Children engage in competitive altruism

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ABSTRACT

Humans cultivate their reputations as good cooperators, sometimes even competing with group mates, to appear most cooperative to individuals during the process of selecting partners. To investigate the ontogenetic origins of such "competitive altruism," we presented 5- and 8-year-old children with a dyadic sharing game in which both children simultaneously decided how many rewards to share with each other. The children were either observed by a third-person peer or not. In addition, the children either knew that one of them would be picked for a subsequent collaborative game or had no such knowledge. We found that by 8 years of age, children were more generous in the sharing game not only when their behavior was observed by a third party but also when it could affect their chances of being chosen for a subsequent game. This is the first demonstration of competitive altruism in young children, and as such it underscores the important role of partner choice (and individual awareness of the process) in encouraging human cooperation from an early age.

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Introduction

Humans, in comparison with other primates, are remarkable for their degree of cooperation and altruistic acts toward unrelated individuals (Axelrod & Hamilton, 1981; Tomasello, 2009). Researchers

have consistently been interested in the mechanisms supporting such hyper-cooperation in humans and in how altruism—which on the surface often seems counter to the actor's best interests—is maintained. There are a limited number of ways in which altruism may be stabilized within a population. Most commonly referred to is *direct reciprocity* in which individuals in essence trade favors over time (Trivers, 1971). Also important is so-called *indirect reciprocity* in which individuals cultivate their reputation for cooperation with others (because cooperators naturally want to interact with one another and not cheaters; Alexander, 1987). In situations where an observer chooses among potential partners for a mutually beneficial collaborative enterprise, the potential partners might even compete with one another to appear to be the best cooperator. Roberts (1998) labeled this process *competitive altruism.* It has been argued that competitive altruism has played an especially important role in the evolution of humans' ultra-cooperative (even moral) tendencies (Baumard, André, & Sperber, 2013; Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012). Unlike their great ape relatives, early humans became obligate collaborative foragers, which meant that choosing a good partner and being chosen as a partner in turn were essential to an individual's success.

A number of studies have provided evidence that adult humans are motivated to develop a reputation for being a good partner and, better yet, for being the most cooperative in their group (Barclay & Willer, 2007; Debove, André, & Baumard, 2015; Sylwester & Roberts, 2010; see also Hardy & Van Vugt, 2006, for reputation-based generosity). For example, Barclay and Willer (2007) conducted a study consisting of three conditions in which two players took part in a continuous prisoner's dilemma while a third player either had knowledge of the contributions of both players or not. In a second step, the third player either was randomly paired with one of the two initial players (either having knowledge about their contributions or not) or was allowed to choose one of them after being informed about their contributions. Only the two conditions in which the observer was informed about the donations allowed the two players to develop their reputations for being collaborative partners, whereas competition for being chosen as a future partner was present only in the last condition. As predicted, people donated more money, and thus actively competed to be more generous, than others in the condition where partner choice played a role than when donation could only result in self-presentation as a good partner (see also Experiment 1 in Sylwester & Roberts, 2010, for similar findings). Furthermore, competing for being the most altruistic partner paid off given that the most generous individuals were chosen more often as cooperative partners than those who donated less. Compellingly, after being chosen, players donated near zero in the second game, indicating that being generous in the first round was merely a strategic investment that was unnecessary in the second game where generosity had no effect on future interactions. In another study (Sylwester & Roberts, 2010), participants played a public goods game in which they could contribute any amount of the money they received to a common pool, after which they had the opportunity to select a partner for a second cooperative game. Thanks to the possibility of partner choice, individuals who had cooperated in the first game were more likely to be recruited for the second game than non-cooperators and received higher payoffs. Finally, in a recent study, Debove et al. (2015) not only showed that partner choice can result in competitive altruism when the biological market is uneven—in this case, when there are fewer individuals selecting partners than individuals seeking to be chosen—but also showed that it can lead to fairness in contexts where choosers and those being chosen are equally present. The results of these studies demonstrate that in the right situation adult humans will engage in competitive altruism.

