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# Children show economic trust for both ingroup and outgroup partners

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## ABSTRACT

Trust is a critical aspect of human cooperation, allowing individuals to overcome the risks posed by such interactions because of others' presumed cooperative inclinations. Adults sometimes mitigate these risks by preferentially trusting members of their own social group, yet it is currently unclear if the early emergence of children's trust in others' cooperative tendencies is affected by their intergroup psychology. Here we tested whether group membership impacts two key aspects of trust-based cooperation in young children – their trust in others' willingness to reciprocate an investment (assessed using the Investment Game, Study 1), and their trust in others' generosity (assessed using the Faith Game, Study 2). In both studies, children assigned to novel and otherwise arbitrary groups demonstrated general preferences for ingroup members on several measures. However, group membership did not influence their decisions about economic trust. In Study 1, 4- and 6-year-old children showed high levels of trust in both ingroup and outgroup members' tendency to reciprocate an investment. In Study 2, 6- to 7-year-old children similarly showed high levels of trust in ingroup and outgroup members' generosity, and they did so regardless of whether their group membership was a matter of common knowledge between themselves and the trustee. These findings show that young children's preferences for ingroup members do not result in bias due to shared group membership when making economic trust decisions. Rather, children tend to exhibit trust in the cooperativeness of others regardless of group membership.

## 1. Introduction

Trust is essential for cooperation to flourish. Cooperative activities are intrinsically risky – by participating in cooperative interactions, individuals' outcomes are dependent on the contributions of others – so discerning when and with whom to cooperate is a critical challenge. Trust, commonly defined as a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviors of others (Rousseau, Sitkin, Burt, & Camerer, 1998), helps us navigate this challenge as it selectively encourages us to take a 'leap of faith' and to engage in cooperation with partners that are deemed reliable. Yet trust-based cooperation is also multifaceted. In some situations, people must discern if their social partners will be generous (e.g., by sharing resources, giving help, or providing opportunities) and if, as a consequence, they are willing to make themselves reliant on their partners' cooperative decisions. In other situations, initiating cooperation requires one party to make an initial investment in the

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hope that others will return benefits at a later date (e.g., making an advance payment for a delivery, investing in a company, or writing a first draft of a joint article). In these cases, people have to trust that their social partner will reciprocate these favors and resist temptations for exploitation. Studying by what mechanisms these forms of trust are established, and how they develop over the course of ontogeny, is critical for our understanding of when and under what circumstances individuals are willing to enter into cooperative interactions (Balliet & Van Lange, 2013; Ostrom & Walker, 2003).

While grounded in a long tradition in developmental psychology, prior work on trust in children has mostly focused on children's socioemotional trust in their caregivers (e.g., Ainsworth, Blehar, Waters, & Wall, 1978) and their trust in information provided by others, sometimes called epistemic trust (Birch, Vauthier, & Bloom, 2008; Corriveau, Fusaro, & Harris, 2009; Koenig, Clément, & Harris, 2004; Stengelin, Grueneisen, & Tomasello, 2018). However, this trust in information is critically different from forms of trust that are engaged in cooperative behaviors involving the exchange of valuable resources, which is sometimes referred to as *economic trust* (e.g., Stanley, Sokol-Hessner, Banaji, & Phelps, 2011). Here, individuals actively incur a material risk based on their positive expectations of others' generosity or reciprocal motives, and their personal outcomes are directly dependent on the decisions of their partner.

The most common experimental paradigm to study economic trust is the Investment Game (also called the Trust Game; Berg, Dickhaut, & McCabe, 1995). In this game, one individual (the investor or trustor) is given a resource that they can either keep to themselves or invest by transferring it to a social partner (the trustee). If they choose to invest, the resource is multiplied by a factor greater than two, and the trustee can then decide how to divide the multiplied resource between themselves and the investor. The Investment Game thus measures people's trust in others' reciprocal motives: it models trust as a bidirectional interaction in which individuals actively initiate cooperation by means of a costly act of investment, in the hope that this will elicit a costly response of reciprocation by the trustee (Balliet, Wu, & De Dreu, 2014). Another key paradigm used to study trust is the Faith Game (Kiyonari and Yamagishi, 1999; Yamagishi et al., 2013). Here, individuals can choose to either obtain a small but certain reward, or to receive whatever amount a trustee in possession of a larger resource decides to share with them. Importantly, there are no opportunities for reciprocity – unlike in the Investment Game. Rather, the trustee is unaware of the trustor's decision when making their choice, and the trustee's payoff is unaffected by whether the trustor decided to trust. In this situation, cooperation is therefore unidirectional, measuring the extent to which people place trust in others' generosity.

How do people come to trust others' cooperative proclivities in this way? Studies with adults have shown that shared group membership is an important factor to generate trust in others' generosity, particularly in the Faith Game (Balliet et al., 2014; Yuki, Maddux, Brewer, & Takemura, 2005). These effects are especially pronounced when one's group membership is common knowledge (that is, when the trustor and the trustee mutually know that they are from the same group), presumably because individuals expect fellow group members to treat each other favorably (Foddy, Platow, & Yamagishi, 2009). One explanation for this phenomenon is that groups function as generalized exchange networks, in which individuals care and expect others to care about their reputations for being good cooperators (Yamagishi, Jin, & Kiyonari, 1999). Individuals may also expect members of their own social group to act in accordance with shared social norms, and therefore be more willing to place trust in ingroup members' cooperative tendencies (Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012). Adults also show increased trust in ingroup members' willingness to return resources in the Investment Game, but this tendency is weaker than in the Faith Game, possibly because in the Investment Game individuals assume others will engage in direct reciprocity irrespective of group membership (Balliet et al., 2014). That is, strategic concerns may outweigh group biases in this context.

What are the origins of these forms of trust-based cooperation, and does shared group membership similarly shape the early emergence of trust in young children? Current evidence indicates that young children already display ingroup biases (see Dunham, 2018, for a recent review). Importantly, these kinds of biases are observed even in minimal group paradigms (Tajfel, Billig, Bundy, & Flament, 1971) in which children are assigned to novel and otherwise meaningless groups (MacDonald, Schug, Chase, & Barth, 2013). For example, 3-year-olds preferentially copy behaviors displayed by ingroup models (Howard, Henderson, Carrazza, & Woodward, 2015), from around age 4 onwards children are more likely to endorse information provided by ingroup members (Corriveau, Kinzler, & Harris, 2013; Kinzler, Corriveau, & Harris, 2011; Rotenberg & Cerda, 1994), and 5-year-olds prefer ingroup members as friends (Plötner, Over, Carpenter, & Tomasello, 2015). Ingroup preferences also affect aspects of children's cooperation: 5-year-olds already tend to share more resources with (Fehr, Bernhard, & Rockenbach, 2008; Sparks, Schinkel, & Moore, 2017; Yazdi, Heyman, & Barner, 2020) and expect to receive more resources from ingroup than outgroup members (Dunham, Baron, & Carey, 2011). They also share more generously when being watched by ingroup than outgroup members, suggesting that they care more about their reputation among members of their own social group (Engelmann, Over, Herrmann, & Tomasello, 2013). However, ingroup preferences seem less influential in children's bargaining behavior and rejection of unfairness (Gonzalez, Blake, Dunham, & McAuliffe, 2020; McAuliffe & Dunham, 2017) suggesting that ingroup biases do not affect children's cooperative decisions in all contexts. That is, while group biases emerge early in development, they do not have an equal impact on all forms of social decision-making.

In particular, it is currently unclear if group biases affect children's decisions about economic trust, such as by promoting trust in specific partners over others. Indeed, little is known about the development of economic trust more generally. Previous research on reciprocity – the practice of exchanging favors over time which trust tends to facilitate (Ostrom & Walker, 2003) – has shown that around age three, children are more inclined to share with someone who shared with them in the past (Vaish, Hepach, & Tomasello, 2018; Warneken & Tomasello, 2013) and, around age five, engage in bouts of reciprocal interaction with peers (e.g., Grueneisen & Tomasello, 2017; House, Henrich, Sarnecka, & Silk, 2013; Melis, Grocke, Kalbitz, & Tomasello, 2016). Around the same age, children also start engaging in more strategic forms of reciprocity, for instance, by preferentially sharing valuable resources with individuals who can later pick them as play partners (Warneken, Sebastián-Enesco, Benjamin, & Pieloch, 2019).

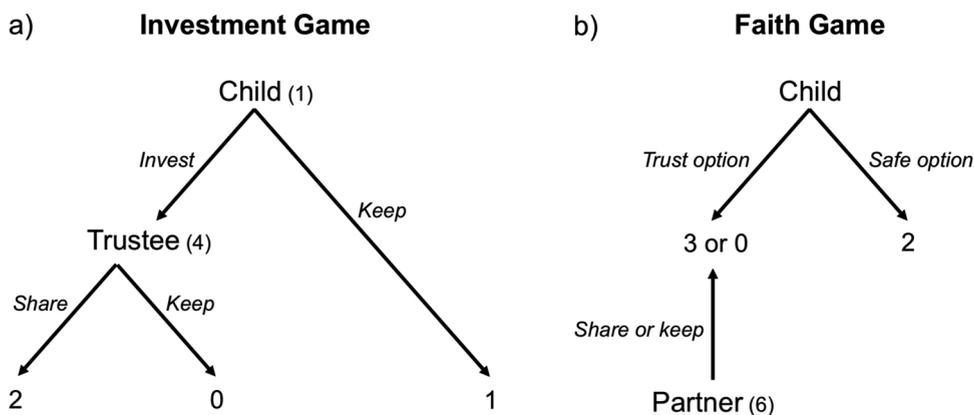
Work specifically examining economic trust indicates parallel developmental change. For example, Rosati, Benjamin, Pieloch, and

Warneken (2019) developed a child-friendly version of the Investment Game in which children were given a coin they could either keep, or invest in a partner by placing it into an apparatus. If they chose to invest, their partner received four coins that they could divide between themselves and the child. As such, investing could therefore result in a payoff larger than their initial endowment if the partner proved trustworthy and shared the resulting coins equally. However, investing also risked the possibility of getting nothing if the partner was selfish. Both 4- and 6-year-old children frequently decided to invest their coin and, importantly, did so more often than in a control condition in which the partner was unable to reciprocate. Children's decisions thus cannot be explained by their generosity towards their partner, and instead reflected an expectation of the partner's trust responsiveness. In an additional experiment, Rosati et al. (2019) found that older children were more likely than younger children to selectively invest in trustworthy partners who had shared their coins compared to untrustworthy partners who always kept the investment. These findings suggest that children may start out trusting relatively indiscriminately and that, over the course of development, individuals' past trustworthiness becomes more important in eliciting children's trust.

