Social Minds Research Group, Eötvös Loránd University, Budapest, Hungary,
[2] Department of Developmental Psychology, University of Bern, Bern, Switzerland

Keywords: social learning, social categorization, cognitive development, understanding social relations, group processes

Editorial on the Research Topic

Learning in Social Context: The Nature and Profit of Living in Groups for Development

One of humans' most distinctive feature is their unique sociality. Research has shown that people are ready to use a variety of cues to draw distinctions between "us" and "them" (Over and Carpenter, 2012). Theories of social categorization share common assumptions: in-group bias may benefit an individual as it helps them to boost their own self-esteem (Tajfel and Turner, 1986) or provides an ideological ground for oppressing others (Sidanius and Pratto, 1993).

Past research in developmental psychology has already provided insight into children's representations of the social world. It has been shown that infants as young as only a few months of age categorize others based on gender (Quinn et al., 2002). They even do so for language (Kinzler et al., 2007), which has been identified as a reliable indicator of group-membership for infants. While there is emergent evidence that already infants form "social categories," little is known about the fact whether infants' social categories reflect an "in-group" preference *per se*, or a preference for people sharing traits with those in their environment.

The central question of this research topic focused on the role of the ability to categorize social partners in the environment for the developing mind. More precisely, we wanted to see whether this ability influences epistemic development as well, beyond the enrichment of social-emotional competencies.

Relatedly, the first question the research topic covers is how children understand the relevance and source of group cohesion. In history, kinship relations have prominently marked the formation of social groups. Yet, experiments have not examined children's knowledge of and reasoning about kinship. The findings of Spokes and Spelke suggest that an explicit understanding of kinship develops slowly over the preschool years. They show that children handle kinship very similarly to how they handle other close social relations, like friendship, from early on. Another cue to group formation might be an individual's allocation of resources to others. More specifically, fairness preference is one important phenomenon with respect to differences in behavior dependent on social relations. The study of Li et al. provides further evidence on the early preference of fair distribution among social partners, and its dependence on disadvantageous positions of the self. Finally, another important cue to group cohesion might be behavioral consensus. Zhao et al. reveal an increase in sensitivity to behavioral consensus in 2- to 5-year-old children and their ability to use this as a marker of group membership. However, in contrast to most previous studies, these authors highlight contexts in which children seem to prefer to learn from unconventional individuals.

The aim of the review of Esseily et al. is to find out (1) how children orient preferences and actions toward social partners and (2) how these preferences change over early ontogeny. They

OPEN ACCESS

Edited and reviewed by:
Jessica S. Horst,
University of Sussex, UK

***Correspondence:**
Ildikó Király
kiralyi@caesar.elte.hu

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *15 February 2017*
Accepted: *22 February 2017*
Published: *09 March 2017*

Citation:
Király I and Buttelmann D (2017) Editorial: Learning in Social Context: The Nature and Profit of Living in Groups for Development. Front. Psychol. 8:336. doi: 10.3389/fpsyg.2017.00336

highlight the role language plays in guiding categorization relative to other cues such as age, race and gender. The authors explain this by the reliability of language regarding informing individuals about the speaker's group membership and consequently, her reliability as a source of culturally relevant information.

Following this idea empirically, Marno et al. show that 12- and already 5-month-old infants selectively attend to informants who are native speakers of their language. The authors suggest that by this young, children can maximize the possibility to acquire potentially important cultural knowledge. van Schaik et al. investigate the effect of novel group membership on young children's motor behavior during a simultaneous movement-observation and -execution task. Their research focus is on online motor copying, in order to understand the influence of group membership on basic coordination processes. Their results reflect an effect of heightened attention toward interaction with an out-group member. This provides important evidence that novel group membership—even if induced by arbitrary or minimal cues—dynamically influences interactive behavior. The findings of these two studies together give new insight into the impact of an opponent's language group membership on children's basic cognitive processes.

Investigating more complex action planning and execution, Krieger et al. ask whether difference in group membership between two models would trigger variation in children's imitative tendencies. They provide empirical evidence on that difference in the model's physical appearance (i.e., race) is not sufficient to elicit an in-group-out-group effect in terms of preference to follow one of the demonstrators behaviorally. In a similar vein, the purpose of Oláh et al.'s study is to investigate more enhanced processes that are cultural in their nature. The authors focused on tool use and show that tool function learning is dependent on demonstrator's group membership, in other words, function learning occurs more prominently when it is introduced as part of a cultural knowledge context.

The above studies provide insight into the characteristics of human-specific learning processes in addition to socio-emotional motivation aspects by showing that children are sensitive to a social partner's group membership. Dependent on task requirements, children flexibly exploit the advantage group membership could provide, like in case of learning from more knowledgeable partners, or paying more attention to potential outgroup members, while ignoring group membership if it delivers no benefit with respect to development.

The last study in this special issue goes beyond the investigation of the possible consequences of the detection of group membership on children's preferences and learning and shows how these consequences can be changed. Tunçgenç and Cohen focus on the robustness of the in-group bias. Their participants—minimally divided into groups—performed movements either synchronously or non-synchronously to an in-group or an out-group member. Self-report and behavioral measures point toward a bonding effect for synchronous movement and, consequently, a decrease in in-group bias.

In sum, this research topic contributes to the understanding of the epistemic function of social category formation by showing that: (1) children use specific cues, like kinship, fairness and consensus to understand group cohesion; (2) once they figured out who is in-group and who is out-group, they attend, act and learn selectively; yet (3) these consequences can be changed by induced synchronous behavior.

AUTHOR CONTRIBUTIONS

All authors listed, have made substantial, direct and intellectual contribution to the work, and approved it for publication.

FUNDING

This work received financial support from OTKA (grant 109 352, PI: IK).

REFERENCES

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Over, H., and Carpenter, M. (2012). Putting the social into social learning: explaining both selectivity and fidelity in children's copying behavior. *J. Comp. Psychol.* 126:182. doi: 10.1037/a0024555

Quinn, P. C., Yahr, J., Kuhn, A., Slater, A. M., and Pascalis, O. (2002). Representation of the gender of human faces by infants: a preference for female. *Perception* 31, 1109–1121. doi: 10.1068/p3331

Sidanius, J., and Pratto, F. (1993). "The inevitability of oppression and the dynamics of social dominance," in *Prejudice, Politics, and the American Dilemma,* eds P. Sniderman and P. Tetlock (Stanford, CA: Stanford University Press), 173–211.

Tajfel, H., and Turner, J. C. (1986). "The social identity theory of intergroup behavior," in *Psychology of Intergroup Relations,* eds S. Worchel and L. W. Austin (Chicago: Nelson-Hall), 2–24.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 29 March 2016
doi: 10.3389/fpsyg.2016.00440

Children's Expectations and Understanding of Kinship as a Social Category

Annie C. Spokes and Elizabeth S. Spelke*

Laboratory for Developmental Studies, Department of Psychology, Harvard University, Cambridge, MA, USA

In order to navigate the social world, children need to understand and make predictions about how people will interact with one another. Throughout most of human history, social groups have been prominently marked by kinship relations, but few experiments have examined children's knowledge of and reasoning about kinship relations. In the current studies, we investigated how 3- to 5-year-old children understand kinship relations, compared to non-kin relations between friends, with questions such as, "Who has the same grandmother?" We also tested how children expect people to interact based on their relations to one another, with questions such as "Who do you think Cara would like to share her treat with?" Both in a storybook context and in a richer context presenting more compelling cues to kinship using face morphology, 3- and 4-year-old children failed to show either robust explicit conceptual distinctions between kin and friends, or expectations of behavior favoring kin over friends, even when asked about their own social partners. By 5 years, children's understanding of these relations improved, and they showed some expectation that others will preferentially aid siblings over friends. Together, these findings suggest that explicit understanding of kinship develops slowly over the preschool years.

Keywords: social cognition, kin preference, development, social categories, resource sharing

OPEN ACCESS

Edited by:
Ildikó Király,
Eötvös Loránd University, Hungary

Reviewed by:
Ruth Ford,
Anglia Ruskin University, UK
Ageliki Nicolopoulou,
Lehigh University, USA

****Correspondence:***
Annie C. Spokes
aspokes@fas.harvard.edu

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *21 December 2015*
Accepted: *11 March 2016*
Published: *29 March 2016*

Citation:
Spokes AC and Spelke ES (2016) Children's Expectations and Understanding of Kinship as a Social Category. Front. Psychol. 7:440. doi: 10.3389/fpsyg.2016.00440

INTRODUCTION

Humans categorize people as members of multiple groups, based on diverse commonalities including family, race, religion, ethnicity, economic class, and gender. We form social categories even in situations in which groups are arbitrary or randomly assigned (Tajfel et al., 1971). Recent research reveals that age, gender, race, ethnicity, and language are salient social categories for infants and young children, who show preferences for members of their own group (e.g., Kinzler et al., 2010). Nevertheless, one important social distinction has received little attention in current investigations of children's social cognitive development, despite its social importance for children worldwide: the distinction between kin and non-kin.

Investigators in anthropology, sociology, and human biology have explored the rich dynamics of familial relations. According to long-accepted principles of evolutionary theory, individuals achieve indirect benefits to their inclusive fitness when their kin survive and reproduce (Hamilton, 1964; cf. Nowak et al., 2010). Thus, humans could be predisposed to track and help kin members. Consistent with this theory, human adults encoded kinship to the same extent as sex and age in a memory confusion paradigm (Lieberman et al., 2008), and they show evidence of a kin detection

mechanism that influences opinions and behaviors related to sibling altruism and incest disgust (Lieberman et al., 2007).

Little research has explored children's knowledge and reasoning about kinship relations, however, and most experiments that have done so suggest that sensitivity to kinship develops slowly. At 5 years, children are apt to apply kinship terms to people on the basis of their typical perceptual features rather than their kinship relations (Landau, 1982). For example, 5-year-old children, asked to determine which person is a "grandmother," typically chose a person who looked old but was pictured without children and grandchildren over a person who looked younger but was pictured with children and children's children (Landau, 1982). Furthermore, children first demonstrate a clear understanding of biological knowledge of life and death between the ages of 5 and 7 years (Carey, 1985; Inagaki and Hatano, 2002), so the underlying biological nature of something like blood relations may not develop until late in childhood. Nevertheless, children may have earlier intuitions about the social nature of kin relations.

In addition to understanding the meaning of different social relations, children need to understand and make predictions about how people will interact with one another, in order to navigate the social world. One domain that is central to human social relations and cooperation is resource sharing. Even before age two, infants are biased toward equal distributions of resources (Schmidt and Somerville, 2011; Sloane et al., 2012; Somerville et al., 2012). Children tend to share resources with others equally when they are able to (e.g., Olson and Spelke, 2008), taking into account the value of a resource when calculating equality (Shaw and Olson, 2013). By age six, children tend to dislike those who do not share equally (Shaw et al., 2012). Nevertheless, children override a preference for equality and accept unequal resource distributions when there is evidence that the recipient is more deserving due to prior behavior or social group status (e.g., Sloane et al., 2012).

Moreover, both adults and young children expect others to share resources according to principles of direct and indirect reciprocity (Wedekind, 2000; Wedekind and Braithwaite, 2002; Greiner and Levati, 2005; Gurven, 2006). Adults have demonstrated a bias to work harder in order to benefit others more closely related to them (Madsen et al., 2007), although young children have not shown a clear preference to benefit kin (Olson and Spelke, 2008). In these studies, 3.5-year-old children were introduced to dolls that were siblings, friends, or strangers with a protagonist doll and helped the protagonist divide up nine resources across trials. Children tended to give more to those who had shared with the protagonist or with others previously, providing further evidence of their sensitivity to direct and indirect reciprocity. Children also gave more to the protagonist's siblings or friends than to strangers, but they gave roughly equally to siblings and friends. However, resources were plentiful enough to be distributed to everyone, and they were relatively low in value (Olson and Spelke, 2008).

Here we investigate further how children understand the relation between siblings as compared to friends or strangers, and how they expect people to interact based on their relations to one another. Will children distinguish among close relations when they must divide up resources of lower availability and therefore higher value? Furthermore, will children demonstrate different sharing behavior when distributing resources among their own close relations rather than in hypothetical, third-party scenarios, or when presented with realistic photographs of faces showing a strong family resemblance rather than with dolls? Finally, will children's understanding track with their expectations for social interactions?

We hypothesize that children may be able to distinguish kin and non-kin from a young age. To test this, we present children with social scenarios using verbal presentation in storybooks and ask explicit questions about their understanding and sharing behavior. We examine whether children show sensitivity to kinship distinctions or whether this sensitivity may not emerge until later in development in these scenarios.

In Experiment 1, we tested 3- and 4-year-old children's conceptual understanding and resource sharing choices for fictional characters in a storybook and examined whether their predictions of sharing toward kin, friends, and strangers were influenced by the value of the resource. In Experiment 2, we tested whether children distinguish kinship from friendship when asked about their own siblings and friends, and we expanded the age of children tested to include 5-year-old children. In Experiment 3, we further investigated 3-, 4-, and 5-year-old children's expectations for social interactions, using physical similarity to enhance kinship cues and probing children's social inferences across a more diverse set of social contexts. Taken together, these studies shed light both on 3- to 5-year-old children's conceptual understanding of kinship and on the ways in which their prosocial decisions are, and are not, affected by kinship.

EXPERIMENT 1

The first study investigated children's expectations for sharing of resources in third-party social interactions among kin, friends, and strangers. The resources varied in value, based on their plenitude or scarcity. This study also tested children's conceptual understanding of siblings, friends, and strangers. An experimenter read children an interactive storybook in which a protagonist character traveled to different locations and interacted with her sibling, her friend, and a child whom she had never met before. Children were asked factual questions about the different characters to probe their understanding of these social relationships. Then, they were asked to predict with whom the protagonist would share a resource.

Materials and Methods

Participants

Ninety-six children from the Cambridge and Boston area participated in this study, with 48 children at each of two ages: 3.5 years (26 female, 36.23–47.43 months, mean age = 41.46 months) and 4.5 years (24 female, 48.27–60 months, mean age = 53.39 months). Children received a gift after their study, and parents were reimbursed for their travel. This study was carried out in accordance with the recommendations of the

Committee on the Use of Human Subjects in Research at Harvard University with written informed consent from a parent or legal guardian of all subjects and verbal agreement from participants.

Materials

We presented participants with fictional characters in a storybook using all hand-drawn, cartoon-like pictures colored with marker. Each story focused on one protagonist who interacted with her sister, friend, and a stranger in different scenarios. The storybook consisted of one warm-up scenario followed by three scenarios each composed of an introductory questions phase and a sharing phase. Thus, children were introduced to four scenarios: one warm-up with animal characters and three test scenarios with human characters and social interactions. In the introductory phase, children were shown the protagonist in a new location, with two other characters. The other characters were described and named, and their relation to the protagonist was indicated: a sister (henceforth, sibling), friend, or a girl she had never met before (henceforth, stranger). Children's understanding of the relations then was probed through two questions focused on the two characters' relationship (described below).

In the sharing phase, participants were introduced to a scenario in which the protagonist now had a valuable resource (e.g., a trip to the beach) to share with one of the two other characters. In all contexts, there was only one resource, so the protagonist could only share with one of the two characters. Children were given drawings symbolizing the resources to be distributed in the storybook: a green pet toy, a cupcake, a seashell, and a banana. The same storybook was used across resource conditions, but the drawings were described as representing differently valued objects across conditions.

Procedure

Children were first told they were going to hear a story about a protagonist, Cara, and her adventures. Then children began the warm-up phase of the study, in which the protagonist was presented with two animals: a dog and a cat. The experimenter asked children two questions about the animals ("Which one likes to play fetch?" and "Which one purrs when you pet it?"). Children were always given positive reinforcement for their answer, whether correct or incorrect. After these questions, the next page in the storybook showed the protagonist with a resource. The warm-up involved a pet toy that was described as being liked by both cats and dogs. The experimenter then gave the child the drawing of the toy and encouraged the child to help the protagonist decide which animal to give it to. Children were encouraged to place the item in front of the animal they chose. If children wanted to give the resource to both animals, they were told to choose one since they only had one toy to give.

After the warm-up phase, the story advanced to the first test block involving people interacting with the protagonist. Each block began with the introductory phase, which first showed the protagonist in a new location: the park, the beach, or the zoo. Children were encouraged to discuss activities for the protagonist to do at the new location in order to keep them engaged in the storybook. The next page in the storybook for each block showed the protagonist with two other characters described as her friend and sibling, friend and stranger, or sibling and stranger. The warm-up phase always came first, but the order of the three social scenarios and pairs was counterbalanced across participants.

After children were introduced to the pair of characters, they were asked two questions about their specific relations to the protagonist. For friend and sibling, the questions were: "Which girl has the same grandparents as Cara?" and "Which girl could Cara meet for the first time at school?" The questions for friend and stranger were: "Which girl has Cara played with many times before?" and "Which girl does Cara not know much about?" For sibling and stranger, children were asked, "Which girl has the same last name as Cara?" and "Which girl has Cara never seen before?"

The next page in the storybook for each block showed the protagonist with a newly acquired resource, as in the warm-up phase. The displayed picture was the same across conditions, but the resource was described differently based on whether the condition is a high- or low-value resource condition. Resource value was manipulated along the dimension of accessibility to the protagonist. In the low-value condition, the protagonist has access to the item or experience frequently or infrequently. In the high-value condition, the protagonist has a one-time-only (and thus extremely infrequent) opportunity to access the resource. There were two versions of the low-value resource script, and an example of each follows:

> Cara brought a very special treat with her to the park. This is her favorite treat, and it is very delicious. *It is very hard to find and Cara hardly ever gets to eat this treat.* Who do you think Cara would like to share her treat with?

> Cara brought a very special treat with her to the park. This is her favorite treat, and it is very delicious. *It is very easy to find and Cara eats this treat a lot.* Who do you think Cara would like to share her treat with?

An example of the high-value resource script is:

> There is going to be a special day at the park with a visiting carnival that has lots of fun treats, games, and rides, just like this special cupcake that Cara has. The carnival will only be there for one day, and Cara can only bring along one person with her, so the person she chooses gets to go and enjoy the treats, games, and rides, but the person she does not choose never gets to go. Who do you think Cara would like to invite along with her?

In the low-value resource conditions, the drawings of the cupcake, seashell, and banana are the objects to be shared in the short vignette, so the participants are encouraged to give the object to the one they believe the protagonist would choose. In the high-value resource condition, the protagonist got to bring along one person to the once-in-a-lifetime experience, and the drawings were described as tickets, and participants were encouraged to give the item to the one they thought the protagonist would like to bring along, thus they need not know the word "ticket" to still understand they give the item to the one she preferred to bring along.

Participants thus used the drawing of the resource to help the protagonist chose a preferred recipient. After their choice, the resource was moved behind the storybook, and a new block began with the protagonist in a new scenario.

Results

To test children's understanding of kin, friend, and stranger relations as well as their expectations for interactions among people in these relations, their responses to each question and their choice for resource sharing were analyzed using a binomial distribution. Children's answers to the comprehension questions were coded as a 0 (incorrect) or 1 (correct). For the resource distribution questions, children scored a 1 for choosing to share with the predicted character: sibling in sibling vs. stranger, friend in friend vs. stranger, and sibling in sibling vs. friend.

Conceptual Understanding Questions

For conceptual understanding questions, we first analyzed children's correct responses within each recipient pair using their average score on the two questions per recipient pair. A 2 (age group) by 3 (recipient pair) repeated measures ANOVA revealed significant main effects of recipient pair, $F(2,188) = 16.1$, $p < 0.001$ and age group, $F(1,94) = 12.72$, $p = 0.001$. There was no significant interaction. Follow-up analyses comparing children's accuracy by age group revealed that 4-year-old children answered with greater accuracy than 3-year-old children, $t(94) = 3.55$, $p = 0.001$. Additional analyses comparing children's responses across recipient pairs revealed that children answered more questions correctly for kin vs. stranger and friend vs. stranger than for kin vs. friend [$F(1,94) = 16.56$, $p < 0.001$; $F(1,94) = 25.92$, $p < 0.001$], but they did not show different performance when comparing kin vs. stranger to friend vs. stranger questions, $F(1,94), = 1.21$, $p = 0.27$.

Next, children's responses on each question were analyzed separately by age using one-sample two-tailed *t*-tests, with chance performance at 0.5 as they chose between two characters with one correct answer (**Table 1**). Correcting for multiple comparisons using Bonferroni correction for two questions in each test block, *p*-values should be considered significant when $p < 0.025$ for these analyses; all *p*-values are given in **Table 1**. Four-year-old children answered correctly on both questions for the sibling vs. stranger, and 3-year-old children answered one correctly (never seen) and one incorrectly (last name). Children at 3- and 4-years-old answered both questions correctly for friend vs. stranger. However, all children erred on questions contrasting sibling with friend.

Resource Sharing Questions

Children showed no clear judgments of differential sharing based on resource value: the 2 (resource value) by 3 (recipient pair: sibling vs. stranger, friend vs. stranger, sibling vs. friend) repeated-measures ANOVAs, conducted at each age, revealed no main effects or interactions (all ps > 0.05).

Due to the minimal impact of the resource value manipulation, we collapsed across cost-level and analyzed children's responses to each test pair using one-sample two-tailed *t*-tests with chance performance set to 0.5 (**Figure 1**). Three-year-olds chose friend over stranger, $t(47) = 2.42$, $p = 0.019$, but not kin over stranger, $t(47) = 0.86$, $p = 0.39$; 4-year-olds chose kin over stranger, $t(47) = 2.77$, $p = 0.008$, and friend over stranger, $t(47) = 2.42$, $p = 0.019$. At neither age did children choose kin over friend or the reverse (both ts $< |1|$).

Additional Analyses

In light of children's poor performance on the comprehension questions, further analyses focused on the performance of subsets of children who might be expected to have a greater understanding of kinship relations. First we compared the responses in the sharing task for children with the same age or older siblings ($n = 47$) as compared to children with younger or no siblings ($n = 49$). For children at age 3–4 years that have a younger sibling, that sibling is an infant or toddler, so the child-aged sibling in the storybook may not relate as directly to their own experience. Nevertheless, the performance of children in these two categories did not differ, $F(1,94) = 0.03$, $p = 0.86$.

Next, we analyzed the performance of the subset of children who answered all six conceptual understanding questions correctly, $n = 22$ (4: 3-year-olds; 18: 4-year-olds, mean age = 52.63 months). First, we compared these children's resource sharing choices to children who did not answer all questions correctly, and the 2 (all correct vs. not all correct) by 3 (recipient pair) RM ANOVA revealed a main effect of answering all comprehension questions correctly, $F(1,94) = 7.05$, $p = 0.009$, showing that these children chose in the predicted direction significantly more often. There were no other main effects

TABLE 1 | Children's conceptual understanding responses in Experiment 1.

	Question	3-year-olds		4-year-olds	
Kin vs. Stranger	Which has the same last name as X?	ns	$p = 0.042$	***K	$p < 0.001$
	Which has X never seen before?	***S	$p < 0.001$	***S	$p < 0.001$
Friend vs. Stranger	Which has X played with many times?	**F	$p = 0.003$	***F	$p < 0.001$
	Which does X not know much about?	**S	$p = 0.003$	***S	$p < 0.001$
Kin vs. Friend	Which has the same grandparents as X?	ns	$p = 0.78$	ns	$p = 0.25$
	Which could X meet for the first time at school?	ns	$p = 0.57$	ns	$p = 0.042$

*Children provided responses about a sibling (K for kin), friend (F), and stranger (S). Three-year-olds answered one question correctly (***P < 0.001) and one incorrectly for kin vs. stranger, both question correctly for friend vs. stranger (**P < 0.005), and both questions incorrectly for kin vs. friend. Four-year-olds answered all questions correctly for kin and friend vs. stranger (***P < 0.001) but both incorrectly for kin vs. friend. All p-values were corrected for multiple comparisons.*

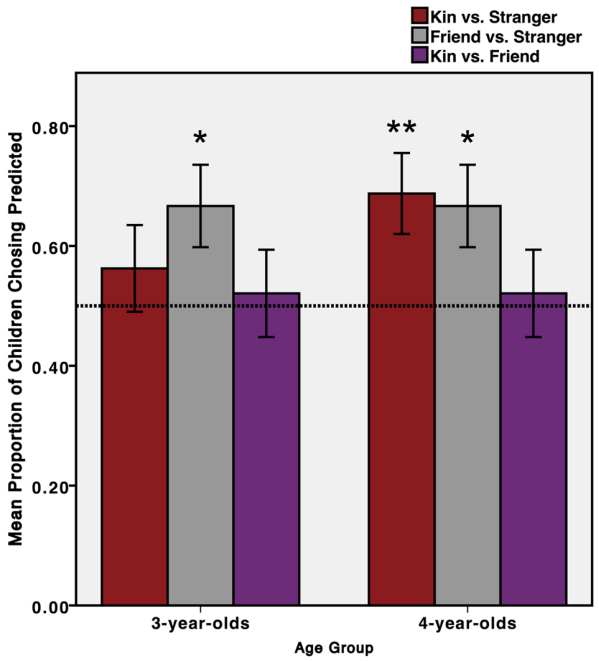

FIGURE 1 | Children's sharing choices in Experiment 1. Children ($n = 96$) allocated a resource to one character in each dyad. Three-year-old children chose to share with a friend over stranger (*$P < 0.05$), and 4-year-old children chose to share with a sibling over stranger (**$P < 0.01$) and friend over stranger (*$P < 0.05$). Error bars represent one standard error.

or interactions. Further analyses showed that children who answered all conceptual understanding questions correctly expected favor to go to kin over stranger, $t(21) = 3.78$, $p = 0.001$, and friend over stranger, $t(21) = 2.98$, $p = 0.007$. They also tended to favor kin over friend, but this tendency was not significant, $t(21) = 1.79$, $p = 0.088$.

Discussion

Across all levels of resource cost, 3- and 4-year-old children showed explicit understanding and differential expectations for resource sharing between siblings and strangers and between friends and strangers, but not between friends and siblings. Children distinguished well between familiar people, whether friends or siblings, and unfamiliar people. In contrast, children did not show the tested distinctions between familiar people within vs. outside the family. Overall, these findings replicate previous findings that children divide plentiful resources equally between siblings and friends (Olson and Spelke, 2008), in roughly the same manner as they do in the current study with limited resources. We did not find differences across scenarios that varied resource value according to accessibility, though this may indicate either that children are insensitive to cost manipulations or that scarcity, the dimension along which cost was manipulated, does not effectively convey value to children of this age.

We did not find that children with siblings were more likely to favor kin over friends than were other children, though this binary categorization of sibling relations may not be sufficiently sensitive. The quality of a child's relationship with a sibling might be a better predictor of sharing with kin in the present experiment than the experience of having a sibling. Future research examining individual differences in sibling relationships could explore this possibility further.

Children's answers to the comprehension questions suggest a different reason for their equal division between siblings and friends: children may be unsure about the conceptual distinction between the two. It is possible, however, that children understood this distinction but had trouble answering the specific questions asked, because they did not understand the term "grandmother" or the significance of surnames. Consistent with this possibility, children who passed all the comprehension questions also failed to show a robust favoring of kin, although they showed a non-significant trend in that direction. Thus, even children who understand the distinction between kinship and friendship may fail to favor kin over friends.

Experiment 2 begins to investigate this possibility in two ways. First, we included more comprehension questions using well-known kin terms such as "mom" as well as questions with no kin terms. Second, we asked children about their own friends and siblings, rather than the friends and sibling of hypothetical characters. Despite children's failure to favor kin over friends in the present study and in previous studies presenting hypothetical characters (Olson and Spelke, 2008), it is possible that young children would choose to favor kin over non-kin when they consider how they would distribute resources to their own friends and relatives. To test this possibility, Experiment 2 presented children with first-person, hypothetical scenarios involving themselves and their own sibling or friend, as well as a stranger. In each of three scenarios within a story, children were told that they received a resource and were asked how they would distribute it. The cupcake and banana both represented shared activities in the low-resource conditions—eating, and feeding animals together, respectively—but the seashell was given in whole as a gift. In order to better equate the three social scenarios, we replaced the seashell with a shovel in Experiment 2 and modified the social scenario to be about building a sandcastle together, a shared activity.

EXPERIMENT 2

The second experiment investigated children's expectations for sharing in hypothetical first-person social interactions among their own kin and friends. An experimenter read children an interactive storybook in which they were the protagonist, who traveled to different locations and interacted with their own sibling, their own friend, or a stranger. Children were asked questions about the different relations as well as with whom they would choose to share a resource. We tested children's conceptual understanding of social relations with additional questions. To specifically test their knowledge of kin compared to non-kin—friends and strangers—the same questions pertaining to kin were asked across pairs with each type of relation. Because 4-year-old children made many errors on the conceptual questions in

Experiment 1, we included 5-year-old children in this experiment to compare their performance to that of younger children.

Materials and Methods

Participants

One hundred eight children from the Cambridge and Boston area participated in this study, with 36 children aged 3.5 years (18 female, 36.07–47.57 months, mean age = 42.76 months), 4.5 years (18 female, 48.17–59.97 months, mean age = 53.08 months), and 5.5 years (18 female, 60.17–71.3 months, mean age = 66.07 months). All participants had at least one sibling in order to make the first-person storybook realistic and relevant. Children received a gift for their participation, and parents received a reimbursement for their travel. This study was carried out in accordance with the recommendations of the Committee on the Use of Human Subjects in Research at Harvard University with written informed consent from a parent or legal guardian of all subjects and verbal agreement from participants.

Materials

This study used an adapted version of the storybook from Experiment 1 that incorporated the participant as the protagonist. There was one storybook for male and one for female participants. The protagonist in each story was drawn without color in the storybook; participants first colored in a cutout version of the protagonist to represent themselves in the storybook. Participants also selected colored cutout drawings of the additional three characters representing a sibling, friend, and stranger from among six possible characters: three males and three females. Participants with a sibling of their same gender had a storybook with all gender-matched characters. If participants only had one or more siblings of the opposite gender, they could select either gender for a friend, and the stranger was gender-matched to the sibling. Participants chose the two characters that represented a sibling and a friend, and the experimenter added the third character to represent the stranger. These characters were inserted into the story at relevant times using Velcro.

The warm-up scenario, including the introductory and sharing phase involving the cat and dog, was the same as Experiment 1 except that it was narrated such that the participant was the protagonist. The experiment consisted of three test blocks, each with an introductory phase followed by a sharing phase. In all three scenarios, the sharing phase involved both a shared object and a shared activity. The drawings of the resources were the same as in Experiment 1 except that a shovel now replaced the seashell, which did not lend itself readily to a shared activity.

Procedure

This study began with participants coloring in a picture of a boy or girl to represent them, which they then used in order to pretend that they were in the storybook. Once children had finished coloring, they were told that other people they knew would also be in the storybook. The experimenter then presented children with drawn, laminated pictures of three boys or girls, depending on the gender of their sibling. The experimenter obtained sibling information from the parents or guardians prior to the study during the consent process. Children were encouraged to choose one picture to be their sibling in the story. Children with multiple siblings were encouraged to choose one to be in the storybook. After children made a selection, they were told that a friend would be in the storybook too, and they were asked to choose from one of the remaining pictures. If children had a gender-matched sibling, they also had a gender-matched friend and stranger. If children had a sibling of the opposite gender, they were allowed to choose a friend of either gender, but the stranger was matched to the gender of the child's sibling. The three pictures that represented the sibling, friend, and stranger were incorporated into the storybook by sticking them onto the pages using Velcro.

Once children had the three pictures chosen and their picture colored for themselves, the experimenter began the story. The first page showed the same character they had colored in, and they were invited to pretend that they were in the storybook. Children were encouraged to place their drawing into the storybook. The story then progressed through the warm-up sequence and practice trial as in Experiment 1 with adjustments in narration to render the story as a first-person narrative.

The test blocks consisted of the protagonist, in this case the participant, in a new scenario and interacting with two of the three other characters: a sibling, a friend, and a stranger. As in Experiment 1, the introductory phase consisted of showing the protagonist at the new location and discussing that new place. Then, the protagonist was shown with two of the characters, children were reminded of who they were ("your sister/brother," "your friend," "a girl/boy you have never met before"), and children were asked questions about these people. Each question was followed by, "Would it be [X] or [Y]?" with the experimenter pointing and labeling the two options by their relationship to the child. Children were asked the same two questions that were used in Experiment 1 during each test block, rephrased into first-person questions, as well as two additional questions. The new questions were: "Which has the same mom as you?" "Which has a different mom than you?" "Which lives in the same house as you?" "Which lives in a different house than you?" The added questions for friend and stranger were: "Which would you invite to your birthday party?" and "Which have you never invited over to play before?" Because the kin concept questions were of specific interest, the questions in the kin and friend as well as the kin and stranger pairs were counterbalanced across children. Question order within test blocks and order of relation pairs were also counterbalanced across participants.

For the sharing phase of each test block, children were shown their own protagonist character with a newly acquired resource: a cupcake, a shovel, or a banana. Children were then told they had one additional item that they could share with one of the two people there with them. The cupcake was described as a treat to eat at the park. Children were told the shovel could be used to build a sand castle with the person they choose, and the banana was for feeding animals at the zoo, and they could bring one person along with them to feed the animals. As in Experiment 1, participants received a drawing of the item and were encouraged to give it to their chosen recipient in the story. After they made a

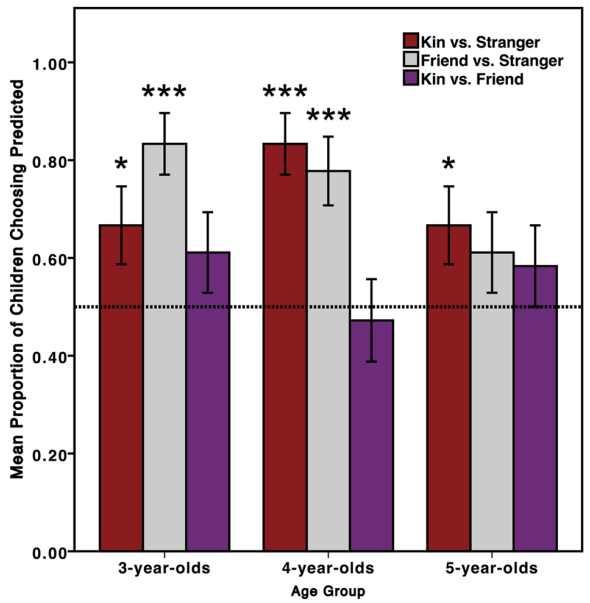

FIGURE 2 | Children's sharing choices in Experiment 2. Children ($n = 108$) allocated a resource to one character in each dyad. Three- and 4-year-old children chose to share with a sibling over stranger and a friend over stranger (*$P < 0.05$; ***$P < 0.001$). Five-year-old children chose to share with a sibling over stranger (*$P < 0.05$). Error bars represent 1 standard error.

decision, the item was placed behind the storybook, and the story proceeded to the next test block.

Results

The same analyses were conducted for Experiment 2 as for Experiment 1. For the resource distribution, children scored a 1 for choosing to share with the predicted character: sibling rather than stranger, friend rather than stranger, and sibling rather than friend. For comprehension questions, children's answers were coded as a 0 (incorrect) or 1 (correct). We used two-tailed one-sample *t*-tests to test whether children's responses were significantly above chance performance of 0.5 (**Figure 2**). This experiment included storybooks with the child as the protagonist and their own siblings and friends (vs. all female characters in Experiment 1). We thus included sex as a variable in the analyses to test for potential sex differences.

Conceptual Understanding Questions

For conceptual understanding questions, we first analyzed children's accuracy for questions within each recipient pair using their average score on the four questions. A 3 (age group) by 3 (recipient pair) repeated measures ANOVA analyzing their responses revealed a significant main effect of age group, $F(2,105) = 23.32$, $p < 0.001$, showing increasing accuracy with age, and no other main effect or interaction. Follow-up analyses comparing children's accuracy by age group revealed a significant difference in responses between 3- and 4-year-olds, $t(105) = 3.24$, $p = 0.002$, between 3- and 5-year-olds, $t(105) = 6.82$, $p < 0.001$, and between 4- and 5-year-olds, $t(105) = 3.61$, $p < 0.001$.

Next, children's responses at each age were analyzed for each question using two-tailed one-sample *t*-tests with chance performance at 0.5 as they chose between two characters with one correct answer (**Table 2**). To correct for multiple comparisons using Bonferroni correction for four questions in each test block, *p*-values should be considered significant when $p < 0.0125$ for these analyses; all *p*-values are given in **Table 2**. All questions asked for kin vs. stranger were also asked for kin vs. friend for different children.

Three-year-olds answered three questions correctly for kin vs. stranger that were answered incorrectly when asked about kin vs. friend, and they correctly knew one answer for kin vs. friend but not kin vs. stranger (**Table 2**). Four-year-olds were correct on half of the questions for kin vs. stranger but only two questions for kin vs. friend. Five-year-olds answered all of the questions correctly.

In questions about a friend vs. stranger, 3-year-olds answered two questions correctly (played with, birthday) and two incorrectly (not know, never invited). Four- and 5-year-olds were correct in answering all questions.

Resource Sharing Questions

Three- and 4-year-old children chose to share with siblings over strangers [$t(35) = 2.092$, $p = 0.044$; $t(35) = 5.29$, $p < 0.001$] and with friends over strangers [$t(35) = 5.29$, $p < .001$; $t(35) = 3.95$, $p < 0.001$] but not with siblings over friends (*p*s > 0.05). Five-year-old children chose to share with siblings over strangers, $t(35) = 2.092$, $p = 0.044$, but not with friends over strangers or with siblings over friends (*p*s > 0.05).

The 2 (sex) by 3 (age group) by 3 (recipient pair: sibling vs. stranger, friend vs. stranger, sibling vs. friend) repeated-measures ANOVA on the measure of children's resource sharing preferences revealed a main effect of recipient pair, $F(2,204) = 6.82$, $p = 0.001$, showing that children chose to share differentially depending on the social contrast. Follow-up analyses comparing children's choices for each recipient pair revealed their stronger sharing preference for the predicted character (sibling in sibling vs. stranger and sibling vs. friend; friend in friend vs. stranger) in sibling vs. stranger, $F(1,102) = 8.58$, $p = 0.004$, and friend vs. stranger, $F(1,102) = 9.39$, $p = 0.003$, as compared to sibling vs. friend, but their sharing preferences did not differ between sibling vs. stranger and friend vs. stranger, $F(1,102) = 0.15$, $p = 0.70$. There was a significant recipient pair by age by sex interaction, $F(4,204) = 3.82$, $p = 0.005$, showing that boys and girls demonstrated different sharing patterns according to recipient as they grow. Three-year-olds show sex differences in preference for two recipient pairs (sibling vs. stranger and sibling vs. friend), whereas 4-year-olds differ by sex for only one recipient pair (friend vs. stranger), and 5-year-olds do not differ for any recipient pair (Supplementary Table S1 in Supplementary Material).

Additional Analyses

To look further into the findings for children who answered all questions correctly in Experiment 1, 3- and 4-year-old children who answered a majority of conceptual understanding questions correctly (10 of 12) in this experiment were analyzed for their

TABLE 2 | Children's conceptual understanding responses in Experiment 2.

	Question	3-year-olds		4-year-olds		5-year-olds	
Kin vs. Stranger ($n = 18$ per question)	Which has the same last name as you?	ns	$p = 0.057$	ns	$p = 0.16$	**K	$p = 0.002$
	Which have you never seen before?	**S	$p = 0.002$	**S	$p = 0.002$	***S	$p < 0.001$
	Which lives in the same house as you?	***K	$p < 0.001$	***K	$p < 0.001$	***K	$p < 0.001$
	Which lives in a different house than you?	**S	$p = 0.002$	ns	$p = 0.014$	***S	$p < 0.001$
	Which has the same grandparents as you?	ns	$p = 1.0$	**K	$p = 0.002$	***K	$p < 0.001$
	Which could you meet for the first time at school?	ns	$p = 0.65$	**S	$p = 0.002$	***S	$p < 0.001$
	Which has the same mom as you?	ns	$p = 1.0$	ns	$p = 0.014$	***K	$p < 0.001$
	Which has a different mom than you?	ns	$p = 0.65$	ns	$p = 0.014$	***S	$p < 0.001$
Friend vs. Stranger ($n = 36$)	Which have you played with many times?	***F	$p < 0.001$	***F	$p < 0.001$	***F	$p < 0.001$
	Which do you not know much about?	ns	$p = 0.017$	***S	$p < 0.001$	***S	$p < 0.001$
	Which would you invite to your birthday party?	*F	$p = 0.006$	***F	$p < 0.001$	*F	$p = 0.006$
	Which have you never invited over to play?	ns	$p = 0.32$	***S	$p < 0.001$	***S	$p < 0.001$
Kin vs. Friend ($n = 18$ per question)	Which has the same last name as you?	ns	$p = 1.0$	ns	$p = 0.057$	***K	$p < 0.001$
	Which have you never seen before?	ns	$p = 0.16$	ns	$p = 0.16$	***F	$p < 0.001$
	Which lives in the same house as you?	ns	$p = 0.16$	**K	$p = 0.002$	***K	$p < 0.001$
	Which lives in a different house than you?	ns	$p = 0.057$	**F	$p = 0.002$	***F	$p < 0.001$
	Which has the same grandparents as you?	ns	$p = 0.65$	ns	$p = 0.65$	***K	$p < 0.001$
	Which could you meet for the first time at school?	ns	$p = 1.0$	ns	$p = 0.16$	**F	$p = 0.002$
	Which has the same mom as you?	ns	$p = 0.65$	ns	$p = 0.057$	***K	$p < 0.001$
	Which has a different mom than you?	**F	$p = 0.002$	***F	$p < 0.001$	***F	$p < 0.001$

*Children provided responses about a sibling (K for kin), friend (F), and stranger (S). Three- and 4-year-olds answered only some questions correctly, and 5-year-olds demonstrate a clear understanding of the distinctions between relations in answering all questions correctly (*P < 0.0125; **P < 0.0025; ***P < 0.001; corrected for multiple comparisons).*

sharing choices. Only 9 of those children answered all questions correctly, but there were twice as many questions as Experiment 1, so the criteria for correct responses was relaxed. Children with 10 of 12 correct, $n = 28$ (7: 3-year-olds; 21: 4-year-olds, mean age = 50.8 months) expected favor to go to kin over stranger, $t(27) = 6.60$, $p < 0.001$, and friend over stranger, $t(27) = 4.36$, $p < 0.001$, but not to kin over friend, $t(27) = 0.37$, $p = 0.71$. Thus, Experiment 2 failed to confirm the non-significant trend toward a preference for kin over friend shown by children who passed all the comprehension questions in Experiment 1.

Discussion

Overall, young children showed a preference to share with their own siblings and friends over children they had never met before, but they shared roughly equally with their own sibling and friend. Three- and 4-year-old children showed a similar pattern of sharing with their own relations in Experiment 2 as they did in third-party scenarios in Experiment 1, except that 3-year-olds now also chose to share with a sibling over a stranger. Although 3- to 4-year-old children continued to make some errors on the comprehension questions, failures of comprehension do not account for their failure to favor kin over strangers.

Five-year-old children showed weaker patterns: They expressed a significant but small preference for sharing with their own siblings over strangers and no preference for sharing with friends over strangers or with siblings over friends. In general, five-year-old children showed less preferential sharing with known over unknown social partners. This finding may result from the new social environments such children encounter as they start school and interact with unfamiliar children whom they are encouraged to treat fairly and nicely—in this experiment, children similar to the stranger. Though the present study did not collect information on children's school experience, future research could address whether the difference in performance between younger and older children in this study was related to school experience. At 5 years, children's performance on the comprehension questions revealed the clearest understanding of the distinction among the three types of relationships, even as children's performance on the resource distribution questions suggested a de-emphasis of these distinctions in sharing contexts.

Experiment 2, like Experiment 1, provided no evidence for an in-group bias toward a family member over a non-family friend, suggesting children do not consider family to be a privileged in-group, even when children make resource-sharing decisions about their own siblings. However, this experiment tested only one domain of social interaction: resource sharing. It is possible that children would be more sensitive to family as a group in other social contexts. For example, adults are more likely to favor their close relatives in specific social contexts involving aid in serious times of need (Burnstein et al., 1994). Experiment 3 addressed this question by examining children's expectations for social interactions across a more diverse set of social settings involving both helping and sharing.

A further limitation of Experiments 1 and 2 concerns the use of hand-drawn illustrations to represent people. Even though the children in Experiment 2 were asked to pretend that they and their actual friends and siblings were participants in the story, the depicted scenarios may not have been compelling in demonstrating cues to relatedness. In the next experiment, pictures of actual children were used and faces were

morphed such that siblings resembled one another. With this manipulation, we return to the third-party narrative structure of Experiment 1 and ask whether children expect other children to favor kin over non-kin in sharing and giving contexts.

Experiment 3 investigated further children's expectations for social interactions across multiple contexts to see whether their preferences from the first-person scenarios of Experiment 2 replicated or differed when children were presented with a third-person task with enhanced cues to kinship and a wider range of social scenarios. We focused primarily on the relationship comparison for which children did not show a clear preference to favor one person over the other: sibling vs. friend.

EXPERIMENT 3

In this Experiment, we tested 3- 4-, and 5-year-old children's expectations for third-party social interactions between siblings and friends, as in Experiments 1 and 2, using new cues to kinship and new methods. We used face morphology software to present more compelling cues to sibling relations in a third-party context. Given the stable developmental improvement in conceptual understanding questions presented in previous experiments, we did not include any conceptual understanding questions and instead added additional questions regarding expectations for social interactions. Additional social scenarios were added because children did not show strong preferences in resource sharing contexts in the previous experiment, and adults have demonstrated kin preference in specific contexts that call for more costly help (Burnstein et al., 1994; Essock-Vitale and McGuire, 1985). Rather than manipulate resource cost, we presented contexts that called for helping or sharing, asking whether children thought the protagonist character would more readily come to the aid of a sibling than a friend.

Materials and Methods

Participants

Forty-eight Cambridge and Boston area children participated in this study: 16 3.5-year-olds (8 female, mean age = 41.87 months), 16 4.5-year-olds (8 female, mean age = 52.73 months), and 16 5.5-year-olds (8 female, mean age = 66.45 months). All participants had at least one sibling. Children received a gift for their participation, and parents were given a travel reimbursement. This study was carried out in accordance with the recommendations of the Committee on the Use of Human Subjects in Research at Harvard University with written informed consent from a parent or legal guardian of all subjects and verbal agreement from participants.

Materials

We presented children with two different sets of faces on a computer, described as a protagonist, his or her brother or sister (henceforth, sibling), and his or her friend. The stimuli consisted of photographs of real children, one of which was created using morphing, so to maintain high quality of the images, stimuli was presented on a computer, though the vignettes were still presented to children like stories. For each trial, children were introduced to three characters and explicitly told how the central character was related to the other two characters (as a friend or sibling). Then children were asked whom they thought the central character might prefer to interact with across four different prosocial scenarios involving helping and sharing in the context of short vignettes.

Procedure

Children were told they were going to hear some stories. For each trial, three children's faces appeared on the screen with the protagonist in the center and two individuals on either side of the protagonist. One character's image had been created by morphing the protagonist's face with a third, unseen child's face such that the character resembled the protagonist as a sibling would. Within a trial, all three characters were of the same sex. There were two sets of characters, one set of girls and one of boys, each presented in two trials for a total of four trials. Two trials involved prosocial interactions resembling sharing—the protagonist could give one recipient a cookie or lend one recipient a bike. The other two trials involved helping: the protagonist could assist one recipient in completing a puzzle or math homework (See Supplementary Materials for full vignettes). Each triad of characters—the protagonist and the two relations—was presented on two trials. The orders of picture sets and test questions were counterbalanced across children as well as which side the sibling was on and which character's image had been morphed to be the sibling. Two more sets of characters appeared on four additional trials testing other social comparisons, but we do not present their findings here, because they always followed the present trials and their findings are not readily interpretable (see the Supplementary Materials).

The experimenter introduced the protagonist first by name, pointing at the central picture, and then introduced the first outer character by name, pointing to his or her picture. Then, children were told the two characters had a lot in common and were given one other piece of information about their relationship (e.g., they went to the same school (friend) or lived in the same house (sibling)). Next, children were told how the characters were related: respectively, as friends or as brothers/sisters. Finally, children were introduced to a hypothetical scenario in which the protagonist had to make a decision as to whom he or she would choose to share with or help. An example was:

> One day at school, Timmy is working on a dinosaur puzzle and Charlie is working on a train puzzle. Peter likes dinosaurs and trains. Who do you think Peter will help with their puzzle – Timmy or Charlie?

Children were encouraged to point to the picture of the child they thought the protagonist would choose. After making a choice, the experimenter proceeded to the next trial and introduced or reintroduced the next set of characters. When characters were reintroduced a second time in new stories, the experimenter would remind children of who each character was and how the protagonist was related to the other two characters while pointing to each one. For example:

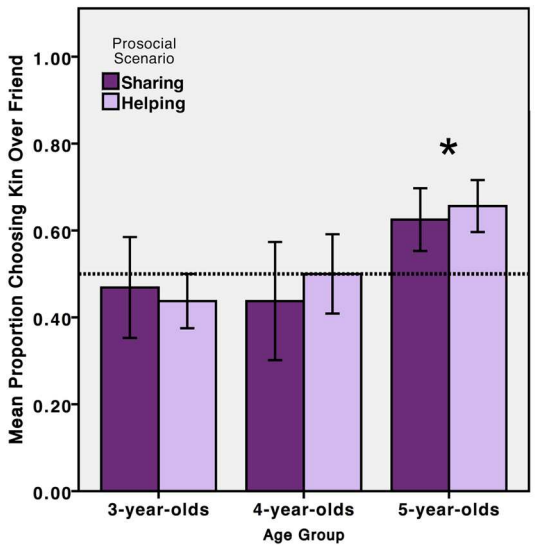

FIGURE 3 | Children's social choices in Experiment 3. Three- and 4-year-old children ($n = 32$) did not show a clear social preference between sibling and friend, but 5-year-old children ($n = 16$) did choose for the protagonist in the vignettes to favor a sibling over friend (*$P < 0.05$). Children's responses followed the same pattern for both sharing and helping prosocial scenarios. Error bars represent one standard error.

> Do you remember Peter? Peter and Charlie both live in the same house. They are brothers. Peter and Timmy both go to the same school. They are friends.

Next, a new hypothetical scenario was introduced and children were asked how they thought the protagonist would behave. The vignettes were presented in one of four counterbalanced orders.

Results

Children's responses on each trial were coded as choosing the sibling (1) or friend (0). The 3 (age group) by 4 (question) repeated-measures ANOVA on children's selections revealed no significant main effects or interactions (all ps > 0.05), though there was a marginal main effect of age group, $F(2,45) = 2.42$, $p = 0.10$.

Each age range was then analyzed for an overall preference for sibling over friend. Children's four choices were summed and analyzed using a two-tailed, one-sample t-test with chance performance set to 0.5 (**Figure 3**). Children did not expect protagonists to choose their siblings over their friends at three years of age ($M = 0.45$, $SD = 0.26$), $t(15) = -0.72$, $p = 0.49$, or four years of age ($M = 0.44$, $SD = 0.31$), $t(15) = -0.81$, $p = 0.43$. Five-year-olds did expect the protagonists to favor kin over friends ($M = 0.63$, $SD = 0.22$), $t(15) = 2.24$, $p = 0.041$.

Discussion

Despite increasing the salience of sibling relations using facial morphology, 3- and 4-year-old children did not expect preferential prosocial behavior toward siblings over friends. In contrast to younger children and to the findings of Experiment 2, however, 5-year-old children now expected the protagonist to favor their sibling, with a non-significant trend suggesting that an expectation of prosocial behavior toward kin seems to develop by around 5 years. The presence of shared face morphology between the sibling characters may have increased the salience of the sibling relation at this age. Alternatively or in addition, the inclusion of more social contexts may have triggered an increased expectation for favoring kin in 5-year-old children. Younger children may not yet have a clear understanding of kinship or friendship, or, alternatively, they may understand distinctions among these relations but not have robust sharing preferences among them.