Whereas these studies document the presence of competitive altruism in human adults, little is known about the ontogeny of human children's skills and motivations for such forms of altruism. Early in ontogeny, human infants seemingly perform altruistic acts indiscriminately (Warneken & Tomasello, 2009). After this stage, and relevant to the current investigation, young children begin to care about their reputation. As early as 5 years of age, children not only behave more generously when observed by others (Engelmann & Rapp, 2018; Engelmann, Herrmann, & Tomasello, 2012; Leimgruber, Shaw, Santos, & Olson, 2012) but also invest in their reputation in order to benefit at a later point by indirect reciprocity (e.g., Engelmann, Over, Herrmann, & Tomasello, 2013). Recently, it has been shown that by 4 years of age children invest in their reputation in a competitive group setting and that by 5 years children flexibly apply different reputational strategies depending on context (Rapp, Engelmann, Herrmann, & Tomasello, in press). Preschoolers' concern for their reputation is even more nuanced in that they take into account not only the fact of being observed but also the nature of the audience (e.g., authority, team, in-group member). (Banerjee, 2002a; Engelmann et al., 2013; Goffman,

1959; Piazza, Bering, & Ingram, 2011). Also relevant for the current investigation is a recent finding demonstrating that children compare their own generosity with the generosity of a peer. Specifically, Tasimi, Dominguez, and Wynn (2015) showed that children's preference for a generous child was reduced when a comparison with their own (lesser) generosity was possible and, hence, their reputation was at stake. Finally, and most pertinent to the current study, Aloise-Young (1993) asked 6-, 8-, and 10-year-old children to explain to a potential team member why they should be picked as a partner for a game. From 8 years of age, participants exhibited appropriate self-promoting behavior in order to convince another child to pick them as a partner for a skill-based game (Aloise-Young, 1993). Although this documents the ability of children to present themselves in ways that maximize their chances of being picked as a partner, it does not provide evidence for competitive altruism. First, children in this study were not in direct competition with peers. Second, the relevant dimension for partner choice in the study was not altruism but rather children's skill at playing a game. Thus, none of these previous studies investigated children's concern for their cooperative reputation in a partner choice scenario where they needed to compete with another peer to be chosen.

We wished to investigate the ontogeny of competitive altruism, specifically the act of investing in one's reputation at a personal cost in a competitive context. In the current study, children competed to be chosen by a peer to play a highly rewarding game. In Study 1 (8-year-olds) and Study 2 (5-year-olds), child dyads participated in a dyadic sharing game where both children simultaneously decided how many balls to share with each other. In Study 1, each dyad was assigned to one of four conditions that varied in two ways. First, children either were observed by a peer (observer conditions) or played the game anonymously (anonymous conditions). Second, either the children were told that after finishing the initial game one of them would be picked by a third peer to play a special and more rewarding second game (choice conditions) or they had no knowledge of this second game (no choice conditions). We predicted that the lowest sharing rates would occur in the two anonymous conditions where there was no possibility of reputational benefit for being generous. We further predicted that sharing rates would increase in the audience condition (observer/no choice) where an observer was aware of children's generosity and, thus, reputation building was possible. However, the highest sharing rates should occur in the competitive altruism condition (observer/choice). Participants should invest in their reputation for being generous persons in order to outcompete another peer for being chosen by the observer as a future interaction partner for a mutualistic game. Finally, we predicted that in the competitive altruism condition children's sharing would decrease from the first game, in which their choices may be strategic, to the second game, in which their distributive choices remain private and do not influence future interactions. We did not expect a similar decrease in sharing in the anonymous/choice condition given that reward allocations remained anonymous in both games.

Based on previous studies showing that children's concern about their reputation and their use of self-presentational strategies increase between 5 and 8 years of age (Aloise-Young, 1993; Banerjee, 2002a; Engelmann et al., 2012, 2013; Leimgruber et al., 2012; Piazza et al., 2011; Shaw et al., 2014), we predicted that 5-year-olds would care about their reputation and donate more in observer conditions compared with anonymous conditions. However, based on the findings by Aloise-Young (1993), we expected only our older age group (8-year-olds) to attempt to strategically outcompete potential rivals for the best collaborative reputation through generous donations, that is, to engage in competitive altruism.