Yet the Investment Game measures only one component of trust-based cooperation. No study to date has investigated children's trust in the Faith Game where individuals decide whether they are willing to incur a personal risk based upon the presumption of others' generosity. Importantly, adults are particularly likely to trust ingroup members in the Faith Game when their shared group membership is common knowledge, rather than individual knowledge – that is, when they both mutually know that they are from the same group, compared to when only the trustor knows (Balliet et al., 2014; Foddy et al., 2009). Imagine deciding whether to trust someone you know to be an alum of your alma mater, compared to trusting someone who knows you are a fellow alum too, and who knows that you know that they know, and so on. This is a key distinction because common knowledge removes all ambiguity about individuals' joint group membership. It therefore provides assurance to individuals that their social partners will treat them fairly: They can rely on their partners' ingroup preferences and their partners cannot plausibly deny knowing about their joint group membership, thus lacking a justification for withholding fair treatment from fellow ingroup members. Indeed, young children do adjust their cooperative decisions to the common knowledge they have with others in a number of cooperative contexts (Grueneisen, Wyman, & Tomasello, 2015; Siposova, Tomasello, & Carpenter, 2018; Siposova, Grueneisen, Helming, Tomasello, & Carpenter, 2021).

Together, current evidence shows that young children are sensitive to group membership, account for group membership in some forms of cooperative decision-making, and adjust their decisions to engage in economic trust specifically in response to a partner's trustworthiness. However, no study to date has examined if children adjust their decisions to trust based on group membership, or tested the impact of group membership on their trust in reciprocity versus trust in other's generosity. Current evidence from children and adults suggests three possibilities for the potential role of group biases in decisions about trust. First, given patterns in adults, children might also show greater ingroup biases in their trust in others' generosity (particularly when their group membership is a matter of common knowledge), compared to their group biases concerning people's willingness to reciprocate prosocial acts. Second, young children might show strong ingroup biases in their trust in others' cooperative tendencies across the board, and not clearly discriminate across contexts. A final possibility is that young children do not show these biases at all: they may start out generally trusting (or mistrusting) individuals indiscriminately and then show adult-like group biases only later in development.

Here we addressed these issues in two studies examining the role of group membership in children's economic trust. In Study 1, 4- and 6-year-old children played multiple rounds of the Investment Game with ingroup and outgroup partners (using a version of the minimal group paradigm). In line with research documenting ingroup biases from early in development (Dunham, 2018) we hypothesized that shared group membership elicits children's trust. As a consequence, we predicted that children would be more likely to invest in ingroup than in outgroup partners. However, an alternative is that children assume others will reciprocate costly acts of investment, regardless of their group affiliation, similar to the fact that adults seem to assume others will engage in direct reciprocity irrespective of group membership (Balliet et al., 2014). For example, children may primarily base their trust decisions on others' past



**Fig. 1. Overview of the game structures.** Numbers represent children's rewards. Numbers in brackets represent rewards players can invest/share. a) Investment Game from Study 1. Children receive one reward they can invest or keep. If they invest, the trustee can divide 4 rewards between themselves and the child. b) Faith Game from Study 2. Children can choose between a safe option of 2 rewards and a trust option containing 3 or 0 rewards depending on whether a partner had previously shared their endowment of 6 rewards.

trustworthiness (which was held constant) rather than membership per se. In that case, group membership might be less relevant for children's trust decisions in the current Investment Game.

Study 2 then used the Faith Game to investigate 6- to 7-year-olds' trust in in- and outgroup members' generosity. In this preregistered study, children interacted with both ingroup and outgroup members, as in Study 1, but we also manipulated whether or not children's group membership was a matter of common knowledge between themselves and the trustee. Based on theories proposing that groups function as containers for generalized exchange networks (Yamagishi et al., 1999) or signal shared cooperative norms and values (Tomasello et al., 2012), we predicted that children would expect ingroup members to be more generous than outgroup members and that, as a result, they would be more willing to trust ingroup members – especially when their group membership was commonly known. We further predicted this tendency to be particularly strong in this context since, unlike in the Investment Game, children could not rely on their partners to engage in direct reciprocity which might alleviate group effects. An alternative hypothesis is that children start out trusting indiscriminately, in which case, group membership might not matter. Together, the studies aim to provide a first look into the potential role of group membership in children's economic trust decisions.

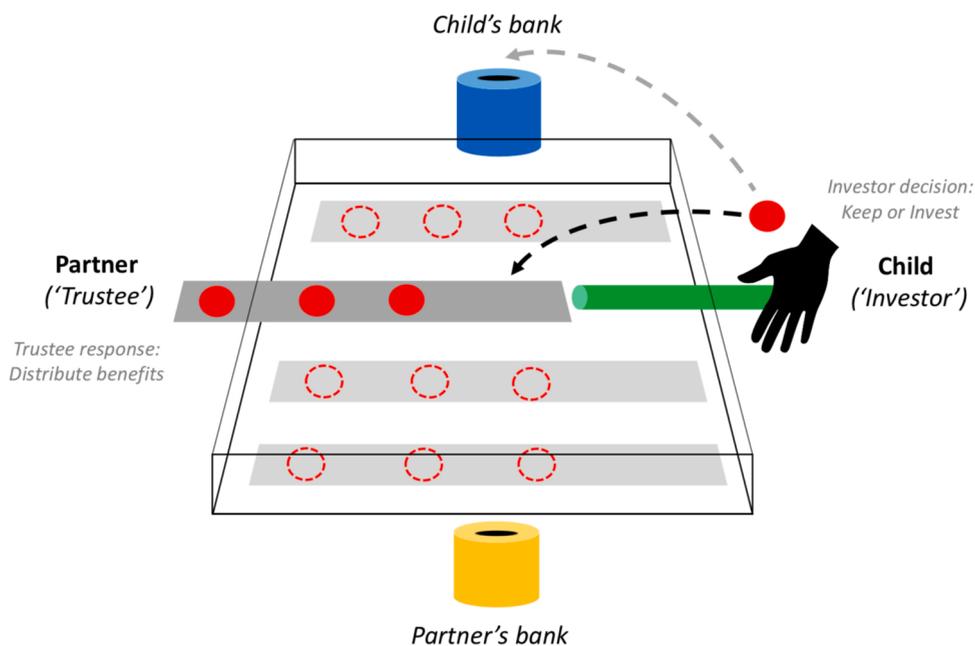
## 2. Study 1

In this study, 4- and 6-year-old children played the Investment Game (Fig. 1). The basic premise of the task was that the child could choose whether or not to invest a token in an interactive partner – the 'trustee' – who then could choose whether to reciprocate that act of trust. In a within-subjects design, we manipulated whether the trustee was an ingroup or an outgroup member using a version of the minimal group paradigm. We tested 4- and 6-year-olds as these age groups both exhibit economic trust in the Investment Game but this age range also captures developmental change in this period (Rosati et al., 2019). We predicted that children would be more likely to invest in the ingroup trustee. Since children have been shown to display ingroup biases already at age 4 (Dunham, 2018) we predicted group membership effects in both age group.

## 3. Method

### 3.1. Participants

Thirty-two children (16 4-year-olds;  $M = 4$  years 7 months, range:  $M = 4$  years 0 months –  $M = 4$  years 11 months, 50 % girls, 16 6-year-olds,  $M = 6$  years 6 months, range:  $M = 6$  years 0 months –  $M = 6$  years 11 months, 50 % girls) were included in the analysis. Eleven additional children were tested but excluded because they failed the comprehension checks (6) (see procedure section for details), because they did not sufficiently understand English (3), experimenter error (1), or fussiness (1). The sample size was determined *a priori* based on prior work using the same trust paradigm (Rosati et al., 2019). Children were from a medium-sized city in the USA and were tested at a university laboratory. No information regarding race or socio-economic background was collected. The study was approved under IRB protocol [protocol number masked for review] at [authors' institution, masked for review].



**Fig. 2.** Experimental setup of the Investment Game. Children received a coin they could either keep or invest. If they invested, their partner received four coins they could divide between themselves and the child.

### 3.2. Setup and conditions

We used the same apparatus and basic setup as prior work examining the development of trust in the investment game (Rosati et al., 2019). On each trial, children received a coin that they could either keep for themselves or invest by sending it to a recipient ‘trustee’. Invested coins were ‘multiplied’ by four, and then the trustee could choose whether or not to reciprocate and send some of the coins back to the child. In prior work (Rosati et al., 2019) this investment condition was compared to a dictator game condition, revealing that children are significantly less likely to invest when there is no opportunity for reciprocity and demonstrating that children comprehend the reciprocal nature of this task.

To implement this game, children interacted with the trustee via an apparatus: a 50 × 60 cm with a transparent Plexiglass cover, placed on a child-sized table. The child and the trustee sat across from each other at the apparatus. Both individuals had a personal ‘bank’ (a jar) where they could store tokens they accumulated in the game, which later were exchangeable for prizes. On each trial, children received a coin which they could either keep to themselves (by putting it into their bank) or place into the apparatus onto a tray. The tray (9 × 30 cm) had four coin-slots, three of which already contained a coin. Only trays that had a full complement of four coins could be pushed over to the partner, so children could use their coin to complete the tray. (The apparatus consisted of four trays, one for each trial, but only one tray was visible and accessible at a time). They could then use a stick to push the completed tray of four coins over to the ‘trustee,’ who could decide how to divide the coins between their own bank and the child’s bank. Thus, by investing their coin, children increased the total number of coins in play, but as the trustee chose how to distribute the coins, the child faced the risk of getting nothing (see Fig. 2 for a schematic overview).