GENERAL DISCUSSION

We found that 3-, 4-, and 5-year-old children overall showed a preference for sharing with siblings and friends over strangers (children they have never met), but they did not have a strong preference between a sibling and a friend. Children expected the same sharing behaviors when distributing limited resources as they do for plentiful resources, replicating past research (Olson and Spelke, 2008). Thus, children did not privilege family members as an in-group, or at least not in resource sharing scenarios comparing family members (siblings) to known social partners outside the family (friends) (Experiments 1 and 2). When siblings are made more salient and social contexts were more varied, 5-year-olds, but not 3- and 4-year-olds, did expect third party protagonists to favor their siblings over their friends (Experiment 3).

Children's understanding of these social pairs: sibling and friend, sibling and stranger, friend and stranger, improved with age, as 5-year-old children's performance revealed a clearer understanding of the distinction among the three types of relationships than 3- and 4-year-olds'. Children showed good understanding for friend vs. stranger contrasts by ages 3 or 4 (Experiment 1 and 2, respectively) and good understanding for sibling vs. stranger contrasts by ages 4 or 5 (Experiment 1 and 2, respectively). For sibling vs. friend contrasts, only 5-year-old children answered most questions correctly.

Five-year-old children's performance revealed a clearer understanding of the distinction among siblings, friends, and strangers, even as their resource distribution beliefs suggest a de-emphasis of these distinctions in sharing contexts. At least when sharing scenarios are depicted in illustrated storybooks, specifically, the oldest children were less biased against sharing with strangers.

Although children organize their social world in a variety of ways, grouping individuals by gender, accent or language, and race, the present studies suggest that family relations are not clear to children from a young age. Children distinguish people who are socially related to one another (family members, friends, neighbors) from those who are not (strangers) before they understand the types of relations that connect the people they know. These distinctions begin to emerge at five years in the present studies.

By 5 years, but not before, children start to expect in-group benefits to be given to kin over familiar and valued non-kin, friends. Several factors could explain the late emergence of this expectation. Children may only develop an explicit kinship bias once they have a clear understanding of what constitutes kin vs. non-kin. The comprehension questions given in Experiment 2 provide evidence that children do not clearly differentiate between friends and siblings conceptually until around age 5. This differentiation may be necessary in order to expect favor to go to kin. Prior to age 5, children confuse familiar relations like friends and family, and thus they may expect favor to go to either party.

Young children differentiate how they share based on the recipient, but they do not show much evidence for a kinship bias until around age five, and even then, it is not a robust preference. In both third- and first-person hypothetical sharing contexts, children expected favor to go to familiar others like friends and siblings over strangers, even with a limited resource. However, at 3 and 4 years, children did not demonstrate a clear expectation for whether a sibling or friend should be privileged when choosing between the two. Young children expected equal treatment of siblings and friends in the distribution of resources that are plentiful (Olson and Spelke, 2008) or scarce (Experiments 1–3). In the present studies, the failure of young children to differentiate between friends and siblings is observed not only when resources have minimal value but when their value is increased, and not only when the story presents characters that are unknown to the child, but also when it depicts the child and his or her own sibling and friend in a hypothetical social scenario (Experiment 2).

Adults are more likely to rely on close kin when needing more costly help (Essock-Vitale and McGuire, 1985; Burnstein et al., 1994), but children are not sensitive to the manipulation of cost presented here. This negative finding may indicate either that children are insensitive to cost manipulations or that the experiment failed to manipulate cost effectively for children.

Thus, the present studies demonstrate that an ability to distinguish kin from non-kin emerges slowly over development in these verbally presented, explicit social scenarios, with no evidence for an early emerging ability even in contexts where the stakes are higher or more relevant to the children. However, these findings do not rule out that children may be sensitive to kin distinctions in different circumstances or with different presentations of kin and social relations.

Children's resource sharing with siblings may not be the best measure of kinship preference, because their allocation of resources to siblings may depend on additional factors such as the quality of their relationship or age difference. Sibling competition over resources may also lead them to prefer to share with a friend over a sibling, as according to theories on sibling rivalry, full siblings compete so long as the benefits outweigh the costs two to one (Hamilton, 1964). Future research could examine whether children show preference for siblings in other areas or whether they show preference for other types of family relations, such as parents. However, this study would need to find a relevant match in familiarity and age (as friend was to sibling) for child-adult relations that are not parents (e.g., nanny or teacher). The present studies do not rule out a preference for kin but do demonstrate that children do not have a robust preference for all kin over non-kin, as they do not robustly share with siblings over friends.

In addition to their ambiguity about sharing, 3- and 4-year-old children show some confusion about what defines sibling vs. friend relationships. By the time children are 5 years old, they demonstrate a better understanding of each relationships, and they also show biases for family over others in some social contexts (Experiment 3), although not in all contexts (Experiment 2).

Why do children confuse friends and siblings when answering questions like, "Who has the same mom as you?" One answer may be that children do not have a clear representation for each type of relationship: friend, sibling, stranger, and that this develops with more experience as they grow. Alternatively, children may have clear representations but lack the vocabulary to demonstrate their understanding. For example, children need to understand words like "same" and "different", and kinship terms like "grandparent" to answer questions correctly. Though Experiment 2 presented additional comprehension questions to the battery from Experiment 1 to better assess children's understanding, further research into how well they understood the kin terms and the questions we presented could help distinguish between these explanations.

Another possibility is that children may have representations for these relations, but the specific cues they use to identify and distinguish between them do not work as effectively in modern society. If children distinguish family from friends on the basis of the information that was most reliable in our evolutionary past, one should consider how human groups and social relations were organized then in order to know how to define the groups. One theory posits that family members were defined by communal sharing relationships, in which members are treated as equally and share benefits altruistically among members (Fiske, 1992). However, friends in modern times also show many features that once defined only family relations. For instance, a child is likely to have their friends over to their house, share food with them, and see their own parents acting in a nurturing and protective manner toward their friends. These are all behaviors that children would have only seen directed toward siblings and other family members historically. Thus, what defines the idea of a sibling for a small child may be activated by the type of relationship they have with their friends now. The line between friend and sibling may be blurred in their experience and conceptions, and the distinction may not become explicit and clear until around 5 years of age, when further experience, likely including school experience, may start to clarify these social group boundaries. Before then, both may be seen as communal sharing relationships.

Children also have vastly greater social experiences to drawn upon at age five relative to age three. Socialization pressures could influence 5-year-old children's sharing preferences in encouraging them to reach out to increasingly to new children around their age, in these experiments, strangers. Children are encouraged to share with others not only in their homes but also in contexts with children they may not have met before

including schools, museums, daycare, parks, playgrounds, and other public places where they interact with new children. The present experiments were conducted in a lab environment, which may share many features with these other environments—for example, the experimenter is an unfamiliar friendly adult much like a teacher or children's museum guide—and thus, the lab may elicit socialized patterns of sharing.

A broader aversion to strangers in early childhood could also be driving young children's more robust preferences for familiar others to strangers compared to that of 5-year-olds. Most parents encourage their children to avoid strangers, and children of all ages may adhere to this advice equally, however, older children may have different definitions of what individuals may count as a caution-warranting stranger. More specifically, a child their own age that they may not have met before would not be the type of stranger their parents warn them about. Moreover, they may recognize certain contexts in which they should be more or less wary—schools and playgrounds may be safer than airports, parking lots, or amusement parks. Younger children may not have the social experience or skill to differentiate between varying people and contexts, and thus they show a stronger aversion to strangers in our storybook contexts.

Adults' tendency for altruism toward kin is mediated by emotional closeness (Korchmaros and Kenny, 2001). This finding raises the possibility that children's equal sharing with friends and family is influenced by this variable as well. Though emotional closeness may have been a factor when children were considering their own relations (Experiment 2), it is less likely to be a factor in the hypothetical third-person scenarios used in Experiments 1 and 3. It is possible, however, that children considered their own relations when making decisions in third party scenarios, and thus emotional closeness or quality of relationship with siblings or friends may still have played a role. Future research could measure or manipulate emotional closeness or relatedness as potential mediating factors in children's sharing behavior in order to further investigate whether the present findings could be influenced by such factors.

Even if children made no clear distinction between kin and friends in the present experiments, it is possible that they distinguish kin from friends in other contexts. Future research using more sensitive measures of a potential in-group kinship preference, such as implicit measures, might reveal such distinctions. In the present experiments, children are asked explicitly whom they think a character will share with or whom they would like to share with. Adults show a tendency to favor kin in an explicit context as well as a more implicit measure, such as the amount of time they are willing to hold a physically challenging position in order to win money for someone (Madsen et al., 2007). In that case, adults unknowingly hold the position longer for those more closely related to them. A similar study could be conducted with children to see if they put in more effort for kin when they are not as aware of the costs.

These findings raise additional questions for future research. First, is the slow development of understanding of kinship relations a universal feature of human development, or is it specific to children from western, industrialized societies? It is possible that children in traditional societies, in which people live in extended families and emphasize kin relations, come to understand kin relations more precociously. Second, do young children fail to understand any kin relations, or only sibling relations? Children may be able to distinguish their parents from unrelated but highly familiar adults who care for them. However these questions are answered, the present findings shed light on how children are navigating their social worlds and suggest that there is not a sharp, robust in-group boundary that divides kin from non-kin.

AUTHOR CONTRIBUTIONS

AS and ES designed the research; AS collected and analyzed the data; and AS and ES wrote the paper. Both authors approved the final version of the manuscript for submission.

FUNDING

This material is based upon work supported by the Center for Brains, Minds and Machines (CBMM), funded by an NSF STC award [CCF-1231216]. This research was also funded by a National Institutes of Health Grant [5R01HD023103] to ES.

ACKNOWLEDGMENTS

We thank Ellyn Schmidt, Molly Dillon, Harvard Laboratory for Developmental Studies, and the families who participated.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/article/10.3389/fpsyg.2016.00440

REFERENCES

Burnstein, E., Crandall, C., and Kitayama, S. (1994). Some Neo-Darwinian decision rules for altruism: weighing cues for inclusive fitness as a function of the biological importance of the decision. *J. Pers. Soc. Psychol.* 67, 773–789. doi: 10.1037/0022-3514.67.5.773

Carey, S. (1985). *Conceptual Change in Childhood*. Cambridge: MIT Press.

Essock-Vitale, S. M., and McGuire, M. T. (1985). Women's lives viewed from an evolutionary perspective: II. Patterns of helping. *Ethol. Sociobiol.* 6, 155–173. doi: 10.1016/0162-3095(85)90028-7

Fiske, A. P. (1992). The four elementary forms of sociality: framework for a unified theory of social relations. *Psychol. Rev.* 99, 689–723. doi: 10.1037/0033-295X.99.4.689

Greiner, B., and Levati, M. V. (2005). Indirect reciprocity in cyclical networks: an experimental study. *J. Econ. Psychol.* 26, 711–731. doi: 10.1016/j.joep.2004.04.003

Gurven, M. (2006). The evolution of contingent cooperation. *Curr. Anthropol.* 47, 185–192. doi: 10.1086/499552

Hamilton, W. D. (1964). The genetical evolution of social behavior I & II. *J. Theor. Biol.* 7, 1–16 & 17–52. doi: 10.1016/0022-5193(64)90038-4

Inagaki, K., and Hatano, G. (2002). *Young Children's Naïve Thinking about the Biological World*. New York, NY: Psychology Press. doi: 10.4324/9780203759844

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Korchmaros, J. D., and Kenny, D. A. (2001). Emotional closeness as a mediator of the effect of genetic relatedness on altruism. *Psychol. Sci.* 12, 262–265. doi: 10.1111/1467-9280.00348

Landau, B. (1982). Will the real grandmother please stand up? The psychological reality of dual meaning representations. *J. Psycholinguist. Res.* 11, 47–62. doi: 10.1007/BF01067501

Lieberman, D., Oum, R., and Kurzban, R. (2008). The family of fundamental social categories includes kinship: evidence from the memory confusion paradigm. *Eur. J. Soc. Psychol.* 38, 998–1012. doi: 10.1002/ejsp.528

Lieberman, D., Tooby, J., and Cosmides, L. (2007). The architecture of human kin detection. *Nature* 445, 727–731. doi: 10.1038/nature05510

Madsen, E. A., Tunney, R. J., Fieldman, G., Plotkin, H. C., Dunbar, R. I., Richardson, J. M., et al. (2007). Kinship and altruism: a cross-cultural experimental study. *Br. J. Psychol.* 98, 339–359. doi: 10.1348/000712606x 129213

Nowak, M. A., Tarnita, C. E., and Wilson, E. O. (2010). The evolution of eusociality. *Nature* 466, 1057–1062. doi: 10.1038/nature09205

Olson, K. R., and Spelke, E. S. (2008). Foundations of cooperation in young children. *Cognition* 108, 222–231. doi: 10.1016/j.cognition.2007. 12.003

Schmidt, M. F., and Somerville, J. A. (2011). Fairness expectations and altruistic sharing in 15-month-old human infants. *PLoS ONE* 6:e23223. doi: 10.1371/journal.pone.0023223

Shaw, A., DeScioli, P., and Olson, K. R. (2012). Fairness vs. favoritism in children. *Evol. Hum. Behav.* 33, 736–745. doi: 10.1016/j.evolhumbehav.2012.06.001

Shaw, A., and Olson, K. R. (2013). All inequality is not equal: children correct inequalities using resource value. *Front. Emot. Sci.* 4:393. doi: 10.3389/fpsyg.2013.00393

Sloane, S., Baillargeon, R., and Premack, D. (2012). Do infants have a sense of fairness? *Psychol. Sci.* 23, 196–204. doi: 10.1177/0956797611422072

Somerville, J. A., Schmidt, M. F., Yun, J. E., and Burns, M. (2012). The development of fairness expectations and prosocial behavior in the second year of life. *Infancy* 18, 40–66. doi: 10.1111/j.1532-7078.2012.00129.x

Tajfel, H., Billing, M., Brundy, R., and Flament, C. (1971). Social categorization and intergroup behavior. *Eur. J. Soc. Psychol.* 1, 149–178. doi: 10.1002/ejsp.2420010202

Wedekind, C. (2000). Cooperation through image scoring in humans. *Science* 288, 850–852. doi: 10.1126/science.288.5467.850

Wedekind, C., and Braithwaite, V. A. (2002). The long-term benefits of human generosity in indirect reciprocity. *Curr. Biol.* 12, 1012–1015. doi: 10.1016/s0960-9822(02)00890-4

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 30 August 2016
doi: 10.3389/fpsyg.2016.01274

Young Children's Development of Fairness Preference

*Jing Li[1], Wen Wang[2], Jing Yu[3] and Liqi Zhu[1]**

[1] Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [2] Human Development and Family Studies, College of Social Science, Michigan State University, East Lansing, MI, USA, [3] Department of Psychology, University of Maryland, Baltimore County, Baltimore, MD, USA

Fairness is one of the most important foundations of morality and may have played a key role in the evolution of cooperation in humans beings. As an important type of fairness concern, inequity aversion is the preference for fairness and the resistance to inequitable outcomes. To examine the early development of fairness preference in young children, sixty 2- and 3-year-old children were recruited to examine young children's preferences for fairness using a forced choice paradigm. We tested how toddlers acted when they took charge of distributing resources (two candies) to themselves and others and when they were the recipients of both other-advantageous distribution and self-advantageous distribution. Different alternative options were paired with the same fair option in the two conditions. In the other-advantageous condition, children had fewer resources in the alternative options than others, whereas their resources in the alternative options were greater than others' in the self-advantageous condition. The results showed that more children displayed fairness preferences when they distributed resources between two friends than when they distributed resources between a friend and themselves. In both scenarios, 3-year-old children were more likely to demonstrate fairness preference than 2-year-old children. The findings suggest that inequity aversion develops in young children and increases with age over the course of early childhood. When they were recipients, there was a trend in young children's preference for fairness in the other-advantageous condition compared with the self-advantageous condition. This suggests that children might tend to be more likely to display inequity aversion when they are in a disadvantageous position.

Keywords: fairness, inequity aversion, young children, forced choice paradigm, distribution

OPEN ACCESS

Edited by:
Ildikó Király,
Eötvös Loránd University, Hungary

Reviewed by:
Joanne Tarasuik,
Swinburne University of Technology, Australia
Georgiana Susa,
Babeş-Bolyai University, Romania

****Correspondence:***
Liqi Zhu
zhulq@psych.ac.cn

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *29 January 2016*
Accepted: *10 August 2016*
Published: *30 August 2016*

Citation:
Li J, Wang W, Yu J and Zhu L (2016) Young Children's Development of Fairness Preference. Front. Psychol. 7:1274. doi: 10.3389/fpsyg.2016.01274

INTRODUCTION

As the philosopher John Rawls noted, 'the fundamental idea in the concept of justice is fairness' (Rawls, 1958). Fairness is one of the most important foundations of morality in both older (Piaget, 1965; Kohlberg, 1969) and newer (Haidt and Graham, 2007) theories of moral psychology. Unsurprisingly, fairness concerns have received much attention in the areas of behavioral economics (Fehr and Schmidt, 1999), psychology (Declerck et al., 2009) and evolutionary biology (Fehr and Fischbacher, 2003; Bräuer et al., 2006). Human beings have a substantial desire for fairness and show strong aversions to inequity (Fehr and Schmidt, 1999). Even third parties who do not personally suffer from the inequity will punish others for unfair behavior to achieve fairness (Fehr and Fischbacher, 2004; Dawes et al., 2007; Fehr et al., 2008b). Inequity aversion and the rejection of unfairness are considered essential for maintaining cooperation and reducing

opportunities for free riders (Kogut, 2012) and thus may have played a key role in the evolution of cooperation in humans (Fehr and Schmidt, 1999; Fehr and Fischbacher, 2003).

A wealth of empirical evidence gathered by experimental economists and psychologists suggests that a high percentage of people are strongly motivated by other-regarding preferences and that concerns for fairness and reciprocity cannot be ignored in social interactions (Fehr and Schmidt, 2003). Theories such as the dual concern model (Pruitt and Rubin, 1986) and the social utility model (Loewenstein et al., 1989) suggest that people prefer to consider the other's benefits in their distribution decisions in addition to the wish to maximize one's own utility. According to the social utility model, people feel more comfortable and experience greater satisfaction with the equal distribution of resources than with inequitable allocations, even when those inequities are self-advantageous (Loewenstein et al., 1989; Kogut, 2012). In addition, the ERC (Equity, Reciprocity, and Competition) model, proposed by Bolton and Ockenfels (2000), highlights the concern for one's relative position (competition) in social interactions.

As an important type of fairness concern, inequity aversion is one's preferences against receiving either more or less than someone else (Fehr and Schmidt, 1999). Although people are especially motivated to achieve fairness when the inequity is to one's own disadvantage, there is some evidence showing that the desire for fairness is strong even when the inequity is to one's advantage (Haynes and Gilovich, 2010). As proposed by Fehr and Schmidt (1999), there are two kinds of inequity aversion (IA): one is disadvantageous IA, in which another individual receives more than oneself, and the other is advantageous IA, in which one receives more than another individual (Hatfield et al., 1978). It is argued that adults will sacrifice their own benefits to eliminate inequalities they view as unfair by punishing unequal outcomes, both when they are offered more resources than a social partner (advantageous IA) and when they are offered relatively fewer resources (disadvantageous IA) (Fehr and Schmidt, 1999; Camerer, 2003; Fehr and Fischbacher, 2003; Dawes et al., 2007). Therefore, the sense of fairness has at least two distinct components, including a desire to be fair and a desire to signal to others that they are fair (Shaw et al., 2014).

The research on sharing behavior in adults suggests that people tend to share their resources and feel better with an equal distribution even when no strategic considerations exist (Loewenstein et al., 1989). Adult preferences for equity using strategic and economic games have been investigated in different cultures (Fehr and Fischbacher, 2003; Henrich et al., 2005; Camerer and Fehr, 2006), and substantial behavioral variability across social groups was found; theories of both cultural evolution as well as gene–culture co-evolution are assumed to explain the interaction between altruists and selfish individuals and individual heterogeneity in altruism. However, less is known about how the preference for fairness develops in childhood.

Some researchers have found that children begin to understand fairness between the ages of 4 and 6 years old. Lane and Coon (1972) found that 4-year-olds generally distributed stickers selfishly to a fictitious partner, whereas most 5-year-olds distributed stickers more equally to fictitious partner. Similarly, Damon (1975) found that 4-year-old children often confused fairness with their own desires in hypothetical dilemmas, while 5-year-olds began to focus on strict equality. Several studies using behavioral economics methods (e.g., dictator game and ultimatum game) (Gummerum et al., 2008) have found that 3- to 4-year-old children would like to share some resources, but a preference for equal distribution does not emerge until 7 years of age or later (Harbaugh et al., 2003; Benenson et al., 2007). Fehr et al. (2008a) found that most 3- to 4-year-old children behaved selfishly, whereas most 7- to 8-year-olds preferred equitable resource distribution, suggesting that children under 6 years old behaved primarily based on selfish desires than on fairness concerns. Children's preferences for equal distributions increased with age (Benenson et al., 2007; Blake and Rand, 2010; Gummerum et al., 2010). Children between 6 and 8 years old begin to incur costs to avoid inequality such as discarding a resource to avoid an unequal resource distribution (Blake and McAuliffe, 2011; Shaw and Olson, 2012). Similarly, Hook and Cook (1979) suggested that 8-year-old children are more willing to bear costs to achieve fairness than 3-year-old children. In sum, fairness preferences develop late in children, at the minimum, 6 or 7 years of age is when children distribute resources equally; however, they develop an increasing preference for fairness throughout the course of childhood (Fehr et al., 2008a; Shaw et al., 2014).

On the other hand, recent research on infants and preschoolers challenges this notion, showing that knowledge of fairness and fair behavior emerges earlier than expected. Infants who are 16 months old are able to pay attention to equality in resource distribution by expecting resources to be allocated equally among recipients using an index of looking time and manual choices provided (Geraci and Surian, 2011; Schmidt and Sommerville, 2011). Infants at 19 months of age looked longer when one puppet received both items than when each puppet received one item using a looking-time paradigm, suggesting that 19-month-old infants expected an equal allocation (Sloane et al., 2012). Similar experiments have shown that even 15-month-olds expect equal resource allocations (Sommerville et al., 2013). In addition, a substantial amount of empirical evidence suggests that 3- to 4-year-old children already show a preference for fairness in different contexts. Three-year-old children might notice and be averse to disadvantageous inequality in distributions (Birch and Billman, 1986). Children aged 3.5–4 years old show a strong preference for giving one object equally to each doll (Olson and Spelke, 2008). Children aged 4 years old favor equality over giving others more resources and prefer fairness over generosity in some circumstances (Kenward and Dahl, 2011). Around the same age, they exhibit negative emotional reactions to unequal distribution and are willing to incur costs to ensure that they do not have less than others (LoBue et al., 2011). Phenomena on inequity aversion in young children have been reported from the developmental perspective, suggesting an early onset of inequity aversion (Blake and McAuliffe, 2011; Paulus et al., 2013).

The existing empirical evidence on whether 3- to 4-year-old and younger children prefer fairness (i.e., experience inequity aversion) is not conclusive, indicating the need for more studies on the ontogenetic origins of fairness. Specifically, older

studies (e.g., Damon, 1975) suggested that children do not develop fairness preferences until they are 5 years old or older, whereas recent studies on infants and preschoolers showed that a fairness preference emerges even in children younger than 2 years old. The discrepancy might be due to the differences in both the paradigms and contexts. For example, infant studies have adopted a preferential looking-time paradigm, which is effective in gaining insight into the young mind by assessing the characteristics of infants' innate cognitive faculties (Cohen and Cashon, 2003), whereas older studies (e.g., Lane and Coon, 1972 and Damon, 1975) used fictitious partners or hypothetical dilemmas, which differ from real distribution contexts. In addition, the inconsistent results on the preference for fairness in young children might be due to the fact that some research focused on the knowledge of fairness, whereas other research focused on fair behavior. It is argued that having knowledge about the principles of fairness does not guarantee that one will use them when making decisions (Blake et al., 2014). For example, when given a set of stickers, children between 3 and 8 years of age recognize that sharing half of the stickers with an absent child would be the right thing to do, but only 7- to 8-year-old children actually distribute the stickers equally (Smith et al., 2013). This gap between knowledge of fairness and fair behavior might occur because younger children cannot inhibit their desires for resources and thus fail to follow the fairness norms they already know (Blake et al., 2014). The desire to maintain an advantageous position compared with one's peers is also adopted to explain this gap (Blake et al., 2014).

It is argued that the development of children's aversion to disadvantageous and advantageous inequity is asymmetrical (McAuliffe et al., 2013). Children as young as 3 years old accept allocations that would place themselves in a relatively advantageous position and reject those that would put them at a relatively disadvantageous position (exhibiting aversion to disadvantageous inequity) (Fehr et al., 2008a; Takagishi et al., 2010; Blake and McAuliffe, 2011; LoBue et al., 2011; Sheskin et al., 2014). However, children do not develop an aversion to advantageous inequity until 8 years old (Blake and McAuliffe, 2011; Shaw and Olson, 2012). In addition, experiments on non-human animals have demonstrated that domestic dogs (Range et al., 2009) and non-human primates (Jensen et al., 2006; Proctor et al., 2013) are both sensitive to disadvantageous inequity, but no evidence supports the notion that non-human animals perform aversion to advantageous inequity. These findings from human children and non-human animals might suggest that separate developmental mechanisms underlie these two forms of inequity aversion (McAuliffe et al., 2013).

Despite the demonstrated cross-cultural variability in young children's (Rao and Stewart, 1999; Rochat et al., 2009) and adults' (Henrich et al., 2005) resource distribution behaviors, a potentially universal inclination for inequity aversion is worth noting (Paulus, 2015). More fairness in distributive justice is evident in 3- to 5-year-old children growing up in small-scale urban and traditional societies that are thought to promote more collective values (Rochat et al., 2009). Rao and Stewart (1999) found that 4-year-old Chinese children showed more spontaneous sharing than Indian children, while Indian children performed substantially more passive sharing. Moreover, Zhu et al. (2008) found that Chinese children and adolescents of 9, 12, and 14 years of age displayed a decreasing preference for fairness with age in a dictator game as the proposer, while many studies in Western cultures found an increasing tendency in fairness preference with age (Eisenberg et al., 1998; Fehr et al., 2008a; Shaw et al., 2014). Cultures that have a scarcity of resources and a greater power distance (i.e., put less emphasis on equality) and those that are less individualistic (i.e., put less emphasis on the rights of individuals) (Hoftede et al., 2010) constitute the cornerstone of human inequity aversion (Paulus, 2015). Traditional Chinese culture especially emphasizes equity, for example, Confucius argued that "Do not worry about poverty, but rather about the unequal distribution of wealth" (Confucius, 1980).

Previous fairness research has mostly relied on explicit measures, such as interviews and questionnaires, to indicate preference for fairness, which requires verbal responses from children (Premack, 2007). However, verbal reports may underestimate what children actually know, and thus behavioral observations might be a more effective way to examine fairness preferences in younger children (LoBue et al., 2011). Economists have argued that two simple fairness-related constructs, disadvantageous IA and advantageous IA, can be measured without verbal reports (Loewenstein et al., 1989; Fehr and Schmidt, 1999). A forced choice paradigm is suitable for children younger than 2 years old who have limited cognitive and linguistic competence (Hamlin et al., 2007) and is usually adopted to assess children's responses to specific forms of inequity (Blake and McAuliffe, 2011). Specifically, children must choose between two options, for example, an advantageous allocation (two candies for me and none for you) and an equal allocation (e.g., one candy for me and one for you) that are presented simultaneously.

In sum, a clear inconsistency in whether young children display a fairness preference was found in previous studies, and little research on young children's preference for fairness has been conducted in non-Western cultures. The goal of this study was to examine young Chinese children's fairness preferences using an economic game paradigm. It is argued that the knowledge-behavior gap might lead to inconsistent results regarding when children are able to display a fairness preference, and children younger than 3 years might have knowledge of fairness but not display fair behavior. In the present study, we mainly focused on young children's actual fair behavior (as the distributor). Scenarios about distributing resources as a third party and distributing resources between the self and another child were both included in our study. In addition to children's fair behavior when they are in power as the distributors, children's reactions when they are powerless recipients in dictator games (Eckel and Grossman, 1996) may provide a complementary picture of children's preferences for fairness. A forced choice paradigm, which is sensitive to young children, was adopted in this study. In addition, cross-cultural variability in young children's preference for fairness has been shown in previous studies. The preference for fairness in children 2–3 years of age in Chinese culture, a typical Eastern culture that emphasizes power

distances, interdependence and group harmony, was examined in our study.

This study aimed to examine the development of fairness preference in 2- and 3-year-old Chinese children when they acted as distributors and as recipients. We hypothesized that young children would allocate resources equally when they were distributors, that the preference for fairness would increase with age, and that when they were recipients, children as young as 2 years old would prefer proposers who equally allocated resources.

EXPERIMENT 1. CHILDREN'S FAIRNESS PREFERENCE WHEN THEY WERE DISTRIBUTORS

Method

Participants

Sixty 2- and 3-year-old children were recruited from two child care centers in Baoding, Hebei province, China. One 2-year-old child was excluded from the analysis because he did not pay attention to the experimental procedures. The demographic characteristics of the children included in the analysis are shown in **Table 1**.

The ethics committee of the Institute of Psychology, Chinese Academy of Sciences, approved our experiments. Informed consent forms were obtained from all children's parents.

Procedure

A 2 (age: 2-year-old and 3-year-old) * 2 (distribution conditions: distribute between self and friend and distribute between two friends) design was adopted in this experiment.

The experiments were conducted in a quiet room at the child care centers. In the warm-up phase, one human-like puppet and two similar rabbit puppets were introduced to the children. In the test phase, there were two conditions:

Condition 1: Distribute resources between self and friend. Children were offered two candies and were asked whether/how many they would like to give to another "friend," which was a human-like puppet. The instructions were as follows. "Now I am giving you two candies. They are yours. Would you like to share with Lele (the human-like puppet)?" If the answer was "yes," then the question "how many candies would you like to share with Lele?" was asked.

Condition 2: Distribute resources between two friends. Children were offered two candies and were asked to distribute both of these candies to two "friends," which were two similar rabbit puppets. The puppets were set on two sides of a table. The distances between the two puppets and the children were the same. The instructions were as follows. "Here I have two candies, and they will be given to the two rabbits. I'd like to ask you to help me distribute the two candies to the rabbits. How many candies would you like to distribute to the rabbit on the left? How many candies to the rabbit on the right? Please place the candy in front of the rabbit."

Children's answers were coded as 0 (for an unfair distribution) and 1 (for a fair distribution).

TABLE 1 | Age and gender distribution across conditions with children as distributors.

Group	Distribute between self and friend		Distribute between two friends	
	Months	*n* (male)	Months	*n* (male)
2-year-old	28.1 ± 5.1	41 (23)	29.5 ± 4.5	26 (19)
3-year-old	40.5 ± 3.2	18 (10)	40.2 ± 4.0	11 (4)

Results

Children's choices were first compared with the level of chance by binomial tests (see **Figure 1**). For 2-year-old children, their preference for fairness did not differ from chance when they distributed the resources between themselves and their friend (54% of 2-year-old children preferred fairness, $p > 0.05$). However, when they distributed the resources between two friends, they significantly preferred fairness compared to the level of chance (85% of 2-year-old children preferred fairness, $p < 0.001$). For 3-year-old children, they were more likely to prefer fairness above and beyond the level of chance both when they distributed the resources between themselves and their friend (89% of 3-year-old children preferred fairness, $p < 0.001$) and when they distributed the resources between two friends (100% of 3-year-old children preferred fairness). This suggested that 3-year-old children significantly preferred to distribute equally in both conditions, whereas 2-year-old children performed randomly when distributing resources between themselves and their friend but significantly preferred to distribute equally when distributing resources between two friends.

The binary logistic regression showed that more children displayed a fairness preference when they distributed resources between two friends than when they distributed resources between themselves and their friend [$\chi^2(1) = 6.17$, $\beta = -1.56$, $p = 0.013$]. Three-year-old children were more likely to prefer fairness than 2-year-old children regardless of whether they distributed resources between themselves and their friend or between two friends [$\chi^2(1) = 5.66$, $\beta = -1.93$, $p = 0.017$].

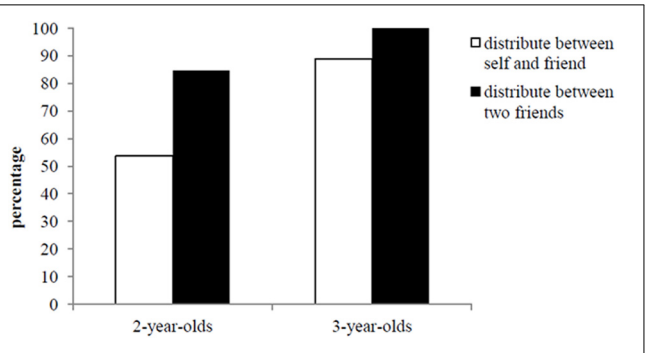

FIGURE 1 | Children's fairness preference when they were the distributors.

The interaction between distribution conditions and age was not significant [$\chi^2(1) = 2.56$, $p = 0.109$].

Experiment 1 revealed young children's fairness preferences when they were the distributors. We were further interested in understanding young children's fairness preferences when they were the recipients, which we examined in Experiment 2.

EXPERIMENT 2. CHILDREN'S FAIRNESS PREFERENCE WHEN THEY WERE RECIPIENTS

Method

Participants

The same 60 children participated in study 2 (completing four tasks in total). The order of the four tasks was counterbalanced. Three children were not included in the analysis because they did not finish the study, and one child was not included in the analysis because he did not pay attention to the procedures. The demographic characteristics of the children included in the analysis are shown in **Table 2**.

The ethics committee at the Institute of Psychology, Chinese Academy of Sciences, approved our experiments. Informed consent forms from children's parents were obtained for all subjects.

Procedure

A 2 (age: 2-year-old and 3-year-old) * 4 (distribution conditions: (2,0)−(1,1), (1,0)−(1,1), (1,2)−(1,1), and (0,2)−(1,1)) design was adopted in this experiment.

The experiments were also conducted in a quiet room at the child care centers. The entire experiment was demonstrated as a puppet show to attract the young children's attention. A forced choice paradigm was adopted to examine young children's preference for fairness. In the warm-up phase, one human-like puppet was introduced to the children as their counterpart. The participating child and the human-like puppet were both the recipients. Four pairs of hand puppets were also prepared, and each hand puppet pair was the same except for their colors.

The experimenter used two hand puppets: one that distributed fairly between the child and the counterpart and another that distributed unfairly. The two hand puppets were placed in front of the child, and the distances between the child and these two hand puppets were the same. A control question of "how many gifts did the distributor give to you and your counterpart?" was first asked. Only children who answered the control question correctly moved into the test question phase; otherwise, the experimenter played the puppet show again. In the test question phase, the child was asked to choose which distributor he or she liked. Children's answers were coded "1" for choosing the fair distributor and "0" for the unfair distributor.

There were four conditions that reflected different combinations of the fair versus unfair distributions (**Table 2**). In each condition, the fair puppet distributor gave both the participant and his or her counterpart one gift; the unfair puppet distributor gave the participant either more or less than his or her play partner. In the (1, 1)−(2, 0) scenario, the fair distributor allocated one gift to the subject and one gift to his or her counterpart; the unfair distributor gave the subject two gifts and nothing to the counterpart. The order of the equal and unequal distributions in each condition, the position of the fair distributor and the unfair distributor, and the sequence of the four conditions were all counterbalanced.

Results

The children's preferences for fairness are shown in **Figure 2**. Children's choices were compared to the level of chance by binomial tests. For 2-year-old children, they significantly preferred fairness in the (1,2)−(1,1) condition [70% of 2-year-old children preferred fairness, $p = 0.012$] and the (0,2)−(1,1) condition [88% of 2-year-old children preferred fairness, $p < 0.001$], and their choices were similar to the level of chance in the (2,0)−(1,1) [58% of 2-year-old children

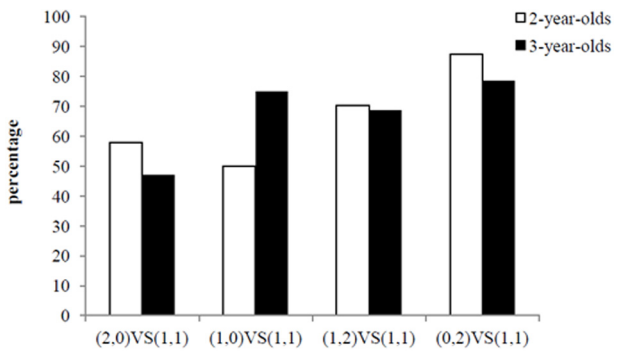

FIGURE 2 | The percentage of children preferring to fairness when others distributed resources for them and puppet.

TABLE 2 | Age and gender distribution across conditions with children as recipients.

Age group	(1,1)−(2,0)		(1,1)−(1,0)		(1,1)−(1,2)		(1,1)−(0,2)	
	Months	*n* (male)	Months	*n* (male)	Months	*n* (male)	Months	*n* (male)
2-year-old	28.2 ± 5.3	38 (23)	28.1 ± 5.2	40 (24)	28.1 ± 5.2	37 (21)	29.0 ± 4.8	24 (13)
3-year-old	40.7 ± 3.3	17 (9)	40.7 ± 3.4	16 (9)	40.7 ± 3.4	16 (9)	40.3 ± 3.5	14 (6)

Four alternative options were paired with fair option (1,1) in these four conditions. For example, in the (1,1)−(2,0) scenario, the fair distributor allocated one gift to the subject, and one gift to his or her counterpart, whereas the unfair distributor gave the subject two gifts and nothing to the counterpart. Children were asked which distributor they preferred.

preferred fairness, $p > 0.05$] and (1,0)−(1,1) [50% of 2-year-old children preferred fairness, $p > 0.05$] conditions. For 3-year-old children, they significantly displayed a fairness preference in the conditions of (1,0)−(1,1) [75% of 3-year-old children preferred fairness, $p = 0.041$] and of (0,2)−(1,1) [79% of 3-year-old children preferred fairness, $p = 0.026$], and their preference choices were similar to chance in the (2,0)−(1,1) [47% of 3-year-old children preferred fairness, $p > 0.05$] and (1,2)−(1,1) [69% of 3-year-old children preferred fairness, $p > 0.05$] conditions. This suggested that 2-year-old children significantly preferred fair choices when they were in the disadvantaged position in the alternative options but selected randomly when they were in the advantageous position in the alternative option. Three-year-old children significantly preferred fair choices when they were in the clearly disadvantaged position in the alternative option [(0,2)] and also preferred fairness when their own benefit in the fair option did not decrease compared with the alternative option [(1,0)−(1,1)], whereas they selected randomly when their own payoff in the fair option decreased compared with the alternative option [(2,0)−(1,1)].

Binary logistic regression showed that children's preferences for fairness significantly differed across the distribution scenarios when they distributed sources with their friend [$\chi^2(3) = 10.03$, $p = 0.018$]. Preferences for fairness were comparable in the 2- and 3-year-olds when they distributed resources with their friend [$\chi^2(1) = 0.04$, $\beta = -0.07$, $p = 0.837$]. The interaction between the alternative options and age was not significant [$\chi^2(3) = 3.86$, $p = 0.277$]. The two age groups were then combined to further analyze the effect of the alternative options. Compared with the other three alternatives, the (0,2) option was more likely to motivate children to select a fair choice [(0,2) versus (2,0): $\chi^2(1) = 8.15$, $\beta = -1.49$, $p = 0.004$; (0, 2) versus (1,0): $\chi^2(1) = 7.03$, $\beta = -1.38$, $p = 0.008$; and (0,2) versus (1,2): $\chi^2(1) = 2.40$, $\beta = -0.83$, $p = 0.121$]. Young children showed similar fairness preferences between the conditions of (2, 0)−(1, 1) and (1, 0)−(1, 1) [$\chi^2(1) = 0.08$, $\beta = 0.11$, $p = 0.780$], as well as between the conditions of (2, 0)−(1, 1) and (1, 2)−(1, 1) [$\chi^2(1) = 2.65$, $\beta = 0.66$, $p = 0.104$]. This result demonstrated that the children were more likely to display a fairness preference when they were in a disadvantageous position, but not when they were in an advantageous position.

We combined the (2,0) and (1,0) conditions as self-advantageous conditions and (1,2) and (0,2) as other-advantageous conditions (showed in **Figure 3**). There was a trend in young children's preference for fairness in the other-advantageous condition more so than in the self-advantageous condition [$F(1,33) = 3.97$, $p = 0.055$, $\eta_p^2 = 0.11$]. Moreover, in the self-advantageous condition, the interaction between the alternative options and age was significant [$F(1,53) = 3.98$, $p = 0.05$, $\eta_p^2 = 0.07$]. For 2-year-old children, their preferences for fairness were similar when the alternative options [(2, 0) and (1, 0)] were different. However, there was a trend in 3-year-old children to be more likely to consider the other's benefit when their own payoff was the same [$t(15) = -1.732$, $p = 0.10$, $d = 1.1$]. The small sample might have contributed to the absence of significance in 3-year-old children in terms of the value of index *d*. In the other-advantageous conditions, children always preferred fairness [$F(1,34) = 3.62$, $p > 0.05$, $\eta_p^2 = 0.10$].

Discussion

This study aimed to examine the development of fairness preferences in 2- and 3-year-old Chinese children as distributors and recipients. We hypothesized that young children would allocate resources equally when they were distributors, that the preference for fairness would increase with age, and that children as young as 2 years old would prefer proposers who equally allocated resources when they were the recipient. It was found that children displayed fairness preferences early, as young as 2 years old. Young children's fairness preferences increased with age and were influenced by distribution contexts.

Fairness Preference When Children Were the Distributors

Young children's preference for fairness increased with age both when distributing resources between self and friend and distributing between two friends. Moreover, 3-year-old children displayed higher levels of fair behavior than the level of chance in both conditions, whereas 2-year-old children performed randomly in conditions of distributing resources between themselves and their friend but significantly preferred to distribute equally in conditions of distributing resources between two friends. The results suggested an early onset of inequity aversion (Blake and McAuliffe, 2011; Paulus et al., 2013)

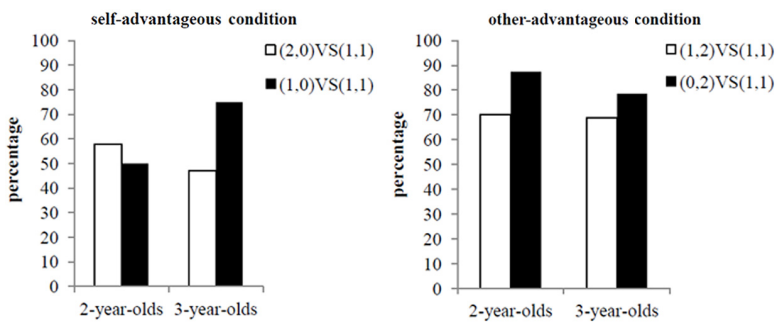

FIGURE 3 | Children's fairness preference in conditions of self-advantageous and other-advantageous when they were the recipients.

and provided evidence of inequity aversion based on young children's actual fair behavior, not only on fair knowledge (Sloane et al., 2012; Sommerville et al., 2013). Moreover, an increasing preference for fairness over the course of early childhood was also evident, similar to the findings in Western cultures (Eisenberg et al., 1998; Fehr et al., 2008a; Shaw et al., 2014). These findings suggest that there is cross-cultural consistency in the early onset of inequity aversion and increasing fairness preference in young children.

In addition, young children were more likely to prefer fairness when they distributed resources between two friends than when they distributed resources between themselves and their friend. This might be due to the fact that self-interest served as an important motivating factor when they distributed resources between themselves and a friend. The difficulties in inhibiting their strong desire for candies might have led them to show a lower level of fairness preference (Blake et al., 2014). On the other hand, preference for fairness has typically been measured by children's judgments regarding how to allocate resources between third parties (Damon, 1979), and thus the self-interest motive is excluded by this method. Our study examined young children's preference for fairness as a third party as well, and we found that young children displayed a high level of fairness preference when they distributed resources between two friends, especially in 3-year-old children. The attempts of young children to achieve equal distributions when they were third parties provided evidence for a strong inequity aversion (Paulus, 2015).

Fairness Preference When Children Were the Recipients

We found that young children's preferences for fairness differed in the four distribution scenarios when they were the recipient; specifically, (0,2) as the alternative option was more likely to motivate young children to select a fair choice. Moreover, there was a trend toward young children's preference for fairness in the other-advantageous condition than in the self-advantageous condition. Children were also more likely to prefer fairness with fewer payoffs in the other-advantageous condition. In other words, children tended to be more likely to show inequity aversion when they were in a disadvantageous position than when they were in an advantageous position. This result is similar to the findings of previous studies. For example, Birch and Billman (1986) found that 3-year-old children might notice and be averse to disadvantageous inequality in distributions. In addition, children 4–7 years old accepted allocations that put themselves at a relatively advantageous position and rejected those that put themselves at a relatively disadvantageous position (Blake and McAuliffe, 2011; Sheskin et al., 2014).

Although no significant differences in the preference for fairness were found between 2- and 3-year-old children when they were the recipients, further analysis showed that 3-year-old children were more likely to consider others' benefit when their own payoff was the same in the self-advantageous condition. In the condition (1,1)−(1,0), called the "prosocial game" in Fehr et al.'s (2008a) study, children's payoff was the same, while others' payoff was different. Three-year-old children were more likely to consider others' interest and show other-regarding preferences than 2-year-old children. Children were at an advantageous position in the (1,1)−(2,0) conditions, and they had to inhibit their own strong desire for candy and thus incur costs to behave fairly. In total, 58% of the 2-year-olds and 47% of the 3-year-old children preferred fairness in this condition, which both did not differ from chance (50%). Thus, we argued that children as young as 2 years old might already have developed a fairness preference and not be completely self-interested. In the meantime, this conclusion should be considered cautiously, and additional research should be conducted to further test the robustness of the finding.

For 2-year-old children, they were more likely to prefer fairness in the (1,1)−(1,2) condition, called the "envy game" in Fehr et al.'s (2008a) study, than in the (1,1)−(1,0) condition. Children's payoffs remained the same, but the other's payoffs were greater than their own in the (1,1)−(1,2) condition and less than their own in the (1,1)−(1,0) condition. Two-year-old children may already know how to avoid disadvantages in fairness by comparing their own payoff to others' and may make decisions based on their relative advantage rather than focusing solely on their own gains (Blake et al., 2014). The concern for a relative advantage may prevent children from acting on their fairness knowledge when they actually allocate resources, especially in younger children. As the ERC (Equity, Reciprocity, and Competition) model states, competition in social interactions is highly considered by individuals (Bolton and Ockenfels, 2000). It is argued that competition may render fairness considerations irrelevant when there is no opportunity to punish the monopolist (Fehr and Schmidt, 1999).

Children younger than 2 years old already display a fairness preference (Sloane et al., 2012; Sommerville et al., 2013). In the present study, although 2-year-old children began to prefer fairness in some conditions, their performance in some conditions, such as distributing resources between self and friend as a distributor and distributing resources in self-advantageous conditions as recipients, was similar to that of the random level. The difference might be due to the fact that knowledge of fairness was examined in Sloane et al.'s (2012) and Sommerville et al.'s (2013) study, whereas fair behavior through participant involvement was examined in our study. This gap between fairness knowledge and fair behavior might be due to children's desire to maintain an advantageous position compared to their peers (Blake et al., 2014). Moreover, this gap is argued to be motivated in children by a context of windfall gains, in which strategic concerns with maintaining an advantageous position relative to their peers appear to prevent children from following fairness norms (Blake et al., 2014). As in our study, the resources were given by the experimenter and were not earned by the participants. It is predicted that children younger than 2 years old might be able to apply fairness norms in the context of gaining resources through collaborative efforts. In addition, a weak executive function may prevent young children from inhibiting their desires for the resources (i.e., candy) when they are in charge of the distribution, and they are accordingly unable to follow the fairness norms that they already know (Blake et al., 2014).

Limitations and Implications

Fewer 3-year-olds than 2-year-olds participated in this study. A larger sample size of participants should be recruited, time and resources permitting, to increase the statistical power of testing the developmental differences in fairness preferences of 2- and 3-year-old children.

We would have found it interesting to examine the development of fairness preferences in children. However, only cross-sectional data were collected in this study. Longitudinal designs and analysis will be a future direction of this research.

Young Chinese children's fairness preferences were examined in the study. This is one of the few studies conducted in a non-Western sample. Future studies should increase the scientific knowledge regarding child development in different cultural contexts.

Children as young as 2 years old already displayed fairness preferences in our study. To provide evidence for the ontogenetic origins of fairness, future research can examine whether the preference for fairness emerges in even younger children. Eye tracking technology is an effective way to investigate psychological mechanisms in young children, even in non-verbal infants. Future studies should adopt eye tracking technology to investigate the evolutionary origins of fairness preferences in younger children.

CONCLUSION

When young children allocated resources as the distributor, their preference for fairness increased with age, and they were more likely to prefer fairness when they distributed resources between two friends than when they distributed resources between themselves and a friend. Our results suggest that even young children (2-year-olds) display inequity aversion and this preference for fairness increases over the course of early childhood.

When young children were distributed resources as the recipients, their preference for fairness differed in the four distribution scenarios. There was a trend in young children's preferences for fairness in the other-advantageous condition in comparison with the self-advantageous condition. That is, children may tend to be more likely to display inequity aversion when they are in a disadvantageous position.

AUTHOR CONTRIBUTIONS

WW, JL, and LZ designed the experiment. WW collected the data. JL analyzed the data. JL, WW, JY, and LZ wrote the manuscript.

FUNDING

This project was supported by the National Nature Science Foundation of China [31300859], the National Social Science Foundation of China (14ZDB161), and the Chinese Academy of Sciences (KJZD-EW-L04).

REFERENCES

Benenson, J. F., Pascoe, J., and Radmore, N. (2007). Children's altruistic behavior in the dictator game. *Evol. Hum. Behav.* 28, 168–175. doi: 10.1016/j.evolhumbehav.2006.10.003

Birch, L. L., and Billman, J. (1986). Preschool children's food sharing with friends and acquaintances. *Child Dev.* 57, 387–395. doi: 10.2307/1130594

Blake, P. R., and McAuliffe, K. (2011). "I had so much it didn't seem fair": eight-year-olds reject two forms of inequity. *Cognition* 120, 215–224. doi: 10.1016/j.cognition.2011.04.006

Blake, P. R., McAuliffe, K., and Warneken, F. (2014). The developmental origins of fairness: the knowledge–behavior gap. *Trends Cogn. Sci.* 18, 559–561. doi: 10.1016/j.tics.2014.08.003

Blake, P. R., and Rand, D. G. (2010). Currency value moderates equity preference among young children. *Evol. Hum. Behav.* 31, 210–218. doi: 10.1016/j.evolhumbehav.2009.06.012

Bolton, G. E., and Ockenfels, A. (2000). ERC: a theory of equity, reciprocity, and competition. *Am. Econ. Rev.* 90, 166–193. doi: 10.1257/aer.90.1.166

Bräuer, J., Call, J., and Tomasello, M. (2006). Are apes really inequity averse? *Proc. R. Soc. Lond. B Biol. Sci.* 273, 3123–3128. doi: 10.1098/rspb.2006.3693

Camerer, C. F. (2003). *Behavioral Game Theory: Experiments in Strategic Interaction*. Princeton, NJ: Princeton University Press.

Camerer, C. F., and Fehr, E. (2006). When does "economic man" dominate social behavior? *Science* 311, 47–52. doi: 10.1126/science.1110600

Cohen, L. B., and Cashon, C. H. (2003). "Infant perception and cognition," in *Handbook of psychology: Developmental psychology*, Vol. 6, eds R. M. Lemer, A. M. Easterbrooks, and J. Mistry (Hoboken, NJ: John Wiley & Sons, Inc), 65–89.

Confucius (1980). *The Analects of Confucius*. Beijing: Zhonghua Book Company.

Damon, W. (1975). Early conceptions of positive justice as related to the development of logical operations. *Child Dev.* 46, 301–312. doi: 10.2307/1128122

Damon, W. (1979). *The Social World of the Child*. San Francisco, CA: Jossey-Bass.