Study 1

Method

Participants

Participants were 128 8-year-old children (64 girls; age range = 7.9–8.3 years) from a medium-sized German city (population ~500,000). The children were tested in same-sex pairs (64 dyads in total; 16 dyads per condition as set a priori). In addition, 6 female confederates (ages 7–9 years) and 8 male confederates (ages 7–9 years) participated throughout the study. Confederates and participants were recruited from different day-care centers to ensure that children did not know each other

before coming to the child laboratory for this study. All participants (predominantly Caucasian) were native German speakers and came from mixed economic backgrounds. Informed consent was obtained for all children from their parents. An additional 12 8-year-old dyads were tested but excluded. The reasons for exclusion were as follows: one child or both children told their partner how many balls they shared or looked at the outcome of the other child (one child: $n = 5$; both children: $n = 4$; resulting in a total of $n = 14$ children), confederate errors ($n = 2$, resulting in a total of $n = 4$ children), stopped playing ($n = 1$, resulting in a total of $n = 2$ children), and technical problems ($n = 2$, resulting in a total of $n = 4$ children).

Apparatus

A wooden rectangular box ($66 \times 100 \times 12$ cm) topped by a plastic occluder (50×100 cm) was attached to a small wooden table. Two opaque plastic ducts, 5 cm in diameter, ran through the box at a diagonal such that each duct started on one side and ended on the opposite side. The bottom hole of each duct ended in a small wooden box ($81 \times 40 \times 30$ cm) akin to a cupboard with a hinged door at the front. Each door had a different symbol (car or house) attached to it with Velcro. A second apparatus, identical to the first except for its color (gold), was placed opposite the first one (see Fig. 1). In addition, cardboard boxes with a lid and marked by either a car or house symbol served as containers in which balls were provided. Two little toy suitcases depicting either a car or a house served as reward collecting boxes (see Fig. 2). Plexiglas tubes (length = 25 cm, diameter = 4 cm) with a rubber cork could be baited with green or golden Styrofoam balls (diameter = 3 cm) and sent through the opaque ducts into the small wooden boxes. Stickers served as rewards, which were exchanged for the collected balls at the end of the session.

Procedure

In the study, two children played a sharing game. The goal of the game was to collect as many balls as possible. At the end of the game, the balls were exchanged for prizes. The children sat on opposite sides of the apparatus with a blocked view of each other (see Figs. 1 and 2). Before every trial (four in total), each child received a box containing seven balls and a Plexiglas tube. The children were told by the first experimenter (E1) that they could put as many balls in this tube as they wished to send to the other child through an opaque duct. In addition, children were informed that they should leave the balls they wanted to keep in their box and close the lid so that no one could see how many balls were inside. The small tube containing the balls that were sent to the other child fell into an opaque wooden box hidden to both participants. Each dyad was assigned to one of four conditions that varied in two aspects. In two conditions (observer/choice and observer/no choice), another child (confederate) was present. The confederate sat in front of a second apparatus identical to the one with which the dyad was playing but golden in color (see Fig. 1). In the other two conditions (anonymous/choice and
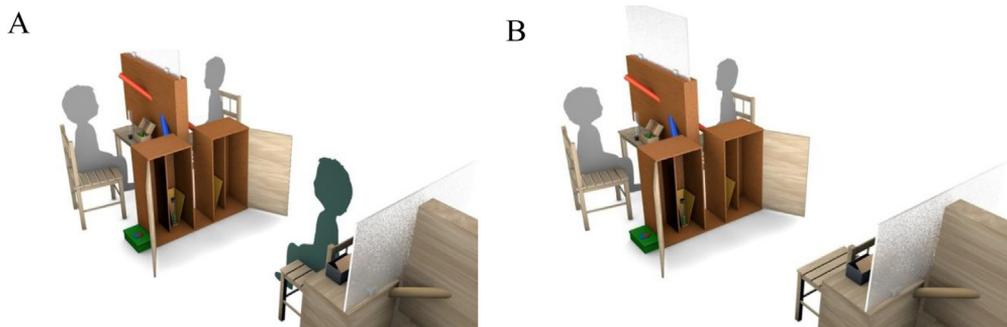
Fig. 1. Experimental setup in the observer conditions (observer/choice and observer/no choice) (A) and anonymous conditions (anonymous/choice and anonymous/no choice) (B). Participants sat on opposite sides of the apparatus with no visual access to each other. In the observer conditions, a peer confederate sat in front of the second golden apparatus. In the beginning of each trial, participants received a tube and seven green balls. The shared balls were sent through a duct and landed in a wooden box. The number of shared balls was visible to the observer only after opening the doors to the boxes.