In a within-subjects design, children played this game with an ingroup or an outgroup trustee (played by two puppets). We manipulated group membership using a child-friendly minimal group paradigm (Dunham et al., 2011) in which children and the puppet trustees were assigned to arbitrary groups (the blue or the orange team) based on their color preference. Prior work using a similar setup and design showed that both 4- and 6-year olds discriminated between trustworthy and untrustworthy partners, sharing more with the trustworthy partner over trials (Rosati et al., 2019).

### 3.3. Procedure

#### 3.3.1. Introduction and apparatus familiarization

An experimenter (E1) first introduced the tokens to be won in the game (poker chips referred to as “coins”) and explained that children could exchange them for toys at the end. Specifically, children viewed shelves displaying low-value items (pens, paper clips), medium-value items (stickers, keychains), and high-value items (bouncy ball, slinky) on different tiers. Attached to the shelves was a photo of either a small, medium, or large number of tokens, respectively, and E1 explained that if children earned “these many coins” (pointing to the corresponding photo), they could pick prizes from the respective shelf (in the end, all children could pick a high-value reward).

Children were then presented with the apparatus and asked to operate it by themselves. During the apparatus demonstration, E1 explained that only trays that held four coins could be pushed over to the other side. In the first trial, all coin-compartments were full so that children only had to push it to the other side and collect the coins there. On the second trial, the tray contained three coins. Children received a fourth coin, placed it into the tray, pushed it over, and collected the coins on the other side. On the next trial, the tray only contained one coin. Children received another coin, placed it into the tray, but because the tray was not full, they could not push the tray to the other side and collect any coins. Children thus learned how to operate the apparatus and that only trays containing four coins could be pushed to the other side. On the last trial, the tray remained covered and E1 instructed children to put the coin they received directly into their bank. This served to illustrate that children had the option to keep the coin and not put it into the tray.

As a comprehension check, children were then presented with a new set of four trays, two of which contained three coins while the others only contained one (counterbalanced between participants as 1–3-3–1 vs 3–1-1–3). On each trial, children received one more coin and could decide what to do with it, with the idea being that they should only place it into the tray when doing so completed the tray and children could access all coins on the other side. If children placed the coin in a tray containing only one coin, they could not access any coins and E1 reiterated the game rules (i.e., that only full trays can be pushed to the other side). When children had the chance to access the coins on the other side, children almost always placed the coin in the tray (98 %). Overall, they chose correctly in 83 % of all trials. Thus, this comprehension check indicated that they generally understood the task.

#### 3.3.2. Group membership manipulation and preference test

Children were introduced to two partners – two gender-matched puppets played by a second experimenter (E2). After a short warm-up game, children were asked to state their color preference (blue vs. orange). Based on their preference, children were assigned to the blue or the orange group and given a corresponding necklace and ribbon to wear. One puppet then stated the same color preference as the child and was assigned to the same group, while the other puppet stated the opposite preference and was assigned to the other group (which puppet was the ingroup partner was counterbalanced across children).

To assess children’s group preferences, the experimenter then showed children line drawings of seven gender-matched pairs consisting of one ingroup and one outgroup member (adapted from Jordan, McAuliffe, & Warneken, 2014). In each of 7 trials, the experimenter put a card with the line drawings in front of the child and, without mentioning depicted children’s group membership, asked children to indicate who they would like to be friends with. The number of times children chose the ingroup member was taken as an ingroup preference score. Moreover, after completing all test trials, children were asked to indicate which of the two partners of the Investment Game they would rather be friends with (1 trial).

### 3.3.3. Test

Children played four blocks of four test trials each. In two blocks, they played with the ingroup partner and in two blocks with the outgroup partner (with partners alternating on each block). Prior to each test block, the child was asked to state which group they are in and which group the puppet is in. Which partner children played with first was counterbalanced. In all test trials, the trays contained three coins at the start and children received one additional coin. Children could either keep the coin to themselves by putting it into their bank or invest it by placing it into the tray and pushing the tray over to the partner, in which case the partner could divide the four coins in the tray between themselves and the child. If children decided to invest the coin, the partner always divided the coins equally (i.e., two coins each). Both partners were thus equally trustworthy, and, from an economic perspective, it was worth investing the coin.

To illustrate the partner's choice options and to highlight that transferring coins to the partner involved the risk of getting nothing, children received four practice trials (two with each partner) before the first and the third block. In these trials, the trays were full from the start. Children thus had to push the trays over to their partner and the partner could divide the coins between themselves and the child. Both partners kept all coins to themselves in one trial and shared them equally in another trial. The order of giving or keeping the coins remained the same for both puppets throughout a testing session and was counterbalanced between participants. The experience children had with each partner was thus identical.

### 3.4. Analysis

For our main analysis, we ran a Generalized Linear Mixed Model (GLMM, Baayen, 2008) with binomial error structure. The dependent variable was whether or not children invested their coin in a given trial. The test predictors were the partner's group membership (in- vs. outgroup) and age (four vs. six), as well as their interaction. We included gender as a control predictor and subject ID as a random effect to account for the fact individual children contributed multiple data points. We also included the random slopes of the partner's group membership nested within subject ID to assure Type 1 error rates at the nominal level of 0.05 (Schielzeth & Forstmeier, 2009).

Analyses were fitted in R (R Core Team, 2018) using the function "glmer" of the R-package lme4 (Bates, Maechler, Bolker, & Walker, 2014). To test whether the test predictors combined had a significant effect, we first compared the full model described above with a null model not including the test predictors but retaining the control predictors, random effect, and random slopes components using a likelihood ratio test (this prevents multiple testing issues, Forstmeier & Schielzeth, 2011). If the full-null comparison indicated a significant effect, individual predictors were examined by dropping them from the model one by one using the function "drop1".

In auxiliary analyses, we ran the same model but additionally examined the effect of children's ingroup preference (as indicated by the post-manipulation preference test) and whether children's trust decisions changed over trials (see Results section for details). No other variables or interactions were investigated. To inspect if children displayed ingroup preferences in the preference test and the post-test partner preference question we ran one-sample t-tests and a binomial test, respectively. Data was coded live and in addition recorded on video. To assess interrater reliability, the investment decisions of six children were randomly selected and independently coded by a second coder, blind to the predictions of the study. Agreement between coders was perfect. The data can be accessed via [https://osf.io/b59jx/?view\\_only=cd34f775998442e3b9e069bccade53a6](https://osf.io/b59jx/?view_only=cd34f775998442e3b9e069bccade53a6).

## 4. Results

### 4.1. Ingroup preferences

Children showed clear ingroup bias in our two preference tests. Specifically, they were more likely to choose ingroup than outgroup characters as friends in the 7-trial preference test (one-sample t-test,  $t(31) = 6.10, p < 0.001$ ). This was the case in both age groups (6-year-olds:  $t(15) = 4.08, p < 0.001$ ; 4-year-olds:  $t(15) = 4.46, p < 0.001$ ). Children also preferred being friends with the ingroup puppet than with the outgroup puppet as indicated by their responses to the post-test partner preference question (23 out of 32; binomial test,  $p = 0.020$ ). Children thus displayed clear ingroup preferences, overall.

### 4.2. Investment game decisions

Overall, children were significantly more likely to invest than to keep their coin (71 % of all trials; one-sample t-test,  $t(31) = 3.99, p < 0.001$ ) suggesting that children were generally trusting. This was the case in both age groups (4-year-olds, 73 % investment decisions, one-sample t-test,  $t(15) = 2.72, p = 0.016$ ; 6-year-olds, 69 % investment decisions, one-sample t-test,  $t(15) = 2.90, p = 0.011$ ). Moreover, children showed a general tendency to trust already on trial 1 and they did so both for ingroup partners (75 % investment decisions, binomial test,  $p = 0.007$ ) and outgroup partners (69 % investment decisions, binomial test,  $p = .050$ ). However, the comparison of our full model with the null model revealed that the test predictors combined (i.e., partner's group membership, age, and their interaction) did not significantly affect children's trust decisions,  $\chi^2(3) = 2.36, p = .501$  (none of these predictors individually impacted decisions to trust either, see Supplementary Material for detailed model outputs). We followed up with some exploratory analyses. First, we added the interaction between children's ingroup preference score from the pre-test preference test and group membership to our full model. This interaction did not have a significant effect (estimate = 0.053, standard error (SE) = 0.155),  $\chi^2(1) = 0.13, p = .724$ , 95 % confidence interval (CI) = [-0.289, 0.433], indicating that children with stronger ingroup preferences were not more likely to trust ingroup compared to outgroup partners than children displaying weaker or no ingroup preferences.

We also explored whether children's trust decisions changed over time. For instance, children may have started out trusting

ingroup members more than outgroup members but then generally adopted a trusting attitude as they experienced both partners to be equally trustworthy. We therefore added the predictor trial number (ranging from 1 to 8 in each condition) and its interaction with partner's group membership to our initial model. This revealed that children did not discriminate more between in- and outgroup partners at different stages of the experiment (interaction between trial number and partner's group membership: estimate = 0.030,  $SE = 0.109$ ,  $\chi^2(1) = 0.08$ ,  $p = .782$ , 95 % CI = [-0.155, 0.164]), nor did they become generally more or less trusting over time (main effect of trial number: estimate = -0.058,  $SE = 0.055$ ,  $\chi^2(1) = 1.12$ ,  $p = .286$ , 95 % CI = [-0.178, 0.059]). Indeed, children's tendency to trust on trial 1 was very similar for in- and outgroup partners (75 % and 69 %, respectively). See Fig. 3 for an overview of the results.