Dawes, C. T., Fowler, J. H., Johnson, T., McElreath, R., and Smirnov, O. (2007). Egalitarian motives in humans. *Nature* 446, 794–796. doi: 10.1038/nature05651

Declerck, C. H., Kiyonari, T., and Boone, C. (2009). Why do responders reject unequal offers in the Ultimatum Game? An experimental study on the role of perceiving interdependence. *J. Econ. Psychol.* 30, 335–343. doi: 10.1016/j.joep.2009.03.002

Eckel, C. C., and Grossman, P. J. (1996). Altruism in anonymous dictator games. *Games Econ. Behav.* 16, 181–191. doi: 10.1006/game.1996.0081

Eisenberg, N., Fabes, R. A., and Spinrad, T. L. (1998). "Prosocial development," in *Handbook of Child Psychology*, 5th Edn, Vol. 3, ed. W. Damon (New York, NY: Wiley & Sons), 701–778.

Fehr, E., Bernhard, H., and Rockenbach, B. (2008a). Egalitarianism in young children. *Nature* 454, 1079–1083. doi: 10.1038/nature07155

Fehr, E., and Fischbacher, U. (2003). The nature of human altruism. *Nature* 425, 785–791. doi: 10.1038/nature02043

Fehr, E., and Fischbacher, U. (2004). Third-party punishment and social norms. *Evol. Hum. Behav.* 25, 63–87. doi: 10.1016/S1090-5138(04)00005-4

Fehr, E., Goette, L., and Zehnder, C. (2008b). *A Behavioral Account of the Labor Market: The Role of Fairness Concerns*. Working Paper No. 394. Zurich: University of Zurich.

Fehr, E., and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *Q. J. Econ.* 114, 817–868. doi: 10.1162/003355399556151

Fehr, E., and Schmidt, K. M. (2003). "Theories of fairness and reciprocity: evidence and economic applications," in *Advances in Economics and Econometrics*, eds L. H. M. Dewatripont and S. Turnovky (Cambridge: Cambridge University Press), 208–257.

Geraci, A., and Surian, L. (2011). The developmental roots of fairness: infants' reactions to equal and unequal distributions of resources. *Dev. Sci.* 14, 1012–1020. doi: 10.1111/j.1467-7687.2011.01048.x

Gummerum, M., Hanoch, Y., and Keller, M. (2008). When child development meets economic game theory: an interdisciplinary approach to investigating social development. *Hum. Dev.* 51, 235–261. doi: 10.1159/000151494

Gummerum, M., Hanoch, Y., Keller, M., Parsons, K., and Hummel, A. (2010). Preschoolers' allocations in the dictator game: the role of moral emotions. *J. Econ. Psychol.* 31, 25–34. doi: 10.1016/j.joep.2009.09.002

Haidt, J., and Graham, J. (2007). When morality opposes justice: conservatives have moral intuitions that liberals may not recognize. *Soc. Justice Res.* 20, 98–116. doi: 10.1007/s11211-007-0034-z

Hamlin, J. K., Wynn, K., and Bloom, P. (2007). Social evaluation by preverbal infants. *Nature* 450, 557–559. doi: 10.1038/nature06288

Harbaugh, W. T., Krause, K., and Liday, S. J. (2003). *Bargaining by Children, Working Paper*. Eugene, OR: University of Oregon.

Hatfield, E., Walster, E. H., Walster, G. W., and Berscheid, E. (1978). *Equity: Theory and Research*. Boston, MA: Allyn & Bacon.

Haynes, G., and Gilovich, T. (2010). "The ball don't lie": how inequity aversion can undermine performance. *J. Exp. Soc. Psychol.* 46, 1148–1150. doi: 10.1016/j.jesp.2010.05.008

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., et al. (2005). "Economic man" in cross-cultural perspective: behavioral experiments in 15 small-scale societies. *Behav. Brain Sci.* 28, 795–815. doi: 10.1017/S0140525X05000142

Hoftede, G., Hofstede, G. J., and Minkov, M. (2010). *Cultures and Organizations: Software of the Mind: Intercultural Cooperation and Its Importance for Survival*. New York, NY: McGraw-Hill.

Hook, J., and Cook, T. D. (1979). Equity theory and the cognitive ability of children. *Psychol. Bull.* 86, 429–445. doi: 10.1037/0033-2909.86.3.429

Jensen, K., Hare, B., Call, J., and Tomasello, M. (2006). What's in it for me? Self-regard precludes altruism and spite in chimpanzees. *Proc. R. Soc. Lond. B* 273, 1013–1021. doi: 10.1098/rspb.2005.3417

Kenward, B., and Dahl, M. (2011). Preschoolers distribute scarce resources according to the moral valence of recipients' previous actions. *Dev. Psychol.* 47, 1054–1064. doi: 10.1037/a0023869

Kogut, T. (2012). Knowing what I should, doing what I want: from selfishness to inequity aversion in young children's sharing behavior. *J. Econ. Psychol.* 33, 226–236. doi: 10.1016/j.joep.2011.10.003

Kohlberg, L. (1969). "Stage and sequence: the cognitive-developmental approach to socialization," in *Handbook of Socialization Theory and Research*, ed. D. A. Goslin (Chicago, IL: Rand McNally).

Lane, I. M., and Coon, R. C. (1972). Reward allocation in preschool children. *Child Dev.* 42, 1382–1389. doi: 10.2307/1127523

LoBue, V., Nishida, T., Chiong, C., DeLoache, J. S., and Haidt, J. (2011). When getting something good is bad: even three-year-olds react to inequality. *Soc. Dev.* 20, 154–170. doi: 10.1111/j.1467-9507.2009.00560.x

Loewenstein, G. F., Thompson, L., and Bazerman, M. H. (1989). Social utility and decision making in interpersonal contexts. *J. Pers. Soc. Psychol.* 57, 426–441. doi: 10.1037/0022-3514.57.3.426

McAuliffe, K., Blake, P. R., Kim, G., Wrangham, R. W., and Warneken, F. (2013). Social influences on inequity aversion in children. *PLoS ONE* 8:e80966. doi: 10.1371/journal.pone.0080966

Olson, K. R., and Spelke, E. S. (2008). Foundations of cooperation in young children. *Cognition* 108, 222–231. doi: 10.1016/j.cognition.2007.12.003

Paulus, M. (2015). Children's inequity aversion depends on culture: a cross-cultural comparison. *J. Exp. Child Psychol.* 132, 240–246. doi: 10.1016/j.jecp.2014.12.007

Paulus, M., Gillis, S., Li, J., and Moore, C. (2013). Preschool children involve a third party in a dyadic sharing situation based on fairness. *J. Exp. Child Psychol.* 116, 78–85. doi: 10.1016/j.jecp.2012.12.014

Piaget, J. (1965). *The Moral Judgment of the Child*. New York, NY: Free Press.

Premack, D. (2007). "Foundations of morality in the infant," in *Social Brain Matters: Stances on the Neurobiology of Social Cognition*, ed. F. I. A. O. Vilarroya (Atlanta, GA: Editions Rodopi), 161–167.

Proctor, D., Williamson, R. A., de Waal, F. B., and Brosnan, S. F. (2013). Chimpanzees play the ultimatum game. *Proc. Natl. Acad. Sci. U.S.A.* 110, 2070–2075. doi: 10.1073/pnas.1220806110

Pruitt, D. G., and Rubin, J. Z. (1986). *Social Conflict: Escalation, Stalemate, and Settlement*. New York, NY: Random House.

Range, F., Horn, L., Viranyi, Z., and Huber, L. (2009). The absence of reward induces inequity aversion in dogs. *Proc. Natl. Acad. Sci. U.S.A.* 106, 340–345. doi: 10.1073/pnas.0810957105

Rao, N., and Stewart, S. M. (1999). Cultural influences on sharer and recipient behavior sharing in Chinese and Indian preschool children. *J. Cross Cult. Psychol.* 30, 219–241. doi: 10.1177/0022022199030002005

Rawls, J. (1958). Justice as fairness. *Phil. Rev.* 67, 164–194. doi: 10.2307/2182612

Rochat, P., Dias, M. D., Liping, G., Broesch, T., Passos-Ferreira, C., Winning, A., et al. (2009). Fairness in distributive justice by 3-and 5-year-olds across seven cultures. *J. Cross Cult. Psychol.* 40, 416–442. doi: 10.1177/0022022109332844

Schmidt, M. F., and Sommerville, J. A. (2011). Fairness expectations and altruistic sharing in 15-month-old human infants. *PLoS ONE* 6:e23223. doi: 10.1371/journal.pone.0023223

Shaw, A., Montinari, N., Piovesan, M., Olson, K. R., Gino, F., and Norton, M. I. (2014). Children develop a veil of fairness. *J. Exp. Psychol. Gen.* 143, 363–375. doi: 10.1037/a0031247

Shaw, A., and Olson, K. R. (2012). Children discard a resource to avoid inequity. *J. Exp. Psychol. Gen.* 141, 382-395. doi: 10.1037/a0025907

Sheskin, M., Bloom, P., and Wynn, K. (2014). Anti-equality: social comparison in young children. *Cognition* 130, 152–156. doi: 10.1016/j.cognition.2013.10.008

Sloane, S., Baillargeon, R., and Premack, D. (2012). Do infants have a sense of fairness? *Psychol. Sci.* 23, 196–204. doi: 10.1177/0956797611422072

Smith, C. E., Blake, P. R., and Harris, P. L. (2013). I should but I won't: why young children endorse norms of fair sharing but do not follow them. *PLoS ONE* 8:e59510. doi: 10.1371/journal.pone.0059510

Sommerville, J. A., Schmidt, M. F., Yun, J. E., and Burns, M. (2013). The development of fairness expectations and prosocial behavior in the second year of life. *Infancy* 18, 40–66. doi: 10.1111/j.1532-7078.2012.00129.x

Takagishi, H., Kameshima, S., Schug, J., Koizumi, M., and Yamagishi, T. (2010). Theory of mind enhances preference for fairness. *J. Exp. Child Psychol.* 105, 130–137. doi: 10.1016/j.jecp.2009.09.005

Zhu, L., Huangfu, G., Keller, M., Mou, Y., and Chen, D. (2008). The development of Chinese children 's decision – making in ultimatum and dictator games. *Acta Psychol. Sin.* 40, 402–408. doi: 10.3724/SP.J.1041.2008.00402

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 05 October 2016
doi: 10.3389/fpsyg.2016.01510

Using Behavioral Consensus to Learn about Social Conventions in Early Childhood

Wanying Zhao, Andrew S. Baron and J. K. Hamlin*

Department of Psychology, University of British Columbia, Vancouver, BC, Canada

Adults make inferences about the conventionality of others' behaviors based on their prevalence across individuals. Here, we look at whether children use behavioral consensus as a cue to conventionality, and whether this informs which cultural models children choose to learn from. We find that 2- to 5-year old children exhibit increasing sensitivity to behavioral consensus with age, suggesting that like adults, young humans use behavioral consensus to identify social conventions. However, unlike previous studies showing children's tendencies to prefer and to learn from members of a consensus, the present study suggests that there are contexts in which children prefer and learn from unconventional individuals. The implications of these different preferences are discussed.

Keywords: social conventions, selective learning, social groups, social evaluation, innovation, cultural learning

OPEN ACCESS

Edited by:
David Buttelmann,
University of Bern, Switzerland

Reviewed by:
Olivier Pascalis,
Université Grenoble Alpes, France
Sabine Seehagen,
University of Waikato, New Zealand

****Correspondence:***
Wanying Zhao
wzhao@psych.ubc.ca

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *16 February 2016*
Accepted: *20 September 2016*
Published: *05 October 2016*

Citation:
Zhao W, Baron AS and Hamlin JK (2016) Using Behavioral Consensus to Learn about Social Conventions in Early Childhood. Front. Psychol. 7:1510. doi: 10.3389/fpsyg.2016.01510

INTRODUCTION

Humans are creatures of social convention. Social conventions prescribe group-specific ways of being, facilitating smooth, and cooperative social interactions amongst group members (Cialdini and Trost, 1998; Henrich and Henrich, 2007). They serve as symbolic markers of group membership, making it easy to identify whether an individual belongs to an in-group or to an out-group (Boyd and Richerson, 1987; Fitch, 2000). Conventional behaviors are often also of high quality, because they have been vetted by numerous people over repeated use, and therefore represent an efficient and effective way of doing things. Social conventions shape the ways in which we fulfill our most basic biological functions, including how we eat, sleep, and have sex (e.g., Ford and Beach, 1951; Jenni and O'Connor, 2005; Schultz et al., 2007). Members of every culture follow their societies' rules for how to behave from early in life (Henrich et al., 2001; Killen and Smetana, 2005), and are exquisitely sensitive to whether others follow group conventions, willingly punishing unconventional behaviors at personal cost (Gintis, 2000; Fehr et al., 2002; Henrich, 2006). Indeed, even very young children rapidly acquire new social rules, and protest if those rules are violated (Schmidt et al., 2010; Schmidt and Tomasello, 2012). Here, we explore the development of sensitivity to social convention by examining whether young children exhibit social preferences for individuals who adhere to a group's shared behavior (e.g., a dance), and whether these preferences influence children's selection of whom to learn from.

Adults identify potential social conventions by looking to the behaviors of the majority, and, once a convention is identified, modify their behaviors to reflect it (Latané and Darley, 1968; Prentice and Miller, 1993; Cialdini et al., 2006; Goldstein et al., 2008). A growing body of recent work suggests that young children are similarly sensitive to the behaviors of the majority, and readily use majority behaviors to learn about their culture. For example, when presented with

several potential informants, 3- and 4-year-olds preferentially accept information from a 3-member consensus rather than a lone individual (Corriveau et al., 2009); children's tendency to follow the majority is so strong that it can even lead children to discount their own perceptual judgments (Corriveau and Harris, 2010; see Asch, 1952 for adult evidence). Selectively learning from those who produce familiar conventional behaviors is already observable in infancy: 14-month-olds are more likely to imitate individuals who have produced conventional versus unconventional acts (e.g., putting shoes on one's feet versus one's hands; Zmyj et al., 2010). Finally, if no consensus information is currently observable, young children readily use indirect cues to majority behavior: 3-year-olds preferentially learn from familiar models versus unfamiliar ones (Reyes-Jaquez and Echols, 2013), and 14-month-olds are more likely to imitate in-group versus out-group members (Buttelmann et al., 2013). Together, these findings suggest that young children are sensitive to potential sources of conventional knowledge, and that they selectively take on new information from these sources (Bar-Haim et al., 2006; Kinzler et al., 2007; Powell and Spelke, 2013).

While it is often beneficial to follow conventions performed by the majority of group members, there may be situations in which doing so is less optimal. For instance, sometimes the majority is simply incorrect, and so viewing majority behaviors in some privileged light would lead to error (e.g., Prentice and Miller, 1993). Indeed, despite work demonstrating that children sometimes slavishly follow the majority (Corriveau and Harris, 2010), other studies suggest that children are sensitive to the possibility that majorities can be wrong. For example, Schillaci and Kelemen (2014) found that 4-year-old children followed the consensus when majority and minority opinions were equally likely to be true; however, children followed a minority opinion if the minority opinion were more plausible. In a related study, 4- and 5-year olds were equally likely to learn about how to open novel puzzle boxes from an individual versus a group when opening success-rates were equated; however, children were more likely to learn from a successful individual than from an unsuccessful group (Scofield et al., 2013; Wilks et al., 2015). Together, these studies suggest that children's sensitivity to majority behaviors is flexible: they will avoid learning from the majority when the majority is clearly unsuccessful.

Of course, young learners will frequently be confronted with situations in which it is impossible to determine the relative "success" of a given behavior, given that much of what humans do is causally opaque. For example, in many language learning situations, all labels are unfamiliar to the learner, and there is no way of determining from the input which labels go with which concepts. In addition, there are entire classes of human behaviors, for example dances and rituals, which are causally opaque and socially motivated, and thus have no physically evaluable outcomes (Legare et al., 2015). The learning of rituals requires conforming to the way group members perform actions with a high degree of accuracy (Herrmann et al., 2013; Watson-Jones et al., 2014). Presumably, in these situations children should be particularly motivated to acquire the behaviors of the majority, and to learn further information from those who have produced majority behaviors. However, although to date much research has established that children preferentially accept novel labels or artifact functions from a majority (Corriveau and Harris, 2010; Chen et al., 2013; Schillaci and Kelemen, 2014), to our knowledge, few studies have yet explored whether children are sensitive to group consensus in arbitrary action domains like dancing (for discussion see, Legare and Nielsen, 2015). The current studies were designed to fill this gap in the literature, by examining children's reactions to and preferential learning from an individual who performs the same-dance as several other individuals, versus an individual who performs a novel-dance. We hypothesized that children would identify the dance as a convention or a ritual behavior, and would therefore prefer and preferentially learn from individuals who perform it.

THE PRESENT STUDY

Children watched a live action dance show, depicting generic Smurf plush toys. Four identical Smurfs performed sequences of arbitrary physical movements making up different dances. The experiment was conducted following the recent release of a Smurfs movie, so the toys were familiar and engaging to many children. Smurfs look like members of a distinct social group, and were introduced as such by the Experimenter, by saying "Do you know who these guys are? They are Smurfs!."

We wished to know if kids prefer individuals who follow a consensus over those who do not. However, we needed to ensure that any observed preferences would in fact be due to consensus, and not due to something simpler, such as behavioral familiarity or exposure frequency. To address whether children differentiate between group-relevant conventions (behaviors that are performed by multiple different individuals in a group) and simple behavioral familiarity (behaviors that are performed frequently), participants were randomly assigned to either the "Consensus condition" or the "Repetition condition." In the Consensus condition, children were introduced to the group of Smurfs and then viewed four Smurfs (heretofore the Demonstrators) perform the very same-dance, one at a time, for a total of four dances. In the Repetition condition, children were introduced to the same four Smurf Demonstrators, but then viewed just one Demonstrator perform the same-dance repeatedly, for a total of four dances. Following the Demonstrator(s)' dances, one new Smurf performed the dance that the Demonstrator(s) had just performed (heretofore the "same-dance" Protagonist), and a second new Smurf Protagonist performed a novel-dance (the "novel-dance" Protagonist).

Subsequently, we explored children's social preferences for and learning tendencies from the novel- and same-dance Protagonists. To measure social preference, children were presented with the two Protagonists and asked to identify which they liked. To measure learning, each Protagonist provided a label for a novel object, and children were asked to endorse one label or the other. We reasoned that if children form preferences and selectively learn based on conventionality, they should distinguish the same-dance from the novel-dance Protagonists in the Consensus condition but not the Repetition condition. However, if children prefer individuals simply based on

behavioral familiarity, then they should show similar preferences and learning in both the Consensus and Repetition conditions. Furthermore, if children deem conventional knowledge to be beneficial, they should select and learn from the same-dance Protagonist.

Methods

Participants

One hundred and ninety-eight children participated in the study (Mean age = 3.98, 44.6% female, range = 2 years, 0 days – 6 years, 0 days, with an equal number of children above and below the mean age). Data from 19 children were excluded due to parental interference, or to providing no choice on both the dependent measures. Participants were recruited during a visit to the Living Lab at Science World, a local Science Centre, and tested in a sound proof room dedicated for behavioral science research. A legal guardian provided consent for child participants. The majority of participants were White and all were English speaking (though not necessarily as a first language), though a range of ethnicities and SES backgrounds were represented.

Procedures

Introduction

Children were tested individually in a testing room, seated across a table from the Experimenter. To introduce the study, the Experimenter gestured to four Demonstrator Smurfs seated in a group to the left and two Protagonist Smurfs seated in a group to the right, all across from participants on the table, and asked, "Do you know who these guys are? That's right, they're Smurfs! We're going to see these Smurfs do a dance today." Protagonists were distinguishable from each other by wearing vertically striped vs. horizontally striped hats; they were otherwise identical (**Figure 1** for stimuli). After the introductions, Protagonists were removed from the table and placed out of sight, while Demonstrators remained seated on the table.

Demonstration

Each dance began with a Demonstrator saying "My turn!" in an excited voice, and then moving to the center of the stage. The Demonstrator then performed either the "Jumping" dance or the "Swaying" dance (counterbalanced across participants). The Jumping dance consisted of jumping up and down four times, and the Swaying dance consisted of swaying side to side four times; both dances were performed at the same rhythm, for the same total duration, and Smurfs moved approximately the same distance (up and down, or side to side) from their starting places during each one. After completing the dance, the Demonstrator returned to its initial position. In the Consensus condition, each of the 4 Demonstrators performed the same-dance in turn. In the Repetition condition, one of the 4 Demonstrators performed the same-dance 4 times in a row. To maximize the similarity between the Consensus and Repetition conditions, the Repetition Demonstrator said "My turn!" at the start of each dance, and returned to his original position between each dance. After the Demonstrators' performance, the Experimenters said, "ok Bye! See you later!" and were removed together from the table.

Protagonist phase

Following the demonstration phase, the Protagonists were brought out to the table and reintroduced to the participant. The Experimenter said, "Let's see what these guys do!" One of the Protagonists performed the same-dance as the Demonstrators, and the other Protagonist performed the novel-dance. For example, when the Demonstrators performed the Jumping dance, the same-dance Protagonist also performed the Jumping dance, while the novel-dance Protagonist performed the Swaying dance. Dances performed by the Demonstrator(s), performance orders, and Protagonist type (whether they performed the same or novel-dance) were counterbalanced across subjects.

Preference

After each child viewed the dances, they were presented with the two Protagonists side-by-side in the center of the table and asked, "Which one do you like more?" If the child did not provide a choice after 3 s, they were prompted by the Experimenter, "Do you like one of these guys more than the other?" A small number of children ($n = 9$, 4.3% of the sample) claimed to like the two Protagonists equally; their responses for Liking were excluded from the analyses. Responses from 176 children were included in the analyses reported below.

Learning

Following their response for Liking, we examined whether children exhibit a preference for one of the two actors in a novel context probing knowledge about object labels. For this task, an unfamiliar object (a metal thermos cap) was introduced. The Experimenter held the object and rotated it in different angles, then placed it on the table in front of the child. Children were asked if they knew what it was; none did. The Experimenter then said, "These guys have different names for this object, let's hear what they think it's called." The Experimenter then picked up each of the Protagonists in turn to point at the cap and label it; one said, "It's a pavo!" and the other said, "It's a loba!" Children were then asked, "What do you think it's called?" Children's responses were recorded, and all participants were thanked and given a sticker for their participation. If children's choice of cultural models is motivated by learning from those they like, we should expect responses for this question to be correlated with their choice of Protagonist.

Results

Liking

In response to the question "who do you like more?" children picked the novel-dance Protagonist more often in the Consensus condition (57 of 81, or 70.3%, binomial probability test, $p < 0.001$, two-tailed), but did not show a preference in the Repetition condition (51 of 90, or 56.6%, binomial probability test, $p = 0.246$, two-tailed). There was marginally significant effect of condition (Pearson's $\chi^2 = 3.44$, $p = 0.064$). This supports our prediction that children's social preferences are informed by what an individual does, relative to the overall distribution of observed behaviors. However, the preference for the novel-dance Protagonist opposed our predictions, and suggests that children sometimes prefer individuals who

FIGURE 1 | Smurf puppets used in Study 3: demonstrators on the left, and Protagonists on the right.

TABLE 1 | Proportion of children who liked the novel-dance Protagonist, by age and by condition.

	Consensus		Repetition		Difference between conditions	
Age group	**Pr (novel)**	***p*-value***	**Pr (novel)**	***p*-value***	***p*-value****	***n***
2–3	0.53	1	0.62	0.27	0.543	46
3–4	0.65	0.21	0.69	0.21	0.823	40
4–5	0.76	0.016	0.52	1	0.071	54
5–6	0.81	0.006	0.44	0.81	0.009	34

**Binomial probability test (two-tailed), **Pearson χ^2 test.*

introduce novel, rather than conventional, behaviors. However, subsequent age analyses revealed that these preferences showed marked differences by age.

Liking by age

Two- and three-year-old children did not show significant preferences for either Protagonist in either Consensus or Repetition conditions (see **Table 1** for children's Protagonist choices by age and study condition). The proportion of 2-year-olds who preferred the novel-dance Protagonist was 53% in the Consensus condition (binomial probability test, $p = 1$), and 62% in the Repetition condition (binomial probability test, $p = 0.27$), and the proportion of 3-year-olds was 65% in the Consensus condition (binomial probability test, $p = 0.21$), and 69% in the Repetition condition (binomial probability test, $p = 0.21$). Furthermore, there was no significant difference between conditions at either age (Pearson $\chi^2 = 0.37$, $p = 0.543$ for 2 year-olds, $N = 46$ and $\chi^2 = 0.05$, $p = 0.823$ for 3 year olds, $N = 40$). Children started to show a significant preference for the novel-dance character at age 4 (proportion choosing novel-dance Protagonist = 76%, $p = 0.016$, two-tailed), and did so only in the Consensus, but not the Repetition, condition (proportion choosing novel-dance Protagonist = 48%, $p = 1$; Pearson $\chi^2 = 3.26$, $p = 0.071$, $N = 54$). This pattern became more pronounced by age 5, where 88% of children in the Consensus condition chose the novel-dance Protagonist ($p = 0.006$), compared to 44% in the Repetition condition ($p = 0.81$). The difference between conditions is significant by a Pearson χ^2 ($p = 0.009$, $N = 34$). In summary, the overall pattern described earlier was due to both the 4 and 5 year olds differentiating between Repetition and Consensus conditions, and preferring the novel-dance Protagonist in the Consensus condition. See **Figure 2** for graph depicting the proportion of children who chose the novel-dance Protagonist.

Magnitude estimates for liking

To estimate the effect sizes of the comparisons discussed above, we employed a second analytic strategy to predict children's likelihood of preferring the novel-dance Protagonist. For this analysis, a binary logistic regression was run using combined data from participants of all age groups. In the binary logistic regression model, condition (Repetition, Consensus), age (centered on sample mean of 3.98), sex (female, male), and a condition by age interaction term were entered as model predictors for likelihood of choosing the novel-dance Protagonist. An omnibus test of the model was significant ($\chi^2(4) = 10.977$, $p = 0.027$), improving our ability to predict infants' Protagonist choices on 3% of cases. Together, the coefficients explained approximately 8.2% of the variance in target choice (Nagelkerke $R^2 = 0.082$). Logistic Regression coefficients and standard errors for each predictor variable are shown in **Table 3**.

Looking at individual predictors, analyses revealed that being in the Consensus condition predicted children being 1.7 times

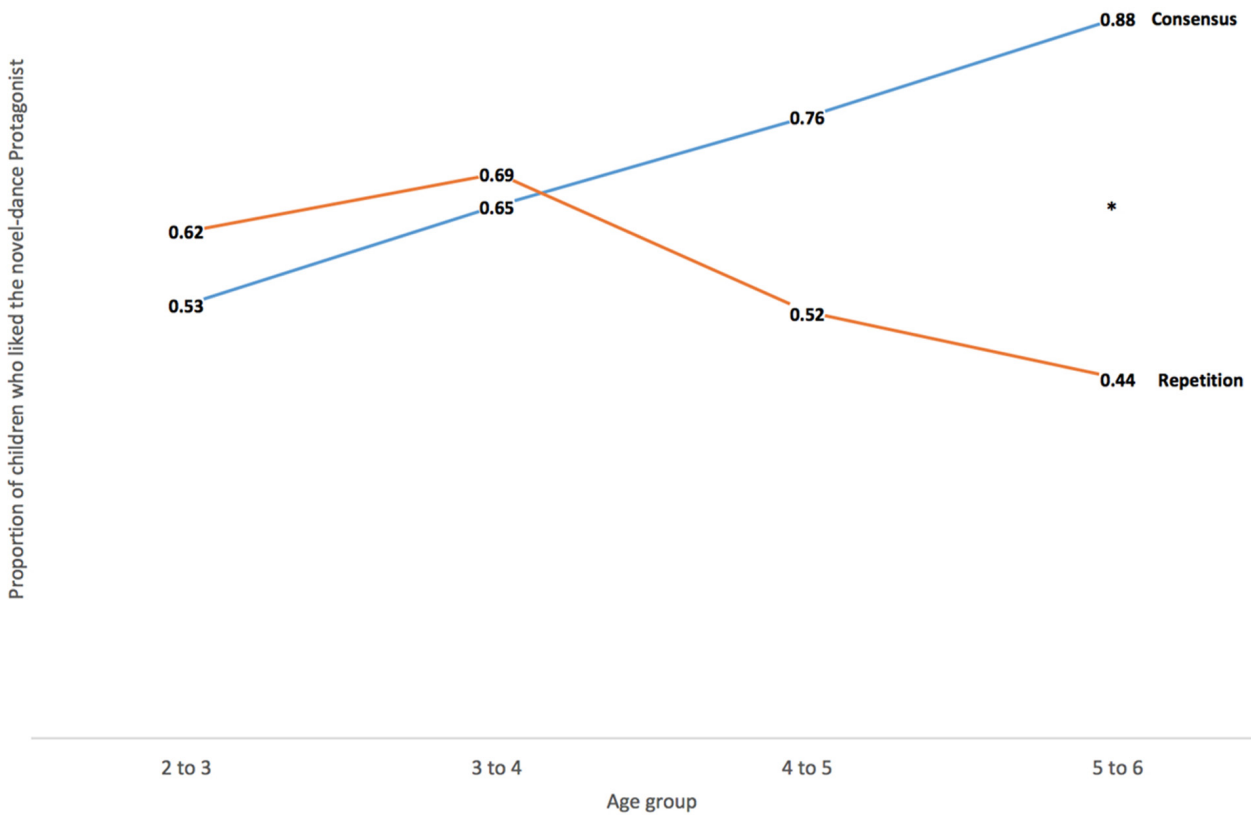

FIGURE 2 | Proportion of children who liked the novel-dance Protagonist, by age, and by condition. *$p < 0.05$.

TABLE 2 | Proportion of children who learned from the novel-dance Protagonist, by age, and by condition.

Age group	Consensus		Repetition		Difference between conditions	
	Pr (novel)	*p*-value*	Pr (novel)	*p*-value*	*p*-value**	*n*
2–3	0.53	1	0.54	1	1	46
3–4	0.55	1	0.5	1	1	40
4–5	0.58	0.55	0.41	0.44	0.22	54
5–6	0.81	0.024	0.29	0.14	0.003	34

**Binomial probability test (two-tailed), ***Pearson χ^2 test.*

as likely to pick the novel-dance Protagonist, compared to the Repetition condition (or 0.58 times as likely to choose the same-dance Protagonist; logistic regression coefficient = −0.546, $p = 0.096$, Odds Ratio = 0.579). Sex was also a significant predictor, such that boys were nearly twice as likely to prefer the novel-dance Protagonist as girls (or 0.51 times as likely to prefer the same-dance Protagonist; logistic regression coefficient = −0.673, $p = 0.042$, Odds Ratio = 0.51) regardless of condition. While we did not predict this difference, such a result is consistent with previous findings of gender differences in conformity (e.g., Maccoby and Jacklin, 1974; Eagly, 1978; Cooper, 1979; Eagly and Carli, 1981). Age alone was not a significant predictor; however, children's likelihood of differentiating their choice by condition increased with age, indicating that for every 1 year increase in age, children were 1.8 times as likely to prefer the novel-dance Protagonist in the Consensus condition as compared to the Repetition condition (or 0.57 times as likely to prefer the same-dance Protagonist; logistic regression coefficient = −0.583, $p = 0.055$, Odds Ratio = 0.57).

Learning

Overall, children were more likely to adopt the label for the unfamiliar object from the novel-dance Protagonist in the Consensus condition (60.5% or 49 of 81 children), than in the Repetition condition (39 of 89, or 43.8%; Pearson χ^2 test $p = 0.029$, two-tailed). (See **Table 2** for proportion of children who learned from the novel-dance Protagnoist, by age, and by condition). Consistent with our results for liking, children appeared sensitive to the distribution of observed behaviors for making informant choices. In particular, children adopted the

TABLE 3 | Liking and learning from the same-dance Protagonist, predicted by age, sex, condition, and age-by-condition interaction term.

Predictors	Liking (*SE*)	Learning (*SE*)
Age (centered)	0.068 (0.184)	0.334 (0.192)†
Sex	−0.673 (0.331)*	0.256 (0.323)
Condition	−0.546 (0.329)†	−0.579 (0.314)†
Age × Condition	−0.583 (0.305)†	−0.783 (0.293)**
Observations *(n)*	176	174

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$.
Logistic regression coefficients are the natural log (ln) of odd ratios for each predictor. Standard errors are presented in parentheses.

unfamiliar object label from a Smurf who performed a novel-dance, after having seen a group of Smurfs first perform a shared dance. As with liking judgments, children's informant preference became increasingly pronounced with age. See **Figure 3** for graph depicting the proportion of children who learned from the ovel-dance Protagonist.

Effects of age

Two-, three-, and four-year old children were equally likely to learn from the novel-dance Protagonist as the same-dance Protagonist in both Consensus and Repetition conditions (proportion preferring to learn from the novel-dance Protagonist, at 2–3 years = 53%, $p = 1$, $N = 46$; at 3–4 years = 55%, $p = 1$, $N = 40$; at 4–5 years = 58%, $p = 0.58$, $N = 54$). Only 5-year-olds made a significantly different choice of informant in the Consensus condition than from the Repetition condition, with 81% preferring to learn from the novel-dance Protagonist in the Consensus condition (binomial probability test, $p = 0.024$, two-tailed), and 29% in the Repetition condition. The difference in choice patterns between Consensus and Repetition conditions was significant by a Pearson χ^2 test ($\chi^2 = 8.93$, $p = 0.003$, $N = 34$).

Magnitude estimates for learning

Using the same analytic approach as for the liking measure, we conducted a binary logistic regression to examine the magnitude of difference in likelihood by age and by condition. Condition, age, sex, and age-by-condition interaction term were entered as model predictors for likelihood of choosing the novel-dance Protagonist. An omnibus test of the model was significant ($\chi^2(4) = 10.997$, $p = 0.027$), improving our ability to predict infants' informant choice on 9.2% of cases. Together, the coefficients explain approximately 8.1% of the variance in informant choice (Nagelkerke $R^2 = 0.081$; see **Table 3** for binary logistic regression coefficients and standard errors for each predictor).

Turning to the individual predictors, children in the Consensus condition were nearly twice as likely to endorse the novel-dance Protagonist's label for the novel object as those in the Repetition condition (logistic regression coefficient = −0.579, $p = 0.065$, OR = 0.56 for the same-dance Protagonist). Age was a marginally significant predictor, such that older children were 1.4 times more likely to prefer the same-dance informant (logistic regression coefficient = 0.334, $p = 0.076$, OR = 1.397). However, a significant Condition by Age interaction indicates that with every year increase in age, children in the Consensus condition were 2.1 times as likely to endorse the novel-dance Protagonist's label for the unfamiliar object, compared to the Repetition condition (logistic regression coefficient = −0.783, $p = 0.008$, OR = 0.457 for the same-dance Protagonist). Unlike the preference measure, sex was not a significant covariate for which Protagonist's label children endorsed. This issue will be revisited in the general discussion.

Liking Predicts Learning

Children's liking for a Protagonist significantly predicted whom they wanted to learn from. In a separate logistic regression model using Liking to predict informant choice, children who reported liking a Protagonist were five times as likely to learn from that same Protagonist than were children who did not report the same preference (logistic regression coefficient = 1.605, $p < 0.001$; OR = 4.98). In this model, Condition moderated by Age continues to be a significant predictor (logistic regression coefficient = −0.642, $p = 0.039$, OR = 0.526). That is, children increasingly differentiated their preferences across study conditions with age, showing a preference to learn from the novel-dance informant in the Consensus condition, and no clear preference in the Repetition condition. In this analysis, we removed Sex as a covariate, since it was a non-significant predictor in the full model, and including it greatly hampers the model's predictions fit to the observed data. Hosmer and Lemeshow test indicate that the predicted data did not significantly differ from the observed data ($\chi^2(8) = 5.594$, $p = 0.693$), indicating good model fit. Together, preference (same-dance Protagonist, novel-dance Protagonist), condition, age, and an age-by-condition interaction term accounted for 22.8% of variability in children's informant choices (Nagelkerke $R^2 = 0.228$) and also improved predictions of those choices on 19% of cases. Logistic Regression coefficients and standard errors for each predictor variable are shown in **Table 4**.

Discussion

In both liking and learning measures, children's choices differed by age. The youngest tested groups (2 and 3 year olds) did not differ in their choice of Protagonist across Consensus and Repetition conditions – it appears that they were insensitive to the distribution of information across individuals in our paradigm. In contrast, 4 and 5 year olds were influenced by behavioral consensus across individuals (they preferred the Protagonist who did a novel-dance), but not repetitive actions by a single individual (in which they chose the two Protagonists equally); this effect was more pronounced in older children, suggesting a greater readiness to discriminate individuals based on conventionality. The transitional age at which children in our sample differentiated between Consensus and Repetition conditions occurs around 4 years of age for preference, and a year later for informant choice, hinting at the possibility that preference informs model choice in this paradigm. Five-year-olds in our sample preferentially learned a novel object label from the novel-dance Protagonist, but were equally likely to learn from the same-dance Protagonist and novel-dance Protagonist in

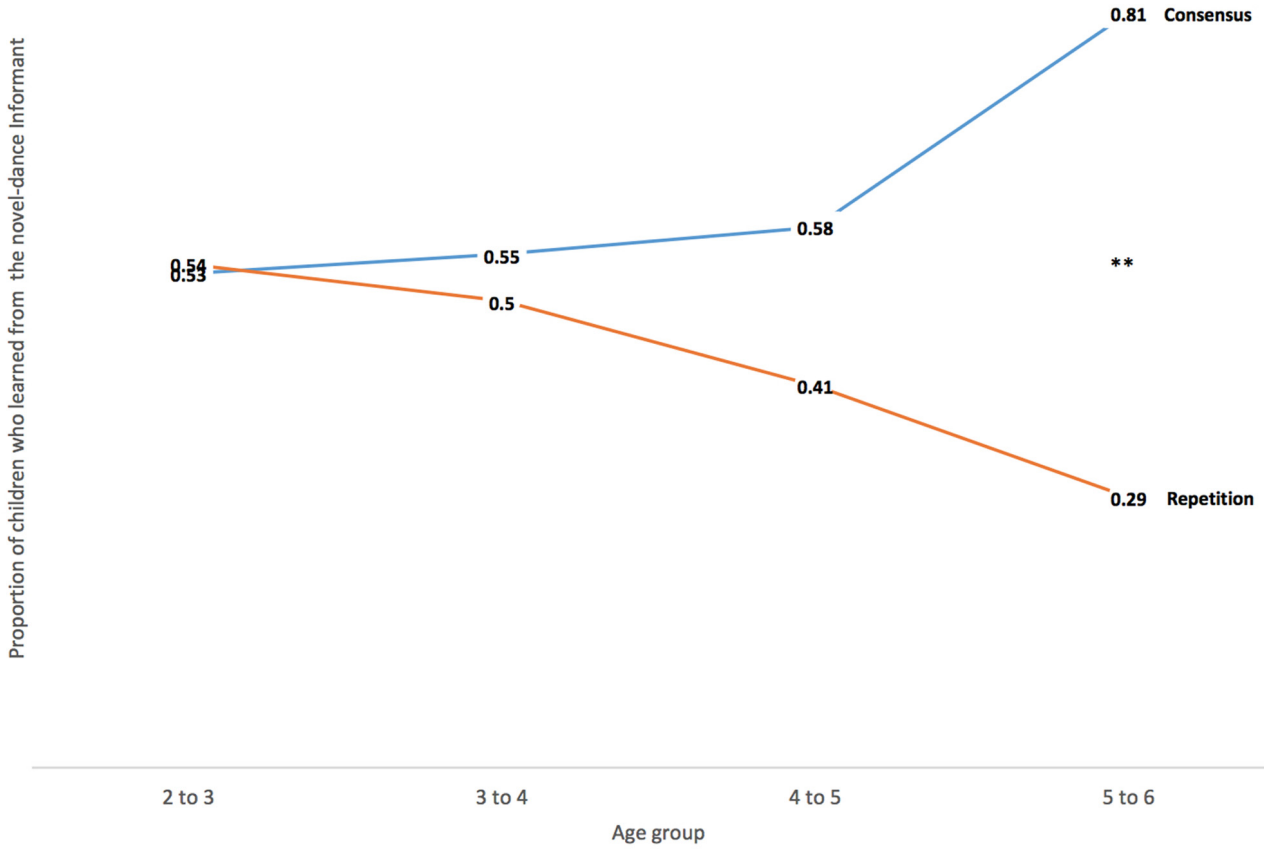

FIGURE 3 | Proportion of children who learned from the novel-dance Protagonist, by age, and by condition. $^{**}p < 0.01$.

TABLE 4 | Learning predicted by Liking, Age, Condition, and Age × Condition interaction term.

Predictors	Learning (*SE*)
Age (centered)	0.339 (0.202)†
Condition	−0.441 (0.340)
Age × Condition	−0.642 (0.310)*
Liking	1.605 (0.362)***
Observations *(n)*	169

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Logistic regression coefficients are the natural log (ln) of odd ratios for each predictor. Standard errors are presented in parentheses.

the Repetition condition, continuing the trajectory that emerges nearly a year earlier.

While these results suggest that the ability to differentiate between familiar and conventional information emerges around 4 years of age, we cannot rule out the possibility that they are due to age-related changes in domain-general processes, such as working memory. Indeed, as with all studies that report a developmental difference and an absence of a given ability at a young age, it is important to differentiate between children's ability to perform on the task and their conceptual understanding. It is possible that two- and 3-year-old children's results may be an artifact of immature memory for actors' dances, rather than indifference between familiarity and conventionality *per se* (see Hamlin, 2014). Future research could explore whether age related differences in working memory accounts for the developmental findings we observed.

GENERAL DISCUSSION

We set out to examine whether preschool-aged children differentiate between conventional behaviors, performed by several members of a group, and equally frequent behaviors performed by just one member of a group. We demonstrated preschool-aged children were more likely to exhibit a social preference in the face of consensus behavior than frequent behavior. Furthermore, contrary to our initial hypotheses, children preferred to learn from individuals who performed novel actions versus those who performed conventional actions.

Children's preferences for the unconventional actor indicate that they sometimes prefer innovative members of the group. While inconsistent with previous findings that children trust informants who were part of a consensus over a dissenter (Corriveau et al., 2009), these results are consistent with studies showing that children and adults are willing to learn from minorities who are successful (Scofield et al., 2013;

Schillaci and Kelemen, 2014; Wilks et al., 2015). They are also consistent with models of cultural evolution, wherein occasional injection of innovations (through individual learning, or errors in social learning) to a cumulative repertoire help human groups adapt to changing environments (Lehmann et al., 2010; Boyd et al., 2011). Indeed, individuals who always produce behaviors that the rest of the group performs are necessarily limited as sources of new insights; thus, another reason to follow minorities may be to acquire innovative behaviors that the group does not yet know. This motivation may have driven children's preferences and learning behaviors in the current studies (Legare and Nielsen, 2015).

Another (non-mutually exclusive) possibility for the disagreement between these findings and studies showing children prefer to learn from consensus members is the study's methodological design. Previous research with 3-year-olds suggests that imitative fidelity is higher after witnessing synchronous than successive actors (Herrmann et al., 2013), presumably because synchronicity is a cue by which viewers infer that an act is a ritual. In this study, Demonstrators were shown to perform dances sequentially, rather than synchronously, and thus may have not cued the interpretation that the dances are performances of a ritual. Future studies may wish to examine adding ritual cues and their effects on children's preferences for conventional models.

Another way in which our methodology may have produced disagreement with previous studies is that our study established consensus in one domain (dancing), and examined learning in a different domain (object labeling). Thus, children were initially introduced to the informants in a context where learning may not have been a relevant objective. Children's subsequent desire to learn from a model may be informed by positive feelings toward the individual formed during the dance phase, rather than a direct assessment of their skill in word labeling. Future studies should attempt to tease apart these possibilities. The age patterns in our results provide some support for children's choices being motivated by liking: 4 year olds in our sample reliably showed a preference for novel-dance Protagonists, a full year before they as a group reliably *learned* from novel-dance Protagonists. The timing of these effects, together with the strong relationship between children's expressed preference and their subsequent choice of informant, suggests that children may first form a favorable impression of a Protagonist, which eventually informs who they choose to learn from in a different context. If so, it is possible that at least some proportion of children's model choices are driven by a halo effect, whereby children simply learn from those they like, rather than any critical evaluation of potential models in each context a new (Dunham et al., 2011; Baron and Dunham, 2015). Previous studies' reliance on single task measures may risk inflating the degree to which preschoolers demonstrate epistemic vigilance, especially in the context of longstanding relationships in which they like all the informants. Indeed, spillover effects in children's informant choice have been observed to a limited extent in past studies (e.g., Chudek et al., 2012). Future studies may benefit from using more multi-task measures to explore the boundary conditions on such cross-task spillover.

An additional possibility is that children preferred and learned from the novel-dance Protagonist because they were relatively certain that all the individuals were part of the same group. That is, in previous studies where children have selectively learned from members of a consensus, group status has either not been made explicit, or it was clear that both in-group and out-group members were involved (Corriveau et al., 2009; Chen et al., 2013). In these situations, children may have used consensus behavior as a cue to who was in the same group, and preferred to learn from in-group members. In contrast, in the present paper all characters were Smurfs, they were introduced together, and the study was run just after a Smurfs movie was released that many participants reported seeing. For these reasons, presumably children believed that all the characters were part of the same "Smurfs" group. If so, children may not have needed to use conventionality as a cue to group membership or group-specific knowledge, and so were free to evaluate Protagonists' behaviors based on other factors, such as creativity or added informational value.

A further possibility is that children's preferences could have been driven by a desire for identity expression. In our particular experimental set-up, children were invited to play a game, and likely assessed it to be a situation in which uniqueness and self-expression are acceptable. Indeed, these qualities are often encouraged by the broader North American culture (Markus and Kitayama, 1991; Bond and Smith, 1996). Furthermore, there were no obvious repercussions for learning from the "wrong" model in our paradigm, making our results consistent with previous work suggesting that people's reliance on conformity decreases as the stakes of accuracy decrease (Baron et al., 1996). Children in our study may have perceived the learning task as having low-stakes, and therefore saw it as an opportunity more suited to expressing their individuality than to accurately learning an object label.

Two patterns of results in the current studies are suggestive that the experimental paradigm may have cued social contexts where self-expression (versus adhering to social convention) is normative and appropriate: (1) older children showed stronger preferences for the unconventional actor, since greater levels of acculturation occurs with age, and (2) boys showed a stronger preference for the unconventional actor than girls in the older age group, as females are more likely to receive stronger cultural pressures to conform (e.g., Block, 1973; Hansson et al., 1980; Eagly, 1983; Eagly and Wood, 1985). This possibility warrants further research into how the importance of accuracy of learning outcomes (i.e., stakes) affect children's choices to learn from conventional vs. unconventional individuals.

Children's selective social preferences based on prevalent behaviors suggest that at an early age, humans are sensitive to group-relevant behaviors, independent of familiarity. Whether or not one adheres to group conventions increasingly inform preschool aged children's choice of social partners, and cultural models. Children's use of consensus information appear to lead to context-dependent preferences, suggestive of competing motives to adhere to group conventions and to acquire new information. Overall, these studies point to an early ontogeny of group

level reasoning that aid young humans in learning about social conventional knowledge.

AUTHOR CONTRIBUTIONS

WZ, AB, and JH designed the study, WZ carried out data collection and statistical analyses, WZ wrote the manuscript with input from AB and JH. All authors granted final approval of the manuscript version to be published.

ACKNOWLEDGMENT

This work was supported by funding from the Social Sciences and Humanities Research Council of Canada.

REFERENCES

Asch, S. E. (1952). "Group forces in the modification and distortion of judgments," in *Social Psychology*, ed. S. E. Asch (Englewood Cliffs, NJ: Prentice-Hall, Inc.), 450–501.

Bar-Haim, Y., Ziv, T., Lamy, D., and Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychol. Sci.* 17, 159–163. doi: 10.1111/j.1467-9280.2006.01679.x

Baron, A. S., and Dunham, Y. (2015). Representing "Us" and "Them": building blocks of intergroup cognition. *J. Cogn. Dev.* 16, 780–801. doi: 10.1080/15248372.2014.1000459

Baron, R. S., Vandello, J. A., and Brunsman, B. (1996). The forgotten variable in conformity research: impact of task importance on social influence. *J. Pers. Soc. Psychol.* 71, 915. doi: 10.1037/0022-3514.71.5.915

Block, J. H. (1973). Conceptions of sex role: some cross-cultural and longitudinal perspectives. *Am. Psychol.* 28, 512. doi: 10.1037/h0035094

Bond, R., and Smith, P. B. (1996). Culture and conformity: a meta-analysis of studies using Asch's (1952b, 1956) line judgment task. *Psychol. Bull.* 119, 111. doi: 10.1037/0033-2909.119.1.111

Boyd, R., and Richerson, P. J. (1987). The evolution of ethnic markers. *Cult. Anthropol.* 2, 65–79. doi: 10.1525/can.1987.2.1.02a00070

Boyd, R., Richerson, P. J., and Henrich, J. (2011). The cultural niche: why social learning is essential for human adaptation. *Proc. Natl. Acad. Sci. U.S.A.* 108, 10918–10925. doi: 10.1073/pnas.1100290108

Buttelmann, D., Zmyj, N., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Chen, E. E., Corriveau, K. H., and Harris, P. L. (2013). Children trust a consensus composed of outgroup members—but do not retain that trust. *Child Dev.* 84, 269–282. doi: 10.1111/j.1467-8624.2012.01850.x

Chudek, M., Heller, S., Birch, S., and Henrich, J. (2012). Prestige-biased cultural learning: bystander's differential attention to potential models influences children's learning. *Evol. Hum. Behav.* 33, 46–56. doi: 10.1016/j.evolhumbehav.2011.05.005

Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., and Winter, P. L. (2006). Managing social norms for persuasive impact. *Soc. Influ.* 1, 3–15. doi: 10.1080/15534510500181459

Cialdini, R. B., and Trost, M. R. (1998). "Social influence: social norms, conformity and compliance," in *The Handbook of Social Psychology*, Vol. 1–2, eds D. T. Gilbert, S. Fiske, and G. Lindzey (New York, NY: McGraw-Hill), 151–192.

Cooper, H. M. (1979). Statistically combining independent studies: a meta-analysis of sex differences in conformity research. *J. Pers. Soc. Psychol.* 37, 131. doi: 10.1037/0022-3514.37.1.131

Corriveau, K. H., Fusaro, M., and Harris, P. L. (2009). Going with the flow preschoolers prefer nondissenters as informants. *Psychol. Sci.* 20, 372–377. doi: 10.1111/j.1467-9280.2009.02291.x

Corriveau, K. H., and Harris, P. L. (2010). Preschoolers (sometimes) defer to the majority in making simple perceptual judgments. *Dev. Psychol.* 46, 437–445. doi: 10.1037/a0017553

Dunham, Y., Baron, A. S., and Carey, S. (2011). Consequences of "minimal" group affiliations in children. *Child Dev.* 82, 793–811. doi: 10.1111/j.1467-8624.2011.01577.x

Eagly, A. H. (1978). Sex differences in influenceability. *Psychol. Bull.* 85, 86. doi: 10.1055/s-0031-1281708

Eagly, A. H. (1983). Gender and social influence: a social psychological analysis. *Am. Psychol.* 38, 971. doi: 10.1037/0003-066X.38.9.971

Eagly, A. H., and Carli, L. L. (1981). Sex of researchers and sex-typed communications as determinants of sex differences in influenceability: a meta-analysis of social influence studies. *Psychol. Bull.* 90, 1. doi: 10.1037/0033-2909.90.1.1

Eagly, A. H., and Wood, W. (1985). "Gender and influenceability: stereotype versus behavior," in *Women, Gender, and Social Psychology*, eds V. E. O'Leary, R. K. Unger, and B. S. Wallston (Hillsdale, NJ: Lawrence Erlbaum), 225–256.

Fehr, E., Fischbacher, U., and Gächter, S. (2002). Strong reciprocity, human cooperation, and the enforcement of social norms. *Hum. Nat.* 13, 1–25. doi: 10.1007/s12110-002-1012-7

Fitch, W. T. (2000). The evolution of speech: a comparative review. *Trends Cogn. Sci.* 4, 258–267. doi: 10.1016/S1364-6613(00)01494-7

Ford, C. S., and Beach, F. A. (1951). *Patterns of Sexual Behavior*. Oxford: Harper and Paul B. Hoeber.