Fig. 2. Basic experimental setup of the first sharing game for all four conditions from a bird's-eye view.

anonymous/no choice), no confederate was present. Depending on condition, either the children were told that after finishing the initial game one of them would be picked by another child (the confederate) to play the golden game (observer/choice and anonymous/choice) or they were not told about it (observer/no choice and anonymous/no choice). The assignment to conditions was randomized, and all four conditions were run in parallel.

Before each dyad played the game together, each child was individually introduced to the apparatus in the familiarization phase as follows. E1 entered the room with the child, who was given a bracelet with either a car or house symbol on it. E1 told the child that the goal of the game was to collect as many balls as possible. Then E1 pointed out that there were two games present (apparatuses) that are played using the same rules. She also emphasized that the golden apparatus was very special and that playing with it even included playing with golden balls. Then she told the child that they would first play with the ordinary game and that the child might be able to play with the fancy golden one at a later time. The child was told to sit down on the side of the apparatus that depicted the same symbol as his or her bracelet and was told that another child with the other symbol would later sit on the other side. E1 continued explaining how the apparatus works: "If you put something in this duct on your side, it will slide to the other child's side and will end up in their opaque wooden box. And if something is placed in the duct on the other side, it will end up in your box." Then E1 gave the child a box with two green balls and emphasized that they belonged to the child. Then she handed over a transparent tube depicting the other child's symbol and explained how the game is played while demonstrating by putting one ball in the tube and sending it to the other side. E1 continued to explain that the remaining balls, which were still in the box, belonged to the child and would be collected in a little suitcase depicting the same symbol next to the apparatus (see Fig. 2). Then E1 showed the child where the tube containing the ball landed by opening both opaque boxes. E1 explained that the ball arrived in the other child's box and that it would be collected in his or her little suitcase, whereas nothing had yet arrived on the child's side. After this demonstration, the child was allowed to play alone (i.e., without instructions by E1). E1 handed the child a box containing seven balls and a tube while explaining that all the balls belonged to the child. Then E1 repeated that the child could decide to put as many balls in the tube as he or she wished to send to the other child. The child should leave the balls that he or she wanted to keep in the child's box and should close the box after making the decision. After that, E1 went to the other side, where she also baited a tube and sent the tube through

the apparatus. After they both sent their tubes, E1 explained that from then on they were not allowed to look in any of the boxes and that a second experimenter (E2) would enter the room shortly and put all the balls that remained in the child's box and the ones that arrived in the opaque box from the other child in the child's suitcase. The child was told that only at the end of the game would he or she and the other child be allowed to look in their suitcases. Then they left the room.

After each child participated in the familiarization phase, both children participated in four trials in only one of the following four conditions:

Anonymous/No choice (control): Each trial started with E1 entering the testing room with both children and pointing out the presence of the special game with the golden balls, which were double the value of the green balls and with which the children might play later. Then the children sat down on their respective sides. E1 reminded both children that the goal was to collect as many balls as possible and told them that they would each receive a box with seven balls that belonged to them. Then both children were told that they would receive a tube in which they should put as many balls as they wanted to give to the other child. The balls that the children wanted to keep for themselves should remain in their boxes, and the children should close the lid after sending the tube through the apparatus. Before E1 left the room, she handed the tubes to the children while telling them to remain on their sides and not to speak or look in the opaque boxes until she returned. Once the children finished their ball allocations (which E1 observed through a DV-Walkman from outside), they left the room with E1. E2 entered the room, put the collected balls from both children in their respective suitcases, and set up the game for the next trial.