## 5. Discussion

The study revealed two main findings. First, young children tend to be trusting: they showed a preference to invest their coin (rather than keep it) on around 70 % of all trials even though this meant that they risked receiving nothing if the trustee did not reciprocate. These findings align with previous work using this task, which also showed that 4- and 6- years had a similar strong preference to share their coin in the Investment Game, in contrast to a preference to keep the coin in a matched Dictator Game where reciprocation was not possible (Rosati et al., 2019). Importantly, children showed a tendency to trust from their first choice, suggesting that their trust cannot be explained by learning through experience over the test trials that both partners were similarly trustworthy in terms of their likelihood to reciprocate. In fact, in the practice trials, in which the partners shared a windfall resource, both partners exhibited the same behavior: they shared their coins with the child on one of these trials, and kept all coins to themselves on the other. If these sharing rates are taken as a benchmark, children's trust decisions in the main test then seem fairly optimistic. But it is also important to note that children were not oblivious to the risks involved: in the comprehension check at the beginning of the session, they placed the coin in the tray 98 % of the time when there were already three coins in the tray and they could retrieve the rewards themselves, suggesting that, when interacting with an actual partner in the test, they did adjust their choices to the possibility of being taken advantage of.

Second, children did not show a preference to invest in ingroup members compared to outgroup members. Crucially, children of both age groups exhibited clear ingroup preferences on two independent control measures: they first displayed a clear preference for hypothetical ingroup members over outgroup members as friends after the group manipulation and further indicated that they would rather be friends with the specific ingroup puppet they interacted with in the game, compared to the outgroup puppet. Given this latter finding, children's tendency to invest in ingroup and outgroup partners at similarly high rates thus cannot be explained by group effects not extending to the puppets. We also did not observe any group effects on decisions to trust when we statistically accounted for the strength of the ingroup bias. One possibility is that children's confidence in their partner's cooperativeness stems from the fact that they did not simply have to place trust in their partner's generosity but rather in their partner's responsiveness to their own prosociality. They may have assumed that, because they and their partner depended on one another, their partner would interpret their investment as a prosocial signal and, as a consequence, return the favor by reciprocating – a common explanation for why adults show reduced group biases in trust games with opportunities for direct reciprocation (Balliet et al., 2014).

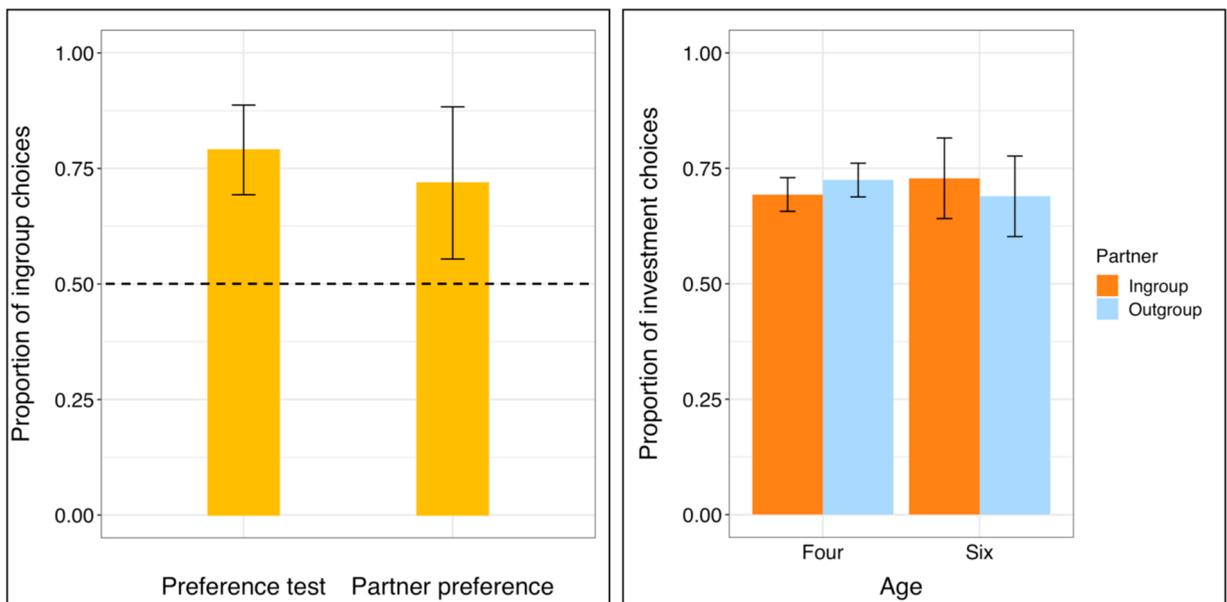


Fig. 3. Results of Study 1. Left panel: Proportion of children's ingroup choices in the preference test and post-test partner preference question. The dashed line represents the chance level. Right panel: Proportion of investment choices divided by age and partner. Chance level = 0.50. Error bars represent 95 % confidence intervals.

Overall, these findings indicate that children in this age favor ingroup members, but are not swayed by group biases when making decisions about economic trust. However, it is possible that other factors may have ameliorated any potential group biases. For instance, once children obtain information about a partner's willingness to share, they may base their trust decisions on past experiences rather than on other, arguably less direct, sources of information such as group membership. Since children in the current study had identical experiences with each partner during the practice period, this could have eliminated any group effects children may otherwise have shown. Children may have also trusted indiscriminately because they felt they had some control over their partner given that they could have withdrawn their trust in future rounds if their partner failed to prove trustworthy. Finally, a limitation of the current study was the small sample size. While the sample size was based on previous work, it is possible that we missed more subtle group effects than those examined by Rosati et al. (2019). Indeed, effect sizes for ingroup favoritism in studies with adults tend to be small (Balliet et al., 2014). While the almost identical trust rates for ingroup and outgroup partners (71.1 % and 70.7 %, respectively) suggest that this is unlikely, a larger sample would be a stronger test. To address these possibilities, we ran a second study exploring children's trust in in- and outgroup members' generosity using the Faith Game.

## 6. Study 2

Study 2 investigated children's trust using the Faith Game. Since the Faith Game consists of a unidirectional interaction, children could not rely on their partner's tendency to reciprocate an investment (see Fig. 1), and instead had to place trust in their partner's presumed generosity. Moreover, children did not gain any prior experience with their partner, did not receive feedback between trials about their partner's behavior, and thus no form of partner control was possible. Hence, if these factors masked any group effects in the Investment Game, we would expect group membership to affect children's trust decisions in the Faith Game (see Balliet et al., 2014, for a similar argument). Alternatively, if group membership does not affect young children's trust, we would expect children to put faith in in- and outgroup members equally in this context as they did in Study 1. In addition, Study 2 investigated whether children's trust was affected by whether their group membership was common knowledge between themselves and their partner. This manipulation helps elucidate if young children generally trust ingroup members to be generous, or if they rather trust ingroup members to treat fellow ingroup members favorably. We tested 6–7-year-olds because this is the age range where children show a sensitivity to whether they have common knowledge with others in a range of cooperative interactions (e.g., Grueneisen et al., 2015a; Grueneisen, Wyman, & Tomasello, 2015; Siposova et al., 2018, 2021). We predicted that children would be more likely to trust in- than outgroup members, especially when they had common knowledge about their shared group membership.

## 7. Method

### 7.1. Participants

64 6- to 7-year-old children ( $M = 6$  years 11 months, range:  $M = 6$  years 0 months –  $M = 7$  years 11 months, 50 % girls) participated in the study. To address the potential limitations of samples size in Study 1, here were doubled the sample size to better assess if there are subtle effects of group membership on trust decisions. Two children had to be excluded from the analysis because of experimenter error (no video was recorded) or because the child had previously participated in the study. One additional child was invited but not tested due to shyness. Children were from a medium-sized city in the USA and were tested at the university laboratory. No information regarding race or socio-economic background was collected. The project was approved by the Institutional Review Board of [authors' institution, masked for review].

### 7.2. Setup and conditions

In a  $2 \times 2$  mixed design, children were randomly assigned to arbitrary groups using a minimal group manipulation, and then played the Faith Game with an ingroup and an outgroup partner (within-subjects factor). Partners were other children that participants were introduced to via the experimenter's smartphone (unbeknownst to participants, these children were not real). Because children did not play this game 'live' with the partner, we could here use real children as the partner instead of puppets. In the Faith Game, children could choose between a safe option consisting of two stickers, and a trust option containing either three or zero stickers (depending on whether their partner had shared an endowment of six stickers). In addition, we manipulated whether children's group membership was a matter of common knowledge or individual knowledge (between-subjects factor).

### 7.3. Procedure

#### 7.3.1. Group membership manipulation and preference test

Children were tested individually in a quiet room of a child laboratory. A first experimenter (E1) first informed the target child that two other children – one on the orange and one on the green team – would also participate in the activity but, because they were in different parts of the building, children would not meet in person. Instead, they would interact with each other via E1's phone. Children were then asked to point to one of E1's hands and, depending on the color of a coin E1 held in that hand, were assigned to either the orange or the green team and given corresponding group markers to wear (children could choose between a scarf and a t-shirt in their team color). To increase group identification, E1 then asked children to indicate which of three animals (cat, dog, horse) and which of three fruits (apple, banana, strawberry) they liked the most, in response to which E1 claimed that most children from the child's group

had stated the same preference.

To assess children's group preferences, E1 first showed children three line-drawings, each depicting gender-matched pairs of children consisting of an in- and an outgroup member. Children were told the drawings represented children who had participated at an earlier date. For each pair, children were asked to guess who had engaged in a praiseworthy action (made cookies for their friends, helped their parents to clean the house, scored a goal at soccer practice; these items were adapted from Dunham et al., 2011). The number of times children chose the ingroup member produced an ingroup bias score. In addition, children were asked to indicate how much they expected to like ingroup and outgroup members they meet for the first time on a four-point Likert-like smiley scale (ranging from really like to really don't like). This provided a second and potentially even more fine-grained measure of children's group preference than those used in Study 1.