Gintis, H. (2000). Strong reciprocity and human sociality. *J. Theor. Biol.* 206, 169–179. doi: 10.1006/jtbi.2000.2111

Goldstein, N. J., Cialdini, R. B., and Griskevicius, V. (2008). A Room with a viewpoint: using social norms to motivate environmental conservation in hotels. *J. Consum. Res.* 35, 472–482. doi: 10.1086/586910

Hamlin, J. K. (2014). Context-dependent social evaluation in 4.5-month-old human infants: the role of general versus domain-specific processes in the development of social evaluation. *Front. Psychol.* 5:614. doi: 10.3389/fpsyg.2014.00614

Hansson, R. O., Allen, M. M., and Jones, W. H. (1980). Sex differences in conformity: instrumental or communal response? *Sex Roles* 6, 207–212. doi: 10.1007/BF00287343

Henrich, J. (2006). Costly punishment across human societies. *Science* 312, 1767–1770. doi: 10.1126/science.1127333

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., et al. (2001). In search of homo economicus: behavioural experiments in 15 small-scale societies. *Am. Econ. Rev.* 91, 73–78. doi: 10.1257/aer.91.2.73

Henrich, J., and Henrich, N. (2007). *Why Humans Cooperate: A Cultural and Evolutionary Explanation*. Oxford: Oxford University Press.

Herrmann, P. A., Legare, C. H., Harris, P. L., and Whitehouse, H. (2013). Stick to the script: the effect of witnessing multiple actors on children's imitation. *Cognition* 129, 536–543. doi: 10.1016/j.cognition.2013.08.010

Jenni, O. G., and O'Connor, B. B. (2005). Children's sleep: an interplay between culture and biology. *Pediatrics* 115, 204–216. doi: 10.1542/peds.2004-0815B

Killen, M., and Smetana, J. (eds). (2005). *Hand Book of Moral Development*, 2nd Edn. New York, NY: Psychology Press.

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Latané, B., and Darley, J. M. (1968). Group inhibition of bystander intervention in emergencies. *J. Pers. Soc. Psychol.* 10, 215. doi: 10.1037/h0026570

Legare, C. H., and Nielsen, M. (2015). Imitation and innovation: the dual engines of cultural learning. *Trends Cogn. Sci.* 19, 688–699. doi: 10.1016/j.tics.2015.08.005

Legare, C. H., Wen, N. J., Herrmann, P. A., and Whitehouse, H. (2015). Imitative flexibility and the development of cultural learning. *Cognition* 142, 351–361. doi: 10.1016/j.cognition.2015.05.020

Lehmann, L., Feldman, M. W., and Kaeuffer, R. (2010). Cumulative cultural dynamics and the coevolution of cultural innovation and transmission: an ESS

model for panmictic and structured populations. *J. Evol. Biol.* 23, 2356–2369. doi: 10.1111/j.1420-9101.2010.02096.x

Maccoby, E. E., and Jacklin, C. N. (1974). *The Psychology of Sex Differences*, Vol. 1. Palo Alto, CA: Stanford University Press.

Markus, H. R., and Kitayama, S. (1991). Culture and the self: implications for cognition, emotion, and motivation. *Psychol. Rev.* 98, 224–253. doi: 10.1037/0033-295X.98.2.224

Powell, L. J., and Spelke, E. S. (2013). Preverbal infants expect members of social groups to act alike. *Proc. Natl. Acad. Sci. U.S.A.* 110, E3965–E3972. doi: 10.1073/pnas.1304326110

Prentice, D. A., and Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: some consequences of misperceiving the social norm. *J. Pers. Soc. Psychol.* 64, 243–243. doi: 10.1037/0022-3514.64.2.243

Reyes-Jaquez, B., and Echols, C. H. (2013). Developmental differences in the relative weighing of informants' social attributes. *Dev. Psychol.* 49, 602–613. doi: 10.1037/a0031674

Schillaci, R. S., and Kelemen, D. (2014). Children's conformity when acquiring novel conventions: the case of artifacts. *J. Cogn. Dev.* 15, 569–583. doi: 10.1080/15248372.2013.784973

Schmidt, M. H., Rakoczy, H., and Tomasello, M. (2010). Young children attribute normativity to novel actions without pedagogy or normative language. *Dev. Sci.* 14, 530–539. doi: 10.1111/j.1467-7687.2010.01000.x

Schmidt, M. H., and Tomasello, M. (2012). Young children enforce social norms. *Curr. Dir. Psychol. Sci.* 21, 232–236. doi: 10.1177/0963721412448659

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., and Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychol. Sci.* 18, 429–434. doi: 10.1111/j.1467-9280.2007.01917.x

Scofield, J., Gilpin, A. T., Pierucci, J., and Morgan, R. (2013). Matters of accuracy and conventionality: prior accuracy guides children's evaluations of others' actions. *Dev. Psychol.* 49, 432–438. doi: 10.1037/a0029888

Watson-Jones, R. E., Legare, C. H., Whitehouse, H., and Clegg, J. M. (2014). Task-specific effecs of ostracism on imitative fidelity in early childhood. *Evol. Hum. Behav.* 35, 204–210. doi: 10.1016/j.evolhumbehav.2014.01.004

Wilks, M., Collier-Baker, E., and Nielsen, M. (2015). Preschool children favor copying a successful individual over an unsuccessful group. *Dev. Sci.* 18, 1014–1024. doi: 10.1111/desc.12274

Zmyj, N., Buttelmann, D., Carpenter, M., and Daum, M. M. (2010). The reliability of a model influences 14-month-olds' imitation. *J. Exp. Child Psychol.* 106, 208–220. doi: 10.1016/j.jecp.2010.03.002.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

MINI REVIEW
published: 20 October 2016
doi: 10.3389/fpsyg.2016.01645

The Relative Importance of Language in Guiding Social Preferences Through Development

Rana Esseily, Eszter Somogyi and Bahia Guellai*

Laboratoire Ethologie, Cognition, Développement, Université Paris Ouest Nanterre la Défense, Nanterre, France

In this paper, we review evidence from infants, toddlers, and preschoolers to tackle the question of how individuals orient preferences and actions toward social partners and how these preferences change over development. We aim at emphasizing the importance of language in guiding categorization relatively to other cues such as age, race and gender. We discuss the importance of language as part of a communication system that orients infants and older children's attention toward relevant information in their environment and toward affiliated social partners who are potential sources of knowledge. We argue that other cues (visually perceptible features) are less reliable in informing individuals whether others share a common knowledge and whether they can be source of information.

Keywords: language, categorization, social preferences, socio-cognitive development, social behavior

Edited by:
David Buttelmann,
University of Bern, Switzerland

Reviewed by:
Bruce Douglas Homer,
The Graduate Center (CUNY), USA
Zoe Liberman,
University of California, Santa Barbara, USA

****Correspondence:***
Rana Esseily
rana.esseily@u-paris10.fr

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *15 January 2016*
Accepted: *07 October 2016*
Published: *20 October 2016*

Citation:
Esseily R, Somogyi E and Guellai B (2016) The Relative Importance of Language in Guiding Social Preferences Through Development. Front. Psychol. 7:1645. doi: 10.3389/fpsyg.2016.01645

INTRODUCTION

For efficient interactions, we need to form cognitive representations of our social partners and of human groups in general. Several studies describe the social cues and categories that influence adults' everyday interactions and have important downstream consequences for how we construe others (Tajfel et al., 1971; Stangor et al., 1992). There is a growing body of literature on how infants and children process interactive situations and the cues that orient their social preferences and behaviors. Some cues are well documented and show a strong bias for categorization and for guiding infants' social behavior, namely gender, age and ethnic origin. Language on the other hand, has received interest only more recently despite the fact that individuals are exposed to their native language already in their mothers' womb, that language is shared by communities, and is a vector for cultural learning. The aim of the present paper is to review evidence showing that language is a special cue as important, if not more important, than gender, age or ethnic origin in guiding social categorization and preferences. The hypothesis we propose is that language, unlike other cues, is a marker for cultural affiliation where social partners share the same norms and are knowledgeable. Through childhood, it is important for developing human beings to pay attention to cues that guide them toward potential sources of information and learning. For learning, choosing a native speaker as a social partner is a relevant matter, however, choosing an individual upon his ethnic origin may not be reliable. The relative importance of these categorizations can also change with age as older children learn more about each of these categories and build a hierarchy model of their world. We shall first review studies that focused on gender, race and ethnic origin on the one hand and language on the other hand in infants, toddlers, and

preschoolers. Then we shall proceed with studies that weighed the relative importance of these cues.

GENDER, AGE, RACE AND ETHNIC ORIGIN

One of the most salient and robust cues in early life along which we can divide our social world is gender. Very early in life, infants already show preferences according to the gender of the photograph presented to them: 3- and 4-month-old infants prefer looking at female faces rather than male faces (Quinn et al., 2002). Knowledge of gender categories increases during the second year of postnatal life. By 18 months, girls are able to match gender labels with appropriate faces (Poulin-Dubois et al., 1998) and infants' tendency to categorize dolls according to gender increases sharply between 18 and 22 months of age (Johnston et al., 2001). At 18 months infants also start to show awareness of gender-associated toy stereotypes by looking longer at faces that match the gender stereotyping of a previously presented toy (Serbin et al., 2001) and by showing specific patterns of sequential touching of gender-typed toys associated with their own sex (Levy, 1999). At the beginning of their second year, toddlers show awareness of the typical activities of men and women by looking longer at surprising, stereotype-inconsistent photographs than at stereotype-consistent ones (Poulin-Dubois et al., 2002) and tend to select a 'sex appropriate' doll when imitating a gender stereotyped action (Serbin et al., 2001).

Age also emerges as an early cue and by 6 months of age, infants already categorize faces from different age groups as they prefer looking at images of same age peers rather than images of older infants (Sanefuji et al., 2006). Age is an important indicator of an observed person's knowledgeability, which further contributes to guiding infants' attention. Thus, Zmyj et al. (2012) found that 12-month-olds (and also younger infants but less reliably) preferred to observe older children. The authors argue that older children provide both a level of similarity as well as increased competence that creates a zone of proximal development (Vygotsky, 1978) for the younger, which possibly prefer to observe older peers in order to learn from them. Indeed, in Vygotsky's theory (Vygotsky, 1978), more capable peers who guide children in performing an activity create a zone of proximal development, which allows children to perform activities at a higher level than the level at which they could perform independently.

As to ethnic origin, it has been shown that preference for own-race versus other-race faces appears at 3-months of age (Quinn et al., 2002; Kelly et al., 2005; Bar-Haim et al., 2006). However, Social preferences based on ethnic origin emerge only between 2.5 and 5 years of age (Kinzler and Spelke, 2011), which is later than gender-, age- and language-based preferences. Considerable amount of research has examined the development of children's attitudes toward members of their own and other ethnic groups. These studies have revealed that children, and especially those living in multi-ethnic communities, can categorize people based on physical cues (e.g., skin color) and by around 4 years of age their ethnic awareness enables them to distinguish between members of different ethnic groups. By 6–7 years of age, children identify themselves with their own ethnic groups, exhibiting preference and positivity toward members of their own groups and negativity toward members of other ethnic groups (see reviews by: Aboud, 1988; Nesdale, 2001). Thus, race while certainly important for older children may not be as important for young children early in development. Possibly because in early development the ethnic origin of an individual does not convey any information to the infant other than his perceptible properties, whereas age can be an indicator for expertise, competence, reliance and authority and gender can give reliable information about possible areas of interest. Thus, infants and children may have expectations about shared knowledge with someone sharing or not the same expertise (age) and interest (gender) unlike someone only sharing the same color.

LANGUAGE AS A MARKER GUIDING SOCIAL BEHAVIOR

Language provides a wide range of information about people such as their geographic origin, social status, gender, and ethnic group (Labov, 1976, 2001). The reason why language can be considered as a strong cue in development is threefold: (1) it drives social preferences early in development, (2) it is a social marker for affiliation and social interaction and (3) language is a vector for social and cultural learning. In this section, we will review evidence for each of these functions.

Language is already an important cue in guiding infants' early social preferences, and more particularly in-group preferences. Recent evidence suggests that newborns prefer to look at a person who previously spoke to them than at someone who was silent (Coulon et al., 2011; Guellai and Streri, 2011). Soon after birth, and throughout early infancy, young infants prefer listening to their native language rather than to a foreign one (Mehler et al., 1988). They can also discriminate among different languages based on rhythmic or phonological cues (Mehler et al., 1988; Bosch and Sebastian-Galles, 1997; Nazzi et al., 1998; Best and McRoberts, 2003; Kuhl et al., 2006; Weikum et al., 2007). Beyond these early achievements, language can guide infants' social preferences: infants as young as 6-months prefer looking at the video of a woman who previously talked to them in their native language with a native accent (i.e., American English), than at a woman who previously spoke in a foreign language (i.e., Spanish) (Kinzler et al., 2007). At 7-months, they prefer listening to a tune that had been introduced by a native speaker compared to a tune introduced by a foreign speaker (Soley and Sebastián-Gallés, 2015). At 10 months they preferentially choose toys offered by a native speaker over a toy offered by a non-native one (Kinzler et al., 2012) and at 12 months they select food that was first tasted by a native rather than a non-native speaker (Shutts et al., 2009). Dialect may also be a reliable and more precise cue to social preferences

because it provides information about an individual's social and ethnic identity. In a recent study, Okumura et al. (2014) showed that 9- and 12-month-old infants preferentially touched a toy offered by a native-dialect speaker compared to a toy offered by a non-familiar dialect speaker. These findings clearly show the importance of infants' social and linguistic environment in the early development of social preferences.

Other studies put forward the role of language in marking affiliation and in guiding social interactions (Kinzler et al., 2010, 2011; Kinzler and Dautel, 2012; Howard et al., 2015). Most children choose faces paired with native-accented voices as friends and they consider them nicer compared to faces paired with non-native accented voices (Kinzler and DeJesus, 2013) and this is also true for bilinguals (Souza et al., 2013). In a recent study (Liberman et al., 2016), the affiliative function of language was directly tested in 9-month-old infants. Infants saw a video of two actors who either spoke the same language (English–English or Spanish–Spanish) or different languages (English–Spanish). Then, in the test phase, infants saw videos of the same actors either showing affiliation (waving and smiling to each other) or disengagement (turning their back to each other). Infants in this study expected affiliation behavior when the actors spoke the same language and were surprised when the actors disengaged. When the actors spoke different languages, infants were surprised when they exhibited affiliation behavior compared to disengagement. Taken together, these studies show that infants use language as a marker for affiliation and for social interactions.

Furthermore, there is evidence that language also constitutes a strong cue for learning by pointing out the knowledgeability of a social partner. Oláh et al. (2014) investigated how the language a model speaks (foreign or native) is associated with the conventionality of this model's tool use habits (conventional or unconventional). They found that 2-year-olds associated a foreign language to the model if he had previously performed goal-directed actions in a non-conventional way (e.g., comb hair with fork), but formed an association between the foreign language and another person if previously the model had been seen to act in a conventional way (eat with fork), making it unlikely that he was the source of the foreign language utterance. This shows that language conveys as well as affiliation, social norms and cultural information about the knowledge members of a community share and thus potential sources of learning. Few studies investigated how language can be a vector for learning. These few studies show that 14-month-olds infants (Buttelmann et al., 2013) and preschool children (Kinzler et al., 2011; Howard et al., 2015) selectively imitate a novel action demonstrated by a native-accented speaker compared to a non-native accented speaker. However, this preference is modulated by other factors such as accuracy: even though preschoolers prefer labels provided by native speakers compared to non-native speakers, they override their preference when the native speakers are not accurate in labeling familiar words for example (Corriveau et al., 2013). Thus, accuracy but also morality has been shown to influence the linguistic in-group bias (Kinzler and DeJesus, 2013; Hetherington et al., 2014).

HOW DO CHILDREN WEIGH SOCIAL CUES?

The studies mentioned above show both the flexibility with which children divide their social world, as well as the importance of gender, race, age and language in guiding children's social preferences and behavior toward others. Most of these studies, however, target children's preferences between modalities of the same social category (between the two genders or two races for instance), and do not directly compare the relative importance of categories when compared to one another. Yet social partners stand at the crossroads of multiple social categories, which are thus interdependent, meaning that the impact of each social cue is weighted differently according to the context. We can note that relatively few studies have investigated how intersectionality unfolds early in development (for a review see Kinzler et al., 2010). Thus, in addition to examining social category emergence, an important direction for future research is to investigate priorities in children's social categories by directly comparing the influence of more than one category and investigating how cues depend from one another with the same method and population of children.

What determines the priority of one category over another? For adults, the influence of age, gender, and race has been attributed to each category's visual salience (Fiske, 1998). It is possible that children's social category formation is also largely reliant on visual observations of properties that differ among individuals, since these factors are noticeable with minimal effort. Indeed, children demonstrate in-group biases based on minimal groupings for "blue" and "yellow" groups created by labeling and a visual cue to group membership (different colored t-shirts that are randomly assigned), but not in the absence of supporting visible distinctions (Bigler et al., 1997). Beyond visual salience, however, findings from evolutionary psychology show that evolution by natural selection may have favored attention to certain social categories over others – for example, gender over race—and that this relative weighting is continually visible in adulthood (Kurzban and Leary, 2001).

Studies comparing different categories confirm this evolutionary perspective and show that encoding social categories is not automatic. Even though, race appears to be a more salient cue for directing visual preference and can override gender at 3 months of age (Kelly et al., 2005, 2007; Quinn et al., 2008), somewhat later in childhood though and also in adults (Kurzban and Leary, 2001), it becomes a less privileged marker of social category membership than gender or age. For example, Weisman et al. (2015) showed that 3- to 6-years old children showed a preference bias toward both gender and race but they were more likely to learn facts about children of different gender than children of the same gender and equally likely to confuse targets within and across racial groups. This clearly shows that race is a less fundamental social category compared

to gender and does not constitute an important cue for learning. Again, when 3-year-old white preschoolers were asked to choose between objects or activities that were presented by unfamiliar people who differed in gender, race (white, black), or age (child, adult), gender and age were more robust guides to children's preferences than race (Shutts et al., 2010). In a further study (Rhodes and Gelman, 2009) in which 5-year-olds were prompted to reason about the categorization of others, children viewed gender as a naturalized category that is objectively determined. In contrast, race was seen as flexibility determined, similarly to how children reason about artifacts. These findings indicate that in preschoolers, gender and age are both reliable categories and used more robustly and consistently than race.

Next to gender and age, language also emerges as hierarchically superior to other characteristics along which infants, toddlers and preschoolers form judgments about a person. Given the importance of language in guiding infants' and children's social interactions, more studies weighing language and other social categories are needed to fully understand the relative importance of language. There is some evidence that language (more particularly accent) takes priority over other cues such as race at 5 years of age (Kinzler et al., 2009, 2010; Kinzler and Dautel, 2012). For instance, children choose native-accented speakers as friends, even when they are of a different race (Kinzler et al., 2009), which shows that children are sensitive to cultural markers beyond physical similarities.

GENERAL DISCUSSION

The aim of this review was to answer two questions: (i) how do infants, toddlers and preschoolers categorize their potential social partners and orient their social preferences and (ii) what is the relative importance of language in guiding these behaviors? The studies reviewed clearly show that from early on and as young as 3 months of age, infants categorize individuals on the basis of physical and linguistic characteristics. They also show that infants' and children's social behaviors are deeply influenced by group identity and membership. Studies in older children show that children's preferences are not based on experience and familiarity only but rather on sharing cultural norms and knowledge with members of a given group. They also show that group memberships are not immutable and behaviors toward in-groups and out-groups can be modulated by other contextual information such as morality or accuracy.

Children can also prioritize available cues: indeed, from birth, infants are oriented toward elements that make sense in their environment and from which they can learn something. Their curiosity and internal motivation make them explore their environment with the goal of making new discoveries. In their everyday exploration, infants encounter social partners who also have the power to transmit some knowledge about the world. Characteristics of these partners are crucial to pay attention to because they indicate whether the partner is knowledgeable or not. Age and gender become rapidly robust cues that refer to expertise and competence while race is not related to partner's ability to teach something new. Language on the other hand is special and maybe even more important than other cues because as seen above it guides early social preferences and it is both a marker for affiliation and for knowledgeability as it is shared between people of a same community and it vehicles a multitude of new information. Further studies weighing language and other social categories are required to better understand the relative importance of language.

Another question that needs to be addressed to capture the full picture is the universality of some of these markers and specifically language as a marker for group affiliation. Indeed if language is important in guiding children's behavior and overrides other cues such as race, then it is probably a common cue detected very early in life helping infants to orient their attention toward members of their own community with whom knowledge may be shared.

AUTHOR CONTRIBUTIONS

All authors listed, have made substantial, direct and intellectual contribution to the work, and approved it for publication.

FUNDING

The authors gratefully acknowledge the financial support of Fondation de France.

REFERENCES

Aboud, F. E. (1988). *Children and Prejudice*. Oxford: Basil Blackwell.

Bar-Haim, Y., Ziv, T., Lamy, D., and Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychol. Sci.* 17, 159–163. doi: 10.1111/j.1467-9280.2006.01679.x

Best, C. C., and McRoberts, G. W. (2003). Infant perception of non-native consonant contrasts that adults assimilate in different ways. *Lang. Speech* 46(Pt 2–3), 183–216. doi: 10.1177/00238309030460020701

Bigler, R. S., Jones, L. C., and Lobliner, D. B. (1997). Social categorization and the formation of intergroup attitudes in children. *Child Dev.* 68, 530–543. doi: 10.2307/1131676

Bosch, L., and Sebastian-Galles, N. (1997). Native-language recognition abilities in 4-month-old infants from monolingual and bilingual environments. *Cognition* 65, 33–69. doi: 10.1016/S0010-0277(97)00040-1

Buttelmann, D., Zmyj, N., Daum, M., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Corriveau, K. H., Kinzler, K. D., and Harris, P. L. (2013). Accuracy trumps accent in children's endorsement of object labels. *Dev. Psychol.* 49, 470–479. doi: 10.1037/a0030604

Coulon, M., Guellai, B., and Streri, A. (2011). Recognition of unfamiliar talking faces at birth. *Int. J. Behav. Dev.* doi: 10.1177/0165025410396765

Fiske, S. T. (1998). "Stereotyping, prejudice, and discrimination," in *The Handbook of Social Psychology*, Vol. 2, 4th Edn, eds S. T. Fiske, D. T. Gilbert, and G. Lindzey (New York, NY: McGraw-Hill), 357–411.

Guellai, B., and Streri, A. (2011). Cues for early social skills: direct gaze modulates newborns' recognition of talking faces. *PLoS ONE* 6:e18610. doi: 10.1371/journal.pone.0018610

Hetherington, C., Hendrickson, C., and Koenig, M. (2014). Reducing an in-group bias in preschool children: the impact of moral behavior. *Dev. Sci.* 17, 1042–1049. doi: 10.1111/desc.12192

Howard, L. H., Henderson, A. M., Carrazza, C., and Woodward, A. L. (2015). Infants' and young children's imitation of linguistic in-group and out-group informants. *Child Dev.* 86, 259–275. doi: 10.1111/cdev.12299

Johnston, K. E., Bittinger, K., Smith, A., and Madole, K. L. (2001). Developmental Changes in infants' and toddlers' attention to gender categories. *Merrill Palmer Q.* 47, 563–584. doi: 10.1353/mpq.2001.0023

Kelly, D. J., Quinn, P. C., Slater, A. M., Lee, K., Ge, L., and Pascalis, O. (2007). The other-race effect develops during infancy: evidence of perceptual narrowing. *Psychol. Sci.* 18, 1084–1089. doi: 10.1111/j.1467-9280.2007.02029.x

Kelly, D. J., Quinn, P. C., Slater, A. M., Lee, K., Gibson, A., Smith, M., et al. (2005). Three-month-olds, but not newborns, prefer own-race faces. *Dev. Sci.* 8, F31–F36. doi: 10.1111/j.1467-7687.2005.0434a.x

Kinzler, K. D., Corriveau, K. H., and Harris, P. L. (2011). Children's selective trust in native-accented speakers. *Dev. Sci.* 14, 106–111. doi: 10.1111/j.1467-7687.2010.00965.x

Kinzler, K. D., and Dautel, J. B. (2012). Children's essentialist reasoning about language and race. *Dev. Sci.* 15, 131–138. doi: 10.1111/j.1467-7687.2011.01101.x

Kinzler, K. D., and DeJesus, J. M. (2013). Children's sociolinguistic evaluations of nice foreigners and mean Americans. *Dev. Psychol.* 49, 655–664. doi: 10.1037/a0028740

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2012). "Native" objects and collaborators: infants' object choices and acts of giving reflect favor for native over foreign speakers. *J. Cogn. Dev.* 13, 67–81. doi: 10.1080/15248372.2011.567200

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Kinzler, K. D., Shutts, K., DeJesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children's social preferences. *Soc. cogn.* 27, 623–634. doi: 10.1521/soco.2009.27.4.623

Kinzler, K. D., and Spelke, E. S. (2011). Do infants show social preferences for people differing in race? *Cognition* 119, 1–9. doi: 10.1016/j.cognition.2010.10.019

Kuhl, P. K., Stevens, E., Hayashi, A., Deguchi, T., Kiritani, S., and Iverson, P. (2006). Infants show a facilitation effect for native language phonetic perception between 6 and 12 months. *Dev. Sci.* 9, F13–f21. doi: 10.1111/j.1467-7687.2006.00468.x

Kurzban, R., and Leary, M. R. (2001). Evolutionary origins of stigmatization: the functions of social exclusion. *Psychol. Bull.* 127, 187–208. doi: 10.1037/0033-2909.127.2.187

Labov, W. (1976). *Sociolinguistique*. Paris: Éditions de Minuit.

Labov, W. (2001). *Principles of Linguistic Change: Social Factors,* Vol. 2. Oxford: Blackwell.

Levy, G. D. (1999). Gender-typed and non-gender-typed category awareness in toddlers. *Sex Roles* 41, 851–873. doi: 10.1023/A:1018832529622

Liberman, Z., Woodward, A. L., and Kinzler, K. D. (2016). Preverbal infants infer third-party social relationships based on language. *Cogn. Sci.* doi: 10.1111/cogs.12403 [Epub ahead of print].

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoncini, J., and Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition* 29, 143–178. doi: 10.1016/0010-0277(88)90035-2

Nazzi, T., Bertoncini, J., and Mehler, J. (1998). Language discrimination by newborns: toward an understanding of the role of rhythm. *J. Exp. Psychol. Hum. Percept. Perform.* 24, 756–766. doi: 10.1037/0096-1523.24.3.756

Nesdale, D. (2001). "Development of prejudice in children," in *Understanding Prejudice, Racism, and Social Conflict*, eds M. Augoustinos and K. Reynolds (London: Sage).

Okumura, Y., Kanakogi, Y., Takeuchi, S., and Itakura, S. (2014). [Twelve-month-old infants show social preferences for native-dialect speakers]. *Shinrigaku Kenkyu* 85, 248–256. doi: 10.4992/jjpsy.85.13024

Oláh, K., Elekes, F., Bródy, G., and Király, I. (2014). Social category formation is induced by cues of sharing knowledge in young children. *PLoS ONE* 9:e101680. doi: 10.1371/journal.pone.0101680

Poulin-Dubois, D., Serbin, L. A., and Derbyshire, A. (1998). Toddlers' intermodal and verbal knowledge about gender. *Merrill Palmer Q.* 44, 338–354.

Poulin-Dubois, D., Serbin, L. A., Eichstedt, J. A., Sen, M. G., and Beissel, C. F. (2002). Men don't put on make-up: toddlers' knowledge of the gender stereotyping of household activities. *Soc. Dev.* 11, 166–181. doi: 10.1111/1467-9507.00193

Quinn, P. C., Uttley, L., Lee, K., Gibson, A., Smith, M., Slater, A. M., et al. (2008). Infant preference for female faces occurs for same-but not other-race faces. *J. Neuropsychol.* 2(Pt 1), 15–26. doi: 10.1348/174866407X231029

Quinn, P. C., Yahr, J., Kuhn, A., Slater, A. M., and Pascalis, O. (2002). Representation of the gender of human faces by infants: a preference for female. *Perception* 31, 1109–1121. doi: 10.1068/p3331

Rhodes, M., and Gelman, S. A. (2009). Five-year-olds' beliefs about the discreteness of category boundaries for animals and artifacts. *Psychon. Bull. Rev.* 16, 920–924. doi: 10.3758/PBR.16.5.920

Sanefuji, W., Ohgami, H., and Hashiya, K. (2006). Preference for peers in infancy. *Infant Behav. Dev.* 29, 584–593. doi: 10.1016/j.infbeh.2006.07.007

Serbin, L. A., Poulin-Dubois, D., Colburne, K. A., Sen, M. G., and Eichstedt, J. A. (2001). Gender stereotyping in infancy: visual preferences for and knowledge of gender-stereotyped toys in the second year. *Int. J. Behav. Dev.* 25, 7–15. doi: 10.1080/01650250042000078

Shutts, K., Banaji, M. R., and Spelke, E. S. (2010). Social categories guide young children's preferences for novel objects. *Dev. Sci.* 13, 599–610. doi: 10.1111/j.1467-7687.2009.00913.x

Shutts, K., Kinzler, K. D., McKee, C. B., and Spelke, E. S. (2009). Social information guides infants' selection of foods. *J. Cogn. Dev.* 10, 1–17. doi: 10.1080/15248370902966636

Soley, G., and Sebastián-Gallés, N. (2015). Infants prefer tunes previously introduced by speakers of their native language. *Child Dev.* 86, 1685–1692. doi: 10.1111/cdev.12408

Souza, A. L., Byers-Heinlein, K., and Poulin-Dubois, D. (2013). Bilingual and monolingual children prefer native-accented speakers. *Front. Psychol.* 4:953. doi: 10.3389/fpsyg.2013.00953

Stangor, C., Lynch, L., Duan, C., and Glas, B. (1992). Categorization of individuals on the basis of multiple social features. *J. Pers. Soc. Psychol.* 62, 207–218. doi: 10.1037/0022-3514.62.2.207

Tajfel, H., Billig, M. G., Bundy, R. P., and Flament, C. (1971). Social categorization and intergroup behaviour. *Eur. J. Soc. Psychol.* 1, 149–178. doi: 10.1002/ejsp.2420010202

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

Weikum, W. M., Vouloumanos, A., Navarra, J., Soto-Faraco, S., Sebastian-Galles, N., and Werker, J. F. (2007). Visual language discrimination in infancy. *Science* 316:1159. doi: 10.1126/science.1137686

Weisman, K., Johnson, M. V., and Shutts, K. (2015). Young children's automatic encoding of social categories. *Dev. Sci.* 18, 1036–1043. doi: 10.1111/desc.12269

Zmyj, N., Daum, M. M., Prinz, W., and Aschersleben, G. (2012). Infants' attentional preference for object-related actions of older children compared to object-related actions of peers and adults. *Infant Behav. Dev.* 35, 533–542. doi: 10.1016/j.infbeh.2012.03.003

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 03 August 2016
doi: 10.3389/fpsyg.2016.01150

Infants' Selectively Pay Attention to the Information They Receive from a Native Speaker of Their Language

Hanna Marno[1,2], Bahia Guellai[3], Yamil Vidal[2], Julia Franzoi[2], Marina Nespor[2] and Jacques Mehler[2]*

[1] Department of Cognitive Science, Central European University, Budapest, Hungary, [2] Language, Cognition and Development Lab, International School for Advanced Studies, Trieste, Italy, [3] Laboratoire Ethologie Cognition, Université Paris Ouest Nanterre La Défense, Paris, France

From the first moments of their life, infants show a preference for their native language, as well as toward speakers with whom they share the same language. This preference appears to have broad consequences in various domains later on, supporting group affiliations and collaborative actions in children. Here, we propose that infants' preference for native speakers of their language also serves a further purpose, specifically allowing them to efficiently acquire culture specific knowledge via social learning. By selectively attending to informants who are native speakers of their language and who probably also share the same cultural background with the infant, young learners can maximize the possibility to acquire cultural knowledge. To test whether infants would preferably attend the information they receive from a speaker of their native language, we familiarized 12-month-old infants with a native and a foreign speaker, and then presented them with movies where each of the speakers silently gazed toward unfamiliar objects. At test, infants' looking behavior to the two objects alone was measured. Results revealed that infants preferred to look longer at the object presented by the native speaker. Strikingly, the effect was replicated also with 5-month-old infants, indicating an early development of such preference. These findings provide evidence that young infants pay more attention to the information presented by a person with whom they share the same language. This selectivity can serve as a basis for efficient social learning by influencing how infants' allocate attention between potential sources of information in their environment.

Keywords: cultural knowledge, infants, native speakers, attention, social learning

OPEN ACCESS

Edited by:
David Buttelmann, University of Bern, Switzerland

Reviewed by:
Jennifer M. Zosh, Pennsylvania State University, Brandywine, USA
Moritz M. Daum, University of Zurich, Switzerland

****Correspondence:***
Hanna Marno
hanna.marno@gmail.com

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *29 February 2016*
Accepted: *18 July 2016*
Published: *03 August 2016*

Citation:
Marno H, Guellai B, Vidal Y, Franzoi J, Nespor M and Mehler J (2016) Infants' Selectively Pay Attention to the Information They Receive from a Native Speaker of Their Language. Front. Psychol. 7:1150. doi: 10.3389/fpsyg.2016.01150

INTRODUCTION

Infants' sensitivity to their native language has been shown shortly after their birth (Mehler et al., 1988; Nazzi et al., 1998). Indeed, there is evidence that 6-month-old infants prefer to listen to words of their own language (Jusczyk et al., 1993), and when they can choose whether to listen to a continuous speech stream in their native language or in a foreign language, already 2-days-old newborns prefer to listen to the speech stream in their native language (Moon et al., 1993). Furthermore, newborns' cries' melody reflects the melodic contour of their native language (Mampe et al., 2009). This indicates the importance of prenatal experience in speech processing

(Partanen et al., 2013). In addition, this early sensitivity to native language speech patterns later results in fine tuned discrimination of the phonetic contrasts of their native language: while between the age of 6 and 12 months infants' non-native phonetic perception slowly declines, their sensitivity to native-language phonetic contrasts increases (Kuhl et al., 2006).

Importantly, beyond the merely auditory preference for native speech patterns, language perception also plays a role in early social evaluations and preferences. For instance, at the age of 6 months, infants do not only show a preference for their native language, but they also prefer to look at a person, who previously spoke in their language, relative to a person, who spoke in a foreign language (Kinzler et al., 2007). In addition, the same effect was shown also with contrasting native and foreign accents (Kinzler et al., 2007). At 12 months, infants also tend to choose a food that was positively commented by a native speaker, rather than a food that was presented in a context of a similarly positive attitude of a foreign speaker (Shutts et al., 2009). Furthermore, by the age of 5 years, children would rather become friends with a native accented speaker of their language, than with a foreign accented speaker, even if they can understand equally well both speakers (Kinzler et al., 2007).

Language is not the only cue driving social categorization during development. When looking at the emergence of social preferences, it seems that throughout childhood, children categorize others based on their perceptual characteristics such as gender (for a review see Maccoby and Jacklin, 1987), age (French, 1987; Montepare and Zebrowitz, 1998), or ethnic origin (Kowalski and Lo, 2001; Katz, 2003; Kinzler and Spelke, 2011). Nonetheless, when language is pitted against race, children prefer to choose to be friends with a native-accented speaker, even if the person is a member of an other-race group (Kinzler et al., 2009, 2010).

Thus, the question arises: what can be the origins of the privileged status of language that can bias infants' social preferences from very early on? Linguistic cues, defining ethnic boundaries have a long evolutionary history, as many researchers argue (Cosmides et al., 2003; Henrich and Henrich, 2007; Kinzler et al., 2010; Cohen, 2012; Pietraszewski and Schwartz, 2014a,b). Even though during modern times, both race and language might act as important cues when defining social origins, concerning their evolutionary history, they show fundamental differences. Since in the past long-distance traveling could not exceed the geographic scale of race-defining features, those physical properties that characterize different races were not recurrent features in the environment of our ancestors. Thus, it is quite unlikely that we would have developed a dedicated cognitive system in order to be able to categorize people on the basis of race-related physical properties. In the case of language, however, since linguistic variations could evolve in geographically neighboring areas, even short-distance traveling allowed contact with different speakers (Kelly, 1995; Bowern, 2010). Hence, exposure to different languages and accents was most probably a recurrent feature in the environment of our ancestors, leading to the emergence of a cognitive system that is dedicated to categorize people on the basis of lingusitic cues.

This idea is also supported by empirical research. Pietraszewski and Schwartz (2014a,b) used a memory confusion task, which is a widely accepted method for measuring implicit social categorization (Kurzban et al., 2001; Susskind, 2007). In this task, participants watch faces while they are also listening to simple statements. After a distraction task, they are presented with an array of the previously seen faces and asked to remember which statement was produced by which face. Since the task is very difficult with usually a high error rate, participants' answers are largely based on their guesses. Importantly, however, most of their errors are due to non-conscious categorization processes, where faces belonging to the same implicit social category are easily mixed, attributing the statement to another face that belongs to the same category. By using this paradigm, Pietraszewski and Schwartz (2014a) found that subjects tended to categorize people on the basis of their accent, but not on low-level sound features or familiarity (ease-of-processing).

In addition, another series of experiments with the same paradigm revealed that while categorization by race can be suppressed in case other salient grouping factors are present (resulting a different categorization), accent is still a strong factor that guides implicit categorization (Pietraszewski and Schwartz, 2014b). In these experiments the authors presented again the same characters, who instead of producing neutral statements, gave explicit information about their group membership (i.e., charity groups). Furthermore, as a salient physical property, they were also wearing either a red or a yellow T-shirt. These cues, however, were in conflict both with the information about their accent (in the first experiment) and with the information about their race (in the second experiment). Thus, the critical question was whether categorization based on accent, or based on race would be reduced when these cues are no longer valid predictors of group membership. As the results showed, this was the case for race, but not for accent. Accent, but not race, is thus a dedicated dimension of social categorization, as the authors concluded (Pietraszewski and Schwartz, 2014b).

Tracking social categories and group membership is important in order to be able to predict and guide future social interactions (e.g., Cosmides et al., 2003; Kinzler and Spelke, 2011; Cohen, 2012; Kinzler et al., 2012). Importantly, it seems that even during infancy and early childhood, language-based social categorization can bias prosocial behavior (Kinzler et al., 2012). In their study, Kinzler et al. (2012) showed that both 10-month-old infants and 2,5-year-old children were more likely to engage in collaborative actions with native speakers of their language than with foreign speakers. In the experiments, 10-month-old infants saw videos of two objects being presented by either a native speaker or a foreign speaker, respectively. After the demonstration, the videos froze showing the two speakers holding the two objects, and simultaneously two real exemplars of the videotaped objects were placed in front of the infants. When having the option to choose between these real exemplars, infants reached significantly more often toward the object that was offered by the native speaker. In a second experiment 2,5-year-old children had the opportunity to give an object to one of the two speakers. According to the results, children were more likely to offer the object to the native speaker (Kinzler

et al., 2012). Thus, as the authors concluded, already in early development, language is a crucial factor to guide collaboration and prosocial behavior.

Since collaboration is an important characteristic of the human species (Tomasello et al., 2005, 2012; Tomasello and Hamann, 2012), being able to track potential collaborators in complex societies, specifically to represent social categories in order to affiliate oneself with different groups of collaborators, is an evolutionarily adaptive behavior (Cosmides et al., 2003). However, besides finding collaborative partners, tracking language-based social groups might also be essential for social learning. Since sharing the same language indicates belonging to the same social group, most probably it also implies sharing the same cultural background, including conventional tool uses or cultural norms and practices of the group (Csibra and Gergely, 2006; Gergely and Csibra, 2006). Thus, selecting those individuals with whom infants and young children share the same language might also serve the epistemic function of acquiring relevant knowledge of their social group.

Indeed, recent studies provided evidence that both infants and young children can use language as a cue to guide their learning processes. For example, based on the language of a demonstrator they can select which information to imitate or to preferably attend (Buttelmann et al., 2013; Soley and Sebastián-Gallés, 2015). In a study in which 14-month-old infants watched a novel action performed by either a native speaker of their language or a foreign speaker, infants imitated more often the action demonstrated by the native speaker (Buttelmann et al., 2013). Furthermore, infants already at the age of 7-months display a preference for tunes that were introduced by a native speaker of their language, as opposed to tunes that were introduced by a foreign speaker (Soley and Sebastián-Gallés, 2015).

However, if infants' and young children's preference for native speakers reflect their motivation to acquire relevant information of their social group, they should first show some attentional selectivity regarding the information they receive from a native speaker of their language, as opposed to the information they receive from a foreign speaker. Thus, we propose that in case infants' and children's language-based selective imitation and preference is driven by their motivation to learn information relevant to their social group, this selectivity should be present already at the level of attention, modulating how infants attend information coming from different speakers.

Despite its relevance regarding the potential epistemic function of infants' and young children's preference for native speakers, this question has received very little attention in the literature. Thus, the purpose of the current study is to investigate infants' attentional processes toward the information they receive from native vs. foreign speakers in their environment. Based on the evidence about infants' selective learning processes from speakers of different languages, we predict that when speakers of different languages provide information, infants will also focus more and explore longer the information coming from a native speaker, as opposed to a foreign speaker, independently from the modality of the information. Furthermore, in case this selectivity of attention is supposed to help the acquisition of relevant information of the social group very early on, we assume that it should be present already in the preverbal period.

To test this prediction, we collected data from eighty 12- and 5-month-old monolingual Italian infants. The infants were first familiarized with two Italian and Slovenian bilingual speakers, one talking to them in Italian and the other talking in Slovenian. After the Familiarization Phase, in the Teaching Phase infants saw clips where the two speakers silently gazed toward two unfamiliar objects, respectively. In the Test Phase, in order to assess infants' interest and motivation for further exploration toward one or the other object, we presented only the two familiar objects together, while infants' looking behavior was measured. We predicted that in case they favor the information that is presented by a speaker of their native language, they would attend longer the object presented by this speaker, compared to the object presented by the foreign speaker. In addition, to have an indication of whether they managed to encode the objects, we decided to include movies in the test phase in which we presented each of the previously observed (i.e., familiar) objects together with a novel one. We predicted that in case infants managed to encode the objects, they would prefer to look longer at the novel object, thus show a novelty effect when they see any of the familiar objects together with a novel one.

EXPERIMENT 1

Materials and Methods

Participants

In Experiment 1, we tested 54, 12-month-old infants from Italian-speaking families, (age range: 11 months, 13 days–12 months and 15 days). The age group was chosen because according to studies on object identification, by the age of 12-months infants are definitely able to identify objects based on object property information (Xu, 1999; Xu et al., 1999, 2004; Van de Walle et al., 2000). Six infants were excluded from analysis due to fussiness, and eight were excluded due to insufficient valid trials. Our study was approved by our institutional review board: the Bioethics Committee of the International School for Advanced Studies. All of our experiments followed the guidelines of this committee and all our protocols were approved by the committee. After being informed about the procedure, the parents of all participants provided written consent.

Stimuli

Infants were presented with videos of female faces and objects. The videos of the Familiarization Phase consisted two videos of faces of two female speakers, centrally located on the screen, in an approximate life-size. The videos of the Teaching Phase first showed a fixation cross, then one of the faces in the middle and a red occluder on either the right or left side of the screen, which would be later removed to reveal a colorful toy, (approximately 25 cm × 25 cm large). The videos of the Test Phase consisted of two colorful toys, located on the right and left side of the screen.

Apparatus and Procedure

Infants sat on a parent's lap at 80 cm from a 17-inches LCD screen in a soundproof booth. Parents wore opaque eye-glasses to prevent them from seeing the stimuli and influence the infants' behavior. Stimuli were presented using Psyscope B70 software. Stimuli presentation was controlled from outside the booth by the experimenter. Sound was played from a loudspeaker located behind the screen. Infants were videotaped during the experiment.

A Tobii T-120 Eye-tracker system recorded infants' gaze position on the screen during the experiment. Before starting the recording, we performed a 5-point calibration. Attractors were presented one after the other on each corner and in the center of the screen. For each attractor, we waited for the position of the gaze to stabilize, before presenting the next one. The difference between the estimated gaze position and the real position of the attractor was used for the calibration. If calibration was not successful it was repeated. No infants were excluded due to failure of calibration. After calibration and during the experiment, infants' gaze position was recorded at a sampling rate of 60 Hz.

Familiarization phase

First, infants went through a Familiarization Phase in which two videos of two female faces were presented, one after the other (**Figure 1A**). Each of these faces was speaking in an infant-directed way while gazing at the infant, for two blocks of 20 s. The blocks of the two speakers alternated and the order of presentation was counterbalanced across subjects. While one of these speakers talked to the infant in her native language (Italian), the other talked to the infant in a foreign language (Slovenian). Both speakers first greeted the infant, then asked her/him about her/his daily activities and told her/him that soon s/he will be watching some nice movies (referring to the experiment) and expressed the hope that the infant will enjoy her/his time in the lab. To control for any possible preference for one face over the other, we recorded Italian–Slovenian bilingual speakers and counterbalanced the language they spoke across infants. The entire Familiarization Phase lasted for 80 s.

Teaching phase

After the familiarization, infants were presented with the Teaching Phase consisting of four trials. Each trial started with 5 s of a centrally presented fixation cross. Following this, one of the characters was presented centrally and an occluder was presented either on the left or on the right side of the screen. For 1 s the face was gazing directly at the infant, and after that over a period of 2 s moved the direction of her gaze toward the occluder. After staying there for 2 s the face silently faded away. Once the face disappeared completely, the occluder was removed in a period of 2 s, revealing an object that stayed on screen for 3 s (**Figure 1B**). Since we wanted to eliminate the use of language at this stage, we decided to use the eye-gaze of the two speakers in order to establish a referential relationship between the speakers and the objects. There is evidence showing that young infants and already newborns tend to follow eye-gaze and understand the referential intention of the gaze (e.g., Farroni et al., 2004; Senju et al., 2008; Csibra, 2010; Marno et al., 2015). Thus, by having the speaker gaze toward the object we ensured that infants would make the inference that the speakers are intentionally showing these objects to them.

To avoid possible effects due to side of presentation of the objects, each speaker presented the same object in two different trials, once on each side of the screen. The trials of the Teaching

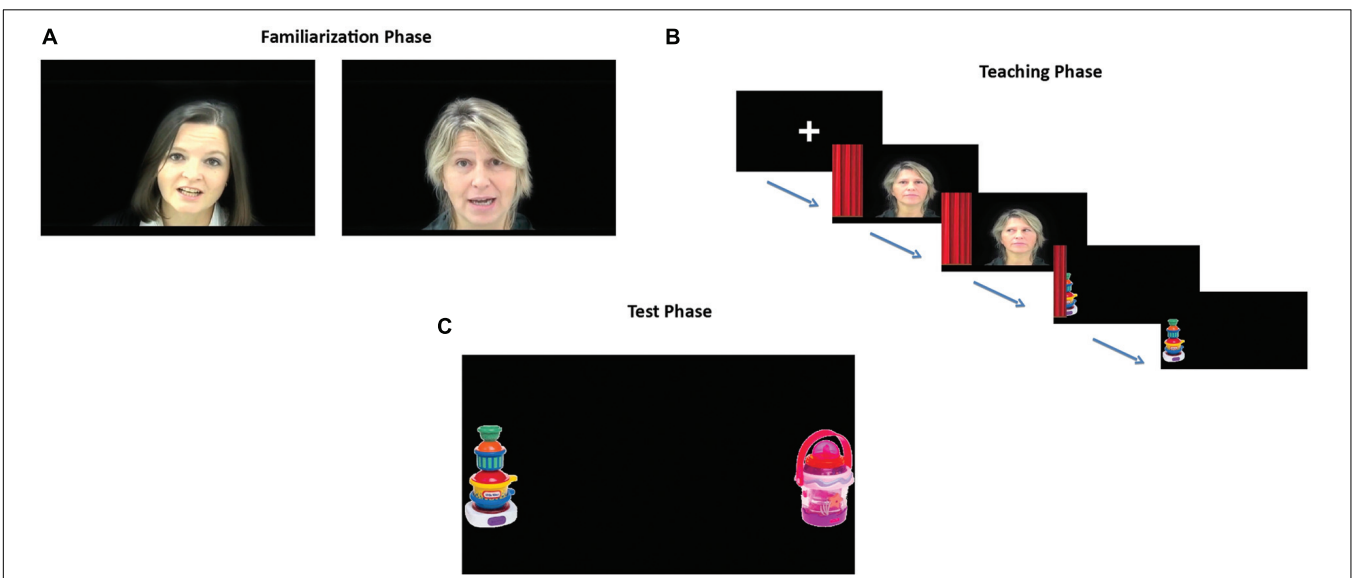

FIGURE 1 | (A) Familiarization Phase. Presentation of the two speakers, one of them was speaking in Italian, the other was speaking in Slovenian to the infants. **(B)** Teaching Phase. The two speakers were silently gazing toward an occluder that later revealed an object. **(C)** Test Phase. Presentation of pairs of objects on the two sides of the screen. The combination of the pairs were: Familiar object presented by the Native Speaker vs. Novel object 1; Familiar object presented by the Foreign Speaker vs. Novel object 2, Familiar object presented by the Native Speaker vs. Familiar object presented by the Foreign Speaker.

Phase were presented in a random order. The entire Teaching Phase lasted for 60 s.

Test phase

The Test Phase consisted of six trials. These trials started with a fixation cross presented centrally for 2.5 s. Afterward, two objects were shown simultaneously, one on the left and one on the right side of the screen, for a period of 10 s. Four objects were presented, out of which two were the objects previously presented during the Teaching Phase, and two were entirely novel objects (**Figure 1C**). Infants saw the test trials in the following combinations: Familiar object presented by the Native Speaker vs. Novel object 1; Familiar object presented by the Foreign Speaker vs. Novel object 2, Familiar object presented by the Native Speaker vs. Familiar object presented by the Foreign Speaker. Each combination was repeated twice in order to balance for the side, thus infants received a total of six test trials that was presented in a random order. The entire Test Phase lasted for 75 s.

Data Analysis

We defined three equally sized regions of interest for the analysis of the infant eye gaze, by dividing the screen into a center, a right and a left ROI. Trials of the Teaching Phase had to meet two criteria to be considered valid. First, infants should gaze for at least 2.5 s (out of 5 s) to the center while the character was displayed. Second, infants should gaze for at least 1.5 s (out of 3 s) to the side of the screen where the object was presented. The infants who did not meet these criteria in all the trials of the Teaching Phase were excluded as they likely did not pay sufficient attention to the speaker, to the object, or generally to the movies. For each test trial, we calculated the difference in cumulative looking time to each of the two objects presented. To assess for temporal drift, we obtained for each trial the difference of the timestamp between consecutive samples. Given that the recording rate was at 60 Hz, the time difference between two samples had to be 16.6 ms. We found no significant deviation from this value.