Anonymous/Choice (control choice): Each trial started with E1 entering the testing room with both children. The two participants took their seats on opposite sides of the apparatus (the same sides they were assigned during familiarization), and E1 reminded the children of the rules of the game as in the other conditions. After the instructions, E1 pointed to the game with the golden balls and told the children that another child, who they had previously met in a warm-up room, would enter the room soon and choose one of them to play the golden game with him or her. She also reminded the children that the golden balls had double the value of the green ones but that the rules of the game were the same. After the children finished each trial, the confederate entered the room and picked one of the children (randomly assigned by the experimenter). Then E1 entered, quickly explained that the rules of the golden game were the same as for the first game, and talked to the child who was not chosen while the other two children played the golden game. Once the children finished their ball allocations in the golden game, they left the room with E1. E2 entered the room, put the collected balls from both children and both games in their respective suitcases, and set up the game for the next trial.

Observer/Choice (competitive altruism): Each trial started with E1 entering the testing room with both children and the confederate (observer). The two participants took their seats on opposite sides of the apparatus (the same sides they were assigned during familiarization), and E1 reminded the children of the rules of the game as in the other conditions. In addition, E1 directed the children's attention to the third child, who was told to sit on a chair placed in front of the golden apparatus from which he or she was supposed to observe the behavior of both children. E1 then explained to the confederate that once the two children had finished playing, only he or she would be allowed to look inside the opaque boxes to discover the number of balls shared. Then the confederate should choose one of the two children to play the golden game with him or her. E1 reminded all the children that golden balls had twice the value of the green ones but that the rules of the game were the same. After the children finished, the confederate looked inside the box and chose the child who shared more balls. E1 entered the room and quickly explained the rules of the game again and then talked to the child who was not chosen while the other two children played the golden game. Once the children finished their ball allocations in the golden game, they left the room with E1. E2 entered the room, put the collected balls from both children and both games in their respective suitcases, and set up the game for the next trial.

Observer/No choice (audience): Each trial started with E1 entering the testing room with both children and the confederate (observer) and pointed out the presence of the special game with the golden balls,

which were double the value of the green balls with which the children might play later. Then the children sat down on their respective sides, and the confederate sat down on a chair in front of the golden apparatus. Then E1 reminded the children of the rules of the game as in the other conditions. E1 then told the confederate that once the two children had finished playing, only he or she would be allowed to look inside the opaque boxes to discover the number of balls shared. Once the children finished their ball allocations (which E1 observed through a DV Walkman from outside), they left the room with E1. E2 entered the room, put the collected balls from both children in their respective suitcases, and set up the game for the next trial.

Coding and analysis

The number of balls shared in both games (the first game and the golden game) was coded for each child by E2. A second coder, who was naive with respect to condition and our hypotheses, independently coded 20% of all trials. Interrater reliability was excellent (Cohen's kappa = .99).

To test whether the number of balls shared in the first game depended on the choice and observer presence, we used a generalized linear mixed model (GLMM; Baayen, 2008) with Poisson error structure and log link function. In this model, we included choice, observer presence, and their interaction as well as gender and trial number as fixed effects (the latter two to control for their effects). As random effects, we included child identity and dyad identity. To keep Type I error rate at the nominal level of .05, we also included random slopes of trial number within both random effects. As an overall test of the effects of choice, observer presence, and their interaction, we compared the full model as described above with a respective null model lacking these three effects but comprising all other terms present in the full model.

The model was fitted in R (Version 3.1.2; R Core Team, 2014) using the function glmer of the R package lme4 (Bates, Maechler, Bolker, & Walker, 2014). Over-dispersion was no issue (maximum dispersion parameter < 0.60), and model stability was assessed by dropping the levels of the random effects one at a time and comparing the estimates obtained with those obtained from the model based on all data. This revealed model instability to be no issue.