### 7.3.2. Faith game

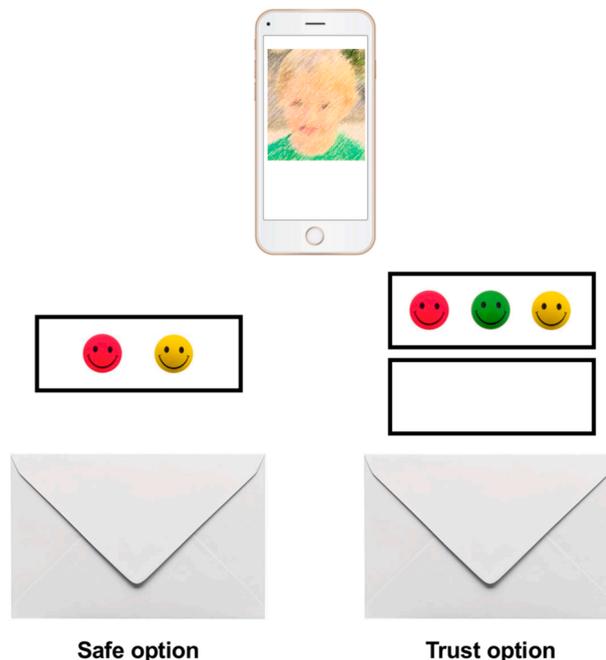
E1 explained that children could choose between two envelopes. One envelope contained two stickers with certainty (safe option). The second envelope contained either zero or three stickers, depending on whether one of the other children, who had received six stickers, had shared their endowment (trust option). Children thus had to decide whether they trusted the other child to have shared their stickers in a fair way to the extent that they would forego a certain reward of two stickers. To explain the game rules, E1 used two example envelopes and visual aids representing stickers (Fig. 4). E1 also asked children to indicate how many stickers they would get if (1) they picked the safe option; (2) they picked the trust option and the other child shared; and (3) they picked the trust option and the other child did not share. Children were generally good at answering these questions (98 %, 98 %, and 72 % correct answers, respectively). If children made a mistake, E1 gave corrective feedback and explained the payoff structure once more.

### 7.3.3. Knowledge state manipulation

Whether or not children's group membership was common knowledge between themselves and their partner was manipulated during the partner introduction. Children were told the partners were real and would interact with children over the phone. In reality, the partners did not exist and they were introduced by a second experimenter (E2) via a messaging server using photos of children and pre-recorded voice messages. We used real photos of two boys and two girls to represent ingroup and outgroup partners (gender-matched to the target child) as well as voice recordings of four different adult females which were edited to resemble boy or girl voices using the software Audacity® (this allowed us to tightly control the speed and intonation of the messages across conditions).

After explaining the Faith Game, E1 introduced children to the first partner. Using their phone, E1 initiated contact with a E2 who children were told was with the partner child. E2 then sent a photo of a child wearing a green or orange t-shirt accompanied by a voice message saying "Hi, I'm [name of the partner] and I'm on the green (orange) team." E1 responded by sending a photo of the child which appeared underneath the partner's photo in the messaging server.

The information contained in the target child's photo was determined by the knowledge state condition: In the *common knowledge*



**Fig. 4.** Experimental setup of the Faith game. Children chose between two envelopes. The safe option contained two stickers with certainty. The trust option contained zero or three stickers depending on whether the partner had shared. Visual aids were used to illustrate the potential outcomes. The partner was displayed on a smartphone screen (the partner's photo is blurred here for confidentiality purposes).

condition, the child’s photo was taken right after the group membership manipulation. The child was thus wearing group markers and their group affiliation was clearly visible. In the *individual knowledge condition*, the child’s photo was taken just prior to the group membership manipulation such that the child’s group affiliation could not be inferred. Children then received another voice message from the partner confirming whether or not they knew if they and the target child were on the same or on different teams (see [Table 1](#) for an overview of the manipulation).

E1 explained that the partner would now receive three sets of six stickers which they could either keep to themselves or share with the target child and that, once they were done, E2 would bring over the envelopes. After one minute, E1 showed the target child the photos and voice messages once more as an additional reminder after which E2 entered with a tray containing the envelopes.

7.3.4. Test

Children played three rounds of the Faith Game with each partner. Before the first round, E1 placed their phone showing the photo of the partner on the table and asked children a) whether they and the partner were on the same or on different teams, and b) whether the partner knew if they were on the same/different teams. Children answered these questions correctly at very high rates (100 % and 95 %, respectively). E1 then re-emphasized that both partners knew (common knowledge condition) or that only the child knew (individuals knowledge condition) that they were in the same or different teams.

In each round, E1 first asked children to indicate whether they thought their partner had shared their stickers (verbal measure of *sharing expectations*). This was done to draw children’s attention to their partner’s behavior and to gain insights into children’s decision-making processes (we did not consider sharing expectations a measure of trust itself since children did not have to incur any risk, but we expected them to inform children’s actual trust decisions). E1 then reiterated the payoff matrix (i.e., that one envelope contained two stickers for sure and the other contained zero or three depending on whether the partner had shared). Children then chose one of the envelopes (*trust decision*). Children did not open the envelopes until the end of the experimental session and thus did not have any information about their partner’s generosity when choosing on subsequent trials.

After playing three rounds with the first partner, E1 introduced children to the second partner (in the same way as the first partner) and children played three rounds with the second partner. Children could then open all envelopes and collect their stickers (all trust envelopes contained three stickers). We counterbalanced whether children were first paired with an ingroup or an outgroup partner, which partner child was the ingroup partner, and which voice recording was used for the ingroup partner.

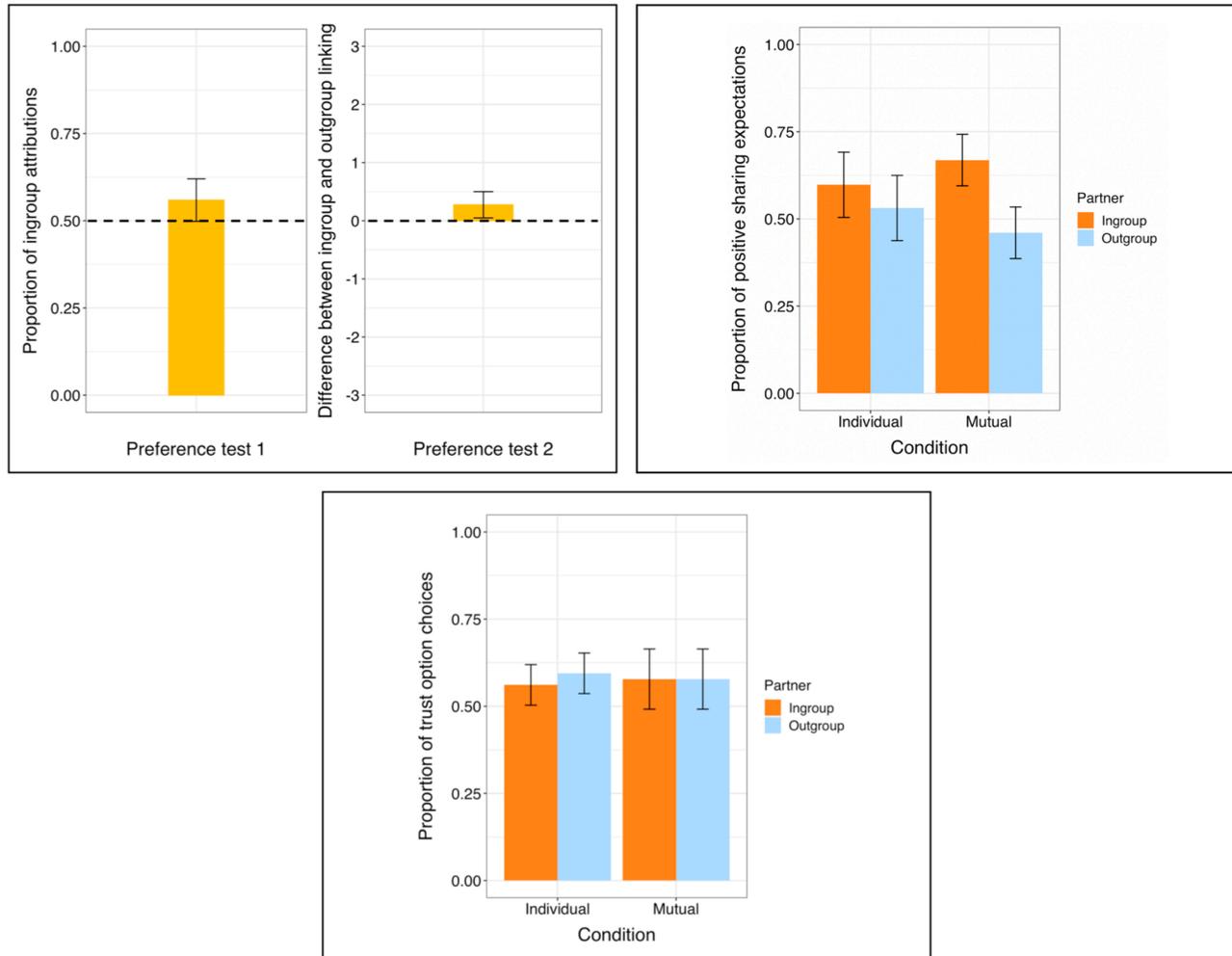
7.4. Analysis

For our main analyses, we ran Generalized Linear Mixed Models (GLMM, [Baayen, 2008](#)) with binomial error structure. The dependent variables were whether or not children expected their partner to have shared (verbal measure) and whether or not they chose the trust option (behavioral measure). The test predictors were the partner’s group membership (in- vs. outgroup), knowledge

**Table 1**

Procedure overview. Children are introduced to a partner via E1’s smartphone. After receiving the partner’s photo and message, a photo of the child is sent to the partner, which either reveals the child’s group membership (common knowledge condition) or not (individual knowledge condition). The partner then sends another message confirming whether or not they know if they and the child are on the same or on different teams. (The partner’s photo is blurred here for confidentiality purposes.).