Results

During the Familiarization Phase, infants on average looked at the Native speaker for 18696 ms ($SD = 322$) and for 178040 ms at the Foreign speaker ($SD = 287$). During the Teaching Phase, we analyzed infants' looking time by comparing average cumulative looking time toward both the object and the speaker in the Native Speaker Condition with the average cumulative looking time toward both the object and the speaker in the Foreign Speaker Condition. This analysis did not produce significant difference, neither in the case of the objects [$t(39) = 1.501$, $p = 0.141$], nor in the case of the speakers [$t(39) = 1.406$, $p = 0.168$]. Thus, independently from the language of the demonstrator, infants looked equally long at both speakers and objects during the Teaching Phase. Next, we calculated the cumulative looking time differences in the Test Phase (**Figure 2**) by extracting the cumulative looking time toward one object minus the other and compared them to chance-level. In both test trials when a novel object was presented, we found a significant novelty effect (in the case of the object presented by the native speaker vs. new object comparison [$t(39) = -2.690$, $p = 0.010$], and in the case of the object presented by the foreign speaker vs. new object [$t(39) = -3.867$, $p < 0.001$]). When the two familiar objects were presented together, infants preferred to look significantly more to the object previously shown by the native speaker [$t(39) = 2.797$, $p = 0.008$]. This difference was also confirmed by a non-parametric binomial test. Out of the 40 infants 28 looked longer at the object that was previously shown by the Native speaker, which was significantly different from chance level ($p = 0.016$). Thus, despite infants spent equally long time to encode the two objects during the Teaching Phase, when they had the opportunity to choose which object to explore

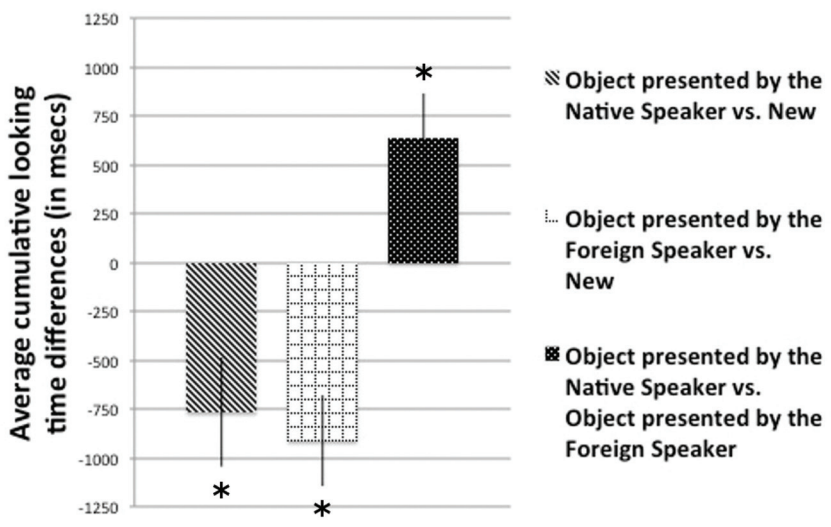

FIGURE 2 | Average looking time differences in the Test Phase in Experiment 1. Bars represent the average looking time differences of 40 infants in the three types of test trials. Error bars indicate SEM. Asterisks show significant differences from chance level.

more, they preferred to look longer at the object presented by the native speaker of their language. We can conclude that language had a modulatory effect on infants' object exploratory behavior.

Given that our data suggests that the language spoken by a presenter modulates 12-month-old infants' object exploration, we wanted to know whether this effect is also present earlier during development. Previous studies showed that already at 6 months of age, infants prefer to look at a person who previously spoke in their native language, as opposed to a person who spoke in a foreign language (Kinzler et al., 2007). Furthermore, 5- and 6-month-old infants showed the same preference toward people who previously spoke to them in a native accent, compared to a person who was speaking in a foreign accent (Kinzler et al., 2007). Thus, if infants' early preference for native or native accented speakers of their language also serves some epistemic functions, then we might find the same effect also at the age of 5-months. To test this prediction, we ran the same study with 5-month-old infants.

EXPERIMENT 2

Materials and Methods

The stimuli, apparatus, and protocol we used were identical to Experiment 1.

Participants

We tested 61, 5-month-old infants from Italian-speaking families, (age range: 4 months and 15 days to 5 months and 14 days). Ten infants were excluded from analysis due to fussiness, and 11 due to insufficient valid trials.

Results

During the Familiarization Phase, infants on average looked at the Native speaker for 19184 ms ($SD = 208$) and for 18976 ms at the Foreign speaker ($SD = 267$). During the Teaching Phase, first we analyzed again infants' looking time by comparing the average looking time toward both the object and the speaker in the Native Speaker Condition with the average looking time toward both the object and the speaker in the Non-Native Speaker Condition. Just as for the 12-month-olds, this analysis did not yield significant differences, neither in the case of the object [$t(39) = 0.040$, $p = 0.968$], nor in the case of the speaker [$t(39) = 0.499$, $p = 0.623$], indicating that also 5-month-old infants looked equally long at both objects and speakers during the Teaching Phase, independently from the language of the demonstrator. Next, we calculated the total looking time differences in the Test Phase (**Figure 3**) and compared them again to chance level. Even though infants looked numerically longer at the novel object, we did not find a significant novelty effect in any of the two language conditions (in the case of the object presented by the native speaker vs. new object comparison [$t(39) = -1.002$, $p = 0.323$], and in the case of the object presented by the foreign speaker vs. new object [$t(39) = -1.141$, $p = 0.261$]). However, as in Experiment 1, when the two familiar objects were presented together, infants again preferred to look significantly more to the object that was previously shown by the speaker of their native language [$t(39) = 2.243$, $p = 0.031$]. Furthermore, just like in the case of the older age group, this difference was also confirmed by a non-parametric binomial test. Out of the 40 infants 29 looked longer at the object that was previously shown by the Native speaker, which was significantly different from chance level ($p = 0.0064$). Thus, these results show that even 5-month-old infants prefer to attend longer the information they

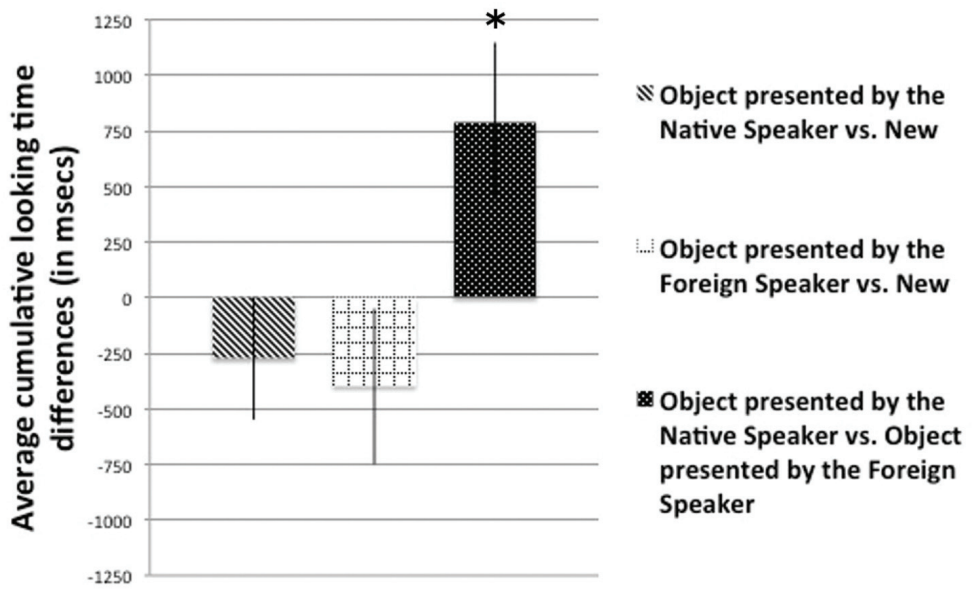

FIGURE 3 | Average looking time differences in the Test Phase in Experiment 2. Bars represent the average looking time differences of 40 infants in the three types of test trials. Error bars indicate SEM. Asterisks show significant differences from chance level.

receive from a speaker of their native language, compared to the information they receive from a foreign speaker.

COMPARISON OF THE TWO STUDIES

Table 1 shows in both age groups infants' cumulative looking time toward each object in each test condition. In order to directly compare the results of the two age groups in the three test conditions, we conducted a One-Way ANOVA where we included age as a grouping factor. This analysis revealed no difference regarding the looking time differences in the three test conditions [$F(78) = 1.535$, $p = 0.219$ in the comparison of infants' looking time toward the object that was presented by the Native speaker vs. the Novel object; $F(78) = 1.482$, $p = 0.227$ in the comparison of infants' looking time toward the object that was presented by the Foreign speaker vs. the Novel object; and $F(78) = 0.134$, $p = 0.715$ in the comparison of infants' looking time toward the two familiar objects]. Thus, even though in the case of the younger age group we did not find a significant novelty effect when they saw one familiar object together with a novel one, when we compared the two age groups, we did not find a significant difference in any of the test conditions. This might be due to the fact that even though 5-month-olds did not look significantly longer at the novel objects, still numerically they showed a tendency toward having a novelty bias.

ANALYSIS OF INFANTS' GAZE-FOLLOWING DURING THE TEACHING PHASE

There is evidence showing that young infants and even newborns tend to follow eye-gaze and understand the referential intention of the gaze (e.g., Farroni et al., 2004; Senju et al., 2008; Csibra, 2010; Marno et al., 2015). However, in order to be sure that also in our design infants tended to follow the gaze of the speakers during the Teaching Phase, we analyzed their looking behavior in the time window from the moment when the speakers' eye-gaze reached the direction of the occluder till the moment when the speakers' faces started to fade away. First, we calculated the percentage of trials in which infants followed the gaze and fixated at the occluder, before it would have revealed the object. This analysis showed that in the 12-month-old group infants followed the eye-gaze in 82% of the trials in the Native speaker condition and in 89% of the trials in the Foreign speaker condition. In the 5-month-old group infants followed the eye-gaze in 82% of the trials in the Native speaker condition and in 73% of the trials in the Foreign speaker condition. Thus, independently of the language of the speaker, infants in both conditions tended to follow the eye-gaze of both speakers. Next, we wanted to see whether the latency of infants' gaze orientation would differ in the two conditions. Since our data did not follow a normal distribution, instead of calculating the mean value we calculated the median of the latency of gaze-orientation. This analysis revealed in the 12-month-old group a 979 ms median latency of orientation toward the occluder in the Native speaker condition and a 1029 ms median latency of orientation in the Foreign speaker condition. The difference between the two values did not reach a level of significance [$t(39) = -0.140$, $p = 0.894$]. Infants in the 5-month-old group showed a 605 ms median latency of orientation toward the occluder in the Native speaker condition and 456 ms median latency of orientation in the Foreign speaker condition. Again, the difference between the two values did not reach a level of significance [$t(39) = 1.39$, $p = 0.171$].

In sum, infants in both age groups tended to follow the gaze of both speakers to the same extend. Additionally, independently from the language of the speakers, infants oriented equally fast toward the occluder to search for a possible referent of the gaze of the speakers. These results provide additional support to our hypothesis, namely that language only modulates infants' motivation for further exploration of the received information, and not their general attentiveness.

DISCUSSION

We proposed that a shared language is a viable cue that can guide infants' social learning to help to maximize the acquisition of knowledge relevant to the social group of the infant. To test this hypothesis, we designed a preferential looking paradigm in which infants had to attend to objects presented by either speakers of their native language or of a foreign language. We predicted that in case infants are selective information seekers and focus more on the information they receive from a native speaker, then they would prefer to explore more and to look longer at the object that was presented by a native speaker, compared to the object that was presented by a foreign speaker. This prediction was confirmed both in the case of 12- and of 5-month-old infants.

TABLE 1 | Average cumulative looking time of the two age groups at each object in each test condition.

Age group	Test condition 1		Test condition 2		Test condition 3	
	Object presented by the Native speaker	Novel object	Object presented by the Foreign speaker	Novel object	Object presented by the Native speaker	Object presented by the Foreign speaker
12-month-old group	3348 ms	4109 ms	3149 ms	4065 ms	3947 ms	3310 ms
5-month-old group	3189 ms	3464 ms	3206 ms	3605 ms	3870 ms	3078 ms

Numbers represent the mean cumulative looking time in milliseconds.

While the older infants always showed a novelty preference when a novel object was presented, when they saw the two familiar objects in a pair, they preferred to look longer at the object that was previously shown by a speaker of their native language. Younger infants, on the other hand, did not show any preference when they saw the familiar objects together with a novel object. However, when the two familiar objects were presented together, similarly to 12-month-old infants, also the 5-month-old subjects preferred to look longer at the object that was presented by the native speaker.

The lack of novelty preference in the group of the younger infants might be because the extent to which they encoded the objects was not sufficient to lead to explicit novelty preference. Previous research on infants' looking time studies showed that in habituation paradigms, during the course of visual processing infants pass through a period of transition between novelty preference and familiarity preference (Roder et al., 2000; Houston-Price and Nakai, 2004). During this period, however, both the familiar and the novel stimuli attract their attention equally, resulting in no difference in infants' looking time toward the familiar and the novel stimuli. Thus, this lack of difference, even though it appears as random looking, may in fact be due to two opposing preferences toward the familiar and the novel stimuli (Roder et al., 2000; Houston-Price and Nakai, 2004). Hence, it might be that in our case while the exposure time to the objects was sufficient for the 12-month-old group to lead to a novelty preference, younger infants would have needed more time in order to express an unambiguous novelty preference.

Our results may seem somewhat surprising when compared with the results of Buttelmann et al. (2013) who found that while 14-month-old infants were more likely to imitate the actions of a native speaker, when s/he expressed her/his preference toward an object, infants' did not rely on this more than on the preference expression of a foreign speaker. How is it possible then that in our case both 12- and 5-month-old infants preferred to look longer at the object that was presented by the native speaker? We believe that this apparent inconsistency of the two studies can be explained by some important differences between the task of Buttelmann et al. (2013) and our task. First, while in the task of Buttelmann et al. (2013) infants were prompted to explicitly choose between two objects by adopting a preference of the model, in our case we only measured their looking time, as an indication of their increased interest toward one object over the other. Thus, while according to the results of Buttelmann et al. (2013) infants did not adopt the preference of the native speaker more often than the preference of the foreign speaker, it remains an open question whether they would still have had an increased interest toward the object that was chosen by the native speaker.

Second, since we applied a within subject design, we could directly contrast the effect of native vs. foreign language, as infants had to choose between the object that was presented by the native speaker and the object that was presented by the foreign speaker. In contrast, in the study of Buttelmann et al. (2013) infants participated only either in the ingroup condition (seeing the attitude expression of the native speaker) or in the outgroup condition (seeing the attitude expression of the foreign speaker). Thus, they never had to choose between the two objects that were presented in the context of the attitude expressions of the two speakers. It thus remains unclear whether during such a forced choice task they would have actually chosen more often the object that was preferred by the native speaker.

One could argue that in our study the longer looking toward the object presented by the native speaker could be due to a novelty effect, because infants might have encoded better the object that was presented by the foreign speaker. However, this alternative explanation would be strikingly at odds with the existing literature. There is abundant evidence that infants from a very early age do not only prefer speakers of their native language (Kinzler et al., 2007), but they also modify their behavior depending on the attitude expressions of speakers of their native language (Shutts et al., 2009). Furthermore, when they have the possibility to accept or to offer objects to different speakers, infants preferably choose the person who previously spoke in their native language, compared to a foreign speaker (Kinzler et al., 2012). Thus, by taking into account infants' increased preference and affiliative tendencies toward speakers of their native language, one should predict that they would also show a bigger interest, hence a deeper encoding of the object that is presented by a native speaker. Suspecting the opposite, namely that infants would encode better objects that are presented by foreign speakers has no theoretical grounding.

Another alternative explanation of our results could be to assume that the ease of processing the native language with which infants are highly familiar would have led to a general preference toward the native speaker, extended to other information that appeared together with the speaker. Ease of processing or cognitive fluency has been shown to be generally associated with positive attitudes, leading to bigger confidence, trust in the truth of the information and a higher valuation (Alter and Oppenheimer, 2009a,b). Thus, it could be a plausible low-level explanation of our results to assume that infants simply had a preference toward the familiar sound-patterns, compared to the foreign sounds. However, in our paradigm, only during the familiarization phase infants had the opportunity to form an association between the speakers and the languages, leading to a familiarity-based preference toward the native speaker. When we first presented the objects, by the time the object appeared on the screen, the speakers were not present any more. Thus, forming a simple perceptual association between the object and the speaker was not possible. Rather than visually associating the speaker and the object, we believe that infants understood the referential intention of the speaker that was signaled by her eye-gaze (Farroni et al., 2004; Senju et al., 2008; Csibra, 2010; Marno et al., 2015), and as a consequence, they oriented their attention toward the previously gazed-at object. This assumption was also confirmed by the results of the gaze-analysis that showed that infants in both age groups tended to follow the direction of the gaze of both speakers. Finally, contrary to previous studies, where infants' and children's object choices took place always in the presence of the speakers (Kinzler et al., 2007, 2012), in our case during the test phase, infants were presented only with the two objects, without the context of the speakers. Thus, even though we cannot completely exclude the possibility that infants'

behavior during the test was influenced by a familiarity effect, we find this possibility unlikely, given that, such a never-ending chain of associations following one familiar stimulus would lead to overgeneralized non-adaptive preferences.

We argue that infants' longer looking time toward the object previously presented by a native speaker of their language reflects their increased interest in and motivation for further object exploration. More specifically, we propose that the shared language may have supported the inference that the content of the speaker's communication (i.e., the presented object) might represent information relevant to the social group of the infant, thus worth learning about. This kind of attentional bias and the selectivity to choose between potential sources of information can be a useful heuristic to optimize efficient learning of tool-uses or conventional norms and practices (Csibra and Gergely, 2006; Gergely and Csibra, 2006).

In the literature there is abundant evidence showing that infants are not passive recipients of the transmitted information, but rational learners who can select from who to learn in their social environment (e.g., Koenig et al., 2004; Koenig and Harris, 2005; Mascaro and Sperber, 2009; Tummeltshammer et al., 2014). This selection process can be guided for example by the reliability of both social and non-social informants (Mascaro and Sperber, 2009; Tummeltshammer et al., 2014). While at the age of 16-months infants are able to distinguish between true and false statements and learn from speakers who display relevant intentional cues (Koenig and Harris, 2005), by the age of 3 years they can select informants based on their past history (i.e., whether they provided true information) and learn about novel labels selectively from reliable informants (Koenig et al., 2004). Moreover, their trust can even be reversed if a previously reliable informant later turns out to be unreliable (Scofield and Behrend, 2008).

However, while tracking the reliability can give information about the trustworthiness of the source of knowledge, in order to maximize efficient learning, it is also important to evaluate the content of the transmitted knowledge. And indeed, there is evidence that infants are also sensitive to the perceived consensus between different informants, which can be the basis of tracking information that is universally shared among members of their culture (e.g., Harris and Corriveau, 2011; Chen et al., 2013). For example, young children tend to endorse claims from those persons who previously shared an agreement (Harris and Corriveau, 2011), even if this consensus was achieved between different race members (Chen et al., 2013). Moreover, when children learn from reliable informants, they also encode the information as normatively more appropriate, and they explicitly protest when a third-party acts deviating from the demonstrated norms (Rakoczy, 2008; Rakoczy et al., 2008, 2009; Rakoczy et al., 2008). Thus, from very early on, children show sensitivity to the information that can be seen as part of their cultural norms or a consensus of their environment.

Importantly, though, according to a recent line of research, accepting social partners as relevant sources of information appears to depend also on linguistic cues, even if the information is not verbal. In their study, Kinzler et al. (2010) showed movies about object-function demonstrations to preschool children. When endorsing the object-function, children relied more on the information they received from a native-accented speaker of their language, compared to the information they received from a foreign-accented speaker. Furthermore, this effect remained the same when in a second experiment both demonstrators spoke non-sense speech (Kinzler et al., 2010).

The relationship between sharing the same behavioral norms and linguistic background was also shown in a study by Oláh et al. (2014) who found that 2-year-old children inferences about the language of a demonstrator depend on whether a performed action was in accordance with the conventional norms of the children or not (Oláh et al., 2014). When children saw unusual actions of a demonstrator (e.g., using a fork to comb her hair), later they expected the demonstrator to speak in a foreign language, rather than in the children's native language. Thus, conventionality and language are both relevant cues to make inferences about a person's cultural background, influencing children's selective learning processes.

In accordance with the theoretical claims of this line of research, we propose that in order to be able to become competent members of their social group, infants must acquire the knowledge shared by their society. This requires not only the ability to recognize members of the same cultural background, but also a modulated attention toward the information they receive from these persons. By showing an increased interest and motivation for further exploration, infants and young children can successfully optimize their learning processes and selectively encode the information they receive from a relevant source of their culture. Our study suggests that such an attention modulatory effect is already present in very young infants. The fact that not only 12-month-old, but also 5-month-old infants preferred to explore longer the object they saw presented by a native speaker of their language implies that very young infants' preference for their native language and for speakers of their language does not only have an importance in social categorization processes, but also in their attention modulation that can potentially lead to successful learning from members of their society. While the present study showed that infants display a modulated attention toward the information they received from a native speaker, further studies should clarify whether this attentional bias would also affect long-term memory processes, leading to a longer-lasting retention of the information young infants receive from members of their cultural society.

AUTHOR CONTRIBUTIONS

HM, BG, and JM designed research. HM, JF, and BG performed research. HM, YV, and JF analyzed data. HM, YV, and MN wrote the paper.

FUNDING

This work was supported by the European Research Council under the European Union's Seventh Framework Programme (*FP7/2007-2013)*/ERC *grant agreement* n° 269502 (*PASCAL*) to

JM. During the preparation of the manuscript, HM was also founded by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC *grant agreement* n° 609819 *(SOMICS)*.

ACKNOWLEDGMENT

We thank Denis Tatone, Agnes M. Kovacs, Ildikó Király, and György Gergely for discussions.

REFERENCES

Alter, A. L., and Oppenheimer, D. M. (2009a). Suppressing secrecy through metacognitive ease cognitive fluency encourages self-disclosure. *Psychol. Sci.* 20, 1414–1420. doi: 10.1111/j.1467-9280.2009.02461.x

Alter, A. L., and Oppenheimer, D. M. (2009b). Uniting the tribes of fluency to form a metacognitive nation. *Pers. Soc. Psychol. Rev.* doi: 10.1177/1088868309341564

Bowern, C. (2010). Correlates of language change in hunter-gatherer and other 'small' languages. *Lang. Linguist. Compass* 4, 665–679. doi: 10.1111/j.1749-818X.2010.00220.x

Buttelmann, D., Zmyj, N., Daum, M., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Chen, E. E., Corriveau, K. H., and Harris, P. L. (2013). Children trust a consensus composed of outgroup members–but do not retain that trust. *Child Dev.* 84, 269–282. doi: 10.1111/j.1467-8624.2012.01850.x

Cohen, E. (2012). The evolution of tag-based cooperation in humans. *Curr. Anthropol.* 53, 588–616. doi: 10.1086/667654

Cosmides, L., Tooby, J., and Kurzban, R. (2003). Perceptions of race. *Trends Cogn. Sci.* 7, 173–179. doi: 10.1016/S1364-6613(03)00057-3

Csibra, G. (2010). Recognizing communicative intentions in infancy. *Mind Lang.* 25, 141–168. doi: 10.1111/j.1468-0017.2009.01384.x

Csibra, G., and Gergely, G. (2006). "Social learning and social cognition: the case for pedagogy," in *Processes of Change in Brain and Cognitive Development. Attention and Performance XXI,* eds Y. Munakata, and M. H. Johnson (Oxford: Oxford University Press), 249–274.

Farroni, T., Johnson, M. H., and Csibra, G. (2004). Mechanisms of eye gaze perception during infancy. *J. Cogn. Neurosci.* 16, 1320–1326. doi: 10.1162/0898929042304787

French, D. C. (1987). Children's social interaction with older, younger, and same-age peers. *J. Soc. Pers. Relatsh.* 4, 63–86. doi: 10.1177/0265407587041005

Gergely, G., and Csibra, G. (2006). "Sylvia's recipe: the role of imitation and pedagogy in the transmission of cultural knowledge," in *Roots of Human Sociality: Culture, Cognition, and Human Interaction*, ed. N. J. Enfield, and S. C. Levenson (Oxford: Berg Publishers).

Harris, P. L., and Corriveau, K. H. (2011). Young children's selective trust in informants. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 366, 1179–1187. doi: 10.1098/rstb.2010.0321

Henrich, J., and Henrich, N. (2007). *Why Humans Cooperate: A Cultural and Evolutionary Explanation*. Oxford: Oxford University Press.

Houston-Price, C., and Nakai, S. (2004). Distinguishing novelty and familiarity effects in infant preference procedures. *Infant Child Dev.* 13, 341–348. doi: 10.1002/icd.364

Jusczyk, P. W., Friederici, A. D., Wessels, J. M., Svenkerud, V. Y., and Jusczyk, A. M. (1993). Infants' sensitivity to the sound patterns of native language words. *J. Mem. Lang.* 32, 402–420. doi: 10.1006/jmla.1993.1022

Katz, J. (2003). "Advertising and the construction of violent white masculinity: From eminem to clinique for men," in *Gender, Race, and Class in the Media Text Reader,* eds G. Dines, and J. HumezA (London: SAGE Publications), 349–358.

Kelly, R. L. (1995). *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Washington, DC: Smithsonian Institution Press.

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2012). 'Native'objects and collaborators: infants' object choices and acts of giving reflect favor for native over foreign speakers. *J. Cogn. Dev.* 13, 67–81. doi: 10.1080/15248372.2011.567200

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Kinzler, K. D., Shutts, K., DeJesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children's social preferences. *Soc. Cogn.* 27, 623–624. doi: 10.1521/soco.2009.27.4.623

Kinzler, K. D., and Spelke, E. S. (2011). Do infants show social preferences for people differing in race?. *Cognition* 119, 1–9. doi: 10.1016/j.cognition.2010.10.019

Koenig, M. A., Clément, F., and Harris, P. L. (2004). Trust in testimony: children's use of true and false statements. *Psychol. Sci.* 15, 694–698. doi: 10.1111/j.0956-7976.2004.00742.x

Koenig, M. A., and Harris, P. L. (2005). The role of social cognition in early trust. *Trends Cogn. Sci.* 9, 457–459. doi: 10.1016/j.tics.2005.08.006

Kowalski, K., and Lo, Y. F. (2001). The influence of perceptual features, ethnic labels, and sociocultural information on the development of ethnic/racial bias in young children. *J. Cross Cult. Psychol.* 32, 444–455. doi: 10.1177/0022022101032004005

Kuhl, P. K., Stevens, E., Hayashi, A., Deguchi, T., Kiritani, S., and Iverson, P. (2006). Infants show a facilitation effect for native language phonetic perception between 6 and 12 months. *Dev. Sci.* 9, F13–F21. doi: 10.1111/j.1467-7687.2006.00468.x

Kurzban, R., Tooby, J., and Cosmides, L. (2001). Can race be erased? Coalitional computation and social categorization. *Proc. Natl. Acad. Sci. U.S.A.* 98, 15387–15392. doi: 10.1073/pnas.251541498

Maccoby, E. E., and Jacklin, C. N. (1987). Gender segregation in childhood. *Adv. Child Dev. Behav.* 20, 239–287. doi: 10.1016/S0065-2407(08)60404-8

Mampe, B., Friederici, A. D., Christophe, A., and Wermke, K. (2009). Newborns' cry melody is shaped by their native language. *Curr. Biol.* 19, 1994–1997. doi: 10.1016/j.cub.2009.09.064

Marno, H., Farroni, T., Dos Santos, Y. V., Ekramnia, M., Nespor, M., and Mehler, J. (2015). Can you see what I am talking about? Human speech triggers referential expectation in four-month-old infants. *Sci. Rep.* 5:13594. doi: 10.1038/srep13594

Mascaro, O., and Sperber, D. (2009). The moral, epistemic, and mindreading components of children's vigilance towards deception. *Cognition* 112, 367–380. doi: 10.1016/j.cognition.2009.05.012

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoncini, J., and Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition* 29, 143–178. doi: 10.1016/0010-0277(88)90035-2

Montepare, J. M., and Zebrowitz, L. A. (1998). Person perception comes of age: the salience and significance of age in social judgments. *Adv. Exp. Soc. Psychol.* 30, 93–161. doi: 10.1016/S0065-2601(08)60383-4

Moon, C., Cooper, R. P., and Fifer, W. P. (1993). Two-day-olds prefer their native language. *Infant Behav. Dev.* 16, 495–500. doi: 10.1016/0163-6383(93)80007-U

Nazzi, T., Bertoncini, J., and Mehler, J. (1998). Language discrimination by newborns: toward an understanding of the role of rhythm. *J. Exp. Psychol. Hum. Percept. Perform.* 24, 756–766. doi: 10.1037/0096-1523.24.3.756

Oláh, K., Elekes, F., Bródy, G., and Király, I. (2014). Social category formation is induced by cues of sharing knowledge in young children. *PLoS ONE* 9:e101680. doi: 10.1371/journal.pone.0101680

Partanen, E., Kujala, T., Näätänen, R., Liitola, A., Sambeth, A., and Huotilainen, M. (2013). Learning-induced neural plasticity of speech processing before birth. *Proc. Natl. Acad. Sci. U.S.A.* 110, 15145–15150. doi: 10.1073/pnas.1302159110

Pietraszewski, D., and Schwartz, A. (2014a). Evidence that accent is a dimension of social categorization, not a byproduct of perceptual salience, familiarity, or ease-of-processing. *Evol. Hum. Behav.* 35, 43–50. doi: 10.1016/j.evolhumbehav.2013.09.006

Pietraszewski, D., and Schwartz, A. (2014b). Evidence that accent is a dedicated dimension of social categorization, not a byproduct of coalitional categorization. *Evol. Hum. Behav.* 35, 51–57. doi: 10.1016/j.evolhumbehav.2013.09.005

Rakoczy, H. (2008). Taking fiction seriously: young children understand the normative structure of joint pretence games. *Dev. Psychol.* 44, 1195–1201. doi: 10.1037/0012-1649.44.4.1195

Rakoczy, H., Warneken, F., and Tomasello, M. (2008). The sources of normativity: young children's awareness of the normative structure of games. *Dev. Psychol.* 44, 875–881. doi: 10.1037/0012-1649.44.3.875

Rakoczy, H., Warneken, F., and Tomasello, M. (2009). Young children's selective learning of rule games from reliable and unreliable models. *Cogn. Dev.* 24, 61–69. doi: 10.1016/j.cogdev.2008.07.004

Roder, B. J., Bushnell, E. W., and Sasseville, A. M. (2000). Infants' preferences for familiarity and novelty during the course of visual processing. *Infancy* 1, 491–507. doi: 10.1207/S15327078IN0104_9

Scofield, J., and Behrend, D. A. (2008). Learning words from reliable and unreliable speakers. *Cogn. Dev.* 23, 278–290. doi: 10.1016/j.cogdev.2008.01.003

Senju, A., Csibra, G., and Johnson, M. H. (2008). Understanding the referential nature of looking: infants' preference for object-directed gaze. *Cognition* 108, 303–319. doi: 10.1016/j.cognition.2008.02.009

Shutts, K., Kinzler, K. D., McKee, C. B., and Spelke, E. S. (2009). Social information guides infants' selection of foods. *J. Cogn. Dev.* 10, 1–17. doi: 10.1080/15248370902966636

Susskind, J. E. (2007). Preadolescents' categorization of gender and ethnicity at the subgroup level in memory. *Br. J. Dev. Psychol.* 25, 213–225. doi: 10.1348/026151006X103654

Soley, G., and Sebastián-Gallés, N. (2015). Infants prefer tunes previously introduced by speakers of their native language. *Child Dev.* 86, 1685–1692. doi: 10.1111/cdev.12408

Tomasello, M., Carpenter, M., Call, J., Behne, T., and Moll, H. (2005). Understanding and sharing intentions: the origins of cultural cognition. *Behav. Brain Sci.* 28, 675–691. doi: 10.1017/S0140525X05000129

Tomasello, M., and Hamann, K. (2012). Collaboration in young children. *Q. J. Exp. Psychol.* 65, 1–12. doi: 10.1080/17470218.2011.608853

Tomasello, M., Melis, A. P., Tennie, C., Wyman, E., and Herrmann, E. (2012). Two key steps in the evolution of human cooperation. *Curr. Anthropol.* 53, 673–692. doi: 10.1086/668207

Tummeltshammer, K. S., Wu, R., Sobel, D. M., and Kirkham, N. Z. (2014). Infants track the reliability of potential informants. *Psychol. Sci.* 25, 1730–1738. doi: 10.1177/0956797614540178

Van de Walle, G. A., Carey, S., and Prevor, M. (2000). Bases for object individuation in infancy: evidence from manual search. *J. Cogn. Dev.* 1, 249–280. doi: 10.1207/S15327647JCD0103_1

Xu, F. (1999). Object individuation and object identity in infancy: the role of spatiotemporal information, object property information, and language. *Acta Psychol.* 102, 113–136. doi: 10.1016/S0001-6918(99)00029-3

Xu, F., Carey, S., and Quint, N. (2004). The emergence of kind-based object individuation in infancy. *Cogn. Psychol.* 49, 155–190. doi: 10.1016/j.cogpsych.2004.01.001

Xu, F., Carey, S., and Welch, J. (1999). Infants' ability to use object kind information for object individuation. *Cognition* 70, 137–166. doi: 10.1016/S0010-0277(99)00007-4

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 08 March 2016
doi: 10.3389/fpsyg.2016.00321

Young Children's Motor Interference Is Influenced by Novel Group Membership

Johanna E. van Schaik, Hinke M. Endedijk, Janny C. Stapel and Sabine Hunnius*

Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, Netherlands

From early childhood onward, individuals use behavior copying to communicate liking and belonging. This non-verbal signal of affiliation is especially relevant in the context of social groups and indeed both children and adults copy in-group more than out-group members. Given the societal importance of inter-group interactions, it is imperative to understand the mechanistic level at which group modulations of copying occur early in development. The current study was designed to investigate the effect of novel group membership on young children's motor behavior during a simultaneous movement-observation and -execution task. Four- to six-year-olds ($n = 65$) first gained membership to one of two novel groups based on their color preference and put on a vest in their chosen color. Subsequently, they were instructed to draw a straight line back-and-forth on a tablet computer that was concurrently displaying a stimulus video in which a model moved her arm congruently or incongruently to the child's instructed direction. In half of the stimulus videos the model belonged to the in-group, while in the other half the model belonged to the out-group, as identified by the color of her dress. The deviations into the uninstructed direction of the children's drawings were quantified as a measure of how much observing the models' behaviors interfered with executing their own behaviors. The motor interference effect, namely higher deviations in the incongruent trials than in the congruent trials, was found only for the out-group condition. An additional manipulation of whether the models' arms followed a biological or non-biological velocity profile had little effect on children's motor interference. The results are interpreted in the context of the explicit coordinative nature of the task as an effect of heightened attention toward interacting with an out-group member. This study demonstrates that already during early childhood, novel group membership dynamically influences behavior processing as a function of interaction context.

Keywords: motor interference, social groups, copying behavior, early childhood, interpersonal coordination

OPEN ACCESS

Edited by:
Ildikó Király,
Eötvös Loránd University, Hungary

Reviewed by:
Erika Nurmsoo,
University of Kent, UK
Gabriella Óturai,
University of Tromsø, Norway

****Correspondence:***
Johanna E. van Schaik
j.e.vanschaik@donders.ru.nl

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *16 December 2015*
Accepted: *21 February 2016*
Published: *08 March 2016*

Citation:
van Schaik JE, Endedijk HM, Stapel JC and Hunnius S (2016) Young Children's Motor Interference Is Influenced by Novel Group Membership. Front. Psychol. 7:321. doi: 10.3389/fpsyg.2016.00321

INTRODUCTION

Copying the behaviors of others occurs in many forms and plays a fundamental role in early social-cognitive development (Jones, 2009; Over and Carpenter, 2013; Marshall and Meltzoff, 2014; Paulus, 2014). Imitative play guides toddlers' everyday interactions with adults (Killen and Uzgiris, 1981) and peers (Nadel, 2002; Eckerman and Peterman, 2004). By the age of two, children's copying behavior is sensitive to the social availability of an adult model (Nielsen, 2006;

Nielsen et al., 2008; Nielsen and Blank, 2011). This social sensitivity increases during early childhood (Over and Carpenter, 2012), as early preferences for similar others (Fawcett and Markson, 2010; Mahajan and Wynn, 2012; Haun and Over, 2013) expand to encompass even arbitrary distinctions to demarcate groups (Dunham et al., 2011; Buttelmann and Böhm, 2014; Plötner et al., 2015). By the age of five, children mimic and imitate the behaviors of novel in-group members more than out-group members (Watson-Jones et al., 2016; van Schaik and Hunnius, under review) and children use information about who copies whom to infer interpersonal affiliations (Over and Carpenter, 2015). These social effects of copying are not confined to childhood; the bi-directionality between copying those you like and liking those who copy you plays an important, often implicit role in adulthood (Chartrand and Lakin, 2013; Lakin, 2013). Hence, throughout the lifespan, but already starting during early childhood interactions, behavior copying is an essential means of communicating similarity and belonging (Over and Carpenter, 2012; Heyes, 2013; Lakin and Chartrand, 2013).

Underlying behavior copying is a neurocognitive coupling between observing and executing actions (Molenberghs et al., 2009; Heyes, 2013; Paulus, 2014; Hamilton, 2015). Ontogenetically, this 'mirror system' is shaped through both observational and active experience (Hunnius and Bekkering, 2014), making it a dynamic product of an infant's social environment (Heyes, 2010, 2013). Additionally, adult neuroimaging studies indicate that mirror system activation is modulated by social group membership. Mirror system and related activation triggered by the observation of actions has been found to be higher when the individual performing the action is an in-group member than an out-group group member, both for pre-existing and novel groups (Gutsell and Inzlicht, 2010; Molenberghs, 2013; Molenberghs et al., 2013; Rauchbauer et al., 2015).

However, the period in-between forming observation-execution associations during infancy and the mirror system's social sensitivity in adulthood is understudied. During the preschool years, the complexity of the social environment in which young children execute and coordinate their behaviors expands and social groups increasingly play a role in daily interactions (Eckerman and Peterman, 2004; Rubin et al., 2006). Considering the social communicative function of copying behaviors reviewed above (Over and Carpenter, 2012), it is imperative to understand social, and particularly group, modulations of copying on a mechanistic level during early childhood.

The motor interference task (Kilner et al., 2003) provides a versatile behavioral measure of observation-execution associations and their modulators. This task, though importantly not a direct measure of neural mirror system activation, is based on the notion that if observing a behavior and executing a behavior elicit overlapping representations, then doing both simultaneously could cause interference (Kilner et al., 2003; Blakemore and Frith, 2005). In the original study, participants moved their arm back-and-forth in a straight line either horizontally or vertically while concurrently observing a confederate performing the same movement in the congruent or incongruent direction. As expected, in the incongruent trials, participants' movement paths showed significant deviations into the direction of the uninstructed axis compared to both congruent trials and baseline trials without concurrent observation. Conditions with a robotic arm instead of a human confederate, though, elicited no interference in the participants' movements, which the authors interpreted as an indication that the task is especially sensitive to biological movements (Kilner et al., 2003).

In a developmental adaptation of the task, Marshall et al. (2010) had 4-year-olds draw straight lines back-and-forth in either horizontal or vertical movements on a tablet computer screen using a stylus. At the same time, the screen was displaying a video of an adult female standing upright and moving her arm in either the congruent or incongruent direction. Like adults, the children in this study experienced motor interference (Marshall et al., 2010). As an initial exploration of the contribution of social factors on children's motor interference, the experiment was then repeated with two different models. In a within-participants design, 4.5-year-olds performed the task atop stimuli of either a same-aged boy or an adult male. The children experienced interference in the peer condition but the interference effect for the adult model disappeared. The authors place the findings in the context of a "like me" framework, emphasizing the social relevance of similar individuals (Marshall et al., 2010). Yet, it is unclear whether the "like me" effects were driven by social factors, since the peer was a possible friend, or biological factors, since the participants' own arm movements were more similar to the peer's movements due to their similar body proportions. Thus, although laying the groundwork, this study's results do not uniquely identify whether social factors influence young children's motor interference.

A following developmental study investigated the influence of movement profile more closely (Saby et al., 2011). In a similar tablet version of the task, 4- to 5-year-old children drew atop a bear puppet moving with a biological or non-biological movement profile. The puppets had previously been animated or not during a story telling session. Contrary to expectations, though, motor interference was found for the biologically moving previously unanimated condition and non-biologically moving previously animated condition. The authors interpreted these results as an attentional effect of expectation violations that resulted from a mismatch between movement profile and animacy (Saby et al., 2011). Taken together, while these two developmental studies (i.e., Marshall et al., 2010; Saby et al., 2011) demonstrate the usability of the task with young children, the data are inconclusive as to the distinct influences of social and biological factors on children's motor interference.

The current study was designed to investigate the influences of social and biological factors on young children's motor interference more directly. Importantly, given the central role of social groups in young children's copying behaviors as reviewed above, as well as the aforementioned evidence suggesting a specific influence of social groups on adults' mirroring, we implemented a novel group manipulation. This provided a developmentally relevant manipulation and allowed us to measure the sensitivity of copying mechanisms to group

processing effects without confounding the groups with past group experience or familiarity (Cikara and Van Bavel, 2014). By explicitly labeling group belonging and exposing the children to repeated interactions (i.e., trials) with in- and out-group models, the groups remained salient throughout the experiment. Additionally, by independently manipulating the movement profile (i.e., biological vs. non-biological) of in- and out-group models, we could isolate the influence of biological factors. Consequently, a 2 (congruency) × 2 (group membership) × 2 (movement profile) within-participants design was used.

It was expected that the motor interference effect would be replicated, by finding higher deviations into the uninstructed drawing direction in incongruent than congruent conditions. Also, interactions of both group membership and movement profile with congruency were expected. Observing in-group members was hypothesized to lead to greater interference effects than observing out-group members, in line with higher copying rates of in-group members than of out-group members (van Schaik and Hunnius, under review). Following the adult motor interference literature (Kilner et al., 2007), it was hypothesized that biological movements would lead to more interference than non-biological movements. Finally, an interaction between congruency, movement profile and group membership was expected in the direction of in-group biological trials showing the most interference.

MATERIALS AND METHODS

Participants

Seventy children (35 female) participated at two primary schools in the Netherlands. Two children did not complete the experiment. The data of three children was at two or more standard deviations from the mean (see also Data Preparation) and was excluded from the final analyses. The final sample consisted of 65 4- to 6-year-olds (33 female; $M = 63.85$ months, $SD = 7.27$ months). Signed informed consent was acquired from the guardian prior to participation. The schools could choose their preferred type of compensation: one school opted for each child receiving a sticker post-participation and the other school opted for a book voucher for the classrooms. This research was approved by the local social science faculty's ethical committee.

Stimuli

Stimulus videos displayed one of three female models (a–c) from the waist up. The baseline stimulus (used for both the practice trials at the beginning of the experiment and baseline trials halfway through the experiment, see also Procedure) consisted of a video recording of model a wearing a green dress and standing still. In this manner, the baseline stimulus only differed from the experimental stimuli in the absence of arm movements, thus controlling for other factors such as body sway. In the experimental stimuli, the model (i.e., models b and c; **Figure 1**) was wearing a blue or red dress. The model moved her arm vertically or horizontally back and forth. The biological movement stimuli were recorded at 25 frames per second. Loops (consisting of one back-and-forth movement) were selected for their straightness and how well they matched the other model's and directions' (i.e., vertical and horizontal) speeds. These loops were then repeated back-to-back such that one stimulus video showed 10 repetitions of the loop (note: this was also done for the baseline stimulus with a segment of 1.5 s). The non-biological movement stimuli consisted of compiled photographs (frame rate = 25) in which the model's arm did not follow a typical biological velocity profile of slowing down at the returning points. Instead, the model's arm position shifted 10° between every two pictures, resulting in a triangular velocity profile. Stimulus videos lasted on average 16.6 s (range 15.9–18.0). The models' dress colors (i.e., blue and red) were digitally edited, such that a full counterbalancing of model identity (i.e., models b and c) and color was possible.

Both stimulus display and the acquisition of data were performed with Presentation software (www.neurobs.com) on a tablet computer (Asus Eee Slate). The stimuli were cropped to be square (720 × 720 pixels; 146 mm × 146 mm on the tablet screen). A hard plastic sheet with an opening overlaying the area of the screen where the videos were played was placed over the tablet screen, to limit the area on which children could draw to precisely the square dimensions of the video. The stylus' position on the screen was acquired at 100 Hz.

Procedure

At the start of the experiment, the child was asked to draw a picture in Microsoft Paint in order to familiarize her with the stylus and tablet computer. Once the child had finished the drawing (or after 2 min), the experimenter started the experiment on the tablet computer. First, the colors red and blue appeared on the left and right sides of the screen (counterbalanced), and the child was asked to tap the stylus on the color they liked more (49% of the sample chose blue). The experimenter congratulated her on her choice and told her that she now belonged to that group. The child was given a vest to wear in the chosen color and the experimenter emphasized the group membership by exclaiming, "Wow! Now you are completely [chosen color], great!"

A practice session followed in which the baseline stimulus was shown twice, once as a horizontal practice and once as a vertical practice (order counterbalanced). The practice trials and all subsequent experimental and baseline trials followed the same procedure; before each stimulus, the screen was black while the experimenter instructed the child to draw a straight line back-and-forth either from side to side (horizontal) or top to bottom (vertical). The experimenter ensured that the child was holding the stylus at an appropriate starting position prior to starting the stimulus video (e.g., on the top or bottom of the screen for vertical trials, or at the left or right side of the screen for horizontal trials). Children were instructed to draw for the duration of each video (i.e., on average, 16.6 s of drawing per stimulus).

Following the two practice trials, the experimenter introduced the child to the two group models. A neutral picture of each model was shown for 7 s, accompanied by the experimenter's explanation, "Look! She (also) belongs to the [color] group. She is (also) wearing [color] clothes." The child was then informed that she would be seeing videos of these models and would have to draw lines like in the practice trials.

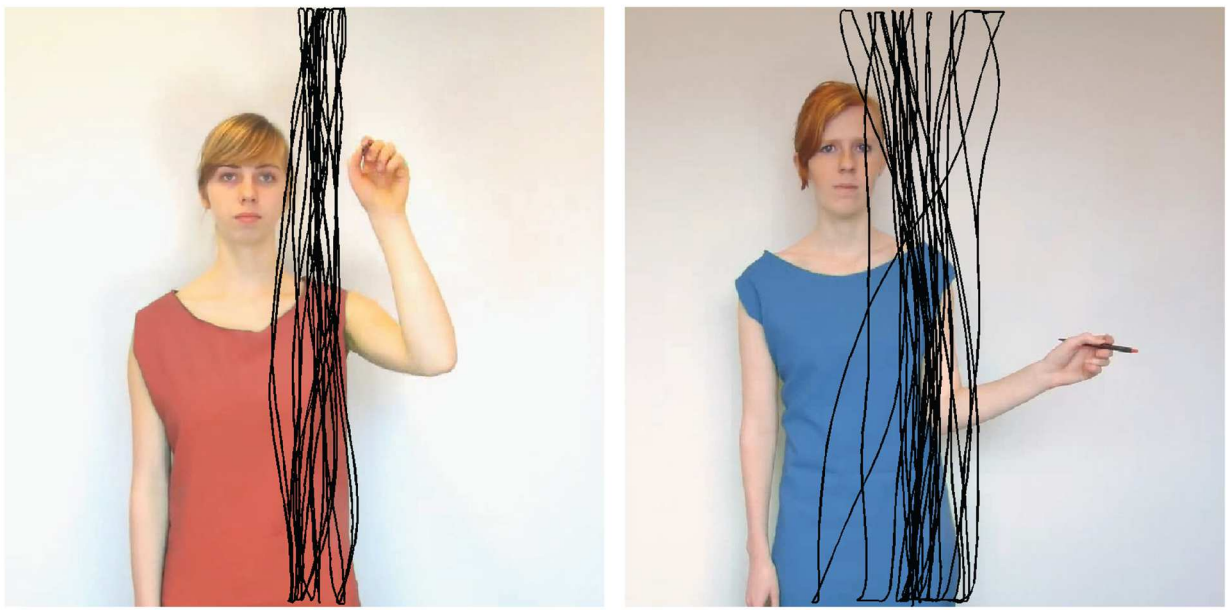

FIGURE 1 | Still frames of two stimulus videos illustrating different conditions. An example participant's drawings from a congruent **(A)** and incongruent **(B)** trial is overlaid in black. The stylus did not leave a line on the screen during the experiment.

During the experimental trials, the experimenter instructed the child as for the practice trials; the experimenter instructed which direction to draw in and ensured the child held the stylus at an appropriate location while the screen was still black before each stimulus video started. The factors congruency (congruent vs. incongruent), movement profile (biological vs. non-biological), and group membership (in-group vs. out-group) were fully balanced within each child's randomization of experimental trials (i.e., eight trials). Whereas direction drawn was counterbalanced within participants, direction observed was counterbalanced across participants; each child drew half of their trials horizontally and half vertically, but always saw either vertical or horizontal videos.[1]Halfway through the experimental trials (i.e., after four trials), the child took a break from working on the tablet by playing a game of Memory for a few minutes. After the break, two baseline trials (i.e., one vertical and one horizontal; order counterbalanced) were performed using the baseline stimulus following the same procedure as the practice and experimental trials. This was followed by the remaining four experimental trials.

At the end, explicit preferences were measured by showing the neutral pictures of the two models on either side of the screen. The experimenter asked two questions in a randomized order (question 1: Who do you like more?; question 2: Who would you like to play with?) and the child responded by tapping the picture of the model she preferred. Before bringing the child back to the classroom, the experimenter thanked the child and emphasized that because the game was over, the groups no longer mattered.

[1]In a pilot, a full counterbalancing of models' movement direction (i.e., 16 trials) proved too long in duration for this age group.

Data Preparation

Motor interference was measured per trial as the standard deviation of all the sampled locations where the screen was touched in the uninstructed axis throughout the trial (Marshall et al., 2010; Saby et al., 2011). To account for individual variability in drawing ability, this was divided by the same measure (i.e., the standard deviation in the uninstructed axis) from the corresponding (i.e., horizontal or vertical) baseline trial, resulting in a 'deviation ratio'. Across participants, baseline outliers were first calculated per direction drawn at two or more standard deviations from the mean. Subsequently, outliers in the deviation ratios were calculated per condition per direction drawn also at two standard deviations. Outlying trials were excluded on a trial-by-trial basis and only three participants did not contribute any trials to the analyses.

RESULTS

First, the efficacy of the social group manipulation was tested. Explicit preferences were analyzed with a binomial test per question. The proportion of children who chose their in-group model in response to the question who they would like to play with (observed proportion = 0.70) was significantly higher than would be expected by chance (i.e., 0.50; $p = 0.002$). In response to the question regarding which model the children liked more, the proportion of children who chose their in-group model did not differ from chance (observed proportion = 0.54, $p = 0.615$). As a control, a chi-square analysis verified that the models were counterbalanced across participants in representing in- and out-group members ($p > 0.250$).

A linear fixed-effect model by means of maximum likelihood estimation was used. The model was performed on the deviation ratios with the factors congruency, group membership, and movement profile (full-factorial; **Figure 2**) and direction drawn as a covariate. There was a significant main effect of congruency, $F(1,385.81) = 17.12$, $p < 0.001$, $r = 0.21$, with deviation ratios in the incongruent conditions ($M = 1.21$, $SE = 0.031$) being higher than in the congruent conditions ($M = 1.05$, $SE = 0.024$). No main effects of movement profile nor group membership were found. Conversely, there was a two-way interaction between congruency and group membership, $F(1,389.36) = 7.24$, $p = 0.007$, $r = 0.14$, and a three-way interaction between congruency, movement profile and group membership, $F(1,396.72) = 4.10$, $p = 0.044$, $r = 0.10$.

The interactions were tested further by repeating the analysis for the in-group and out-group conditions separately. For the in-group analysis there were no significant effects (congruency main effect: $p = 0.143$, all other ps > 0.250). The out-group analysis indicated a main effect of congruency, $F(1,195.43) = 19.42$, $p < 0.001$, $r = 0.30$. Deviation ratios for incongruent out-group trials ($M = 1.28$, $SE = 0.049$) were significantly higher than those for congruent out-group trials ($M = 1.02$, $SE = 0.032$). The interaction between congruency and movement profile did not reach significance ($p = 0.175$, $r = 0.10$). With respect to the original three-way interaction, **Figure 2** and the lack of any effects within the in-group suggest that this interaction was partially driven by the higher difference between incongruent and congruent trials in the biological out-group conditions (difference = 0.339) than in the non-biological out-group conditions (difference = 0.178). In sum, significant interference effects were found in the out-group condition but not in the in-group condition and no significant effects of movement profile were found.

DISCUSSION

In this study, the effects of novel group membership and movement profile on 4- to 6-year-olds' motor interference were investigated. Participants performed back-and-forth movements either congruently or incongruently with respect to an in-group or out-group model's movement direction. The expected motor interference effect was replicated, as incongruent conditions differed significantly from congruent conditions. This effect was only present for the out-group condition and did not occur for the in-group condition. Although there was also an interaction with movement profile, the effect of whether the models moved biologically or non-biologically was minimal.