In an additional model, we investigated whether the effect of trial number depended on the particular combination of choice and observer presence. In this model, we included the three-way interaction among choice, observer presence, and trial number (t transformed to a mean of 0 and a standard deviation of 1) as well as all three two-way interactions between these effects. As a test of the three-way interaction, we compared this full model with one lacking the three-way interaction.

Results

Children differed in their sharing behavior across conditions (Fig. 3). There was a clear impact of choice and/or observer presence on the number of balls shared with the peer (full–null model comparison: $\chi^2 = 10.55$, $df = 3$, $p = .014$). The two-way interaction between choice and observer revealed significance (estimate ± SE = -0.520 ± 0.188, $\chi^2 = 6.190$, $df = 1$, $p = .013$), and so we compared the individual conditions. More specifically, children gave more when their decision was observed by a potential future partner (competitive altruism) than when they were only observed by a peer with unknown future interactions (audience: $p = .002$). However, choice played no important role in the anonymous (control and control choice) conditions in which numbers of shared balls were very similar ($p = .639$). In addition, children were also more generous in the competitive altruism condition in comparison with either of the conditions in which no observer was present (control choice: $p = .013$; control: $p = .049$). A closer look at the pure audience condition revealed that children did not differ in their sharing behavior in comparison with when no audience was present (control choice: $p = .405$; control: $p = .186$).

When including the three-way interaction among choice, observer presence, and trial number, we found this to be clearly significant ($\chi^2 = 6.19$, $df = 1$, $p = .013$), whereby children gave more with increasing trial number in the competitive altruism condition but not in any of the other conditions (Fig. 3). Furthermore, in our exploratory analysis, we found that boys generally shared less than girls (estimate ± SE = -0.29 ± 0.09, $z = -3.21$, $p = .001$).
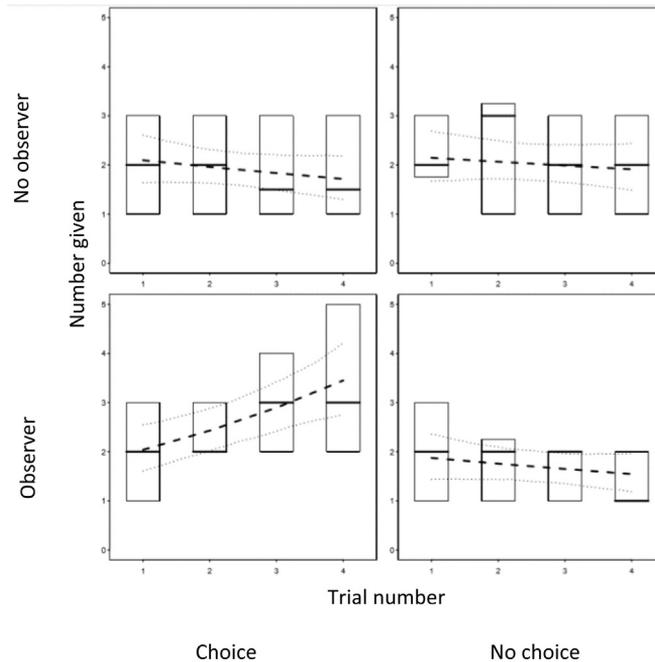
Fig. 3. Results of Study 1. The sharing behavior of 8-year-old children across conditions and trials is shown. The box plots show quartiles and median. The dashed and dotted lines depict the model and its confidence intervals, respectively.

Finally, we investigated whether sharing behavior differed across the first game and the golden game after being chosen by the peer. Recall that the golden game was played only in the competitive altruism and control choice conditions. In the competitive altruism condition, children gave more in the first game ($M = 2.84$), before being chosen, than in the golden game ($M = 2.50$) [$T^+ = 206$, $N = 22$ (7 ties), $p = .008$]. As expected, in the control choice condition, numbers of shared balls did not differ significantly between the first game ($M = 2.05$) and the golden game ($M = 2.23$) [exact Wilcoxon matched-pairs test: $T^+ = 97$, $N = 17$ (15 ties), $p = .338$] (Fig. 4).