	Partner introduction Partner’s photo is sent to child	Knowledge manipulation Child’s photo is sent to partner		Knowledge confirmation Partner highlights common vs. individual knowledge	
Condition		Common knowledge	Individual knowledge	Common knowledge	Individual knowledge
Photo		 Child membership visible	 Child membership not visible		
Audio message 	Hi, I’m Steven, and I’m on the green team.			I’m on the green team and I see that you’re on the green team too. So we both know we’re on the same team.	I’m on the green team but I can’t see which team you’re on. So I don’t know if we’re on the same team.



**Fig. 5.** Results of Study 2. Top left panel: Preference tests – children attributed more positive actions to ingroup than outgroup members (test 1) and expect to like ingroup members more than outgroup members (test 2). Dashed lines represent chance levels. Top right panel: Children’s sharing expectations of ingroup and outgroup partners in the individual and mutual knowledge condition. Bottom panel: Children’s Faith Game choices with ingroup and outgroup partners in the individual and mutual knowledge condition.

state (common vs. individual), as well as their interaction. We included gender and trial number as a control predictor and subject ID as a random effect to account for the fact individual children contributed multiple data points. We also included the random slopes of trial number nested within subject ID. No other variables or interactions were investigated and the remaining analysis approach was identical to Study 1.

To assess interrater reliability, the test decisions of 12 children were randomly selected and independently coded by a second coder, blind to the predictions of the study. Agreement between coders was very good ( $\kappa = 1$  and  $\kappa = 898$ , for the verbal measure of sharing expectations and trust decisions, respectively). Preregistration documents can be accessed via <https://aspredicted.org/blind.php?x=3bd66g>. The data can be accessed via [https://osf.io/b59jx/?view\\_only=cd34f775998442e3b9e069bccade53a6](https://osf.io/b59jx/?view_only=cd34f775998442e3b9e069bccade53a6).

## 8. Results

### 8.1. Ingroup preferences

In the preference tests, children expected to like novel ingroup members more than novel outgroup members (paired samples t-test,  $t(61) = 2.43$ ,  $p = 0.018$ ) and they were slightly more likely to expect ingroup members than outgroup members to have engaged in praiseworthy actions (one-sample t-test,  $t(61) = 1.94$ ,  $p = 0.057$ ). Hence, similarly to Study 1, children displayed ingroup biases overall.

### 8.2. Faith game decisions

Overall, children were more likely to expect their partner to have shared than to have kept the stickers (verbal measure of *sharing expectations*, 57 %, one-sample t-test,  $t(61) = 2.08$ ,  $p = .042$ ). They were also more likely to pick the trust option than the safe option (behavioral *trust decisions*, 58 %, one-sample t-test,  $t(61) = 2.40$ ,  $p = 0.019$ ).

Next, we found that the test predictors combined had a significant effect on children's sharing expectations (full-null model comparison,  $\chi^2(3) = 10.75$ ,  $p = .013$ ). Further analyses revealed that the interaction between group membership and knowledge state was not significant (estimate =  $-0.671$ ,  $SE = 0.448$ ,  $\chi^2(1) = 2.26$ ,  $p = .133$ , 95 % CI =  $[-1.558, 0.204]$ ). However, children were more likely to expect ingroup partners to have shared than outgroup partners to have shared (main effect of group membership, estimate =  $-0.628$ ,  $SE = 0.224$ ,  $\chi^2(1) = 8.02$ ,  $p = .005$ , 95 % CI =  $[-1.072, -0.192]$ ). Whether their group membership was common or individual knowledge did not significantly affect children's sharing expectations (main effect of knowledge state, estimate =  $0.188$ ,  $SE = 0.274$ ,  $\chi^2(1) = 0.47$ ,  $p = .493$ , 95 % CI =  $[-0.358, 0.745]$ ).

By contrast, the test predictors group membership, knowledge state, and their interaction combined did not significantly affect children's actual trust decisions in the Faith Game (full-null model comparison,  $\chi^2(3) = 0.28$ ,  $p = .964$ ; Fig. 5). We followed up this result with some exploratory analyses. First, we computed the difference between children's ingroup liking score and their outgroup liking score as assessed in the preference test. We then added the three-way interaction of this difference score and our test predictors (i.e., group membership and knowledge state) as well as their respective two-way interactions. Compared to our initial model, this did not increase model fit ( $\chi^2(3) = 2.54$ ,  $p = .469$ ), indicating that children who showed greater ingroup liking were not more likely to trust ingroup compared to outgroup partners or responded differently to the knowledge state manipulation than those who expected to like in- and outgroup members equally. We also examined potential effects of trial number on children's trust decisions. There was no significant interaction between trial number and group membership (estimate =  $0.022$ ,  $SE = 0.270$ ,  $\chi^2(1) = 0.01$ ,  $p = .936$ , 95 % CI =  $[-0.519, 0.557]$ ) showing that children were consistent throughout the experiment in their lack of discrimination between in- and outgroup partners. There was also no significant main effect of trial number (estimate =  $-0.121$ ,  $SE = 0.112$ ,  $\chi^2(1) = 1.16$ ,  $p = .281$ , 95 % CI =  $[-0.351, 0.105]$ ), suggesting that children did not generally become more or less trusting over time.

Finally, we entered children's sharing expectations as an additional predictor to test if they were related to children's trust decisions. This revealed that, overall, children were considerably more likely to trust if they expected their partner to have shared than when they expected them to have kept the stickers (estimate =  $2.022$ ,  $SE = 0.286$ ,  $\chi^2(1) = 62.11$ ,  $p < .001$ , 95 % CI =  $[1.519, 2.730]$ ) (see Supplementary Materials for detailed model outputs).

## 9. Discussion

As in Study 1, children in Study 2 were generally trusting. They were more likely to state that they expected social partners to share resources with them than they were to expect partners to keep resources to themselves. They were also more likely to incur a personal risk and forego a certain reward of two stickers (safe option) in favor of picking an uncertain option containing either zero or three stickers depending on their partner's sharing decision (trust option). Since children in Study 2 neither gained any information about either partner's prosociality prior to the game, nor received feedback about their partner's choices between trials, these findings indicate that children generally approach novel partners with a trusting attitude. Note that, rationally speaking, children would have had to assume their partner to share their stickers with a probability of 0.67 or higher for the decision to pick the trust option to be worthwhile given the current payoff structure. While we do not assume children to have explicitly engaged in such a calculation, this fact provides at least indirect evidence that children's faith in their partners' generosity was relatively strong. Children displayed this level of trust even though they had no way of influencing their partner's decisions by withholding their trust and despite having to rely purely on their partner's generosity rather than their partner's responsiveness to their own prosociality.

Furthermore, children were more likely to state that ingroup members would share their stickers than outgroup members, as

indicated by our verbal measure of children's sharing expectations. This finding is in line with previous work (e.g., Dunham et al., 2011) and confirms that young children from the late preschool age onwards expect ingroup members to be nicer than outgroup members. However, whether their group membership was common knowledge between themselves and their partner did not significantly affect children's sharing expectations. The current study thus suggests that 6–7-year-olds do not assume ingroup members to treat fellow ingroup members more favorably than outgroup members – a tendency that is shown by adults (Balliet et al., 2014; Foddy et al., 2009). Perhaps children only show these expectations in the context of more culturally salient group identities or their optimism about their partner's generosity overrode any group effects (cf. Boseovski, 2010). Since participants were close to perfect at answering the control questions and children at this age have been shown to use the common knowledge they have with others in their cooperative decision-making (Grueneisen et al., 2015a; Siposova et al., 2021), this finding is unlikely to be the result of prohibitive task demands. However, future studies might benefit from adopting common knowledge manipulations in which children interact face-to-face with real partners.

Unexpectedly, group membership did not have a significant effect on children's actual trust decisions in the Faith Game. That is, while children were generally more likely to expect ingroup members to share their stickers, they were not more willing to incur a personal risk based on their expectation of generosity when interacting with ingroup members compared to outgroup members (whether or not their group membership was common knowledge also did not affect their decisions). Critically, children did show ingroup biases both in terms of their expectations of other's sharing and on two separate control measures: they expected to like novel ingroup members more than novel outgroup members and they were more likely to attribute praiseworthy actions to ingroup than to outgroup children. As in Study 1, we also did not find an effect of group membership on children's trust decisions when we statistically accounted for the strength of the ingroup bias displayed in the preference test. Hence, while children display ingroup preferences overall, these preferences are not reflected in their trust decisions.

## 10. General discussion

Trust is critical for cooperation and thus identifying the mechanisms eliciting trust is important to understand when and why cooperative interactions occur. While shared group membership is an important factor promoting trust-based cooperation in adults (Balliet et al., 2014; Foddy et al., 2009; Yuki et al., 2005), the two studies reported here provide no evidence that group membership plays a central role in young children's decisions about economic trust. Children were not more likely to trust ingroup than outgroup members to return an investment (Study 1) or to be more generous (Study 2). Although children displayed ingroup biases in terms of generally preferring ingroup members (both studies) and even predicting ingroup members to be more generous (in Study 2), this bias did not impact their cooperative decision-making. Rather, children generally showed high levels of trust for both ingroup and outgroup partners.

One possibility is that children are generally optimistic about others' cooperative tendencies and that this optimism then overrides potential group membership effects. Indeed, previous work has documented a positivity bias in young children's personality judgments, in that they attend to and interpret information selectively and thereby maintain an optimistic view of others (Boseovski, 2010; Lockhart, Chang, & Story, 2002). Children are also more likely to expect other children to share resources with them than would be warranted by children's actual sharing rates (Smith, Blake, & Harris, 2013). What remains puzzling, however, is that, at least in Study 2, children did state that they expected ingroup members to be more likely to share than outgroup members (see also Dunham et al., 2011). But they nonetheless did not differentiate between ingroup and outgroup members in their own decisions to trust, for which their sharing expectations should have been the key determining factor (note that, overall, children were much more likely to choose the trust option when they expected their partner to have shared).