An explicit measure indicated that the group allocation was effective in eliciting an in-group preference. Whereas the abstract question regarding liking did not show an in-group bias, the concrete question of whether children would like to play with the in-group or out-group model did show a significant in-group preference within the sample. This is in line with other studies using the same questions, in which the concrete question shows stronger effects with this age group (van Schaik and Hunnius, under review). This finding indicates that the out-group modulation of the interference effect, although opposite to expectation, holds bearing.

Initially, more motor interference was expected to occur for in-group members than for out-group members. Since motor interference is an effect of action observation-execution coupling, and this, in turn, is thought to contribute to behavior copying, it was expected that the motor interference would reflect the general finding that we (unintentionally) copy individuals we like more than individuals we like less (Chartrand and Lakin, 2013; van Schaik and Hunnius, under review). In favor of this underlying mechanism, a range of adult studies provide evidence for motor interference, under controlled circumstances, being a measure of action observation–execution coupling (e.g., Kilner et al., 2007) and for social modulations of mirror system activation (Molenberghs, 2013). However, in contrast to adult motor interference studies in which social factors are carefully controlled or discrete instances of mimicking an interaction partner's behavior, the present continuous-action measure was embedded in an explicitly instructed social context. As a result, an additional overlaying process involving task-related social motivations likely influenced the underlying mechanisms, and hence influenced the behavioral effects more strongly. For instance, the explicit emphasis on the social groups and the continuous nature of the movements might have led children to experience the task as an instance of coordination (Richardson et al., 2009); like other instances of coordination such as dancing together, participants were carrying out a similar, continuous behavior in the same space as the models. And since interpersonal coordination is a means of establishing liking and affiliation between individuals (Hove and Risen, 2009; Lakin, 2013), additional social goals might have complicated the group manipulation's effect. Here, the out-group motor interference might have been caused by heightened attention toward the out-group model as a result of a need to overcome intergroup differences in what might be experienced as an affiliative, spatially coordinative task.

Two recent studies have found analogous results to those of the present study. In a motor interference study, adults saw pro-social words (e.g., 'group') or anti-social words (e.g., 'alone') superimposed on the screen displaying the model. Contrary to expectation, the anti-social word condition led to higher motor interference than the pro-social condition. One of the authors' interpretations of the findings holds that the anti-social condition threatened the "social harmony" of the interaction leading to increased attempts to affiliate with the model through increased coordination (Roberts et al., 2015, p. 7). Likewise, in a study using novel groups, adult participants who performed a repetitive rhythmic interaction with an out-group member spontaneously synchronized more than those who interacted with an in-group member. The authors similarly interpreted these findings as an effect of overcoming the inter-group differences, paralleling findings of synchrony being used to increase affiliation (Miles et al., 2011). In sum, the out-group interference effect observed in the present study might be a result of increased processing of the out-group member's movement stemming from a desire to overcome the differing group memberships.

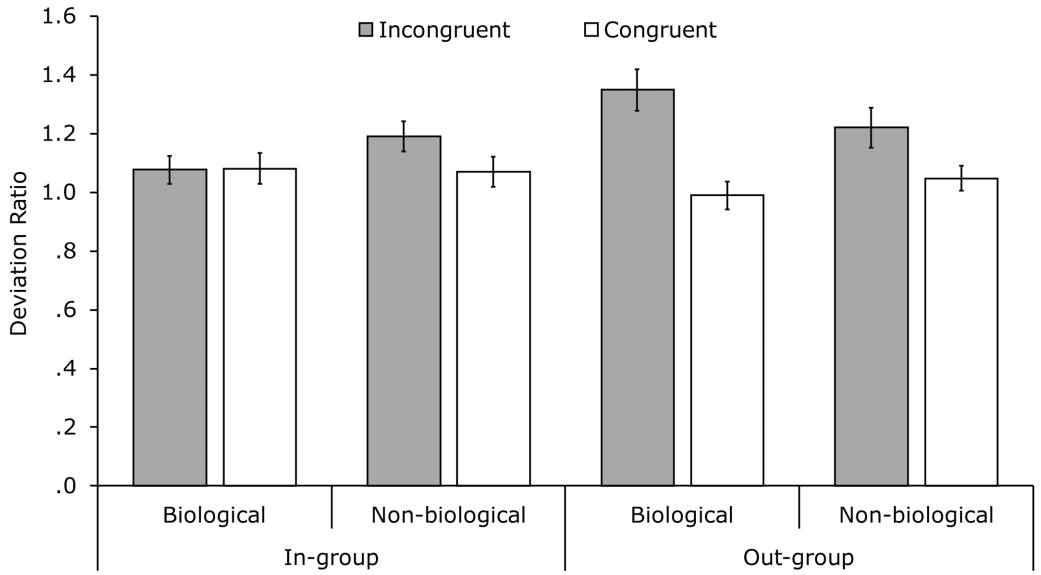

FIGURE 2 | Mean deviation ratios per condition. Deviation ratios were calculated by dividing the standard deviation in the uninstructed direction by the standard deviation in the uninstructed direction from the corresponding baseline trial. Error bars indicate standard errors of the mean.

Notably, though, variants of this account could lead to the same effects. Group boundaries can be perceived as competitive, even in the absence of explicit competition (Cikara and Van Bavel, 2014). Hence, the inter-group differences that in a cooperative case lead to increased affiliation attempts as discussed above (Miles et al., 2011), in another case might lead to wanting to appease a threat through affiliation (Rauchbauer et al., 2015), or in yet a third, more distinct case, could lead to enhanced monitoring of a competitor to facilitate prediction of their potentially dangerous behavior (Gutsell and Inzlicht, 2013; Cikara and Van Bavel, 2014). Each case, though, would lead to increased processing of out-group movements. With respect to this study, one could argue that because children were brought into close contact with a potential threat (i.e., an out-group member), the enhanced interference effect was a result of increased vigilance of the out-group's movement. However, this seems less likely for several related reasons. Threat effects in adults have primarily been found for existing groups and less so for novel group boundaries, which is likely caused by novel group manipulations leading to in-group preferences but not necessarily out-group derogation (Brewer, 1999; Cikara and Van Bavel, 2014). Also, explicit competition leads to considerably more intergroup hostility than simply dividing individuals into groups (Cikara and Van Bavel, 2014). Indeed, considering the age of the current study's participants, these latter considerations are particularly relevant; novel-group-based out-group hate appears to develop between the ages of 6 and 8 (Buttelmann and Böhm, 2014), hence at a later age than the participants in the current study. Nonetheless, the out-group motor interference finding illustrates the complexity of social manipulations in combination with interpersonal tasks and indicates that this dynamic interplay of factors should be investigated further (Cikara and Van Bavel, 2014; Roberts et al., 2015).

Regarding the movement profile, only a limited effect on interference was found, and this was within the already-salient out-group condition. While past adult studies using a full-body paradigm have found higher interference in biological movement conditions (Kilner et al., 2007), a previous developmental study using a similar tablet-based design as the present study also found unexpected effects with respect to movement profile (Saby et al., 2011). Notably, in the tablet adaptation of the task used in this and past developmental studies, the similarity between the participants' and models' movements is reduced as compared to full-body paradigms. In the present stimuli (and in the past study's puppet stimuli reported in Saby et al. (2011), though the puppets are anatomically less similar than the present study's human models) the models make full shoulder-initiated arm movements that cross the midline as in the original adult paradigm but the participating children are asked to make unilateral movements with their wrists and hands in a precision pen-grip. As a result, the extent to which executing their action and observing the model's action elicit overlapping representations is limited, hence reducing the motor interference effect. Our attempt to make wrist and hand configuration more similar between participant and model by having the model hold a pen in her hand seems to have produced insufficient overlap. Additionally, the aforementioned social task demands which led to increased saliency of the out-group condition, possibly diminished attention toward less salient features of the videos (i.e., the kinematic differences) reducing the overall influence of the movement profile manipulation even more. Yet, since within the out-group condition the pattern tended toward biological trials leading to more interference than non-biological trials, the interference that was measured is also not merely a spatial congruency effect. Taken together, the degree to which the observed action and the executed action overlapped, and

the saliency of the different characteristics of the stimulus (e.g., social group vs. movement profile) likely diminished the extent to which the movement profile manipulation affected children's motor interference.

CONCLUSION

This study investigated the sensitivity of children's motor interference to group membership and movement profile. Motor interference was only found for out-group members' movements. This effect likely stems from heightened attention toward out-group members as a result of the coordinative nature of this explicitly instructed paradigm. Thus, this work demonstrates that the context of an interpersonal interaction uniquely interacts with the situation's social dynamics, and consequently this interplay affects underlying imitative processes. Future research should continue to investigate how social factors affect copying mechanisms during early childhood, as it is crucial in understanding inter-group interactions.

AUTHOR CONTRIBUTIONS

The study was conceived of and designed by JS and JvS under the supervision of SH. The data were analyzed by HE, JvS, and JS. JvS drafted the manuscript and HE, JS, and SH provided extensive feedback. All authors approved the final version.

ACKNOWLEDGMENTS

The authors thank the participating schools, guardians, and children. Thanks also to Vera Hudepohl, Lydia Vlagsma, and Debbie Wolters for their roles in stimulus filming and data collection and to Erik van den Berge for stimulus editing.

REFERENCES

Blakemore, S. J., and Frith, C. (2005). The role of motor contagion in the prediction of action. *Neuropsychologia* 43, 260–267. doi: 10.1016/j.neuropsychologia.2004.11.012

Brewer, M. B. (1999). The psychology of prejudice: ingroup love our outgroup hate? *J. Soc. Issues* 55, 429–444. doi: 10.1111/0022-4537.00126

Buttelmann, D., and Böhm, R. (2014). The ontogeny of the motivation that underlies in-group bias. *Psychol. Sci.* 25, 921–927. doi: 10.1177/0956797613516802

Chartrand, T. L., and Lakin, J. L. (2013). The antecedents and consequences of human behavioral mimicry. *Annu. Rev. Psychol.* 64, 18.1–18.24. doi: 10.1146/annurev-psych-113011-143754

Cikara, M., and Van Bavel, J. J. (2014). The neuroscience of intergroup relations: an integrative review. *Perspect. Psychol. Sci.* 9, 245–274. doi: 10.1177/1745691614527464

Dunham, Y., Baron, A. S., and Carey, S. (2011). Consequences of "minimal" group affiliations in children. *Child Dev.* 82, 793–811. doi: 10.1111/j.1467-8624.2011.01577.x

Eckerman, C. O., and Peterman, K. (2004). "Peers and infant social/communicative development," in *Blackwell Handbook of Infant Development*, eds G. Bremner and A. Fogel (Oxford: Blackwell), 326–350. doi: 10.1111/b.9780631212355.2004.00016.x

Fawcett, C. A., and Markson, L. (2010). Similarity predicts liking in 3-year-old children. *J. Exp. Child Psychol.* 105, 345–358. doi: 10.1016/j.jecp.2009.12.002

Gutsell, J. N., and Inzlicht, M. (2010). Empathy constrained: prejudice predicts reduced mental simulation of actions during observation of outgroups. *J. Exp. Soc. Psychol.* 46, 841–845. doi: 10.1016/j.jesp.2010.03.011

Gutsell, J. N., and Inzlicht, M. (2013). "Using EEG mu-suppression to explore group biases in motor resonance," in *Neuroscience of Prejudice*, eds B. Derks, D. Scheepers, and N. Ellemers (London: Psychology Press), 278–298. doi: 10.4324/9780203124635

Hamilton, A. F. D. C. (2015). The neurocognitive mechanisms of imitation. *Curr. Opin. Behav. Sci.* 3, 63–67. doi: 10.1016/j.cobeha.2015.01.011

Haun, D., and Over, H. (2013). "Like me: a homophily-based account of human culture," in *Cultural Evolution: Society, Technology, Language, and Religion*, eds P. J. Richerson and M. H. Christiansen (Cambridge, MA: MIT Press), 117–130. doi: 10.1007/978-1-4939-1387-9_6

Heyes, C. (2010). Where do mirror neurons come from? *Neurosci. Biobehav. Rev.* 34, 575–583. doi: 10.1016/j.neubiorev.2009.11.007

Heyes, C. (2013). "What can imitation do for cooperation?," in *Cooperation and its Evolution*, eds K. Sterenly, R. Joyce, B. Calcott, & B. Fraser (Cambridge: MIT Press), 313–331.

Hove, M. J., and Risen, J. L. (2009). It's all in the timing: interpersonal synchrony increases affiliation. *Soc. Cogn.* 27, 949–960. doi: 10.1521/soco.2009.27.6.949

Hunnius, S., and Bekkering, H. (2014). What are you doing? How active and observational experience shape infants' action understanding. *Philos. Trans. R. Soc. B Biol. Sci.* 369:20130490. doi: 10.1098/rstb.2013.0490

Jones, S. S. (2009). The development of imitation in infancy. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 364, 2325–2335. doi: 10.1098/rstb.2009.0045

Killen, M., and Uzgiris, I. C. (1981). Imitation of actions with objects: the role of social meaning. *J. Genet. Psychol.* 138, 219–229. doi: 10.1080/00221325.1981.10534136

Kilner, J. M., Hamilton, A. F., and Blakemore, S.-J. (2007). Interference effect of observed human movement on action is due to velocity profile of biological motion. *Soc. Neurosci.* 2, 158–166. doi: 10.1080/17470910701428190

Kilner, J. M., Paulignan, Y., and Blakemore, S. J. (2003). An interference effect of observed biological movement on action. *Curr. Biol.* 13, 522–525. doi: 10.1016/S0960-9822(03)00165-9

Lakin, J. L. (2013). "Behavioral mimicry and interpersonal synchrony," in *Nonverbal Communication*, 2nd Edn, eds J. A. Hall and M. L. Knapp (Berlin: de Gruyter), 539–575.

Lakin, J. L., and Chartrand, T. L. (2013). "Behavioral mimicry as an affiliative response to social exclusion," in *The Oxford Handbook of Social Exclusion*, ed. C. N. DeWall (New York, NY: Oxford University Press), doi: 10.1093/oxfordhb/9780195398700.013.0025

Mahajan, N., and Wynn, K. (2012). Origins of "Us" versus "Them": prelinguistic infants prefer similar others. *Cognition* 124, 227–233. doi: 10.1016/j.cognition.2012.05.003

Marshall, P. J., Bouquet, C. A., Thomas, A. L., and Shipley, T. F. (2010). Motor contagion in young children: exploring social influences on perception – action coupling. *Neural Netw.* 23, 1017–1025. doi: 10.1016/j.neunet.2010.07.007

Marshall, P. J., and Meltzoff, A. N. (2014). Neural mirroring mechanisms and imitation in human infants. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 369:20130620. doi: 10.1098/rstb.2013.0620

Miles, L. K., Lumsden, J., Richardson, M. J., and Macrae, C. N. (2011). Do birds of a feather move together? Group membership and behavioral synchrony. *Exp. Brain Res.* 211, 495–503. doi: 10.1007/s00221-011-2641-z

Molenberghs, P. (2013). The neuroscience of in-group bias. *Neurosci. Biobehav. Rev.* 37, 1530–1536. doi: 10.1016/j.neubiorev.2013.06.002

Molenberghs, P., Cunnington, R., and Mattingley, J. B. (2009).). Is the mirror neuron system involved in imitation? A short review and meta-analysis. *Neurosci. Biobehav. Rev.* 33, 975–980. doi: 10.1016/j.neubiorev.2009.03.010

Molenberghs, P., Halász, V., Mattingley, J. B., Vanman, E. J., and Cunnington, R. (2013). Seeing is believing: neural mechanisms of action-perception are biased by team membership. *Hum. Brain Mapp.* 34, 2055–2068. doi: 10.1002/hbm.22044

Nadel, J. (2002). "Imitation and imitation recognition: functional use in preverbal infants and nonverbal children with autism," in *The Imitative Mind: Development, Evolution, and Brain Bases*, eds A. N. Meltzoff

and W. Prinz (Cambridge: Cambridge University Press), 42–62. doi: 10.1017/CBO9780511489969.003

Nielsen, M. (2006). Copying actions and copying outcomes: social learning through the second year. *Dev. Psychol.* 42, 555–565. doi: 10.1037/0012-1649.42.3.555

Nielsen, M., and Blank, C. (2011). Imitation in young children: when who gets copied is more important than what gets copied. *Dev. Psychol.* 47, 1050–1053. doi: 10.1037/a0023866

Nielsen, M., Simcock, G., and Jenkins, L. (2008). The effect of social engagement on 24-month-olds' imitation from live and televised models. *Dev. Sci.* 11, 722–731. doi: 10.1111/j.1467-7687.2008.00722.x

Over, H., and Carpenter, M. (2012). Putting the social into social learning: explaining both selectivity and fidelity in children's copying behavior. *J. Comp. Psychol.* 126, 182–192. doi: 10.1037/a0024555

Over, H., and Carpenter, M. (2013). The social side of imitation. *Child Dev.* 7, 6–11. doi: 10.1111/cdep.12006

Over, H., and Carpenter, M. (2015). Children infer affiliative and status relations from watching others imitate. *Dev. Sci.* 18, 917–925. doi: 10.1111/desc.12275

Paulus, M. (2014). How and why do infants imitate? An ideomotor approach to social and imitative learning in infancy (and beyond). *Psychon. Bull. Rev.* 21, 1139–1156. doi: 10.3758/s13423-014-0598-1

Plötner, M., Over, H., Carpenter, M., and Tomasello, M. (2015). The effects of collaboration and minimal-group membership on children's prosocial behavior, liking, affiliation, and trust. *J. Exp. Child Psychol.* 139, 161–173. doi: 10.1016/j.jecp.2015.05.008

Rauchbauer, B., Majdandžić, J., Hummer, A., Windischberger, C., and Lamm, C. (2015). Distinct neural processes are engaged in the modulation of mimicry by social group-membership and emotional expressions. *Cortex* 70, 49–67. doi: 10.1016/j.cortex.2015.03.007

Richardson, M. J., Campbell, W. L., and Schmidt, R. C. (2009). Movement interference during action observation as emergent coordination. *Neurosci. Lett.* 449, 117–122. doi: 10.1016/j.neulet.2008.10.092

Roberts, J. W., Bennett, S. J., and Hayes, S. J. (2015). Top-down social modulation of interpersonal observation–execution. *Psychol. Res.* doi: 10.1007/s00426-015-0666-9 [Epub ahead of print].

Rubin, K. H., Bukowski, W. M., and Parker, J. G. (2006). "Peer interactions, relationships, and groups," in *Handbook of Child Psychology*, 3rd Edn, ed. N. Eisenberg (Hoboken: John Wiley & Sons Inc), 571–645.

Saby, J. N., Marshall, P. J., Smythe, R., Bouquet, C. A., and Comalli, C. E. (2011). An investigation of the determinants of motor contagion in preschool children. *Acta Psychol.* 138, 231–236. doi: 10.1016/j.actpsy.2011.06.008

Watson-Jones, R. E., Whitehouse, H., and Legare, C. H. (2016). In-group ostracism increases high-fidelity imitation in early childhood. *Psychol. Sci.* 27, 34–42. doi: 10.1177/0956797615607205

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 24 June 2016
doi: 10.3389/fpsyg.2016.00963

3-Year-Old Children Selectively Generalize Object Functions Following a Demonstration from a Linguistic In-group Member: Evidence from the Phenomenon of Scale Error

Katalin Oláh[1,2], Fruzsina Elekes[1,3], Réka Pető[1], Krisztina Peres[1] and Ildikó Király[1]*

[1] Department of Cognitive Psychology, Institute of Psychology, Eötvös Loránd University, Budapest, Hungary, [2] Psychobiology Research Group, Institute of Cognitive Neuroscience and Psychology, Centre for Natural Sciences, Hungarian Acadamy of Sciences, Budapest, Hungary, [3] Department of Cognitive Science, Central European University, Budapest, Hungary

OPEN ACCESS

Edited by:
Natasha Kirkham, Cornell University, USA

Reviewed by:
Yuyan Luo, University of Missouri, USA
Yue Yu, Rutgers University-Newark, USA

***Correspondence:**
Katalin Oláh
olah.katalin@ppk.elte.hu

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *15 February 2016*
Accepted: *10 June 2016*
Published: *24 June 2016*

Citation:
Oláh K, Elekes F, Pető R, Peres K and Király I (2016) 3-Year-Old Children Selectively Generalize Object Functions Following a Demonstration from a Linguistic In-group Member: Evidence from the Phenomenon of Scale Error. Front. Psychol. 7:963. doi: 10.3389/fpsyg.2016.00963

The present study investigated 3-year-old children's learning processes about object functions. We built on children's tendency to commit scale errors with tools to explore whether they would selectively endorse object functions from a linguistic in-group over an out-group model. Participants (n = 37) were presented with different object sets, and a model speaking either in their native or a foreign language demonstrated how to use the presented tools. In the test phase, children received the object sets with two modifications: the original tool was replaced by one that was too big to achieve the goal but was otherwise identical, and another tool was added to the set that looked different but was appropriately scaled for goal attainment. Children in the *Native* language condition were significantly more likely to commit scale errors – that is, choose the over-sized tool – than children in the *Foreign* language condition (48 vs. 30%). We propose that these results provide insight into the characteristics of human-specific learning processes by showing that children are more likely to generalize object functions to a category of artifacts following a demonstration from an in-group member.

Keywords: scale error, object function, social category, learning, language

INTRODUCTION

Differentiating between people who belong to our social group from those who do not contributes greatly to our success in social interactions. The ability to detect the boundaries of social categories is not only vital in case of intergroup conflict, but it also helps us govern our behavior in everyday situations, such as determining what language to choose as the form of communication, how to interpret the behavior of the other person, etc. For adults, the process of categorization seems effortless and inevitable when faced with social stimuli (e.g., Taylor et al., 1978). Research with pre-school children have repeatedly shown that category-based thinking, stereotyping and in-group favoritism appear quite early in development (Aboud and Skerry, 1984).

In the past decades, ample evidence has been accumulated to support the notion that the tendency to perceive the social world as made up of groups emerges in infancy, and that this capacity may constitute a special faculty of the human mind (Kinzler and Spelke, 2007). For example, infants already at three months of age seem to be able to differentiate between female and male faces (Quinn et al., 2002), and they prefer to look at faces belonging to their own racial group (Kelly et al., 2005). Importantly, despite the early emergence of the ability to perceive the differences between various social categories, results suggest that some cues of group membership take precedence over others (Kinzler et al., 2010). A growing body of evidence highlights the importance of language in the process of categorization and developing social preferences. For example, Kinzler and Spelke (2011) have shown that 10-month-old and 2.5-year-old children do not preferentially interact with a racial in-group person, but using the same paradigm, a clear preference was observed for a native speaker over a person speaking a foreign language (Kinzler et al., 2007). In another study directly comparing the relevance of race and language in children's choices of friends, 5-year-olds were found to select people who were from a different race, but spoke with their native accent over people of the same race but speaking with a foreign accent (Kinzler et al., 2009).

For children, the importance of identifying members of the same social group lies – at least partly – in the information it may provide about the knowledgeability of the individual (Kinzler et al., 2012; Oláh et al., 2014). Language and accent supposedly prove to be such reliable cues because they usually mark the boundaries of broader cultural groups; therefore people speaking the same language likely share other aspects of cultural knowledge as well. Keeping track of the knowledge state of others is a key factor behind conducting successful social interactions with others, yet it has a special significance for infants and children who are just in the process of acquiring knowledge about the world. Children will be most successful in this endeavor if they can select trustworthy and knowledgeable informants, who will provide information that is valid and useful within the given social context. Language and accent can be good indicators for children whether someone is potentially a reliable teacher for them.

So far, a handful of studies have explored the significance of linguistic group membership in infants' and children's willingness to accept information from someone. Kinzler et al. (2012) have shown that 10-month-old infants extend the preference for native speakers to the objects they interact with. When given the possibility to choose from two toys previously introduced by a native and a non-native speaker, infants reliably choose the one introduced by the native model. Similarly, Shutts et al. (2009) showed that 12-month-old infants' choices of food were influenced by the emotional reactions of linguistic in-groups, but not that of out-groups.

Moreover, Buttelmann et al. (2013) have shown that 14-month-old infants were more likely to imitate a sub-optimal means to achieve a goal following a demonstration by an in-group member than by an out-group member. However no selectivity was observed in endorsing the object preferences of different group members. A study by Howard et al. (2015) further extends our understanding of social category based learning processes by showing that 19-month-old children only took into account the group membership of the model in an imitation task when the demonstration was administered on screen, but not in the case of live modeling. Contrarily, 3-year-old children selectively imitated an in-group member regardless of the mode of the demonstration, showing that selectivity becomes stronger with age.

A relevant question concerns children's learning about object functions, since humans' habits in using artifacts have an inherently cultural aspect. While an artifact may be appropriate to bring about several different goals, a very specific function is usually assigned to them during production. Adults and older children have a strong propensity to define object categories by the intended function, known as the *design-stance* (Dennett, 1989). Casler and Kelemen (2005) have shown that the precursors of this can be found in children as young as 2 years of age. Children of this age seem to represent objects as existing for certain purposes and view this purpose as an intrinsic property of the given object (*the teleo-functional stance*) – though they cannot yet explicitly give explanations in terms of the design-stance. It follows from such a conceptualization of artifact functions that they are not strictly or exclusively determined by the physical properties of the object, but that there is a partly arbitrary or incidental element in the process of assigning functions to objects. This arbitrary component makes object functions variable across cultures. Thus, object functions constitute a part of our cultural knowledge (e.g., whether we use a fork or chopsticks for eating).

Another important quality of object functions is that they are generally causally opaque by simple observation (Csibra and Gergely, 2009), therefore novices must rely on culturally knowledgeable individuals to pass on information about the intended function. In this study, we build on the phenomenon of scale error to investigate whether children can flexibly modulate their learning processes in response to the cultural group membership of the person demonstrating the object function.

The term scale error refers to young children's tendency to disregard the actual size of the object they are interacting with when the object category is familiar to them. As a consequence, for example, they may try to slide down a miniature slide or try to squeeze themselves into a matchbox sized car (DeLoache et al., 2004). DeLoache et al. (2004) have demonstrated this phenomenon in children aged 18–30 months in a free-play setting and suggest that it may stem from an inability to integrate information from distinct processes in visual perception and from a lack of inhibitory control. Specifically, when children encounter an object that activates the representation of a kind of object, an action plan is formed based on stored knowledge of the object category. This action plan, however, does not become inhibited by size information as it would in the case of adults or older children. DeLoache et al. (2004) propose that this may be due to the lack of integration of information processed by the ventral and dorsal visual stream (Milner and Goodale, 1995) or a dissociation between action planning and control (Glover, 2004). Since the study by DeLoache et al. (2004), a number of studies

have confirmed the robustness of scale errors (e.g., Rosengren et al., 2009; Ware et al., 2010).

Casler et al. (2011) have demonstrated the same phenomenon in two-year-old children with instrumental tool-use in a structured setting. In this study, children were presented with novel and familiar object sets. In the first phase of the experiment, a model demonstrated how to use the tools to achieve certain goals. Afterwards, children received the object sets with one alteration: the original tool was replaced by one that was either too big or too small to efficiently bring the goal about. Additionally, they received a novel object that was appropriate for goal attainment, but had not been presented during the demonstration. Under such circumstances, 2-year-old children committed scale errors 31% of the time. Casler et al. (2011) argue that a proneness to committing the scale error may originate from the early emerging teleo-functional stance (Casler and Kelemen, 2005), that is, to view artifacts as existing to serve certain functions. As a consequence, the function of the tool is incorporated into the representation of the object kind and when the category representation becomes active, it inevitably activates the representation of the task the object is for.

Although committing scale errors seems to be a robust phenomenon that has been demonstrated in numerous studies, the occurrence rate of it seems to vary with age. However, results from different studies do not show a clear trend of decreasing or increasing occurrence rates with age. DeLoache et al. (2004) have found that among 18–30 month-old participants, the 20.5–24 month-old group was the most prone to scale errors (with making 1.3 scale errors on 3 object sets on average). On the other hand, Ware et al. (2006) found that when testing children between the ages of 16–24, 29–32, and 35–40 months, the latter group committed the most scale errors.

In this study, we build on the assumption that scale errors occur with tools due to the fact that function constitutes an inherent part of stored knowledge about object categories. We propose that this makes the phenomenon of scale error sensitive to the context of knowledge acquisition. Research suggest that learning about object kinds happens with the help of specialized learning mechanisms that allow the observer to efficiently gain information about a category of objects from a single demonstration (e.g., Futó et al., 2010; Butler and Markman, 2012; for a general description see the Natural Pedagogy Theory, Csibra and Gergely, 2006, 2009; Gergely and Csibra, 2006). Cues, such as eye-contact, specific intonation, and addressing prompt the learner to extract generalizable knowledge from the demonstration (as opposed to episodic information), thus contributing to the generation and enrichment of knowledge stored about object kinds. However, as described in the beginning of this review, efficient learning also requires an ability to select knowledgeable teachers, who can provide valid information. Therefore, we hypothesized that if tool functions were presented by in-group models, children would be more prone to subsequently committing scale errors since the demonstrated function would be more likely to be incorporated into the representation of the object. We followed the methods of Casler et al. (2011) with the modification that the demonstrator was either presented as a speaker of children's native language or a foreign language. We involved 3-year-old children in the study, as this is the age where both the occurrence of scale errors (e.g., Ware et al., 2006) and selectivity based on the linguistic group membership of the model (Howard et al., 2015) have been robustly demonstrated.

MATERIALS AND METHODS

The study was carried out with the approval of the Research Ethics Committee of the Faculty of Education and Psychology of Eötvös Loránd University. Participants' caregivers gave written informed consent.

Participants

Participants were 37 monolingual Hungarian children (14 girls) recruited through advertisements in the local area. Their ages ranged from 30 to 40 months, with a mean of 33.31 months ($SD = 2.69$). Children were randomly assigned to either the *Native* ($n = 17$) or the *Foreign* ($n = 20$) language condition. An additional 9 children were tested but later excluded from the sample due to passivity (3), camera failure (3), experimenter error (2), and the child was bilingual (1).

Materials

The object sets used in the study were inspired by three of the object sets used in the study of Casler et al. (2011). Each set consisted of a target object and three potential tools. There was one tool used in the demonstration phase and two presented in the test phase. One tool used in the test phase was identical to the one introduced during demonstration except that it was too big to bring about the goal, whereas the other testing tool was an alternate to the originally presented one with different perceptual features but corresponding size and affordances. The first object set could be used to paint on paper and consisted of a container with blue paint mixed with water inside (11 × 10.5 × 5 cm), a small paintbrush (19 cm long with a 3.5 × 1.5 cm head), a larger paintbrush that could not fit into the container (24 cm long with a 4.5 × 1.5 cm head) and a silicone brush (19 cm long with a 2.5 × 1.3 cm head). The second object set consisted of a yellow box (25.6 × 12.5 × 9.5) with a hole (1.5 × 1.2 cm) on top and a plastic toy inside that made a whistling noise when pushed on. The small tool used in the demonstration was a yellow wooden flat stick (14.9 cm long, 1.4 cm wide), while its larger counterpart was 29.7 × 3.9 cm in size. The alternate tool was a cylindrical stick painted red (14.8 cm, 9 mm diameter). The target action entailed inserting the tool in the hole to push on the toy inside the box and to elicit the sound. The last object set constituted of a blue box (10 × 10 × 10 cm) with a transparent tube (1.9 cm diameter) attached on top and a small ball inside the tube. The originally presented small tool was a thin wooden stick (14.5 cm long) with wooden balls (1.8 cm diameter) attached on both ends. Its larger counterpart was 25 cm long, while the balls attached were 3.5 cm in diameter. The alternate tool was a stick made out of cork (13 cm long, diameter: 1.5 cm). The target action entailed

pushing the ball out of the tube with the help of the tool. For the object sets (see **Figure 1**).[1]

Procedure

Experiments were conducted by 4 female experimenters of whom 2 took turns in taking the role of Experimenter 1 (E1) and 2 took turns in taking the role of Experimenter 2 (E2); however, the roles were counterbalanced across conditions, thus each experimenter participated in both the *Foreign* and the *Native* language conditions. E1 was the person greeting the participants and administering the test trials, while E2 played the role of the demonstrator. E1 always spoke in the child's native language, whereas the language E2 used depended on condition.

Upon arrival to the laboratory, children were received by E1, who invited the child to participate in a session of free play in order to familiarize children with the environment and the experimenter. When the child seemed comfortable in the setting, E1 escorted the child and the caregiver into the testing room, where children were seated on the caregiver's lap in front of a small table. E1 then told the child that she would be back in a few seconds and left. At this point, a second female experimenter (E2) entered the room and sat down at the opposite end of the table. She started the demonstration by saying three sentences either in Hungarian (participants' native language) or in German (a foreign language to the participants). The sentences were construed in a way that they did not help the interpretation of the object function demonstration, but were not completely unrelated to the context in order to avoid confusing children in the *Native* condition. The sentences could be translated into English as follows: "Where have I put my things? They must be here somewhere. Ah, there they are!". After that, she pulled out the first object set containing the target object and the small tool. She took the tool in her hand, looked at the child with a smile, named the tool by a non-word and demonstrated the action. Then, she put away the object set and performed the demonstration with the other two object sets one after the other. When the demonstration was over, E2 left the room and E1 re-entered. E1 sat down and said to the child: "Now let's play something, shall we? Let me just see what we have here!" She then pulled out the first object set from behind a panel with two alterations compared to the initial demonstration. The tool used in the first phase was replaced by its larger counterpart that was inappropriately scaled to bring about the same goal. The alternate tool was also presented this time. The two tools were placed on the two sides of the target object. Children were allowed to interact with the object set for as long as they showed interest. After that, E1 put away the object set and presented the next one with the same alterations. All children received 3 trials, one with each object set. Children received the object sets in two predefined orders. The order and the side of the tools in the test phase were counterbalanced across conditions.

[1]The object sets could be categorized as either completely novel to children (the yellow box with the toy inside and the blue box with the tube on top) or familiar (painting).

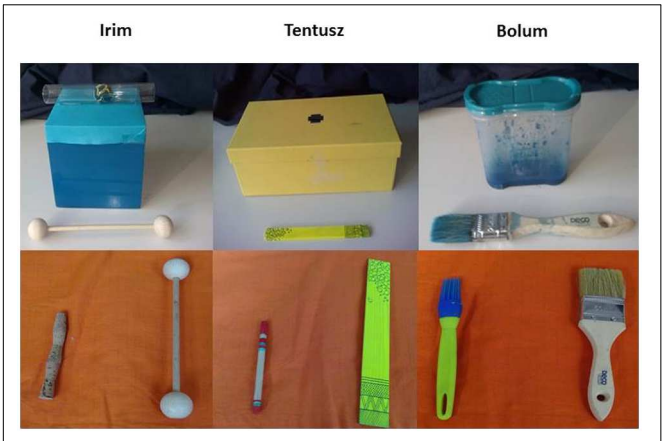

FIGURE 1 | Materials. The picture depicts the target objects with the original tool and the corresponding over-sized and alternate tools presented in the test phase. The original tool was named by a non-word (see top row) in the beginning of each demonstration.

Coding

We analyzed children's choices of tools in the first 1.5 min of the interaction phase with each object set. Only children's first choices were taken into account and we coded whether it was the over-sized (committing the scale error) or the alternate tool (not committing the scale error). Children not choosing a tool during this time were considered passive on the trial (object set) and the trial was excluded from analyses (*Native*: 2 out of 51 trials; *Foreign*: 6 out of 60 trials). An independent coder blind to the research question coded 80% of the videos. Reliability between the coders was good (Cohen's kappa: 0.86).

To test whether children were equally attentive in the *Foreign* condition as in the *Native* condition, children's looking behavior during the demonstration phase was also coded using Solomon Coder (András Péter).[2] We coded the time children spent looking at each action demonstration from the moment E2 named the object she was about to use until the moment she started putting away the object set in question. We found that children in both conditions were attentive for almost the whole duration of the demonstrations (98.6% in the *Foreign* condition and 99.29% in the *Native* condition). The difference between conditions was not significant ($t(30) = 0.72$; $p = 0.48$).

RESULTS

Statistical analyses were performed with the SPSS 20 software. We used Generalized Linear Mixed Models (GLMM) with binary regression to test for differences in the occurrence of scale errors across conditions. We used this method for analyses since the dependent variable is not continuous, but is composed of three nominal values (a choice between the oversized tool and the novel tool on three trials). Therefore a GLMM is the best option as it can treat the different trials separately and thus provides a more elaborate test of the question. We used backwards modeling, where the following variables were included in the initial model,

[2]http://solomoncoder.com

but were later removed as they were not significant: sex and age of the child, the presentation order of the object sets, side of the tools used in the test, the identities of the two experimenters, object type (novel/familiar). "Participant" was added to the model as a factor and "trial" as the repeated measure. In addition to these effects, only condition as a fixed effect was included in the final model.

Condition had a significant main effect on the amount of scale errors committed by children, with more scale errors occurring in the *Native* as opposed to the *Foreign* condition (F (1, 101) = 4.024; $p = 0.048$). On average, participants in the *Native* language condition committed the scale error on 48% of the trials, whereas the rate was 30% in the *Foreign* language condition (**Figure 2**).

The same effect of condition held with a simple comparison of proportions (occurrence rate of scale errors in the two conditions) using a χ^2 test ($\chi^2(1) = 6.81$; $p = 0.009$).

DISCUSSION

Building on the phenomenon of scale error, the present study investigated whether 3-year-old children's learning processes about tool functions would be influenced by the group membership of the person introducing the objects to them. We found that children were less prone to committing scale errors if the demonstration was performed by a person speaking in a foreign language. We propose that this result does not merely inform us about a quite specific phenomenon described in the developmental literature –that is, the occurrence of scale errors – but it reflects the special characteristics of human-specific learning mechanisms. As described in the introduction, scale errors supposedly occur because children do not treat the artifacts they encounter as individual and unique objects, but form representations of object kinds, during which the function assigned to the category of the artifact becomes a core characteristic (Casler et al., 2011). It has been suggested that a specialized learning mechanism helps children to extract kind-relevant, generalizable information from a single demonstration if the interactional partner expresses their intention of passing on knowledge (Csibra and Gergely, 2009). In this study, children supposedly committed the scale error on nearly half of the trials in the *Native* condition because they regarded the initial demonstration as an instance of teaching. Thus, the above-described genericity-bias (Csibra and Gergely, 2009) led them to retrieve the acquired knowledge (the function of the tool) in the presence of another exemplar of the same category (the over-sized counterpart of the original object) and children tried to enforce that function on the given exemplar irrespective of its actual size. It has also been shown that children are more prone to committing scale errors when the objects are named during the demonstration (Hunley and Hahn, 2016). This labeling effect with scale errors originates from the phenomenon that learning of object kinds is facilitated by naming the object (e.g., Booth and Waxman, 2002). In our study, this enhanced the proneness to committing scale errors in the *Native* condition, but children were not equally willing to accept the information from the model speaking a foreign language.

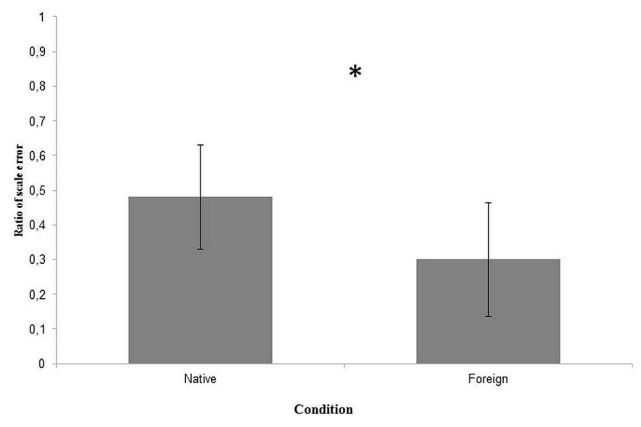

FIGURE 2 | Avarage ratio of scale errors committed in the Native and the Foreign language conditions on the three trials. The asterisk indicates that the difference is significant at the level of 0.05.

We thus propose that the decreased occurrence rate of scale errors in the *Foreign* language condition can be accounted for by the selectivity children exhibit in learning situations. That is, even though children may perceive the teaching intention exhibited by the model, a specific mistrust toward the epistemic state of the model leads them to refuse to endorse the information presented. Results suggest that even though pedagogical cues facilitate learning in general, young children are not equally willing to accept information from all sources. For example, 14-month-old infants are reluctant to imitate a model whose past behavior has turned out to be misleading (Poulin-Dubois et al., 2011) or could be seen as incompetent based on the level of confidence they exhibited (Zmyj et al., 2010). Importantly, studies have also shown that children show selectivity based on the language the potential teacher speaks (e.g., Buttelmann et al., 2013; Howard et al., 2015). Language cues can be of special importance when acquiring culturally relevant knowledge (such as tool functions) since the use of a foreign language is an indication that the person is not familiar with the ways of the given culture. Consequently children may not view them as a reliable source of information. We propose that the drop in the occurrence of scale errors reflect children's resistance to accept the foreign language speaking model as a teacher and therefore they did not extract kind-based knowledge about the objects, which subsequently led to less confusion in the test phase.

Alternatively, the decreased occurrence of scale errors in the *Foreign* condition may not reflect a mistrust in the model, but a failure to encode the teaching intentions of a foreign speaker. This could possibly be the result of an intuition that members of different cultural groups keep to different norms in their behavior; therefore children could exhibit more confusion when interpreting the signals of an out-group member. While this interpretation is not perfectly independent of the one outlined in the previous section, nor are the two necessarily mutually exclusive, the sensitivity to communicative cues may constitute such a fundamental and universal capacity of the human mind

(Csibra and Gergely, 2011), that it is unlikely to be disrupted in such a case.

An alternative explanation for our result could be that children simply paid less attention to the foreign language model and that is why scale errors occurred with less frequency. However, this explanation is not likely, as children were equally attentive during the demonstration regardless of condition and they seemed to understand the basic structures of the different tasks (they attempted to achieve the goal that was demonstrated). If children had been simply inattentive in the *Foreign* condition, then we would have expected to see instances where children were simply lost at how to interact with the novel objects. However, this was not the case; children reached for one of the tools on almost all trials in both conditions (see the section on *Coding*).

Altogether, our participants committed more scale errors than children in the study of Casler et al. (2011). While the ratio of scale errors in their study is comparable to that found in the Foreign language condition (around 30%), this number was substantially higher in the Native language condition (48%). This may be accounted for by the fact that we did not use the exact same object sets as did Casler et al. (2011). Instead of using four object sets, we settled on replicas of three of the ones used in their study. Importantly, Casler et al. (2011) have found that children committed the most scale errors when presented with novel apparatuses and novel tools (40%). In our study, two out of three object sets can be regarded as novel tool-novel apparatus sets, which could have resulted in higher overall ratios.

On the one hand, our study contributes to our understanding of how the group membership of the model influences children's learning processes. On the other, it provides a further piece of evidence to support the claim that scale errors cannot solely be explained in terms of problems of inhibitory control, but that they result from the way children form representations of tools and their functions (Casler et al., 2011). Specifically, children view artifacts as being for certain functions and they treat this artifact-function correspondence in quite a rigid way. Furthermore, our study suggests that scale errors are at least partly the result of the characteristics of human-specific learning processes that result in viewing an object as having a fixed function.

AUTHOR CONTRIBUTIONS

KO, FE, and IK conceived the experiment; KO, PR, and KP ran the experiments; KO, RP and IK analyzed tha data; KO prepared the first draft of the manuscript and FE, RP, KP, and IK provided feedback. The final version of the manuscript was submitted with the approval of all of the authors.

FUNDING

Financial support for this research was provided by the Hungarian Scientific Research Fund under grant number OTKA K-109352.

ACKNOWLEDGMENTS

We would like to thank Anna Berei for her help in conducting the experiments. We are grateful to the participating families for helping us realize this project.

REFERENCES

Aboud, F. E., and Skerry, S. A. (1984). The development of ethnic attitudes a critical review. *J. Cross Cult. Psychol.* 15, 3–34. doi: 10.1177/0022002184015001001

Booth, A. E., and Waxman, S. (2002). Object names and object functions serve as cues to categories for infants. *Dev. Psychol.* 38, 948. doi: 10.1037/0012-1649.38.6.948

Butler, L. P., and Markman, E. M. (2012). Preschoolers use intentional and pedagogical cues to guide inductive inferences and exploration. *Child Dev.* 83, 1416–1428. doi: 10.1111/j.1467-8624.2012.01775.x

Buttelmann, D., Zmyj, N., Daum, M., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Casler, K., Eshleman, A., Greene, K., and Terziyan, T. (2011). Children's scale errors with tools. *Develop. psychol.* 47, 857. doi: 10.1037/a0021174

Casler, K., and Kelemen, D. (2005). Young children's rapid learning about artifacts. *Develop. sci.* 8, 472–480. doi: 10.1111/j.1467-7687.2005.00438.x

Csibra, G., and Gergely, G. (2006). Social learning and social cognition: the case for pedagogy. *Process. Change Brain Cogn. Dev. Attent. Perform. XXI* 21, 249–274.

Csibra, G., and Gergely, G. (2009). Natural pedagogy. *Trends cogn. Sci.* 13, 148–153. doi: 10.1016/j.tics.2009.01.005

Csibra, G., and Gergely, G. (2011). Natural pedagogy as evolutionary adaptation. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 366, 1149–1157. doi: 10.1098/rstb.2010.0319

DeLoache, J. S., Uttal, D. H., and Rosengren, K. S. (2004). Scale errors offer evidence for a perception-action dissociation early in life. *Science* 304, 1027–1029. doi: 10.1126/science.1093567

Dennett, D. C. (1989). *The intentional stance*. Cambridge, MA: MIT press.

Futó, J., Téglás, E., Csibra, G., and Gergely, G. (2010). Communicative function demonstration induces kind-based artifact representation in preverbal infants. *Cognition* 117, 1–8. doi: 10.1016/j.cognition.2010.06.003

Gergely, G., and Csibra, G. (2006). "Sylvia's recipe: The role of imitation and pedagogy in the transmission of cultural knowledge," in *Roots of Human Sociality: Culture, Cognition, and Human Interaction*, eds N. J. Enfield and S. C. Levenson (Oxford: Berg), 229–255.

Glover, S. (2004). Separate visual representations in the planning and control in action. *Behav. brain sci.* 27, 3-24. doi: 10.1017/S0140525X04000020

Howard, L. H., Henderson, A. M., Carrazza, C., and Woodward, A. L. (2015). Infants' and young children's imitation of linguistic in-group and out-group informants. *Child dev.* 86, 259–275. doi: 10.1111/cdev.12299

Hunley, S. B., and Hahn, E. R. (2016). Labels affect preschoolers' tool-based scale errors. *J. Exp. Child Psychol.* doi: 10.1016/j.jecp.2016.01.007 [Epub ahead of print].

Kelly, D. J., Quinn, P. C., Slater, A. M., Lee, K., Gibson, A., Smith, M., et al. (2005). Three-month-olds, but not newborns, prefer own-race faces. *Dev. sci.* 8, F31–F36. doi: 10.1111/j.1467-7687.2005.0434a.x

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2012). 'Native'objects and collaborators: infants' object choices and acts of giving reflect favor for native over foreign speakers. *J. Cogn. Dev.* 13, 67–81. doi: 10.1080/15248372.2011.567200

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Kinzler, K. D., Shutts, K., DeJesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children's social preferences. *Soc. cogn.* 27, 623. doi: 10.1521/soco.2009.27.4.623

Kinzler, K. D., and Spelke, E. S. (2007). Core systems in human cognition. *Prog. Brain Res.* 164, 257–264. doi: 10.1111/j.1467-7687.2007.00569.x

Kinzler, K. D., and Spelke, E. S. (2011). Do infants show social preferences for people differing in race? *Cognition* 119, 1–9. doi: 10.1016/j.cognition.2010.10.019

Milner, A. D., and Goodale, M. A. (1995). *The Visual Brain in Action*, Vol. 27. New York: Oxford University Press.

Oláh, K., Elekes, F., Bródy, G., and Király, I. (2014). Social category formation is induced by cues of sharing knowledge in young children. *PLoS One* 9:e101680. doi: 10.1371/journal.pone.0101680

Poulin-Dubois, D., Brooker, I., and Polonia, A. (2011). Infants prefer to imitate a reliable person. *Infant Behav. Dev.* 34, 303–309. doi: 10.1016/j.infbeh.2011.01.006

Quinn, P. C., Yahr, J., Kuhn, A., Slater, A. M., and Pascalis, O. (2002). Representation of the gender of human faces by infants: A preference for female. *Perception* 31, 1109–1122. doi: 10.1068/p3331

Rosengren, K. S., Gutiérrez, I. T., Anderson, K. N., and Schein, S. S. (2009). Parental reports of children's scale errors in everyday life. *Child Dev.* 80, 1586–1591. doi: 10.1111/j.1467-8624.2009.01355.x

Shutts, K., Kinzler, K. D., McKee, C. B., and Spelke, E. S. (2009). Social information guides infants' selection of foods. *J. Cogn. Dev* 10, 1–17. doi: 10.1080/15248370902966636

Taylor, S. E., Fiske, S. T., Etcoff, N. L., and Ruderman, A. J. (1978). Categorical and contextual bases of person memory and stereotyping. *J. Pers. Soc. Psychol.* 36, 778. doi: 10.1037/0022-3514.36.7.778

Ware, E. A., Uttal, D. H., and DeLoache, J. S. (2010). Everyday scale errors. *Dev. Sci.* 13, 28–36. doi: 10.1111/j.1467-7687.2009.00853.x

Ware, E. A., Uttal, D. H., Wetter, E. K., and DeLoache, J. S. (2006). Young children make scale errors when playing with dolls. *Dev. Sci.* 9, 40–45. doi: 10.1111/j.1467-7687.2005.00461.x

Zmyj, N., Buttelmann, D., Carpenter, M., and Daum, M. M. (2010). The reliability of a model influences 14-month-olds' imitation. *J. Exp. Child Psychol.* 106, 208–220. doi: 10.1111/j.1467-8624.2012.01860.x

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 28 June 2016
doi: 10.3389/fpsyg.2016.00972

Tom Is Not More Likely to Imitate Lisa Than Ying: The Influence of a Model's Race Indicated by Physical Appearance on Children's Imitation

Andrea A. R. Krieger[1], Corina Möller[1], Norbert Zmyj[2] and Gisa Aschersleben[1]*

[1] Developmental Psychology Unit, Saarland University, Saarbrücken, Germany, [2] Developmental Psychology Unit, Technical University of Dortmund, Dortmund, Germany

Recent research has shown that infants and young children up to the age of 5 years are more likely to imitate in-group members than out-group members. Cues like gender, race, age, and language are robust indicators for social categories and, thus, for group membership. Concerning imitation, research mainly focuses on language and accent, whereas race indicated by physical appearance is rarely investigated. Research has shown that the aforementioned factors served as indicators of group membership and influenced children's imitative behavior in such ways that the in-group member was more likely to be imitated. Nevertheless, the question arises how physical appearance of a person itself influences the imitative behavior. In this study, we investigated the effect of group membership (in-group vs. out-group) in 4-year-old children ($N = 48$) on children's imitative behavior. Children observed either an in-group or an out-group model (German vs. Chinese), defined by physical appearance only, which presented novel manual actions in four different tasks. After each presentation, children got the opportunity to imitate the target actions. Furthermore, children were either assigned to a live or a video condition to control for the influence of the presentation mode. Results indicated that 4-year-old children did not imitate the in-group model more often than the out-group model. Furthermore, there was no difference between the two presentation modes. Results were discussed on the basis of research on the in-group-out-group effect. We suggested that a pure difference in the model's physical appearance might not be sufficient to elicit an in-group-out-group effect.