Discussion

The current study is the first to show that by 8 years of age children engage in competitive altruism; children of this age were more prosocial (i.e., shared more balls) when their actions were observed by a potential future partner. Children's sharing behavior cannot be explained simply in terms of an observer effect given that children shared more in the competitive altruism condition (in which their distributions may contribute to their attractiveness as a future partner) than in the audience condition (in which an observer was present but no future interactions were expected). Children of this age onward, thus, do not merely track whether they are observed or not but also selectively invest in their reputation for being generous in order to be selected as a partner for a future interaction.

The observed difference in prosocial behavior across conditions is a result of an increase in prosocial sharing in the competitive altruism condition over the course of the four trials. However, it was not simply the prospect of playing a future game or being chosen in previous trials that increased sharing behavior given that children did not share more when the potential future partner had no knowledge of the outcome of the first game (control choice). The current results extend findings from adults (Barclay & Willer, 2007; Barclay, 2004; Sylwester & Roberts, 2010) and provide initial evidence for the existence of competitive altruism in children as young as 8 years. Furthermore, this study supports the

Fig. 4. Sharing behavior in the first and second games played in the competitive altruism condition. Each circle represents the average behavior of one individual. For each participant, decreased or increased sharing behavior is depicted by dashed lines. The thicker each line is, the more individuals it represents.

notion that children care about their reputation in a strategic way, a tendency previously shown in Engelmann et al. (2013) study, where children shared significantly more resources with an anonymous recipient when the child watching them could reciprocate later. The fact that in the competitive altruism condition children shared less in the golden game (where their sharing behavior remained private) compared with the first game serves to emphasize their attention to strategy. This result corroborates the findings with adults in which donations decreased when their behavior could have no further effect on future interactions (Barclay & Willer, 2007). However, in the control choice condition, where children's sharing behavior was anonymous in the first game, no differences in sharing behavior across the first and second games were detected. This finding further rules out the possibility that children were simply less likely to share the valuable golden balls in comparison with the green balls.

Interestingly, the differences in sharing behavior across conditions became more apparent over the course of the experiment. The increased sharing behavior as a function of trial number is most likely the result of having experienced the relevance of the observer and the second game. To understand the link among the first game, the selection process, and the second game, children might have needed to experience being or not being chosen. However, the increase in sharing over the course of the four trials cannot be reduced to learning the simple rule that giving more balls results in being selected and that being selected leads to giving more balls in the next trial of the first game. Being selected not only depends on each child's absolute shared number of balls but, importantly, also depends on the partner's sharing behavior, which was concealed throughout the experiment. In addition, we did not detect any increase over the four trials in the control choice condition, which should have been the case if children just followed a simple rule.

We did not detect a difference in children's sharing behavior in the pure presence of an audience in comparison with playing with no observer watching (control). This finding is surprising given that 5-year-olds behave more prosocially in the presence of an observer (Engelmann et al., 2012) or a recipient who is fully aware of their actions (Leimgruber et al., 2012). However, the methods of the current study differ in important ways from previous studies (Engelmann et al., 2012; Leimgruber et al., 2012),

which might account for the differences in results. First of all, two children were sharing items at the same time. Second, Leimgruber et al. (2012) had only a recipient present, who was either visible or occluded, but no pure observer. Children displayed consistent generosity only when the recipient was fully visible and aware of the sharing options. When the recipient was occluded or the action was not fully transparent, children were less generous. Third, in Engelmann et al. (2012) study, where an additional pure observer was present, the recipient of the shared items was anonymous instead of physically present. In the current study, on the other hand, children were never completely alone in the room, even in the anonymous condition.