Perhaps, children's trust decisions were at least partly the result of deliberations unrelated to their partner's presumed prosocial inclinations. Specifically, children may have been primarily guided by their general risk preferences. Young children tend to be relatively risk-seeking (Harbaugh, Krause, & Vesterlund, 2002; Levin & Hart, 2003; Paulsen, Platt, Huettel, & Brannon, 2012) and they may have treated both the Investment Game and the Faith Game as simple gambles between a risky and a safe option. It is important to note that some level of risk is intrinsically embedded in decisions to trust, as in the absence of any risk, no trust is needed. That is, situations requiring trust by definition entail risk or uncertainty about the outcome of the decision, but unlike other forms of uncertainty here the source of the risk is social in nature. However, participants in the current study may have perceived the risk of trusting to be relatively low, and perhaps children only feel a need to discriminate between ingroup and outgroup members when the stakes are raised. Whether risk perception and group-based discrimination interact in shaping children's trust decision thus deserves to be explored further. Another question arising from the current work is whether young children apply preferences for risk indiscriminately across non-social and social domains, versus whether they distinguish these sources of risk like adults do. In particular, adults seem to be more averse to social risks, a phenomenon called 'betrayal aversion', and individuals who exhibit great betrayal aversion are also more likely to modulate their cooperation across context (Bohnet, Greig, Herrmann, & Zeckhauser, 2008). Future work could directly test for this possibility by examining children's decisions in the Investment or the Faith Game in relation to their decisions in matched non-social gambles, as well as test whether variation in betrayal aversion is related to developmental change in cooperative decision-making.

An open question stemming from this work and past studies of ingroup biases concerns why children show ingroup favoritism in some cooperative contexts (e.g., Engelmann et al., 2013; Fehr et al., 2008; Misch, Over, & Carpenter, 2016; Sparks et al., 2017; Yazdi et al., 2020) but not in others (e.g., Chernyak, Leimgruber, Dunham, Hu, & Blake, 2019; Gonzalez et al., 2020; Gummerum, Takezawa, & Keller, 2009; McAuliffe & Dunham, 2017). One recent proposal argues that group effects may emerge via two distinct causal pathways (Dunham, 2018): a more affective 'evaluative' pathway where the ingroup is linked to positive traits, presumably by

individuals transferring positive self-assessments to the group, and a more abstract ‘coalitional’ pathway centered on norms of within-group cooperation which impact strategic expectations about reciprocity, trust, and loyalty. If these pathways have different developmental trajectories, this could explain why children in the current study showed ingroup biases on attitudinal and evaluative measures (positive action ascriptions, preference tests, sharing expectations), which might be based on an early-emerging affective pathway, but not on measures of economic trust, which might be based on a norm-based pathway that develops later.

Some prior work also aligns with this proposal. Already around age 5–6, children show ingroup biases on a number of attitudinal measures as well as simple resource allocation and sharing tasks (Bigler, Jones, & Lobliner, 1997; Dunham et al., 2011; Fehr et al., 2008; Sparks et al., 2017; Yazdi et al., 2020). By contrast, in more strategic contexts, group membership did not affect 6–10-year-olds’ tendency to propose fair or to reject unfair recourse divisions in a bargaining task (McAuliffe & Dunham, 2017), or their willingness to pay a cost to reduce inequalities between themselves and a partner (Gonzalez et al., 2020). Group membership also did not affect 4–8-year-olds’ tendency to reciprocate prosocial and antisocial acts (Chernyak et al., 2019; but see Gummerum et al., 2009 for group biases in 11–12-year-olds’ reciprocity). However, the evidence is not entirely straightforward. For instance, Bigler et al. (1997) found that 6–9-year-olds were equally willing to help ingroup and outgroup peers – a behavior one might expect to be at least partially driven by affective processes – whereas, already at age 5, children show ingroup loyalty (Misch et al., 2016) as well as other strategic cooperative behaviors, such as investing resources to improve one’s ingroup reputation (Engelmann et al., 2013). Identifying the boundary conditions under which group membership affects children’s cooperative decision-making thus remains an important task for future studies.

Contrary to our predictions, children showed high levels of economic trust for both ingroup and outgroup partners in the Investment Game and the Faith Game. This contrasts with findings with adults who consistently exhibit higher trust for ingroup members than outgroup members and whose trust in others’ generosity is more strongly affected by group bias compared to their trust in others’ reciprocity, presumably because adults expect others to engage in direct reciprocity regardless of their group membership (Balliet et al., 2014). In future work, it will also be important to investigate whether children’s high levels of trust in both ingroup and outgroup members extends beyond minimal groups and equally applies to familiar groups marked by culturally salient social identities. In fact, such ‘real-world’ groups like gender, ethnicity or religion may show different patterns: while strategic considerations about opportunities to cooperate ameliorate group bias in minimal groups, a finding that is especially relevant when considering trust in reciprocity, children continue to show biases about gender in the same situation (Misch, Paulus, & Dunham, 2021). Moreover, while 5–6-year-olds show sensitivity to their common knowledge with others in a number of contexts (Grueneisen et al., 2015a, Siposova et al., 2018, 2021), children in the current study trusted partners irrespective of the extent to which knowledge about their group membership was shared. Together, these findings indicate that children enter cooperative interactions requiring trust with a high degree of optimism regarding others’ prosociality regardless of their group membership. When and in what contexts children start showing adult-like group biases in their economic trust decisions thus remains an important question for future research.

In conclusion, the current studies represent a first systematic attempt to investigate the role of group membership in children’s economic trust. Across two common economic games that assess different aspects of economic trust, the Investment Game tapping into trust in reciprocity and the Faith Game tapping into trust in other’s generosity, children did not preferentially trust ingroup members over outgroup members despite generally showing ingroup biases. Instead, children showed relatively high levels of trust in others’ reciprocal prosociality and their generosity regardless of group membership, suggesting that children’s early trust-based cooperation emerges independently of their intergroup psychology.

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## Declaration of Competing Interest

None.

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## References

- Ainsworth, M. D., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment*. Hillsdale, NJ: Erlbaum.
- Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics using R*. Cambridge, UK: Cambridge University Press.
- Balliet, D., & Van Lange, P. A. M. (2013). Trust, conflict, and cooperation: A meta-analysis. *Psychological Bulletin*, 139, 1090–1112. <https://doi.org/10.1037/a0030939>
- Balliet, D., Wu, J., & De Dreu, C. K. W. (2014). In-group favoritism in cooperative decision making: A meta-analysis. *Psychological Bulletin*, 140, 1556–1581. <https://doi.org/10.1037/a0037737>
- Bates, D., Maechler, M., Bolker, B., & Walker, S. (2014). *lme4: Linear mixed-effects models using Eigen and S4*. R package version 1.1-7. <http://CRAN.R-project.org/package=lme4>.

- Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior*, 10, 122–142. <https://doi.org/10.1006/game.1995.1027>
- Bigler, R. S., Jones, L. C., & Lobliner, D. B. (1997). Social categorization and the formation of intergroup attitudes in children. *Child Development*, 68, 530–543. <https://doi.org/10.1111/j.1467-8624.1997.tb01956.x>
- Birch, S. A. J., Vauthier, S. A., & Bloom, P. (2008). Three- and four-year-olds spontaneously use others' past performance to guide their learning. *Cognition*, 107, 1018–1034. <https://doi.org/10.1016/j.cognition.2007.12.008>
- Bohnet, I., Greig, F., Herrmann, B., & Zeckhauser, R. (2008). Betrayal aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States. *The American Economic Review*, 98, 294–310. <https://doi.org/10.1257/aer.98.1.294>
- Boseovski, J. J. (2010). Evidence for “rose-colored glasses”: An examination of the positivity bias in young children's personality judgments. *Child Development Perspectives*, 4, 212–218. <https://doi.org/10.1111/j.1750-8606.2010.00149.x>
- Chernyak, N., Leimgruber, K. L., Dunham, Y. C., Hu, J., & Blake, P. R. (2019). Paying back people who harmed us but not people who helped us: Direct negative reciprocity precedes direct positive reciprocity in early development. *Psychological Science*, 30, 1273–1286. <https://doi.org/10.1177/0956797619854975>
- Corriveau, K., Fusaro, M., & Harris, P. L. (2009). Going with the flow: Preschoolers prefer nondissenters as informants. *Psychological Science*, 20, 372–377. <https://doi.org/10.1111/j.1467-9280.2009.02291.x>
- Corriveau, K. H., Kinzler, K. D., & Harris, P. L. (2013). Accuracy trumps accent in children's endorsement of object labels. *Developmental Psychology*, 49, 470–479. <https://doi.org/10.1037/a0030604>
- Dunham, Y. (2018). Mere membership. *Trends in Cognitive Sciences*, 22, 780–793. <https://doi.org/10.1016/j.tics.2018.06.004>
- Dunham, Y., Baron, A. S., & Carey, S. (2011). Consequences of ‘minimal’ group affiliations in children. *Child Development*, 82, 793–811. <https://doi.org/10.1111/j.1467-8624.2011.01577.x>
- Engelmann, J. M., Over, H., Herrmann, E., & Tomasello, M. (2013). Young children care more about their reputation with ingroup members and potential reciprocators. *Developmental Science*, 16, 952–958. <https://doi.org/10.1111/desc.12086>
- Fehr, E., Bernhard, H., & Rockenbach, B. (2008). Egalitarianism in young children. *Nature*, 454, 1079–1084. <https://doi.org/10.1038/nature07155>
- Foddy, M., Platos, M. J., & Yamagishi, T. (2009). Group-based trust in strangers: The role of stereotypes and expectations. *Psychological Science*, 20, 419–422. <https://doi.org/10.1111/j.1467-9280.2009.02312.x>
- Forstmeier, W., & Schielzeth, H. (2011). Cryptic multiple hypotheses testing in linear models: Overestimated effect sizes and the winner's curse. *Behavioral Ecology and Sociobiology*, 65, 47–55. <https://doi.org/10.1007/s00265-010-1038-5>
- Gonzalez, G., Blake, P. R., Dunham, Y., & McAuliffe, K. (2020). Ingroup bias does not influence inequity aversion in children. *Developmental Psychology*, 56, 1080–1091. <https://doi.org/10.1037/dev0000924>
- Grueneisen, S., & Tomasello, M. (2017). Children coordinate in a recurrent social dilemma by taking turns and along dominance asymmetries. *Developmental Psychology*, 53, 265–273. <https://doi.org/10.1037/dev0000236>
- Grueneisen, S., Wyman, E., & Tomasello, M. (2015a). Children use salience to solve coordination problems. *Developmental Science*, 18, 495–501. <https://doi.org/10.1111/desc.12224>
- Grueneisen, S., Wyman, E., & Tomasello, M. (2015b). “I know you don't know I know...” Children use second-order false-belief reasoning for peer coordination. *Child Development*, 86, 287–293. <https://doi.org/10.1111/cdev.12264>
- Gummerum, M., Takezawa, M., & Keller, M. (2009). The influence of social category and reciprocity on adults' and children's altruistic behaviour. *Evolutionary Psychology*, 7, 295–316. <https://doi.org/10.1177/147470490900700212>
- Harbaugh, W. T., Krause, K., & Vesterlund, L. (2002). Risk attitudes of children and adults: Choices over small and large probability gains and losses. *Experimental Economics*, 5, 53–84. <https://doi.org/10.1023/A:1016316725855>
- House, B., Henrich, J., Sarnecka, B., & Silk, J. B. (2013). The development of contingent reciprocity in children. *Evolution and Human Behavior*, 34, 86–93. <https://doi.org/10.1016/j.evolhumbehav.2012.10.001>
- Howard, L. H., Henderson, A. M. E., Carrazza, C., & Woodward, A. (2015). Infants' and young children's imitation of linguistic in-group and out-group informants. *Child Development*, 86, 259–275. <https://doi.org/10.1111/cdev.12299>
- Jordan, J. J., McAuliffe, K., & Warneken, F. (2014). Development of ingroup favoritism in children's third-party punishment of selfishness. *Proceedings of the National Academy of Sciences of the United States of America*, 111, 12710–12715. <https://doi.org/10.1073/pnas.1402280111>
- Kinzler, K. D., Corriveau, K. H., & Harris, P. L. (2011). Children's selective trust in native-accented speakers: Selective trust in native-accented speakers. *Developmental Science*, 14, 106–111. <https://doi.org/10.1111/j.1467-7687.2010.00965.x>
- Kiyonari, T., & Yamagishi, T. (1999). A comparative study of trust and trustworthiness using the game of entronement. *Japanese Journal of Social Psychology*, 15, 100–109.
- Koenig, M., Clément, F., & Harris, P. L. (2004). Trust in testimony: Children's use of true and false statements. *Psychological Science*, 10, 694–698. <https://doi.org/10.1111/j.0956-7976.2004.00742.x>
- Levin, I. P., & Hart, S. S. (2003). Risk preferences in young children: Early evidence of individual differences in reaction to potential gains and losses. *Journal of Behavioral Decision Making*, 16, 397–413. <https://doi.org/10.1002/bdm.453>
- Lockhart, K. L., Chang, B., & Story, T. (2002). Young children's beliefs about the stability of traits: Protective optimism? *Child Development*, 73, 1408–1430.
- MacDonald, K., Schug, M., Chase, E., & Barth, H. (2013). My people, right or wrong? Minimal group membership disrupts preschoolers' selective trust. *Cognitive Development*, 28, 247–259. <https://doi.org/10.1016/j.cogdev.2012.11.001>
- McAuliffe, K., & Dunham, Y. (2017). Fairness overrides group bias in children's second-party punishment. *Journal of Experimental Psychology General*, 146, 485–494. <https://doi.org/10.1037/xge0000244>
- Melis, A. P., Grocke, P., Kalbitz, J., & Tomasello, M. (2016). One for you, one for me: Humans' unique turn-taking skills. *Psychological Science*, 27, 987–996.
- Misch, A., Over, H., & Carpenter, M. (2016). I won't tell: Young children show loyalty to their group by keeping group secrets. *Journal of Experimental Child Psychology*, 142, 96–106. <https://doi.org/10.1016/j.jecp.2015.09.016>
- Misch, A., Paulus, M., & Dunham, Y. (2021). Anticipation of future cooperation eliminates minimal ingroup bias in children and adults. *Journal of Experimental Psychology General*. advance online publication.
- Ostrom, E., & Walker, J. (2003). *Trust and reciprocity: Interdisciplinary lessons for experimental research*. Russell Sage Foundation.
- Paulsen, D. J., Platt, M. L., Huettel, S. A., & Brannon, E. M. (2012). From risk-seeking to risk-averse: The development of economic risk preference from childhood to adulthood. *Frontiers in Psychology*, 3, 313. <https://doi.org/10.3389/fpsyg.2012.00313>
- Plötner, M., Over, H., Carpenter, M., & Tomasello, M. (2015). The effects of collaboration and minimal-group membership on children's prosocial behavior, liking, affiliation, and trust. *Journal of Experimental Child Psychology*, 139, 161–173. <https://doi.org/10.1016/j.jecp.2015.05.008>
- R Core Team. (2018). *R: A language and environment for statistical computing*. URL: R Foundation for Statistical Computing <http://www.R-project.org/>.
- Rosatì, A. G., Benjamin, N., Pieloch, K., & Warneken, F. (2019). Economic trust in young children. *Proceedings of the Royal Society B*, 286. <https://doi.org/10.1098/rspb.2019.0822>
- Rotenberg, K. J., & Cerda, C. (1994). Racially based trust expectancies of native American and Caucasian children. *The Journal of Social Psychology*, 134, 621–631. <https://doi.org/10.1080/00224545.1994.9922992>
- Rousseau, D. M., Sitkin, A. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *The Academy of Management Review*, 23, 393–404. <https://doi.org/10.5465/amr.1998.926617>
- Schielzeth, H., & Forstmeier, W. (2009). Conclusions beyond support: Overconfident estimates in mixed models. *Behavioral Ecology*, 20, 416–420.
- Siposova, B., Grueneisen, S., Helming, K., Tomasello, M., & Carpenter, M. (2021). Common knowledge that help is needed increases helping behavior in children. *Journal of Experimental Child Psychology*, 201, Article 104973.
- Siposova, B., Tomasello, M., & Carpenter, M. (2018). Communicative eye contact signals a commitment to cooperate for young children. *Cognition*, 179, 192–201. <https://doi.org/10.1016/j.cognition.2018.06.010>

- Smith, C. E., Blake, P. R., & 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, Article e59510. <https://doi.org/10.1371/journal.pone.0059510>
- Sparks, E., Schinkel, M. G., & Moore, C. (2017). Affiliation affects generosity in young children: The roles of minimal group membership and shared interests. *Journal of Experimental Child Psychology*, 159, 242–262. <https://doi.org/10.1016/j.jecp.2017.02.007>
- Stanley, D. A., Sokol-Hessner, P., Banaji, M. R., & Phelps, E. A. (2011). Implicit race attitudes predict trustworthiness judgments and economic trust decisions. *Proceedings of the National Academy of Sciences, USA*, 108, 7710–7715. <https://doi.org/10.1073/pnas.1014345108>
- Stengelin, R., Grueneisen, S., & Tomasello, M. (2018). Why should I trust you? Investigating young children's spontaneous mistrust in potential deceivers. *Cognitive Development*, 48, 146–154. <https://doi.org/10.1016/j.cogdev.2018.08.006>
- Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, 1, 149–178. <https://doi.org/10.1002/ejsp.2420010202>
- Tomasello, M., Melis, A., Tennie, C., Wyman, E., & Herrmann, E. (2012). Two key steps in the evolution of human: The interdependence hypothesis. *Current Anthropology*, 53, 673–692. <https://doi.org/10.1086/668207>
- Vaish, A., Hepach, R., & Tomasello, M. (2018). The specificity of reciprocity: Young children reciprocate more generously to those who intentionally benefit them. *Journal of Experimental Child Psychology*, 167, 336–353. <https://doi.org/10.1016/j.jecp.2017.11.005>
- Warneken, F., & Tomasello, M. (2013). The emergence of contingent reciprocity in young children. *Journal of Experimental Child Psychology*, 116, 338–350. <https://doi.org/10.1016/j.jecp.2013.06.002>
- Warneken, F., Sebastián-Enesco, C., Benjamin, N. E., & Pieloch, K. A. (2019). Pay to play: Children's emerging ability to use acts of generosity for selfish ends. *Journal of Experimental Child Psychology*, 188, Article 104675. <https://doi.org/10.1016/j.jecp.2019.104675>
- Yamagishi, T., Jin, N., & Kiyonari, T. (1999). Bounded generalized reciprocity: Ingroup boasting and ingroup favoritism. In E. J. Lawler, S. R. Thye, E. J. Lawler, M. W. Macy, & H. A. Walker (Eds.), *Advances in group processes* (pp. 161–197). Bingley, England: Emerald.
- Yamagishi, T., Mifune, N., Li, Y., Shinada, M., Hashimoto, H., Horita, Y., ... Simunovic, D. (2013). Is behavioral pro-sociality game-specific? Pro-social preference and expectations of pro-sociality. *Organizational Behavior and Human Decision Processes*, 120, 260–271. <https://doi.org/10.1016/j.obhdp.2012.06.002>
- Yazdi, H., Heyman, G. D., & Barner, D. (2020). Children are sensitive to reputation when giving to both ingroup and outgroup members. *Journal of Experimental Child Psychology*, 194, Article 104814. <https://doi.org/10.1016/j.jecp.2020.104814>
- Yuki, M., Maddux, W. W., Brewer, M. B., & Takemura, K. (2005). Cross-cultural differences in relationship and group-based trust. *Personality & Social Psychology Bulletin*, 31, 48–62. <https://doi.org/10.1177/0146167204271305>