Keywords: in-group bias, imitation, children, repetition, presentation mode, culture, race

OPEN ACCESS

Edited by:
Ildikó Király,
Eötvös Loránd University, Hungary

Reviewed by:
Stefanie Hoehl,
University of Heidelberg, Germany
Rana Esseily,
Université Paris Ouest Nanterre La Défense, France

****Correspondence:***
Andrea A. R. Krieger
andrea.krieger@uni-saarland.de

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *14 February 2016*
Accepted: *13 June 2016*
Published: *28 June 2016*

Citation:
Krieger AAR, Möller C, Zmyj N and Aschersleben G (2016) Tom Is Not More Likely to Imitate Lisa Than Ying: The Influence of a Model's Race Indicated by Physical Appearance on Children's Imitation. Front. Psychol. 7:972. doi: 10.3389/fpsyg.2016.00972

INTRODUCTION

Adults differentiate between individuals who belong to their own group (i.e., people of the same race) and individuals who belong to a different group (i.e., people of another race). Many factors can lead to the awareness of group membership, for example gender, race, age, or language (Kinzler et al., 2010). As a consequence, social interaction between individuals is influenced by this discrimination in such ways that either benevolent behavior (i.e., helping each other), or malevolent behavior (i.e., social isolation) can occur (Fiske, 1992; Ruys et al., 2007; Trötschel et al., 2010). Moreover, research has shown decrements in out-group face recognition in adults

as well as in children (Meissner and Brigham, 2001; Shutts and Kinzler, 2007). Thus, it is important to learn more about the origins of this effect and to investigate the differentiation between in-group and out-group members in children. Previous research has shown that children are able to differentiate between in-group and out-group members when membership is indicated by language. For example, 5- to 6-year-old children with another geographic origin (Northern vs. southern American) were chosen to be friends with only when they had the same accent as the participants (Kinzler et al., 2009; Kinzler and DeJesus, 2013). When asking children, which characteristic of a person is more stable, race or language, 9- to 10-year-old children name race as a stable characteristic over time, however, 5- to 6-year-old children state, that people cannot change the language they speak (Kinzler and Dautel, 2012). This indicates the important role of language in relation to race in preschoolers.

Even infants are able to differentiate between in-group and out-group members. Already by the age of 3 months, infants not only preferred faces of their own race over faces of another race, but also showed an improved recognition of faces of their own race (Sangrigoli and De Schonen, 2004; Bar-Haim et al., 2006). Furthermore, 10-months-old infants selectively preferred toys that were offered by someone with a native accent than from someone with a foreign accent (Kinzler et al., 2007). Similarly, 14-month-old infants imitated actions of a model who spoke their native language more often than actions of a model who spoke a foreign language (Buttelmann et al., 2013). Thus, there is ample evidence that language is an important factor influencing the in-group-out-group effect already in infancy.

However, it is still unclear whether children show selectivity in their behavior when language is not available as a cue for group membership, for example, when only the physical appearance of a model is available. Aboud's (1988) sociocognitive theory claims that two overlapping sequences of perceptual-cognitive development influence children's attitude toward other groups. One sequence of development is concerned with changes in the child's focus of attention, in which young children focus on their own beliefs and older children focus on categories of other people as well (Aboud, 1988). Thus, younger children's opinion is influenced by their own awareness of characteristics of other people, whereas preferences of older children are built because characteristics of group membership are influenced by the attitude toward other people. The other sequence involves an affective-perceptual process, which includes attachment to familiar people or objects and fear toward the unknown and is determined by physical appearance up to the age of 7 years. Applying the affective-perceptual process to imitation studies, children should approach the in-group model and imitate more of her actions as compared to the out-group model, even if group membership is only indicated by physical appearance. There are only few studies investigating the influence of race indicated by physical appearance on imitational behavior. Shutts et al. (2010) showed faces of unfamiliar children differing among others in race. Faces were coupled with voice records indicating the name and the preferences of each specific child. 3-year-old children were asked to choose between objects and activities endorsed by those faces. No effect of race was found. The authors concluded that race is not encoded spontaneously and, thus, does not influence children's preferences and choices at this age (Shutts et al., 2010). In another study, 5-year-olds either saw three members of an out-group or of a neutral group demonstrating the same action. Group membership was defined by differently colored scarfs. After having seen the out-group members, children produced more contrasting actions than actions, which matched those of the out-group, whereas children's actions matched those of the neutral group after having seen those (Oostenbroek and Over, 2015). However, this effect was only shown for 5-year-old but not for 4-year-old children. Furthermore, Diesendruck and HaLevi (2006) showed an advantage for labels over physical appearance in 5-year-old children. However, they used line drawn faces instead of pictures of real people and the experimenter told participants, which group they were in (Diesendruck and HaLevi, 2006). In accordance with the aforementioned findings, where physical appearance was defined through colors or drawings more research concerning the physical appearance of a living person and its influence on the imitative behavior of children is needed.

Imitative behavior is not only influenced by a model's group membership but also by the presentation mode. When infants observe an action on TV, they imitate less action steps as compared to when they observed a real-life model (Barr and Hayne, 1999). This so-called *video deficit effect* (Anderson and Pempek, 2005) has been documented in a variety of studies showing that up to the age of 3 years children imitated more actions in live presentation than in video presentation conditions. Thus, from 3 years onward children seem to learn from video and live presentations likewise (Troseth and DeLoache, 1998; Troseth et al., 2006; Howard et al., 2015). However, Reiß et al. (2014) showed that 4-year-old children performed reliably better in the live than in the video condition when Theory of Mind tasks were presented. Based on these somehow inconsistent results, we decided to control for possible distracting influence of the video presentation, and thus a live model condition was introduced in the present study as well.

The aim of the present study was to investigate whether group membership indicated by physical appearance of the model influences 4-year-olds' imitative behavior. To this end, we constructed four novel tasks with different three-step actions. Both a Chinese and a German model presented these actions, and children were given the opportunity to imitate these actions immediately afterward. While these actions were presented on video, we also introduced a live condition (German model only) to control for the possible distracting influence of the video presentation. In the video condition, German preschoolers observed a German and a Chinese model that presented novel, manual actions on objects in two runs. In the first run, children were presented either with the German or with the Chinese model that demonstrated the actions. In the second run, children were presented with the other model that presented the same actions again. After each action, children were allowed to play with the objects. In the live condition, children observed only the German model in both the first and the second run.

We expected children to imitate the in-group model more likely and more quickly than the out-group model if physical

appearance is sufficient. There is clear evidence for 5-year-old children to prefer in-group models over out-group models (Diesendruck and HaLevi, 2006; Oostenbroek and Over, 2015), however, results concerning 3- to 4-year-old children are less clear (Diesendruck and HaLevi, 2006; Shutts et al., 2010). Awareness of race in children begins to emerge at the age of 3 years (Nesdale, 2001), therefore, we tested 4-year-old children in the current study to guarantee that race is detected by the children. Moreover, we expected no difference in imitation performance between video and live presentation at this age.

MATERIALS AND METHODS

Participants

The final sample consisted of 48 German children (M = 4;5 (years; months); range = 3;9-5;0). Additional four children were tested but not included in the final sample due to procedural errors. Children were randomly assigned to two experimental groups (live presentation, $N = 24$; video presentation, $N = 24$). Parents were recruited by telephone from a list of families who had earlier expressed interest in volunteering for research on child development. They received a recompense for travel expenses and children were given a small gift and a certificate for participating. This study has been conducted in accordance with ethical guidelines and received ethical clearance by the local ethics committee at the Saarland University.

Materials

There were four manual tasks. Each task consisted of three wooden building bricks, which were purpose-built (see **Figure 1**). The first task, named *the bridge*, consisted of one blue block [9 cm (length) × 4.5 cm (width) × 4.5 cm (height)], one red rectangular prism (6 × 10 × 4.5 cm) and one blue ball (diameter = 3.3 cm). The red prism and the blue block had yellow millings on each side. The second task, called *the bookend*, consisted of a red L-shaped object (6 × 7 × 10.5 cm), a yellow flat building brick (1.5 × 11.5 × 5.9 cm) and a blue rectangular prism (4.5 × 9 × 4.5 cm). The third task, named *the rod*, was made up of a rod colored half blue and half yellow (length = 11.6 cm; diameter = 3.2 cm) and two balls of different color (blue/yellow; diameter = 3.3 cm). Additionally, there was a red squared block (6 × 7.6 × 6 cm) consisting of two brick-formed identical parts, which were hold together by a magnet. In the middle of the squared side of the block there was hole (diameter = 1.4). The fourth task, called *box*, contained of a blue box (7.3 × 6 × 6 cm), a yellow stick (8 cm; diameter = 1.2 cm), and a red bar (10 × 2.2 × 2.2 cm) with a nub (diameter = 1.5 cm) and two holes under the nub (diameter = 1.3 cm). The blue box had six holes in the side walls (diameter = 1.6 cm) and a flap, which was provided with repelling magnets. Thus, a bit pressure was needed to close it.

For the *bridge*, the model tipped over the blue block on its left side. Then, one edge of the red rectangular prism was placed on one edge of the blue block. Finally, the blue ball was placed on one of the upper yellow millings (see **Figure 1**). For the *bookend*, the model put the L-shaped red object in an upright position. Then, the yellow flat building brick was leaned on the longer side of the L-shaped object. Finally, the blue rectangular prism was leaned on the yellow flat building brick with the longer side of the right angle. For the *rod*, the model put together the two parts of the red squared block with the round opening. Then, she rotated the rod with a 180° turn and positioned it within the round opening of the red squared block. Finally, the blue ball was positioned on top of the rod. For the *box*, the first step was to put the yellow stick into the opening of the box, which the model was facing directly. Then, the model closed the box, which flapped because of the repelling magnets. Finally, she pushed the red bar on the yellow stick and used it to close the lid of the box.

Two female adult models with different race (Chinese vs. German) demonstrated the manual tasks (see **Figure 2**). Both models were comparable in terms of age (31 years vs. 25 years), hair and eye color, but differed in race-specific features (facial proportions and eye relief). Both the Chinese model and the German model were shown in the video condition, and the same German model modeled the actions in the live condition. In two prestudies, one with students, one with children, we checked whether the models differed in other features than their physical appearance. When students ($N = 59$) rated several characteristics of the models (e.g., sympathy), no difference was obtained except that the German model was rated more sociable than the Chinese model. 4-year-old children ($N = 17$) answered questions about sympathy and were asked, which characteristics the models have in common (e.g., openness toward other people, self-confidence). No significant differences between the two models were obtained.

Design

There were two runs, each consisting of the presentation of the four different tasks being presented in counterbalanced order across participants. The German model presented the tasks in the live condition, whereas in the video condition the tasks were presented by the same German and the Chinese model, one run with the German and one run with the Chinese model. The order of the models was counterbalanced across participants. After each task, children were given the possibility to play with the objects. Thus, the influence of the model's race (Chinese vs. German model) was tested in a within-subject design in the video condition. The influence of the presentation mode was tested in a between-subject design (live vs. video; German model). To check the pure factor repetition without an influence of the models race, we analyzed this factor in the live condition (German model only; 1st vs. 2nd run).

Procedure

Children sat on a high chair at a table (74 × 103 × 82 cm) in front of a blue covered wall with an opening (60 cm length) in the middle of it, comparable to a "puppet theater." The opening could be closed by a curtain. In the live condition, children saw the German model performing the manual actions through this opening. In the video condition, a monitor (24″, 50/60 Hz) was positioned exactly into the opening. All aspects of the live demonstration were closely matched to the video demonstration (i.e., the velocity and amplitude of the actions, the duration of the demonstration). If the child looked away

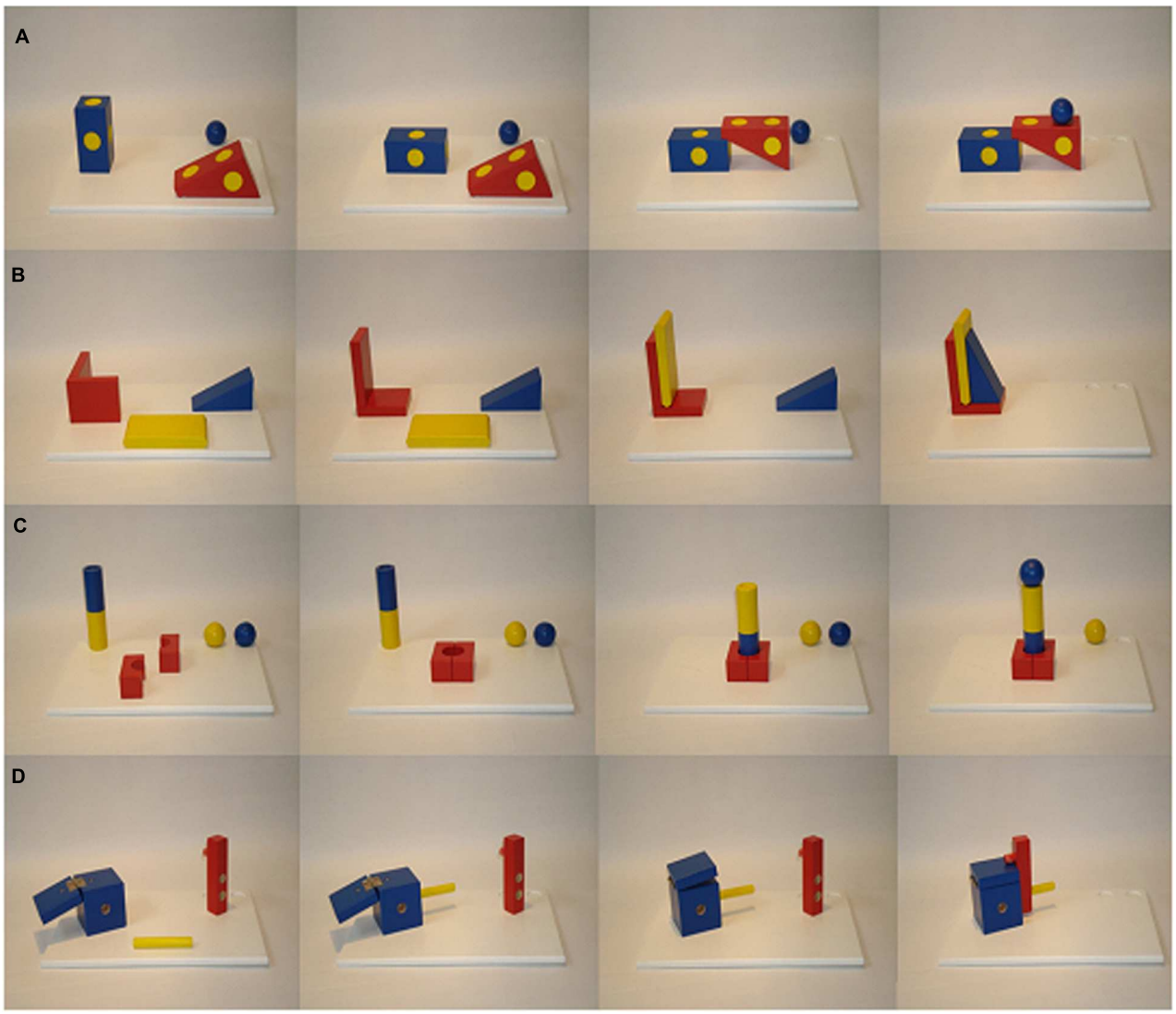

FIGURE 1 | Three-step-action sequence of the four tasks. Starting position and the subsequent three action steps of the bridge **(A)**, the bookend **(B)**, the rod **(C)** and the box **(D)**.

FIGURE 2 | The German Model and the Chinese Model. Photographs of the German (left) and the Chinese (right) model.

from the model, the experimenter who was standing on the side during the presentations reminded the child to look back to the model and focused the child's attention back to the demonstration. Both the video and the live condition followed the same general procedure. An experimenter welcomed the parent and the child. While the parent waited in an extra room and filled in questionnaires concerning some background information of the child (e.g., age, noticeable problems) the child was led to a

separate room and the experimenter instructed the child ("Soon you will see a friend of mine, who is playing with different toys"). First, a bell rang in order to draw the children's attention to the closed curtain. Then, the curtain opened and the model looked directly at the child for 4–5 s. Then, the model looked at the first object and performed the manual action with it. After performing the three steps each task consisted of, the model looked toward the child again. Then, the curtain closed again. Note, that the model did not talk, thus, no language was involved. The experimenter gave the identical objects to the child with a neutral instruction ("Now it is your turn to play with the toys!"). Children were allowed to play with the objects for 30 s, starting when the child touched the first object. The child was told to ring the bell, which was positioned next to it, whenever she/he finished playing with the objects. The experimenter removed the objects after 30 s or after the child rang the bell, and the presentation of the next task started. After the first run, the second run started immediately without a delay in between. When children had completed both runs, they could choose a toy as a reward and were then brought back to their parents. Each session was videotaped by a camera (Canon Legria FS200E) directed frontally at the child, and a second camera (Canon Legria FS406) recorded the child and the model from behind.

Coding and Analyses

Children's behavior was coded from the videotapes. First, latency was coded as the time between the time when the experimenter had placed the objects in front of the child and the child's first touch of an object. Additionally, we coded the number of imitated steps. A step was coded as imitated when children performed the same movement with the same object as the model had demonstrated at any point during the response period. Children could receive a score from 0 to 3 in every single task leading to a sum score ranging from 0 to 12 for each run. These two dependent variables (number of imitated steps and latency of first touch) were taken in account for the main hypothesis, as well as for the control hypotheses. Furthermore, we coded the time children spent looking at the video and the live presentation to check for any differences of children's attention. No significant difference could be found concerning looking time (Wilcoxon text: $z = -1.48$; $p = 0.138$). 60% of the videos were coded by a second independent rater. Interrater agreement was $\kappa = 0.81$, $p < 0.001$.

RESULTS

In-group-out-group Effect

In order to investigate whether there were differences between the two models concerning latency and number of imitated steps a dependent-sample *t*-test was calculated. Results revealed that children did not imitate more action steps when observing the in-group model ($M = 9.25$; $SD = 3.03$) compared to the out-group model ($M = 9.54$; $SD = 2.65$), $t(23) = 0.71$; $p = 0.484$. Similar results were found for latency. Children did not start to play faster with the objects after having watched the German model performing the action as compared to the Chinese model, $t(23) = -1.62$; $p = 0.119$. To control for order effects, two independent-sample *t*-tests were calculated. No effect of order (Chinese-German vs. German-Chinese) was obtained, not for the number of imitated steps, $t(11) = -1.30$; $p = 0.220$ and not for latency, $t(11) = -0.56$; $p = 0.587$.

Presentation Mode

Children's imitation performance did not differ as a function of the presentation mode (German model only). No significant difference was found for the number of imitated steps (live: $M = 8.38$; $SD = 3.32$; video: $M = 9.54$; $SD = 2.65$; $t(46) = -1.17$, $p = 0.185$) as well as for the latency (live: $M = 7.67$; $SD = 5.28$; video: $M = 7.20$; $SD = 4.49$, $t(45) = 0.46$; $p = 0.748$).

Repetition Effect

To test the repetition effect, paired *t*-tests comparing the values obtained in the first and the second run in the live condition were computed (German model only). There were significant differences in the number of imitated steps [$t(23) = -3.29$, $p = 0.003$; see **Figure 3A** left part]. Children copied fewer steps in the first run ($M = 7.67$; $SD = 3.45$) compared to the second run ($M = 9.08$; $SD = 2.99$). Furthermore, mean latency also differed significantly [$t(21) = 2.32$, $p = 0.030$]. In the first run, children started to play later with the objects than in the second run (1st: $M = 9.90$; $SD = 5.45$; 2nd: $M = 6.77$; $SD = 5.52$; see **Figure 3B** left part).

Furthermore, two repeated-measures variance analyses with the within-factor model (German vs. Chinese) and the within-factor repetition (1st vs. 2nd run) for correctly imitated steps and latency were calculated to control for repetition effects in the video condition. Results revealed, that for correctly imitated steps there were no significant main effects for repetition [$F(1,11) = 0.60$; $p = 0.455$] and for model [$F(1,11) = 1.10$; $p = 0.317$] as well as there was no significant interaction between repetition and model, $F(1,11) = 0.63$; $p = 0.630$ (see **Figure 3A** right part). For latency, there was a significant main effect for repetition, $F(1,11) = 5.53$; $p = 0.038$. Children started faster playing with the objects during the second run ($M = 2.44$; $SD = 1.59$) compared to the first run ($M = 3.74$; $SD = 2.69$; see **Figure 3B** right part). There was no main effect for model [$F(1,11) = 3.11$; $p = 0.106$] and no significant interaction between repetition and model, $F(1,11) = 0.313$; $p = 0.587$.

Finally, to compare the live and the video condition two mixed ANOVAs with the within-factor repetition (1st and 2nd run) and the between-factor presentation mode (live vs. video) were calculated. Concerning the number of imitated steps, results revealed a significant main effect for repetition with $F(1,46) = 11.40$; $p = 0.002$, no significant effect of the presentation mode, $F(1,46) = 1.47$; $p = 0.232$, and no significant interaction between repetition and presentation mode, $F(1,46) = 1.98$; $p = 0.166$. Similarly, for the latencies, results revealed a significant main effect for repetition with $F(1,46) = 9.46$; $p = 0.004$, no significant effect of the presentation mode, $F(1,46) = 0,04$; $p = 0.834$, and no significant interaction between repetition and presentation mode, $F(1,46) = 0,37$; $p = 0.544$.

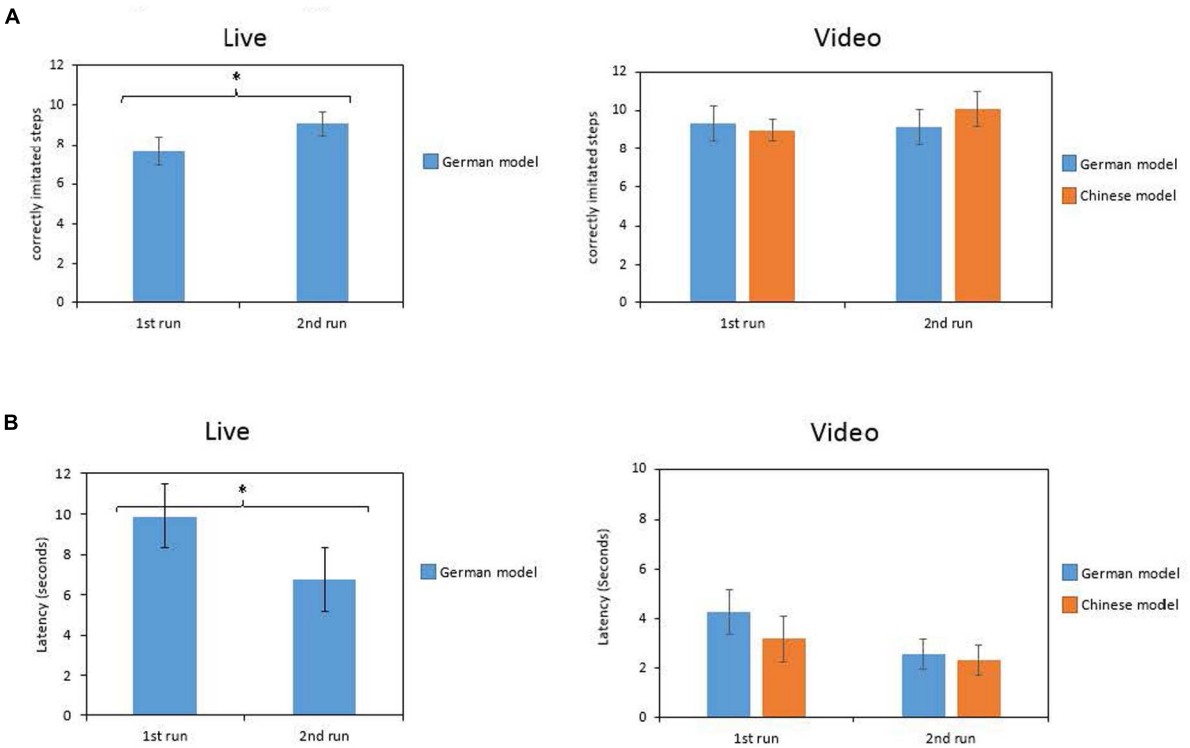

FIGURE 3 | Number of correctly imitated steps (A) and latency (B) in the live and in the video presentation depending on the run (1st and 2nd) and on the race of the model (German vs. Chinese; video presentation only). $^*p < 0.05$.

DISCUSSION

The aim of the present study was to investigate the influence of the model's group membership indicated by physical appearance on 4-year-olds' imitative behavior. The results showed that children did not imitate more action steps after having observed the German model compared to the Chinese model. Similarly, they did not differ in latency to the first touch. At first view, this is not in line with prior research showing that children take the models' group membership into account when they imitate others (e.g., Diesendruck and HaLevi, 2006; Buttelmann et al., 2013; Howard et al., 2015). However, these studies used other indicators than physical appearance as a cue for group membership. We will discuss possible explanations below.

As expected, there were no differences between live and video presentation concerning the imitation performance of the children. This result conformed to prior research, which showed that the video deficit occurs up to the age of three years (e.g., Barr, 2010; but see Reiß et al., 2014 for conflicting results). The lack of this effect also cannot be attributed to differences in the details of the live and video demonstration as the models were well trained to act standardized. Furthermore, we arranged the context of the videos in the same way as it was during the live condition. Previous studies found the in-group-out-group effect when using televised models between 1 and 3 years of age (Buttelmann et al., 2013; Howard et al., 2015). Thus, we believe that it is unlikely the video presentation mode obscured an in-group-out-group effect in children concerning the model's race. Future research might test this assumption in a full-factorial design with video and live presentations for the in-group and out-group model.

Finally, children imitated more steps after the second run than after the first run and started playing faster with the objects. The latter result was found in both the live presentation and the video presentation. This indicates that perhaps 4-year-old children benefit from multiple runs because they get more comfortable with the objects and thus started faster playing with the objects. We assume that this improvement might be due to a higher familiarization to the actions. Concerning the number of imitated steps, there was only a significant improvement within the live condition, where children had only seen the German model presenting the actions. Although the corresponding analysis of variance revealed a significant main effect of repetition and no significant interaction of presentation mode and repetition, this effect can mainly be ascribed to the live condition as indicated by the mean values (see **Figure 3A**). It might well be, that the more children saw the actions, the better they could understand them and thus imitate them more frequently (Sell et al., 1995). Furthermore, children had to focus on the actions twice which could lead to a better rehearsal and storage of the actions (Bandura, 1986). Thus, their recollection was better and they were more likely to imitate. However, we have to take into account that the improvement in imitative behavior was greater after having seen the live model as compared to the video presentation. In fact, the starting level of imitated steps was lower in the live condition

compared to the video presentation and only reached the same level in the second run. Thus, it might be that in the live condition children had to acclimatize to the environment first as it was somehow artificial because the model did not communicate with the child at all.

Concerning the in-group-out-group effect, there are different possible explanations for why the finding is in contrast to prior findings. First, we have to consider the possibility that the results are due to an artefact of the tasks. The imitation tasks could have been too easy for children and thus were performed independently of the model. To control for ceiling effects, we looked at the total amount of children imitating all of the possible 12 steps correctly. Only 5 children (10%) were able to imitate all steps correctly in the first as well as in the second run. This indicates that the tasks were not too easy.

Second, the age of the children could be responsible for these diverging results. Various studies showed that by the age of 5 but not 4 years children take the race into account when dealing with imitation and drawing inferences (Hirschfeld and Gelman, 1997; Oostenbroek and Over, 2015). Similarly, at the age of 3 years children do not seem to comprise the race to guide their behavior or their preferences. For example, Shutts et al. (2010) found, that 3- to 4-year-old children did not use racial information of the models to guide their own preferences for novel items. Furthermore, Kircher and Furby (1971) did not find evidence for 3-year-old children but for 4-year-old children to use race-based information to build preferences. For infants, research also found evidence that there is a preference toward the in-group, which influenced, for example, the eye movements in 3- and 10-month-old infants (Sangrigoli and De Schonen, 2004; Bar-Haim et al., 2006). However, the latter ones were looking time studies and thus can only be compared to results obtained in imitation studies to a very limited amount. Concerning preschool children, there might be a developmental process concerning the awareness of differences between groups and the active use of this information for decisions, like preferences and imitational behavior. Whereas 5-year-old children seem to take into account the race of the model, 3-year-olds do not. Concerning the age of 4 years, findings reported in the literature are less clear. Thus, the age of the children might be one reason for the fact, that we did not find evidence for an in-group-out-group effect in the present study.

Another possible explanation is that the model's mere physical appearance is not sufficient to influence 4-year-old's imitative behavior. Studies investigating how children draw inferences about psychological properties found that children did not use physical appearance but verbal labels about the models' race (Diesendruck and HaLevi, 2006). Most studies, which investigated in-group-out-group effects on imitation, used language as a marker for group membership (Kinzler et al., 2007, 2011; Buttelmann et al., 2013; Howard et al., 2015). In contrast, we neither used any labels for the models nor did the models speak a word during the sessions. When physical appearance is used to indicate a model's racial group membership, it might not be salient enough to serve as a cue for group membership (Diesendruck and HaLevi, 2006). In line with this argument, Shutts et al. (2010) observed that a model's age and gender is more important than a model's race when 3-year-olds choose between objects, which were presented by models differing in age, gender and race. In the present study, we kept the models' age and gender constant in order to analyze the genuine effect of physical appearance. Furthermore, the familiarity of Chinese people could be one possible reason why physical appearance was not salient enough to influence children's imitative behavior. Perhaps children are familiar with the physical appearance of Chinese people because they are around them in everyday life.

In sum, it might well be that the influence of the model's race on children at different ages is moderated by language. That is, language might offer more salient information about the model's race than physical appearance. Thus, the role of language and, most importantly, their interplay should be analyzed in more detail in further studies. Furthermore, the age of children should be analyzed in more detailed studies, which could include also children of the age of 3 and 5 years.

CONCLUSION

Various studies found evidence that children's imitational behavior is influenced by group membership. Belonging to a group is communicated through features like a model's age, gender, and language. The current study manipulating physical appearance only did not show evidence that the model's race elicited the in-group-out-group effect in 4-year-olds. We propose that additional information especially language (e.g., labels) is necessary to highlight group membership at this age and to result in group-specific imitative behavior in children.

AUTHOR CONTRIBUTIONS

All authors originated the idea for the study and contributed to the development of the conceptual framing, and the analysis framework. AK was the primary conductor of analyses and wrote the most of the manuscript. GA, NZ, and CM revised and reworked the manuscript. GA wrote some section and made suggestions for additional analyses.

FUNDING

This research was conducted within the International Research Training Group "Adaptive Minds" and supported by grants from the German Research Foundation (GRK 1457).

ACKNOWLEDGMENT

We thank Tatjana Kaufmann and Lisa Jacob for their help with data collection and all parents and children who participated in this study. Furthermore, we thank Ingo Besserdich for his help conducting the novel tasks. Additionally, we want to thank the reviewer Stefanie Hoehl, Rana Esseily and the editor Ildikó Király for their helpful comments during the revision process.

REFERENCES

Aboud, F. E. (1988). *Children and Prejudice*. Oxford: Basil Blackwell.

Anderson, D. R., and Pempek, T. A. (2005). Television and very young children. *Am. Behav. Sci.* 48, 505–522. doi: 10.1177/0002764204271506

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Upper Saddle River, NJ: Prentice-Hall, Inc.

Bar-Haim, Y., Ziv, T., Lamy, D., and Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychol. Sci.* 17, 159–163. doi: 10.1111/j.1467-9280.2006.01679.x

Barr, R. (2010). Transfer of learning between 2D and 3D sources during infancy: informing theory and practice. *Dev. Rev.* 30, 128–154. doi: 10.1016/j.dr.2010.03.001

Barr, R., and Hayne, H. (1999). Developmental changes in imitation from television during infancy. *Child Dev.* 70, 1067–1081. doi: 10.1111/1467-8624.00079

Buttelmann, D., Zmyj, N., Daum, M., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Diesendruck, G., and HaLevi, H. (2006). The role of language, appearance, and culture in children's social category-based induction. *Child Dev.* 77, 539–553. doi: 10.1111/j.1467-8624.2006.00889.x

Fiske, A. P. (1992). The four elementary forms of sociality: framework for a unified theory of social relations. *Psychol. Rev.* 99, 689–723. doi: 10.1037/0033-295X.99.4.689

Hirschfeld, L. A., and Gelman, S. A. (1997). What young children think about the relationship between language variation and social difference? *Cogn. Dev.* 12, 213–238. doi: 10.1016/S0885-2014(97)90014-9

Howard, L. H., Henderson, A. M., Carrazza, C., and Woodward, A. L. (2015). Infants' and young children's imitation of linguistic in-group and out-group informants. *Child Dev.* 86, 259–275. doi: 10.1111/cdev.12299

Kinzler, K. D., Corriveau, K. H., and Harris, P. L. (2011). Children's selective trust in native-accented speakers. *Dev. Sci.* 14, 106–111. doi: 10.1111/j.1467-7687.2010.00965.x

Kinzler, K. D., and Dautel, J. B. (2012). Children's essentialist reasoning about language and race. *Dev. Sci.* 15, 131–138. doi: 10.1111/j.1467-7687.2011.01101.x

Kinzler, K. D., and DeJesus, J. M. (2013). Northern= smart and Southern= nice: the development of accent attitudes in the United States. *Q. J. Exp. Psychol.* 66, 1146–1158. doi: 10.1080/17470218.2012.731695

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Kinzler, K. D., Shutts, K., DeJesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children's social preferences. *Soc. Cogn.* 27, 623–634. doi: 10.1521/soco.2009.27.4.623

Kircher, M., and Furby, L. (1971). Racial preferences in young children. *Child Dev.* 42, 2076–2078. doi: 10.2307/1127610

Meissner, C. A., and Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: a meta-analytic review. *Psychol. Public Policy Law* 7, 3–35. doi: 10.1037/1076-8971.7.1.3

Nesdale, D. (2001). Language and the development of children's ethnic prejudice. *J. Lang. Soc. Psychol.* 20, 90–110. doi: 10.1177/0261927X01020001005

Oostenbroek, J., and Over, H. (2015). Young children contrast their behavior to that of out-group members. *J. Exp. Child Psychol.* 139, 234–241. doi: 10.1016/j.jecp.2015.05.009

Reiß, M., Becker, A., and Krist, H. (2014). Gibt es einen Videodefiziteffekt bei Aufgaben zur Theory of Mind? [Is there a video deficit effect in Theory of Mind tasks?]. *Z. Entwicklungspsychol. Pädagog. Psychol.* 46, 155–163. doi: 10.(1026)/0049-8637/a000112

Ruys, K. I., Spears, R., Gordijn, E. H., and Vries, N. K. (2007). Automatic contrast: evidence that automatic comparison with the social self affects evaluative responses. *Br. J. Psychol.* 98, 361–374. doi: 10.1348/000712606X132949

Sangrigoli, S., and De Schonen, S. (2004). Recognition of own-race and other-race faces by three-month-old infants. *J. Child Psychol. Psychiatry* 45, 1219–1227. doi: 10.1111/j.1469-7610.2004.00319.x

Sell, M. A., Ray, G. E., and Lovelace, L. (1995). Preschool children's comprehension of a Sesame Street video tape: the effects of repeated viewing and previewing instructions. *Educ. Technol. Res. Dev.* 43, 49–60. doi: 10.1007/BF02300455

Shutts, K., Banaji, M. R., and Spelke, E. S. (2010). Social categories guide young children's preferences for novel objects. *Dev. Sci.* 13, 599–610. doi: 10.1111/j.1467-7687.2009.00913.x

Shutts, K., and Kinzler, K. D. (2007). An ambiguous-race illusion in children's face memory. *Psychol. Sci.* 18, 763–767. doi: 10.1111/j.1467-9280.2007.01975.x

Troseth, G. L., and DeLoache, J. S. (1998). The medium can obscure the message: young children's understanding of video. *Child Dev.* 69, 950–965. doi: 10.1111/j.1467-8624.1998.tb06153.x

Troseth, G. L., Saylor, M. M., and Archer, A. H. (2006). Young children's use of video as a source of socially relevant information. *Child Dev.* 77, 786–799. doi: 10.1111/j.1467-8624.2006.00903.x

Trötschel, R., Hüffmeier, J., and Loschelder, D. D. (2010). When yielding pieces of the pie is not a piece of cake: identity-based intergroup effects in negotiations. *Group Process. Intergroup Relat.* 13, 741–763. doi: 10.1177/1368430210374608

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 27 May 2016
doi: 10.3389/fpsyg.2016.00782

Movement Synchrony Forges Social Bonds across Group Divides

*Bahar Tunçgenç * and Emma Cohen*

Institute of Cognitive and Evolutionary Anthropology, School of Anthropology and Museum Ethnography, University of Oxford, Oxford, UK

Group dynamics play an important role in the social interactions of both children and adults. A large amount of research has shown that merely being allocated to arbitrarily defined groups can evoke disproportionately positive attitudes toward one's in-group and negative attitudes toward out-groups, and that these biases emerge in early childhood. This prompts important empirical questions with far-reaching theoretical and applied significance. How robust are these inter-group biases? Can biases be mitigated by behaviors known to bond individuals and groups together? How can bonds be forged across existing group divides? To explore these questions, we examined the bonding effects of interpersonal synchrony on minimally constructed groups in a controlled experiment. In-group and out-group bonding were assessed using questionnaires administered before and after a task in which groups performed movements either synchronously or non-synchronously in a between-participants design. We also developed an implicit behavioral measure, the Island Game, in which physical proximity was used as an indirect measure of interpersonal closeness. Self-report and behavioral measures showed increased bonding between groups after synchronous movement. Bonding with the out-group was significantly higher in the condition in which movements were performed synchronously than when movements were performed non-synchronously between groups. The findings are discussed in terms of their importance for the developmental social psychology of group dynamics as well as their implications for applied intervention programs.

Keywords: children, in-group attitudes, minimal group paradigm, out-group attitudes, prosociality, social bonding, cooperation, movement synchrony

OPEN ACCESS

Edited by:
David Buttelmann,
University of Bern, Switzerland

Reviewed by:
Thea Ionescu,
Babes-Bolyai University, Romania
James A. Graham,
The College of New Jersey, USA

****Correspondence:***
Bahar Tunçgenç
bahar.tuncgenc@anthro.ox.ac.uk

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *17 February 2016*
Accepted: *09 May 2016*
Published: *27 May 2016*

Citation:
Tunçgenç B and Cohen E (2016) Movement Synchrony Forges Social Bonds across Group Divides. Front. Psychol. 7:782. doi: 10.3389/fpsyg.2016.00782

INTRODUCTION

Peer relationships among friends are at the core of children's lives. Cooperative bonds define children's social sphere of activity, guiding decisions about whom to interact with and whom to avoid. Research has established the relevance of group markers, such as language, skin color and age, in guiding affiliative and cooperative social preferences (see Kinzler et al., 2010). While this 'groupishness' typically engenders positive prosocial sentiment and behavior toward friends in one's own group, group-level preferences can also entrench cross-group divides, ultimately precipitating anti-social prejudice and injustice (e.g., Tajfel, 1970). Although much is now known about how these lines get drawn, there has been relatively little investigation into how they can be effectively erased. Here we investigate the effect of movement synchrony, a core element of interpersonal behavior in social play, conversation, music, sport and exercise on group-based social bonds and

divides. Synchrony has positive effects on social bonding and cooperation in adults (e.g., Wiltermuth and Heath, 2009) and children (e.g., Cirelli et al., 2014a; Rabinowitch and Knafo-Noam, 2015; Tarr et al., 2015). Successful social and educational programs frequently incorporate sports, music and movement activities to improve relationships within and across groups (Bailey, 2005; Schellenberg et al., 2015). Yet, the causal mechanisms underlying their success are largely unknown. The current study explores the idea that performing synchronous movements reduces negative attitudes toward out-groups and bonds individuals across existing group divides.

A vast amount of research on adults suggests that group identities can bond people together and that group-based preferences powerfully shape social attitudes and behaviors toward others (e.g., Tajfel, 1970). People respond more positively to in-group than out-group members (Hewstone et al., 2002), favor their own group and discriminate against the out-group (for a review, see Fiske, 2002), and empathize with and help in-group members more than out-group members (e.g., Stürmer et al., 2005, 2006). This stark distinction in attitudes toward in-group vs. out-group members is known as in-group favoritism and out-group bias (Tajfel and Turner, 1979), or groupishness. In-group favoritism refers to the attribution of positive qualities to one's own group and preferential cooperation toward in-group members, while out-group bias refers to negative attributions and discrimination against the out-group. Despite its potential negative implications for social discrimination, groupishness may be viewed as a kind of cognitive shortcut that can help make sense of the complex social world via generalizing rules of thumb (Tajfel, 1970). In this regard, skills enabling group-based perception and categorization are crucial for social development.

Representation and categorization of the social world along group lines as "us" vs. "them" emerges early in childhood, and potentially has foundations in infancy. Infants as young as 3 months old better recognize and prefer looking at faces of the race they see most often to faces of an unfamiliar race (Kelly et al., 2005). Between 6 and 12 months of age, infants start displaying age-based preferences; they listen longer to the sounds of their peers (Legerstee et al., 1998) and also look longer at the images of their peers (Sanefuji et al., 2006) over adults. Starting from 5 months, infants prefer to look at adults who speak their native language over those who are foreign speakers (Kinzler et al., 2007) and they also prefer adults who speak with a native accent over those who speak with a foreign accent (Kinzler et al., 2007). Ten-month-old infants prefer to receive toys from an adult who speaks their native language (Kinzler et al., 2007) and 14-month-old infants preferentially imitate a native speaker over a foreign speaker (Buttelmann et al., 2013).

In early childhood, group-based social categorization continues to shape children's social attitudes and behaviors, including affiliation. For instance, 3-year old children more readily select objects and activities endorsed by same-sex and same-aged others (Shutts et al., 2010). When asked who they would like to be friends with, 5-year-old children choose native language speakers over foreign language and foreign-accented speakers (Kinzler et al., 2007, 2009). Gender also becomes important in guiding children's friend choices around 4–6 years of age (Martin et al., 1999). Importantly, by this age, group-related biases appear to acquire a conventional element; children not only assume that others would also prefer same-sex partners, but they also anticipate more social approval from others if they play with same-sex peers (Martin et al., 1999). Indeed, this preference for same-sex peers increases until adolescence, when an interest for opposite-sex partners starts to reverse the pattern (Ruble et al., 2006). Notably, however, race-based preferences do not reliably exist until around 4–5 years of age (Bennett and Sani, 2003; Shutts et al., 2010; Weisman et al., 2014; though see Dunham et al., 2013). There is also evidence that, from the age of 5, children's ethnicity-based group biases cut across minimal group preferences. They report liking a member of an out-group more if the out-group is of the same-ethnicity than if he or she is of different ethnicity to them (Nesdale et al., 2004). Further, social status becomes increasingly important: children report liking an out-group more if the out-group has a high status than a low status, and may even prefer to switch their group membership (Nesdale et al., 2004).

Group-related biases emerge even in the absence of real-world divides to which children may be regularly exposed through their development, such as sex, race, age, or language differences. Research within the "minimal group paradigm" has demonstrated that, in both adults and children, arbitrary group memberships can be sufficient to induce group-related stereotyping and preferences (Tajfel et al., 1971). In a minimal group paradigm, people are randomly assigned to groups based on trivial criteria (e.g., the toss of a coin) after which their behaviors and attitudes toward in- and out-group members are assessed. Although the group allocation is random, its effects can be significantly socially divisive. Minimal group paradigm research with young children has shown that, similar to adults, children tend to overlook positive features of the out-group while at the same time selectively encoding positive information about the in-group (Schug et al., 2013). When given the option, children punish selfish acts of out-group members more than those of in-group members (Jordan et al., 2014), allocate more resources to the in-group and attribute more positive characteristics to the in-group (Dunham et al., 2011). Further, children trust and learn information provided by in-group members more, even if the in-group informant has proven to be unreliable and the out-group informant is reliable (MacDonald et al., 2013). Group-related biases in children as incurred by minimal group allocations are observed in assessments with both explicit measures (e.g., directly asking children how they feel about the out-group) and implicit measures (e.g., matching positive/negative adjectives with in-group/out-group; Dunham et al., 2011). Overall, these findings suggest that groupishness can have a pervasive and profound impact on children's social behaviors, preferences, categorizations, and interactions.

Nevertheless, as the research on the relevance of status in children's group preferences has shown, in-group or similarity-based favoritism may be informed or even overturned under certain conditions. Compared to the large amount of research on how biases are established, there is relatively little research on factors that are associated with the attenuation of children's in-group favoritism. A comparison of 5-, 7-, and 9-year-olds showed

that the youngest group displayed more out-group derogation than the older groups, with no difference between 7- and 9-year-olds (Nesdale et al., 2004). This suggests that group-related biases may start to stabilize around 7 years of age. Another study showed that, although 4- to 5-year-old children showed in-group favoritism at baseline, viewing an in-group member behave anti-socially led children to allocate fewer resources and express less liking toward the in-group member (Hetherington et al., 2014). Hence, group stereotyping that young children display under minimal group conditions is not uncompromising; rather, it is strategically attentive to relevant sources of Supplementary Information.

Research in the context of educational and social programs among risk groups and minorities is insightful also. Intergroup contact, for example, can diminish negative attitudes toward racially and ethnically diverse groups in early and middle childhood (e.g., McGlothlin and Killen, 2006; Crystal et al., 2008; Feddes et al., 2009). The effectiveness of intergroup contact appears to stem from the two groups having equal statuses, sharing experiences and forming an overarching group identity that encompasses both groups (Allport, 1954; Rutland and Killen, 2015). Yet, how can these conditions be effectively established? How are such effects achieved? Here we investigate the effect of interpersonal movement synchrony on social bonding across group divides. Evidence from cultural intervention programs supports the view that collective movement, such as in dance, exercise and sport, can reduce intergroup biases and increase bonding and cooperation across groups. For example, school-based community development programs involving dancing in time to rhythms and playing instruments have been shown to increase a range of positive outcomes, including sense of collective identity, understanding of others' cultural values, inclusion of out-group members and feelings of belongingness (Dillon, 2006; Marsh, 2012; for similar results on sports-based programs, see Bailey, 2005). Similarly, training programs conducted with children aged 8–11, which had an emphasis on music production within groups, facilitated emotional empathy (Rabinowitch et al., 2012), sympathy and prosocial attitudes (Schellenberg et al., 2015).

Recent experimental research also has identified positive effects of movement synchrony on bonding and cooperation. In adults, performing synchronous movements, such as walking or tapping in time to the same rhythm as another person, has been shown to enhance feelings of similarity, groupishness, cooperation (Wiltermuth and Heath, 2009; Valdesolo and Desteno, 2011; Reddish et al., 2013) and trust (Launay et al., 2013) among participants. Interestingly, one study found that participants spontaneously synchronized their movements more with minimally constructed out-group members than they did with in-group members (Miles et al., 2011), suggesting that, under certain conditions, movement synchrony may be unconsciously used by individuals to reduce intergroup differences and decrease social distance.

There is mounting evidence also that movement synchrony is linked to pro-sociality and social bonding in children. Infants prefer synchronously-moving social partners to non-synchronously moving partners (Tunçgenç et al., 2015) and help others more if the other person has moved in synchrony with them (Cirelli et al., 2014a). Notably, they do not help a neutral observer who has not performed any movements, suggesting that the pro-social effects of movement synchrony are targeted specifically toward the interactants (Cirelli et al., 2014b), though further research is required to investigate subsequent generalized prosociality toward non-participants (see Carpenter et al., 2013; Reddish et al., 2014). Four-to-six year olds help a game partner more after performing synchronous activities together (Tunçgenç, 2015) and 8–9 year old children report stronger feelings of similarity and closeness after performing rhythmical, synchronous tapping movements with a peer than after comparable non-synchronous movements (Rabinowitch and Knafo-Noam, 2015). Together, these findings affirm the positive social effects of movement synchrony in children. Yet, our understanding of the strength, conditions, and duration of the synchrony effect is still limited. For example, to date, most of the research has investigated children's interactions either with strangers or with one other peer. There are no controlled experimental studies on how movement synchrony operates in more naturalistic group settings among children, the default context of their real-life peer interactions and of the aforementioned intervention and training programs.

Here we aimed to investigate specifically the effect of movement synchrony in facilitating social bonds in an inter-group setting. We hypothesize that movement synchrony between groups facilitates out-group bonding, thereby reducing group-bias between the in-group and the out-group. In order to measure social bonding within and between groups, we used established questionnaires (adapted from Aron et al., 1992; Glass and Benshoff, 2002; Wiltermuth and Heath, 2009; Martin et al., 2012) as well as a new game measure. The game, which we call the Island Game, was an implicit behavioral measure in which physical closeness was used as an indirect measure of social closeness. Physical proximity and approach behavior have long been used as indicators of social closeness and bonding in comparative animal research (e.g., Clay and de Waal, 2013). Social psychology studies conducted with adults have reported strong positive associations between physical proximity and social closeness (IJzerman and Semin, 2010; Fay and Maner, 2012). Inspired by these approaches, the Island Game was developed to measure the effects of synchronous group movement as compared with non-synchronous group movement on group-based preferences by assessing the willingness of children from different groups to be in close proximity with one another (more details below).

METHODS

Participants

One hundred and two participants (53 female, $M_{age} = 105.25$ months, range: 84.10-139.34; $M_{sync} = 104.78$, $M_{non\text{-}sync} = 105.55$) took part in the study. The choice of this age range took account of children's developing motor capabilities. Previous studies have shown that it is only after 7–8 years of age that children can move in synchrony with a rhythm and with other individuals at levels comparable to those of adults (Drake et al., 2000; McAuley

et al., 2006). The participants were recruited from local primary schools in [name of place masked for blind review] and came from middle-class, mixed ethnic backgrounds. All of the children were proficient in the language used during testing [language masked for blind review], although 6 children (3 boys) needed the experimenter's (E) help in completing the questionnaires due to reading difficulties. The study received ethics approval from the University's ethics board and, in line with the Declaration of Helsinki, written permission was obtained from the teachers and the parents of the participants prior to testing.

There were six participants in each session (either 4 boys and 2 girls or 2 boys and 4 girls), split into two arbitrary groups (either 2 boys and 1 girl or 1 boy and 2 girls in both groups). Groups therefore resembled real-life mixed-sex groups, without sex being introduced as another grouping factor as neither group or session consisted exclusively of girls or boys. The within-session age difference among children ranged between 6 months 4 days and 12 months 16 days, a statistically insignificant difference, $F_{(1,\ 15)} = 0.003$, $p = 0.96$. More detailed descriptive statistics on the number of participants by condition are provided in **Table 1**.

Materials and Procedure

General Set-up and Procedure

Each session consisted of 5 phases: (1) minimal group formation, (2) pre-test questionnaires, (3) Moves Task, (4) Island Game, and (5) post-test (long) questionnaire. Three separate areas were created in the experiment room to accommodate the different tasks (see **Figure 1**).

Upon arrival, children were first assigned to one of two groups: the orange group or the green group. Once the groups were formed, children wore vests that matched their group's color and were directed to their group's area. In the Group Areas, there were 3 mats (of matching color to the group's color) with individual shapes printed on them. The shapes were used to identify the children individually. Cards with these shapes printed on them were used throughout the experiment to indicate each child's spot in a task or game. The Group Areas were used for a warm-up activity and for children to complete the questionnaires. The Moves Task took place in an area adjacent to the Group Areas. A tall room divider that occluded visual access separated the Moves Task Areas of the two groups during the training phase. The children learned and practiced the Moves Task within their groups with the room divider present. For the test phase, E removed the divider and the children performed the Moves Task while facing the other group. Following the Moves Task phase, the children were taken to the Island Game Area, where they played the Island Game. Finally, children returned to their Group Areas to complete post-test questionnaires.

TABLE 1 | Descriptive statistics of the sample by condition and in total.

		Synchrony	Non-synchrony	Total
Sex (n = number of participants)	Female	27	26	53
	Male	21	28	49
Tempo (n = number of sessions)	585ms	8	9	17
	555ms	8	9	17
Movement Set (n = number of sessions)	Set 1	8	9	17
	Set 2	8	9	17

Phase 1: Minimal Group Formation

To determine the group composition, children drew cards from a ballot bag. Although the drawing of cards seemed random, in reality, the cards were assorted in such a way to ensure the correct male-female ratio in each group, i.e., by fixing the order of drawing the cards. Cards were colored either orange or green and had certain shapes on them, which were used to identify the children individually (colors and shapes counterbalanced across conditions). To further establish identification with their group, children wore color-coded group vests. They then took their seats on their group's mats and did a warm-up activity. The warm-up activity required the children to work together with their group to draw a group flag that was then hung on the board in their Group Area.

Phase 2: Pre-test Questionnaires

At their individual positions in their Group Areas, children were asked to complete two brief questionnaires to assess how bonded they were to their in-group and to the out-group; the In-group Bonding ($IB_{pre\text{-}test}$) and Out-Group Bonding ($OB_{pre\text{-}test}$) questionnaires, respectively. For a list of the questionnaire items, see Table S1. Both $IB_{pre\text{-}test}$ and $OB_{pre\text{-}test}$ consisted of three 5-point Likert type questions each (where 1 = Strongly disagree, 2 = Disagree, 3 = Don't agree or disagree, 4 = Agree, 5 = Strongly agree). The questions were adapted from questionnaires previously used to examine sports teams' bonding in children (Glass and Benshoff, 2002; Martin et al., 2012). Brief instruction on how to use the Likert scale was given at the beginning. Children completed the questionnaires individually and privately in their own time.

Phase 3: Moves Task

On completion of the pre-test questionnaires, children were brought to the Moves Task Area. This task required the children to perform whole-body movements in time to beats that they heard from their headphones.

Training videos, created by the first author (B.T.), were used. In these, she instructed children on how to perform the moves in time to the beat and demonstrated the moves. All of the moves were basic leg and arm movements such as stepping to the side and stretching or swinging the arms. None required any prior experience and they were selected so as to avoid evoking a particular meaning (e.g., such as in clapping, marching, etc.). For a sample of the moves video used, please refer to the Supplementary Materials video.

For the beats, two auditory tracks of drumbeats (585 and 555 ms) were created using Garageband software. Using Silent Disco technology, each computer was connected to a separate audio channel, from which the drumbeats were presented to children's individual wireless headphones. This way, the two groups in each session could receive their own visual (instruction videos for the moves) and auditory stimuli (the beats presented through the two

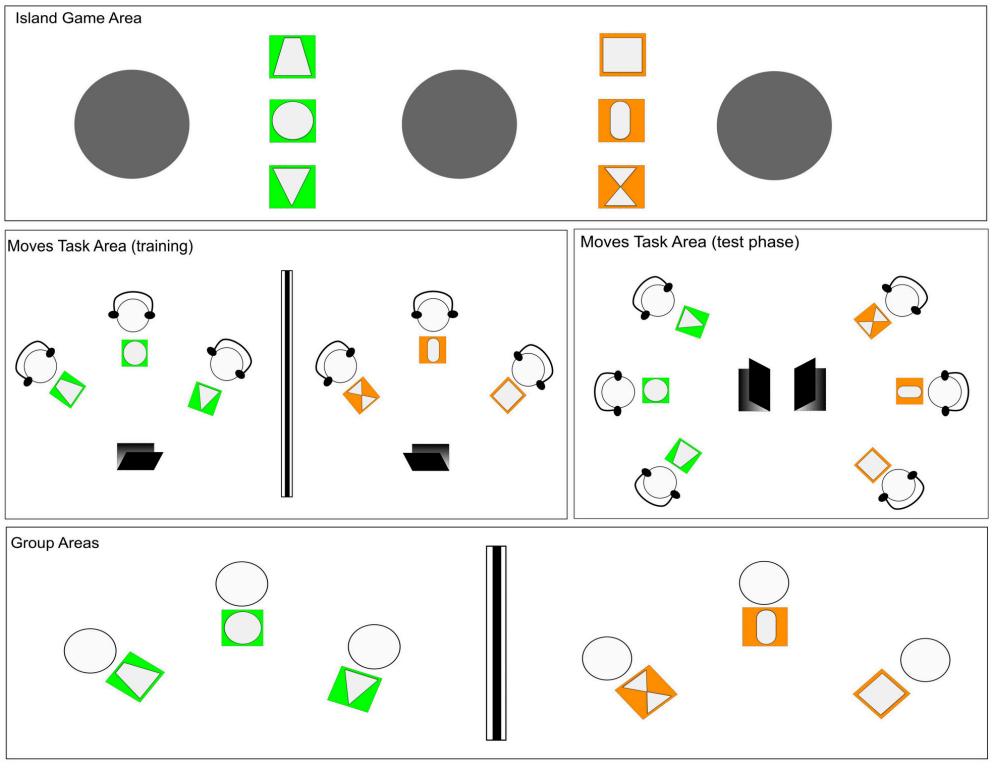

FIGURE 1 | Overview of the study set-up. Phase1, Phase 2, and Phase 5 took place in the Group Areas, Phase 3 in the Moves Task Area and Phase 4 in the Island Game Area.

audio channels) simultaneously without knowing what stimulus the other group was receiving. In the synchrony condition, both groups were presented with the same movement set and the same beats, while in the non-synchrony condition different movement sets and different tempi beats were presented to the two groups. To increase the contrast across conditions, two different movement sets were used, each comprising three moves.

Videos were shown to the children via 13″ computer screens, a separate one for each group. The training videos lasted for just under 6 min. In the videos, the instructor first demonstrated the moves in a step-wise fashion one by one. Following each demonstration, she asked the children to join her in doing the move in time to the beats. When individual training for all three moves was completed, the moves were practiced one final time for the whole duration of the auditory track that was later presented in the test phase. E observed the children during training; all of the children could proficiently perform the moves following the beats by the end of the training.

After the training was over, E instructed the children that they would do the moves once more, this time facing the other group. She removed the room divider between the groups and positioned the children in a crescent shape around the computer screens, so that all children could see all the other group members, their own group members and their video at the same time (see **Figure 1**). In order to eliminate potential memory demands, an instruction-free video of E performing the moves was provided during the test phase too. The test phase lasted for approximately 3 min.

Phase 4: Island Game

The Island Game took place immediately after the Moves Task test. In this game, three islands (charcoal-colored mats of 100 cm diameter) were placed on the floor, each spaced approximately 2 m from the adjacent island. One group of children (orange or green) was positioned in the space between two of the islands and the other group of children was positioned in the space between the other two islands. Two of the islands were therefore closer to either one of the groups and one island in the middle was equally close to both groups (see **Figure 1**). Children's individual positions were determined via the shape cards on the floor.

The game required that the children would start from a crouching position and would quickly run to an island of their choice on the experimenter's signal. At the start of each trial, the children were told to crouch on their dedicated spots with eyes closed and their face to the floor. They maintained this position until E counted down from 3, at which point E announced, "Go!" and the children jumped up and ran to the island that they chose. Choosing to go to an island that was closer to one's own group vs. the other group was taken as a reflection of social closeness to one's own group vs. the other group. The Island Game was repeated 6 times and children's starting positions within their group "zone" were shuffled each time. After the Island Game was

finished, children went back to their Group Area and completed the post-test questionnaires.

Phase 5: Post-test (Long) Questionnaire

The post-test questionnaire comprised of three parts. Unless otherwise stated, all questions were answered on a 5-point Likert type scale (1 = Strongly disagree, 2 = Disagree, 3 = Don't agree or disagree, 4 = Agree, 5 = Strongly agree). A list of the questionnaire items is provided on Table S1.

The first set of questions concerned children's experiences of the activities that they had just done (perceived difficulty, success and enjoyment). The second set of questions was similar to the pre-test questionnaires; items assessed how bonded children felt toward their in-group and the out-group. We named these questionnaires IB_{long} and OB_{long}. Within both IB_{long} and OB_{long}, 3 of the items were identical to those in the pre-test questionnaires, $IB_{pre\text{-}test}$ and $OB_{pre\text{-}test}$. These 3 items ($IB_{post\text{-}test}$ and $OB_{post\text{-}test}$) were analyzed separately to assess how children's bonding levels changed before and after the Moves Task (more details follow in the Results section). The items in IB_{long} and OB_{long} were adapted from existing measures of sports team bonding and bonding questions used in adult synchrony research (see Table S1 for sources for each item).

The third section of the post-test questionnaires was an adapted version of the pictorial Inclusion of Other in Self (IOS) scale, used to assess participants' perceived relationship to the in-group and to the out-group (Cameron et al., 2006). In this scale, two circles representing the participant and the group were displayed with increasing degrees of overlap (from entirely separated to entirely overlapping), yielding five response options. Circles were annotated with stickman figures representing the child (labeled "YOU") and the group (labeled "YOUR GROUP" or "OTHER GROUP"). Participants marked one of the five options that best represented how close or how distant they felt toward the group under question. Instructions on how to interpret the IOS scale were provided to all children at the beginning of the post-test questionnaire phase.

The post-test questionnaires ended with one question (Q48), which asked the children whom they would like to choose as playmates if they were to do some more activities later. Children indicated their response by choosing one of the four multiple-choice answers: (a) 2 people from my group, (b) 2 people from the other group, (c) 1 person from my group and 1 person from the other group, and (d) Any 2 people—I don't mind.

When finished, children were thanked and dismissed from the study. The Moves Task and Island Game phases of all sessions were video recorded for coding purposes.

CODING AND DATA PREPARATION

Moves Task

A coder blind to the hypotheses and conditions watched all of the Moves Task test phases of the videos and rated them for synchrony. First, the coder assessed how synchronously the two groups moved within a session by giving that session a rating from 1 to 7, where 1 = not at all synchronous and 7 = perfectly synchronous, and then made a blind guess as to which condition the video belonged to. Ratings for the synchrony condition ($M_{sync} = 5.75$) were significantly higher than ratings for the non-synchrony condition ($M_{non\text{-}sync} = 3.22$), $t_{(16)} = -5.26$, $p < 0.0001$. Condition guess accuracy was 100%, binomial $p < 0.0001$.

Bonding Questionnaires

Factor analyses were conducted for the six Likert type questionnaires: $IB_{pre\text{-}test}$, $OB_{pre\text{-}test}$, $IB_{post\text{-}test}$, $OB_{post\text{-}test}$, IB_{long}, and OB_{long}. Preliminary tests and correlational analyses confirmed that the questionnaires were suitable for factor analysis (for inter-item correlations see Figures S1–S3; for the other tests see Table S2). From the results of the Principal Component Analysis (PCA), only one component was extracted from each questionnaire, which we interpret as a single, composite construct of social bonding. Only items with a factor loading of >0.4 were retained. Consequently, two items were dropped from the OB_{long} questionnaire, namely the items "I don't like my group" and "I feel bad about my group". For all other questionnaires, all of the items were retained. The detailed results of the PCAs and internal consistency values of each questionnaire can be found in Tables S3 and S4. Given the high internal consistencies of the questionnaires, responses across items for each questionnaire were averaged for each participant and these mean scores were used in subsequent analyses.

IOS Scales

For the IOS scales, children received a score ranging from 1 to 5 depending on the option chosen, with higher scores indicating higher self-group overlap.

Island Game

Participants' island choices were categorically coded as 0, 1 or 2, where 0 = the island closest to the participant's own group and furthest from the other group ("Own Group Island"), 1 = the island in the middle (equidistant from the group islands and to participants from each group), and 2 = the island closest to the other group and furthest from the participant's own group ("Other Group Island"). Reliability analysis on children's Island Game choices, conducted with two coders who were blind to conditions and one who was blind to the hypotheses, revealed good agreement, $r = 0.87$.

Recognizing the potential for island choices to be influenced by the other participants in this group task, we analyzed the Island Game data for Intraclass Correlations (ICC). When all six trials were included in analysis, average intra-session variance differed from the overall variance, $ICC = 0.24$, CI [0.526, 0.720], $F_{(1,\ 100)} = 4.27$, $p = 0.03$, suggesting interdependence among children's responses within trials. Therefore, we assessed ICC for the first trial only, in which children made their initial island choices and which we would therefore expect to be uninfluenced by their own and others' previous choices. The interdependence in children's responses disappeared when only the first trial responses were analyzed, $ICC = 0.009$, CI [−0.014, 0.967], $F_{(1,\ 100)} = 1.16$, $p = 0.28$ (see Supplementary Materials for ICC scores by trial and condition). Hence, to avoid problems of

group-level interdependence in subsequent main analyses, only first trial responses were used.

All analyses were performed using R software (R Core Team, 2013) and following the recommendations of Field et al. (2012).

RESULTS

Minimal Group Bias

A manipulation check for the minimal group effect confirmed that, at baseline (i.e., before performing the Moves Task) children overall reported higher bonding toward their in-group ($M_{IB} = 4.37$) than toward the out-group ($M_{OB} = 3.22$), $F_{(1, 95)} = 73.41$, $p < 0.0001$, $\eta^2 = 0.44$. Being in the synchronous vs. non-synchronous condition did not influence children's pre-Moves Task scores on $IB_{pre\text{-}test}$, $M_{sync} = 4.40$, $M_{non\text{-}sync} = 4.35$, $F_{(1, 94)} = 0.22$, $p = 0.64$, or on $OB_{pre\text{-}test}$, $M_{sync} = 3.21$, $M_{non\text{-}sync} = 3.22$, $F_{(1, 94)} = 0.01$, $p = 0.99$. Within both synchrony and non-synchrony conditions, boys scored lower on out-group bonding questions than girls, $M_{boys} = 2.89$, $M_{girls} = 3.52$, $F_{(1, 94)} = 8.04$, $p = 0.006$. No differences in in-group bonding were found between boys and girls. Further, a main effect of age was found on both in-group and out-group questionnaires, in-group: $F_{(1, 94)} = 4.65$, $p = 0.03$; out-group: $F_{(1, 94)} = 3.66$, $p = 0.06$. With increasing age, a gradual decrease was observed in inter-group biases. However, Bonferroni-adjusted pairwise comparisons revealed no significant differences between any of the age groups between 7 and 11, all ps >0.05. No effect of group color was found in any of the pre-test bonding questionnaires.

Synchrony Effects

Bonding Questionnaires

First, data were checked for any differences across conditions in children's experiences with the games. Children in the synchrony and non-synchrony conditions found the Moves Task similarly easy, $M_{sync} = 4.58$, $M_{non\text{-}sync} = 4.32$, $F_{(1, 100)} = 2.64$, $p = 0.11$. Enjoyment ratings were also similarly high across conditions for the Moves Task, $M_{sync} = 4.25$, $M_{non\text{-}sync} = 4.24$, $F_{(1, 100)} = 0.002$, $p = 0.96$, and the Island Game, $M_{sync} = 4.46$, $M_{non\text{-}sync} = 4.37$, $F_{(1, 100)} = 0.24$, $p = 0.62$. Neither short or long post-test questionnaires were significantly influenced by children's age, sex, group color, tempo, and movement set, all ps > 0.05.

Next, we examined the effect of movement synchrony on children's in-group and out-group bonding in the short pre-test and post-test questionnaires and the long post-test questionnaires. For the short questionnaires, difference scores were calculated by subtracting participants' post-Moves Task scores from their pre-Moves Task scores on the short IB and OB questionnaires, i.e., $IB_{dif} = IB_{post\text{-}test} - IB_{pre\text{-}test}$, by which higher positive scores indicate greater increase in bonding. The exact means of children's IB and OB scores before and after the Moves Task are provided in **Table 2**. No effect of condition was found on the change in children's bonding with the in-group (IB_{dif}), $M_{sync} = 0.03$, $M_{non\text{-}sync} = -0.15$, $F_{(1, 94)} = 2.02$, $p = 0.16$. However, as predicted, OB_{dif} was higher for children in the synchrony condition ($M_{sync} = 0.84$) than for children in the non-synchrony condition ($M_{non\text{-}sync} = 0.25$), $F_{(1, 94)} = 9.16$, $p = 0.003$, $\eta^2 = 0.09$ (see **Figure 2A**). Separate paired-samples t-tests within each condition confirmed that the increase in out-group bonding was significant for the synchrony condition, $t_{(41)} = -5.47$, $p < 0.0001$, $d = 0.84$, but not for the non-synchrony condition, $t_{(53)} = -1.58$, $p = 0.12$.

Similar results were obtained for the long post-test questionnaires: paired t-tests revealed that there was no significant effect of condition on in-group bonding (IB_{long}), $M_{sync} = 3.73$, $M_{non\text{-}sync} = 3.66$, $F_{(1, 100)} = 0.36$, $p = 0.55$, but bonding to the out-group (OB_{long}) was significantly higher in the synchronous than the non-synchronous condition (see **Figure 2B**), $M_{sync} = 3.81$, $M_{non\text{-}sync} = 3.24$, $F_{(1, 100)} = 6.76$, $p = 0.01$, $\eta^2 = 0.06$. Further, following synchronous movement, levels of bonding to the in-group (IB_{long}) and out-group (OB_{long}) were indistinguishable, $M_{IB} = 3.73$, $M_{OB} = 3.81$, $t_{(47)} = -0.71$, $p = 0.48$. In the non-synchrony condition, the difference between in-group bonding (IB_{long}) and out-group

TABLE 2 | Means of the short versions of the pre-test and post-test questionnaires, IB and OB, by condition.

	In-group (IB)		Out-group (OB)	
	Pre-test	Post-test	Pre-test	Post-test
Synchrony	4.40	4.43	3.21	4.04
Non-synchrony	4.35	4.20	3.22	3.46

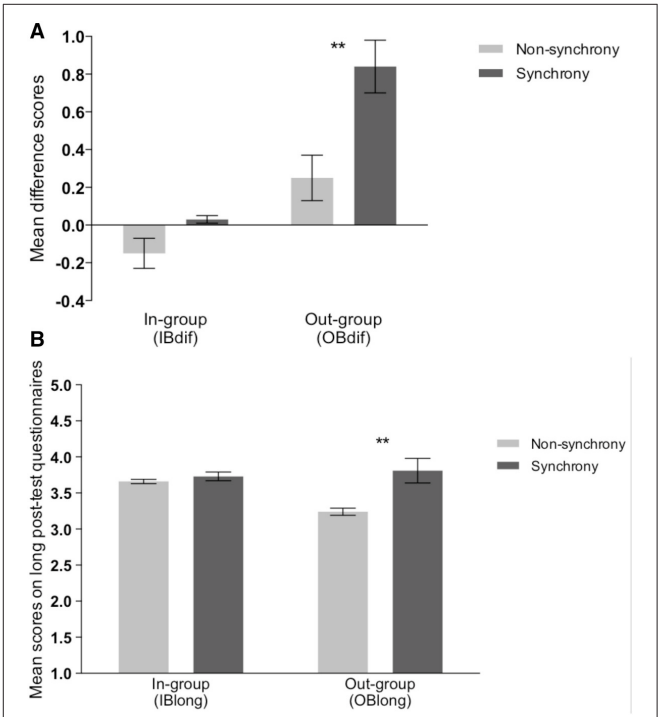

FIGURE 2 | Mean scores on bonding questionnaires by condition. **(A)** Mean difference between pre-test and post-test questionnaire responses by condition. **(B)** Means of the long post-test questionnaire responses, IB_{long} and OB_{long}, by condition. $^{**}p < 0.05$.

bonding (OB_{long}) trended in the predicted direction, $M_{IB} = 3.66$, $M_{OB} = 3.34$, $t_{(53)} = 1.72$, $p = 0.09$, $d = 0.23$.

These results support our hypothesis that, compared to non-synchronous movement, performing synchronous movements increases out-group bonding among participants. Results are further corroborated by condition-wise differences in the reported success of the in-group and out-group Moves Task performances. Ratings for how successful children thought their own group was in performing the Moves Task did not differ significantly between the conditions, $M_{sync} = 4.38$, $M_{non\text{-}sync} = 4.28$, $F_{(1,\ 100)} = 0.27$, $p = 0.60$. However, children in the synchrony condition rated the other group as more successful in the Moves Task ($M_{sync} = 4.15$) than did children in the non-synchrony condition ($M_{non\text{-}sync} = 3.56$), $F_{(1,\ 100)} = 6.36$, $p = 0.01$, $\eta^2 = 0.06$.

IOS Scales

IOS responses were analyzed using ordinal logistic regression to test the prediction that scores for the out-group would be higher in the synchrony condition than in the non-synchrony condition. Data were checked for the proportional odds assumption; no violation was found for either the in-group IOS, $X^2_{(3)} = 5.95$, $p = 0.11$, or the out-group IOS scale, $X^2_{(3)} = 3.35$, $p = 0.34$. Hence, ordinal logistic regression analyses with condition, age, sex, group color, tempo, and movement set as predictors were conducted. None of the predictors were found to have an effect on children's responses for the in-group IOS scale, all ps > 0.05. This indicates that condition did not influence how close children felt toward their in-group following the Moves Task, which is in line with the previous questionnaire findings. For the out-group IOS scale, only condition significantly predicted responses; the odds of children in the synchrony condition scoring higher on the out-group IOS scale was 3.98 times that of children in the non-synchrony condition, $X^2_{(1)} = 13.52$, $p < 0.0001$, 97.5% CI, 1.93–8.43. Moreover, within both the synchrony and the non-synchrony conditions, the differences between in-group and out-group IOS scores were significant, suggesting that even after synchronous movement performance, some in-group favoritism remained (see **Figure 3**), synchrony condition: $t_{(47)} = 3.90$, $p < 0.001$, $d = 0.56$; non-synchrony condition: $t_{(53)} = 7.83$, $p < 0.0001$, $d = 1.07$.

Finally, children's responses to the final item on the post-test questionnaire (Q48) were assessed. This item asked whether the children would choose in-group or out-group members as playmates for a hypothetical future encounter. No difference was found across conditions, $X^2_{(3)} = 5.02$, $p = 0.17$. **Table 3** shows the descriptive statistics of children's responses to Q48.

Island Game

Island Game analyses assessed whether children in the synchrony condition were more likely than children in the non-synchrony condition to choose the "Other Group Island". **Table 4** shows the descriptive statistics of children's Island Game responses by condition. The data did not meet the assumptions of multinomial logistic regression (specifically, the high leverage assumption of multinomial logistic regression, i.e., zero cases in the Non-synchronous/ the "Other Group Island" cell, as can be seen in **Table 4**). Hence, a chi-square test was run to analyze the effects of condition (synchronous vs. non-synchronous) on children's island choices. The result showed a significant effect of condition with a large effect size, $X^2_{(2)} = 13.29$, $p = 0.001$, $\varphi = 0.36$. Children in the non-synchrony condition were 1.69 times more likely to go to the "Own Group Island" than children in the synchrony condition. Moreover, while no child in the non-synchrony condition chose to go to the "Other Group Island", 19% of the children in the synchronous condition chose to do so. In both conditions, children were roughly equally likely to choose the middle island. No significant associations were found between children's age, sex, group color, tempo, and movement set and island choices, all ps > 0.05 (see Table S5). These findings align with the questionnaire results above; children's behavioral responses in the Island Game strongly predicted their scores on the out-group IOS Scale, $F_{(1,\ 100)} = 12.00$, $p = 0.0008$, $R^2 = 0.11$, and out-group bonding questionnaire (OB_{long}): $F_{(1,\ 100)} = 14.51$, $p = 0.0002$, $R^2 = 0.13$, giving confidence in the Island Game as a novel behavioral measure of social bonding and preference in children.

DISCUSSION

This experiment investigated whether synchronous movement reduces inter-group biases and increases bonding among groups. In line with previous research on minimal group effects, we found that children initially displayed in-group favoritism following group allocation and a brief identity-building activity. Subsequent performance of movements in

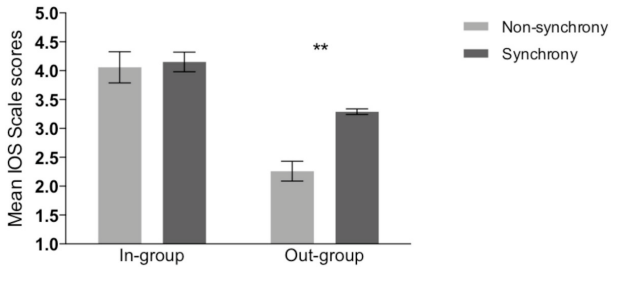

FIGURE 3 | Mean scores on in-group IOS and out-group IOS scales by condition. ** $p < 0.05$.

TABLE 3 | Frequencies (n) of children's responses to Question 48 ("If we came back to do more activities another day, who would you choose to do them with?") by condition.

Response options for Q48	Synchrony	Non-synchrony	Total
2 people from my group	9 (19%)	9 (17%)	18 (18%)
1 person from my group and 1 person from the other group	10 (21%)	6 (11%)	16 (16%)
2 people from the other group	11 (23%)	23 (43%)	34 (33%)
Any 2 people - I don't mind	18 (37%)	16 (29%)	34 (33%)

Column percentages are provided in parentheses next to the frequencies.

TABLE 4 | Frequencies (n) of children's Island Game responses by condition.

	Synchrony	Non-synchrony	Total
"Own Group Island" (the island closest to own group/furthest from other group)	17 (35%)	32 (59%)	49 (48%)
Middle island (the island in the middle, equidistant to both groups and the other islands)	22 (46%)	22 (41%)	44 (43%)
"Other Group Island" (the island closest to the other group/furthest from own group)	9 (19%)	0 (0%)	9 (9%)

Column percentages are provided in parentheses next to the frequencies.

synchrony, as compared to non-synchronous movement, with the opposing group significantly increased out-group bonding. After synchronous movement, there was no difference between bonding to the in-group and the out-group, as measured by the long questionnaire items, though pictorial IOS responses suggest some lingering in-group bias in perceived closeness. Importantly, while synchrony appears to have increased out-group bonding, non-synchrony did not significantly affect bonding toward the out-group. This suggests that merely getting together and moving in the same space has little effect on bonding between groups; rather, it is synchronous movement specifically that brings about a significant positive change.

In addition to questionnaire measures, we also used a novel behavioral measure, the Island Game, as a gauge of social bonding. Analyses from both the questionnaire and behavioral measures revealed greater out-group bonding in the synchrony condition compared to the non-synchrony condition. Since the post-test questionnaires clearly show that in-group bonding was as high after the Moves Task as it was at baseline, the condition-wise effects on Island Game behavior more likely reflect increased out-group bonding, rather than reduced in-group bonding. The Island Game took physical closeness as a proxy for social closeness. This idea finds its roots in established measures of affiliation in primate communities (Clay and de Waal, 2013) and in social psychology studies revealing a relation between physical and social closeness (IJzerman and Semin, 2010; Fay and Maner, 2012). The design was based on playground games that children commonly enjoy and therefore offers high ecological validity (Torbert and Schneider, 1993; Pica, 2011). Children's ratings indicate that the game was fun to play. Importantly, behavioral responses in the Island Game strongly predicted self-report measures. Unlike the questionnaire measures, game instructions do not entail or draw attention to group identity or group competition. The Island Game therefore potentially captures implicit aspects of inter-group biases and social closeness. One limitation of the game, however, is the potential for interdependence; after the first trial, children's responses in the following iterations of the game may have been prone to be influenced by other children's choices. Methodological solutions to reduce such influences could be considered in future developments of the design. Alternatively, larger sample sizes could allow multilevel analysis. These observations notwithstanding, convergent findings with the questionnaire responses confirm that the Island Game successfully measures group bonding with a single-trial assessment.

Several psychological mechanisms may play a role in creating the observed positive effects of movement synchrony on group social bonding. Previous research has shown that people who view their partners more positively tend to spontaneously synchronize their movements with them more than do partners with weaker rapport (Miles et al., 2010). Moving in synchrony can also lead to increased perceptions of similarity (Wiltermuth and Heath, 2009; Valdesolo and Desteno, 2011; Rabinowitch and Knafo-Noam, 2015). Thus, in the current study, performing the same movements in time to the same beats with the out-group might have enhanced rapport and feelings of similarity, thereby alleviating relative negative bias against the out-group. Synchronous movement also increases perceived entitativity (i.e., having the properties of a single, united entity; Campbell, 1958). People who move synchronously with each other are perceived as having higher entitativity (Lakens, 2010) and perceptions of entitativity are mediated by psychological attributions, such as assuming that synchronous partners feel the same, or that they like each other more (Lakens and Stel, 2011). Similarly, from a first-person perspective, interactants report feeling more connected and as part of the same team upon performing synchronous movements (Wiltermuth and Heath, 2009; Wiltermuth S., 2012; Wiltermuth S. S., 2012; Cohen et al., 2013). The results of the present study support the entitativity account, as evidenced by reports of increased connectedness, togetherness and closeness in the synchrony condition. Thus, movement synchrony potentially forges social bonds and fosters more positive attitudes among synchronizing partners.

From a broader evolutionary perspective, it has been suggested that movement synchrony may have facilitated cooperation in large human societies, where bonding with genetically unrelated individuals presented unique challenges (Dunbar and Shultz, 2010). By moving in time to a shared rhythm, personal identities are thought to merge into a unified group identity (McNeill, 1995), accompanied by feelings of collective joy (Ehrenreich, 2006) and collective effervescence (Durkheim, 1915/1965). There is a growing amount of empirical support for the facilitatory effects of movement synchrony on emotion sharing and empathy (Cross et al., 2012; Valdesolo and Desteno, 2011). Understanding and sharing the emotional states of others promotes pro-social behaviors both in human children (Dunfield, 2014) and in non-human primates (Melis et al., 2006; Hare et al., 2007). Therefore, movement synchrony may be a fundamental mechanism in social bonding, serving to mitigate emotional tension among individuals and groups and bond them together within a collective identity.

The current study contributes to our understanding of the developmental origins of both intergroup bias and the social bonding effects of synchronous movement. In revealing an effect of synchrony on out-group bonding, the findings shed light on the flexibility of inter-group biases in middle childhood years, an underexplored question in the social developmental literature

(though see: Hetherington et al., 2014). Notably, at baseline, boys and younger children held a more negative attitude toward the out-group than girls and older children (for similar results, see Buttelmann and Böhm, 2014). Measures taken after the Moves Task reveal that synchrony also erased these differences. That synchronous movement, but not non-synchronous movement, can have these effects could usefully inform social intervention programs, especially in cases where cohesion across groups is challenged by prior social, cultural or economic divides. In this study, minimal group construction produced differences in reported in- vs. out-group bonding; yet, it should be noted that out-group bonding was still in the positive range of the scale (for comparable results on minimal group studies with children, see: Nesdale et al., 2004; Dunham et al., 2011). Relatedly, the increase in out-group bonding, as assessed by the questionnaires, was modest and statistical analyses revealed small effect sizes. Therefore, it remains to be seen whether the positive social effects of movement synchrony could mitigate negative sentiment or even hostility toward real-world out-groups where social divides are strongly entrenched.

Different types of synchronous movements included in bonding activities could yield variable effects also. Here, we manipulated both the content of the moves and the timing of the beats to attain maximal difference across conditions. Perhaps changing the timing alone could facilitate out-group bonding, as is shown to be the case in children's dyadic interactions (Rabinowitch and Knafo-Noam, 2015; Tunçgenç, 2015). Moreover, the movements in the present study were contextualized within a joint physical play context. Previous research has indicated the social benefits of physical activity and exercise in children's play (Biddle and Asare, 2011; Barkley et al., 2014). In the future, it will be important to explore how the bonding effects of synchrony manifest in other cross-group contexts, such as musical interactions (e.g., Kirschner and Tomasello, 2010), sport, exercise, and joint physically active play. Finally, it would be productive to investigate how movement synchrony influences bonds across group members in inter-group settings in adults. Despite the vast literature on dyadic social bonding effects of synchrony in adults, there have been relatively fewer studies on synchrony-induced bonding within groups (e.g., Cohen et al., 2013; Reddish et al., 2013; Davis et al., 2015; Tarr et al., 2015). To our knowledge, no study has examined how synchrony influences inter-group dynamics or group-related biases.

From infancy to adulthood, group-based differences strongly influence social preferences, attitudes, and behaviors toward others. In this study, we showed that a brief, fun movement game, when performed in synchrony with an opposing group, led to increased bonding across group divides. The findings advance our understanding of the links between motor, cognitive and social development in middle childhood years. The new behavioral measure developed, the Island Game, as well as the questionnaires used, offer valid, reliable measures of social bonding that are convenient to administer to young children. Results can helpfully inform social and educational interventions that aim to increase social closeness and cooperation in group settings. Future research should continue to investigate the mechanisms by which movement synchrony forges social bonds, the range of contexts and activities in which these effects work, and the relevance of synchrony for interventions across real-world divides.

AUTHOR CONTRIBUTIONS

BT and EC designed the study, analyzed the data and wrote the paper; BT collected the data.

FUNDING

This research was supported by a British Academy Fellowship to EC (No. MD130076).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: http://journal.frontiersin.org/article/10.3389/fpsyg.2016.00782

REFERENCES

Allport, G. W. (1954). *The Nature of Prejudice*. New York, NY: Doubleday Anchor Books.

Aron, A., Aron, E. N., and Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *J. Pers. Soc. Psychol.* 63, 596–612. doi: 10.1037/0022-3514.63.4.596

Bailey, R. (2005). Evaluating the relationship between physical education, sport and social inclusion. *Educ. Rev.* 57, 71–90. doi: 10.1080/0013191042000274196

Barkley, J. E., Salvy, E. J., Sanders, G. J., Dey, S., Von Carlowitz, K. P., and Williamson, M. L. (2014). Peer influence and physical activity behavior in young children: an experimental study. *J. Phys. Act. Health* 11, 404–409. doi: 10.1123/jpah.2011-0376

Bennett, M., and Sani, F. (2003). The role of target gender and race in children's encoding of category-neutral person information. *Br. J. Dev. Psychol.* 21, 99–112. doi: 10.1348/026151003321164645

Biddle, S. J. H., and Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *Br. J. Sports Med.* 45, 886–895. doi: 10.1136/bjsports-2011-090185

Buttelmann, D., and Böhm, R. (2014). The ontogeny of the motivation that underlies in-group bias. *Psychol. Sci.* 25, 921–927. doi: 10.1177/0956797613516802

Buttelmann, D., Zmyj, N., Daum, M., and Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Dev.* 84, 422–428. doi: 10.1111/j.1467-8624.2012.01860.x

Cameron, L., Rutland, A., Douch, R., and Brown, R. (2006). Changing children's intergroup attitudes toward refugees: Testing different models of extended contact. *Child Dev.* 77, 1208–1219. doi: 10.1111/j.1467-8624.2006.00929.x

Campbell, D. T. (1958). Common fate, similarity, and other indices of the status of aggregates of persons as social entities. *Behav. Sci.* 3, 14–25. doi: 10.1002/bs.3830030103

Carpenter, M., Uebel, J., and Tomasello, M. (2013). Being mimicked increases prosocial behavior in 18-month-old infants. *Child Dev.* 84, 1511–1518. doi: 10.1111/cdev.12083

Cirelli, L. K., Einarson, K. M., and Trainor, L. J. (2014a). Interpersonal synchrony increases prosocial behavior in infants. *Dev. Sci.* 17, 1003–1011. doi: 10.1111/desc.12193

Cirelli, L. K., Wan, S. J., and Trainor, L. J. (2014b). Fourteen-month-old infants use interpersonal synchrony as a cue to direct helpfulness. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 369:20130400. doi: 10.1098/rstb.2013.0400

Clay, Z., and de Waal, F. B. M. (2013). Bonobos respond to distress in others: consolation across the age spectrum. *PLoS ONE* 8:e55206. doi: 10.1371/journal.pone.0055206

Cohen, E., Mundry, R., and Kirschner, S. (2013). Religion, synchrony, and cooperation. *Rel. Brain Behav.* 4, 37–41. doi: 10.1080/2153599X.2012.741075

Cross, I., Laurence, F., and Rabinowitch, T. (2012). "Empathy and creativity in group musical practices: Towards a concept of empathic creativity," in *The Oxford Handbook of Music Education,* eds G. E. McPherson and G. Welch (Oxford: Oxford University Press), 337–353.

Crystal, D. S., Killen, M., and Ruck, M. (2008). It is who you know that counts: intergroup contact and judgments about race-based exclusion. *Br. J. Dev. Psychol.* 26, 51–70. doi: 10.1348/026151007X198910

Davis, A., Taylor, J., and Cohen, E. (2015). Social bonds and exercise: Evidence for a reciprocal relationship. *PLoS ONE* 10:e0136705. doi: 10.1371/journal.pone.0136705

Dillon, S. (2006). Assessing the positive influence of music activities in community development programs. *Music Educ. Res.* 8, 267–280. doi: 10.1080/14613800600779543

Drake, C., Jones, M. R., and Baruch, C. (2000). The development of rhythmic attending in auditory sequences: attunement, referent period, focal attending. *Cognition* 77, 251–288. doi: 10.1016/S0010-0277(00)00106-2

Dunbar, R. I. M., and Shultz, S. (2010). Bondedness and sociality. *Behaviour* 14, 775–803. doi: 10.1163/000579510X501151

Dunfield, K. A. (2014). A construct divided: prosocial behavior as helping, sharing, and comforting subtypes. *Front. Psychol.* 5:958. doi: 10.3389/fpsyg.2014.00958

Dunham, Y., Baron, A. S., and Carey, S. (2011). Consequences of "minimal" group affiliations in children. *Child Dev.* 82, 793–811. doi: 10.1111/j.1467-8624.2011.01577.x

Dunham, Y., Chen, E. E., and Banaji, M. R. (2013). Two signatures of implicit intergroup attitudes: developmental invariance and early enculturation. *Psychol. Sci.* 24, 860–868. doi: 10.1177/0956797612463081

Durkheim, E. (1915/1965). *The Elementary Forms of the Religious Life,* (Trans. J. W Swain). New York, NY: Free Press.

Ehrenreich, B. (2006). *Dancing in the Streets: A History of Collective Joy*. New York, NY: Metropolitan.

Fay, A. J., and Maner, J. K. (2012). Warmth, spatial proximity, and social attachment: the embodied perception of a social metaphor. *J. Exp. Soc. Psychol.* 48, 1369–1372. doi: 10.1016/j.jesp.2012.05.017

Feddes, A. R., Noack, P., and Rutland, A. (2009). Direct and extended friendship effects on minority and majority children's interethnic attitudes: a longitudinal study. *Child Dev.* 80, 337–390. doi: 10.1111/j.1467-8624.2009.01266.x

Field, A., Miles, J., and Field, Z. (2012). *Discovering Statistics Using R*. London: SAGE Publications Ltd.

Fiske, S. T. (2002). What we know now about bias and intergroup conflict, the problem of the century. *Curr. Dir. Psychol. Sci.* 11, 123–128. doi: 10.1111/1467-8721.00183

Glass, J. S., and Benshoff, J. M. (2002). Facilitating group cohesion among adolescents through challenge course experiences. *J. Exp. Educ.* 25, 268–277. doi: 10.1177/105382590202500204

Hare, B., Melis, A. P., Woods, V., Hastings, S., and Wrangham, R. (2007). Tolerance allows bonobos to outperform chimpanzees on a cooperative task. *Curr. Biol.* 17, 619–623. doi: 10.1016/j.cub.2007.02.040

Hetherington, C., Hendrickson, C., and Koenig, M. (2014). Reducing an in-group bias in preschool children: the impact of moral behavior. *Dev. Sci.* 17, 1042–1049. doi: 10.1111/desc.12192

Hewstone, M., Rubin, M., and Willis, H. (2002). Intergroup bias. *Annu. Rev. Psychol.* 53, 575–604. doi: 10.1146/annurev.psych.53.100901.135109

IJzerman, H., and Semin, G. R., (2010). Temperature perceptions as a ground for social proximity. *J. Exp. Soc. Psychol.* 46, 867–873. doi: 10.1016/j.jesp.2010.07.015

Jordan, J. J., Mcauliffe, K., and Warneken, F. (2014). Development of in-group favoritism in children's third-party punishment of selfishness. *Proc. Natl. Acad. Sci. U.S.A.* 111, 1–6. doi: 10.1073/pnas.1402280111

Kelly, D. J., Quinn, P. C., Slater, A. M., Lee, K., Gibson, A., Smith, M., et al. (2005). Three-month-olds, but not newborns, prefer own-race faces. *Dev. Sci.* 8, F31–F36. doi: 10.1111/j.1467-7687.2005.0434a.x

Kinzler, K. D., Dupoux, E., and Spelke, E. S. (2007). The native language of social cognition. *Proc. Natl. Acad. Sci. U.S.A.* 104, 12577–12580. doi: 10.1073/pnas.0705345104

Kinzler, K. D., Shutts, K., and Correll, J. (2010). Priorities in social categories. *Eur. J. Soc. Psychol.* 40, 581–592. doi: 10.1002/ejsp.739

Kinzler, K. D., Shutts, K., Dejesus, J., and Spelke, E. S. (2009). Accent trumps race in guiding children's social preferences. *Soc. Cogn.* 27, 1–11. doi: 10.1521/soco.2009.27.4.623

Kirschner, S., and Tomasello, M. (2010). Joint music making promotes prosocial behavior in 4-year-old children. *Evol. Hum. Behav.* 31, 354–364. doi: 10.1016/j.evolhumbehav.2010.04.004

Lakens, D. (2010). Movement synchrony and perceived entitativity. *J. Exp. Soc. Psychol.* 46, 701–708. doi: 10.1016/j.jesp.2010.03.015

Lakens, D., and Stel, M. (2011). If they move in sync, they must feel in sync: movement synchrony leads to attributions of rapport and entitativity. *Soc. Cogn.* 29, 1–14. doi: 10.1521/soco.2011.29.1.1

Launay, J., Dean, R. T., and Bailes, F. (2013). Synchronization can influence trust following virtual interaction. *Exp. Psychol.* 60, 53–63. doi: 10.1027/1618-3169/a000173

Legerstee, M., Anderson, D., and Schaffer, A., (1998). Five- and eight-month-old infants recognize their faces and voices as familiar and social stimuli. *Child Dev.* 69, 37–50. doi: 10.1111/j.1467-8624.1998.tb06131.x

MacDonald, K., Schug, M., Chase, E., and Barth, H. (2013). My people, right or wrong? Minimal group membership disrupts preschoolers' selective trust. *Cogn. Dev.* 28, 247–259. doi: 10.1016/j.cogdev.2012.11.001

Marsh, K. (2012). "The beat will make you be courage": the role of a secondary school music program in supporting young refugees and newly arrived immigrants in Australia. *Res. Stud. Music Educ.* 34, 93–111. doi: 10.1177/1321103X12466138

Martin, C. L., Fabes, R. A., Evans, S. M., and Wyman, H. (1999). Social cognition on the playground: children's beliefs about playing with girls versus boys and their relations to sex segregated play. *J. Soc. Pers. Relat.* 16, 751–771.

Martin, L. J., Carron, A. V., Eys, M.A., and Loughead, T. M. (2012). Development of a cohesion inventory for children's sport teams. *Group Dyn. Theory Res. Practice* 16, 68–79. doi: 10.1037/a0024691

McAuley, D. J., Jones, M. R., Holub, S., Johnston, H. M., and Miller, N. S. (2006). The time of our lives: life span development of timing and event tracking. *J. Exp. Psychol. Gen.* 135, 348–367. doi: 10.1037/0096-3445.135.3.348

McGlothlin, H., and Killen, M. (2006). Intergroup attitudes of European American children attending ethnically homogeneous schools. *Child Dev.* 77, 1375–1386. doi: 10.1111/j.1467-8624.2006.00941.x

McNeill, W. H. (1995). *Keeping Together in Time: Dance and Drill in Human History*. Cambridge, MA: Harvard University Press.

Melis, A. P., Hare, B., and Tomasello, M. (2006). Engineering cooperation in chimpanzees: tolerance constraints on cooperation. *Anim. Behav.* 72, 275–286. doi: 10.1016/j.anbehav.2005.09.018

Miles, L. K., Griffiths, J. L., Richardson, M. J., and Macrae, C. N. (2010). Too late to coordinate: contextual influences on behavioral synchrony. *Eur. J. Soc. Psychol.* 40, 52–60. doi: 10.1002/ejsp.721

Miles, L. K., Lumsden, J., Richardson, M. J., and Macrae, N. C. (2011). Do birds of a feather move together? Group membership and behavioral synchrony. *Exp. Brain Res.* 211, 495–503. doi: 10.1007/s00221-011-2641-z

Nesdale, D., Durkin, K., Maass, A., and Griffiths, J. A. (2004). Group status, outgroup ethnicity and children's ethnic attitudes. *Appl. Dev. Psychol.* 25, 237–251. doi: 10.1016/j.appdev.2004.02.005

Pica, R. (2011). Helping children cooperate. *Young Child.* 66, 60–61.

Rabinowitch, T.-C., Cross, I., and Burnard, P. (2012). Long-term musical group interaction has a positive influence on empathy in children. *Psychol. Music* 41, 484–498. doi: 10.1177/0305735612440609

Rabinowitch, T.-C., and Knafo-Noam, A. (2015). Synchronous rhythmic interaction enhances children's perceived similarity and closeness towards each other. *PLoS ONE* 10:e0120878. doi: 10.1371/journal.pone.0120878

R Core Team (2013). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

Reddish, P., Bulbulia, J., and Fischer, R. (2014). Does synchrony promote generalized prosociality? *Relig. Brain Behav.* 4, 3–19. doi: 10.1080/2153599XX.2013.764545

Reddish, P., Fischer, R., and Bulbulia, J. (2013). Let's dance together: Synchrony, shared intentionality and cooperation. *PLoS ONE* 8:e71182. doi: 10.1371/journal.pone.0071182

Ruble, D. N., Martin, C. L., and Berenbaum, S. A. (2006). Gender development. in *Handbook of Child Psychology,* eds W. Damon and N. Eisenberg (New York, NY: Wiley). 858–931.

Rutland, A., and Killen, M. (2015). A developmental science approach to reducing prejudice and social exclusion: intergroup processes, social-cognitive development, and moral reasoning. *Soc. Issues Policy Rev.* 9, 121–154. doi: 10.1111/sipr.12012

Sanefuji, W., Ohgami, H., and Hashiya, K. (2006). Preference for peers in infancy. *Infant Behav. Dev.* 29, 584–593. doi: 10.1016/j.infbeh.2006.07.007

Schellenberg, E. G., Corrigall, K. A., Dys, S. P., and Malti, T. (2015). Group music training and children's prosocial skills. *PLoS ONE* 10:e0141449. doi: 10.1371/journal.pone.0141449

Schug, M. G., Shusterman, A., Barth, H., and Patalano, A. L. (2013). Minimal-group membership influences children's responses to novel experience with group members. *Dev. Sci.* 16, 47–55. doi: 10.1111/j.1467-7687.2012.01193.x

Shutts, K., Banaji, M. R., and Spelke, E. S. (2010). Social categories guide young children's preferences for novel objects. *Dev. Sci.* 13, 599–610. doi: 10.1111/j.1467-7687.2009.00913.x

Stürmer, S., Snyder, M., Kropp, A., and Siem, B. (2006). Empathy-motivated helping: the moderating role of group membership. *Pers. Soc. Psychol. Bull.* 32, 943–956. doi: 10.1177/0146167206287363

Stürmer, S., Snyder, M., and Omoto, A. M. (2005). Prosocial emotions and helping: the moderating role of group membership. *J. Pers. Soc. Psychol.* 88, 532–546. doi: 10.1037/0022-3514.88.3.532

Tajfel, H. (1970). Experiments in intergroup discrimination. *Sci. Am.* 223, 96–102. doi: 10.1038/scientificamerican1170-96

Tajfel, H., Billig, M., Bundy, R., and Flament, C. (1971). Social categorization and intergroup behaviour. *Eur. J. Soc. Psychol.* 1, 149–178. doi: 10.1002/ejsp.2420010202

Tajfel, H., and Turner, J. C. (1979). "An integrative theory of intergroup conflict," in *The Social Psychology of Intergroup Relations,* eds W. G. Austin and S. Worchel (Monterey, CA: Brooks/Cole). 33–47.

Tarr, B., Launay, J., Cohen, E., and Dunbar, R. (2015). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biol. Lett.* 11:20150767. doi: 10.1098/rsbl.2015.0767

Torbert, M., and Schneider, L. B. (1993). *Follow Me Too: A Handbook of Movement Activities for Three- To Five-Year-Olds*. University of Virginia; Addison-Wesley.

Tunçgenç, B. (2015). "Are infants' social preferences grounded in action synchrony?," in *The Social Effects of Interpersonal Coordination in Young Children: Synchrony, Mimicry, and Entrainment. Symposium conducted at the Biennial Meeting of the Society for Research in Child Development*, J. van Schaik (Chair) (Philadelphia, PA).

Tunçgenç, B., Cohen, E., and Fawcett, C. (2015). Rock with me: The role of movement synchrony in infants' social and non-social choices. *Child Dev.* 86, 976–984. doi: 10.1111/cdev.12354

Valdesolo, P., and Desteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion* 11, 262–266. doi: 10.1037/a0021302

Weisman, K., Johnson, M. V., and Shutts, K. (2014). Young children's automatic encoding of social categories. *Dev. Sci.* 18, 1036–1043. doi: 10.1111/desc.12269

Wiltermuth, S. (2012). Synchrony and destructive obedience. *Soc. Influence* 7, 78–89. doi: 10.1080/15534510.2012.658653

Wiltermuth, S. S. (2012). Synchronous activity boosts compliance with requests to aggress. *J. Exp. Soc. Psychol.* 48, 453–456. doi: 10.1016/j.jesp.2011.10.007

Wiltermuth, S. S., and Heath, C. (2009). Synchrony and cooperation. *Psychol. Sci.* 20, 1–5. doi: 10.1111/j.1467-9280.2008.02253.x

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

CORRECTION
published: 04 November 2016
doi: 10.3389/fpsyg.2016.01737

Corrigendum: Movement Synchrony Forges Social Bonds across Group Divides

*Bahar Tunçgenç * and Emma Cohen*

School of Anthropology and Museum Ethnography, Institute of Cognitive and Evolutionary Anthropology, University of Oxford, Oxford, UK

Keywords: children, in-group attitudes, minimal group paradigm, out-group attitudes, prosociality, social bonding, cooperation, movement synchrony

A corrigendum on

Movement Synchrony Forges Social Bonds across Group Divides
by Tunçgenç, B., and Cohen, E. (2016). Front. Psychol. 7:782. doi: 10.3389/fpsyg.2016.00782

Reason for corrigendum:
In the original version of our article, there was a typographical error in the Participants section. The name of place and university where the study was conducted and the language of the study were masked for blind review and remained masked in the published version. The relevant sentences should read as (changes marked in bold): "The participants were recruited from local primary schools in **Oxfordshire, UK** and came from middle-class, mixed ethnic backgrounds. All of the children were proficient in **English**, although 6 children (3 boys) needed the experimenter's (E) help in completing the questionnaires due to reading difficulties. The study received ethics approval from the **University of Oxford**'s ethics board and, in line with the Declaration of Helsinki, written permission was obtained from the teachers and the parents of the participants prior to testing."

AUTHOR CONTRIBUTIONS

BT and EC designed the study, analyzed the data, and wrote the paper; BT collected the data.

FUNDING

This research was supported by a British Academy Fellowship to EC (No. MD130076).

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

OPEN ACCESS

Edited and reviewed by:
David Buttelmann, University of Bern, Switzerland

****Correspondence:***
Bahar Tunçgenç
bahar.tuncgenc@anthro.ox.ac.uk

Specialty section:
This article was submitted to Developmental Psychology, a section of the journal Frontiers in Psychology

Received: *18 October 2016*
Accepted: *21 October 2016*
Published: *04 November 2016*

Citation:
Tunçgenç B and Cohen E (2016) Corrigendum: Movement Synchrony Forges Social Bonds across Group Divides. Front. Psychol. 7:1737. doi: 10.3389/fpsyg.2016.01737

Advantages of publishing in Frontiers

OPEN ACCESS
Articles are free to read, for greatest visibility

COLLABORATIVE PEER-REVIEW
Designed to be rigorous – yet also collaborative, fair and constructive

FAST PUBLICATION
Average 85 days from submission to publication (across all journals)

COPYRIGHT TO AUTHORS
No limit to article distribution and re-use

TRANSPARENT
Editors and reviewers acknowledged by name on published articles

SUPPORT
By our Swiss-based editorial team

IMPACT METRICS
Advanced metrics track your article's impact

GLOBAL SPREAD
5'100'000+ monthly article views and downloads

LOOP RESEARCH NETWORK
Our network increases readership for your article

Frontiers
EPFL Innovation Park, Building I • 1015 Lausanne • Switzerland
Tel +41 21 510 17 00 • Fax +41 21 510 17 01 • info@frontiersin.org
www.frontiersin.org

Find us on