To explore the developmental roots of competitive altruism further, in Study 2 we investigated whether 5-year-old children—the age at which they seem to first show concern for reputation (Engelmann & Rapp, 2018)—would also act more prosocially to increase the chance of being chosen as a future interaction partner. Based on previous findings on observer effects in children, together with the results from Study 1 and the discussed differences from previous work, we refrained from including the pure audience and control choice conditions in Study 2. Therefore, we tested 5-year-olds in only two of the four conditions: the competitive altruism condition, where both an observer and a potential future partner were present, and the control condition, where no observer was present and no future interactions were possible.

Study 2

Method

Participants

Participants were 64 5-year-old children (32 girls; age range = 4.9–5.3 years) from a medium-sized German city. As in Study 1, the children were tested in same-sex pairs (32 dyads in total; 16 dyads per condition). In addition, 4 female confederates (ages 7–9 years) and 8 male confederates (ages 7–9 years) participated throughout the study. An additional 15 5-year-old dyads were tested but excluded. The reasons for exclusion were as follows: one child or both children told their partner how many balls they shared or looked at the outcome of the other child (one child: $n = 6$; both children: $n = 8$; resulting in a total of $n = 20$ children), children stopped playing ($n = 2$, resulting in a total of $n = 4$ children), confederate errors ($n = 1$, resulting in a total of $n = 2$ children), and technical problems ($n = 2$, resulting in a total of $n = 4$ children). The children did not know each other before coming to the child laboratory for this study.

Apparatus

The same apparatus and materials as in Study 1 were used.

Procedure

The procedures for the familiarization and test phases were identical to those from Study 1. The only difference was that Study 2 included only two conditions instead of four conditions. Children were randomly assigned to either the control (anonymous/no choice) or competitive altruism (observer/choice) condition.

Coding and analysis

The same coding and analysis as used for the 8-year-olds in Study 1 was conducted. However, for the 5-year-olds the two factors choice and observer were confounded and, hence, only one factor was included. Interrater reliability was excellent (Cohen's kappa = 1).

Results

In comparison with the older children, 5-year-olds did not differ in their sharing behavior across conditions (estimate ± SE = 0.08 ± 0.13, χ^2 = 0.38, df = 1, p = .536). In addition, gender did not have a significant influence on the number of balls shared (estimate ± SE = − 0.07 ± 0.13, χ^2 = 0.31, df = 1,

p = .576). We further investigated whether sharing behavior changed over the course of the study. No significant interaction between condition and trial number was found (estimate ± *SE* = 0.09 ± 0.08, χ^2 = 1.21, *df* = 1, *p* = .272) (Fig. 5). Finally, we also investigated whether sharing behavior in the competitive altruism condition differed across the first game and the golden game after being chosen by the peer. In contrast to the older children, the number of shared balls did not significantly differ between the golden game and the first game [exact Wilcoxon matched pairs test: T^+ = 80.5, *n* = 15 (9 ties), *p* = .261].

Discussion

In Study 2, we investigated whether 5-year-old children would act more prosocially to increase their chances of being chosen as a future interaction partner. In contrast to the older children from Study 1, 5-year-olds did not increase their sharing behavior when observed by a potential future interaction partner. Previous research has shown that 5-year-olds not only start to care about their reputation but also strategically manage their reputation in cases where there may be opportunities for indirect reciprocity (Engelmann et al., 2012, 2013; Leimgruber et al., 2012). However, none of these studies investigated competitive altruism involving a partner choice scenario. Therefore, the current study extends previous findings (Aloise-Young, 1993; Banerjee, 2002a; Piazza et al., 2011; Shaw et al., 2014) by demonstrating that later in ontogeny, at around 8 years of age, children have developed a further component of reputation management—they engage in competitive altruism in the context of partner choice. This observed age difference, and differences with previous studies with 5-year-olds, may be due to an increase in complexity in the task demands. First, in the current study, children did not simply share something with either an anonymous recipient (Engelmann et al., 2013) or a peer (Leimgruber et al., 2012). Instead, two children played a sharing game simultaneously while being observed by a peer. Second, the observer was not just aware of the sharing behavior of the participants
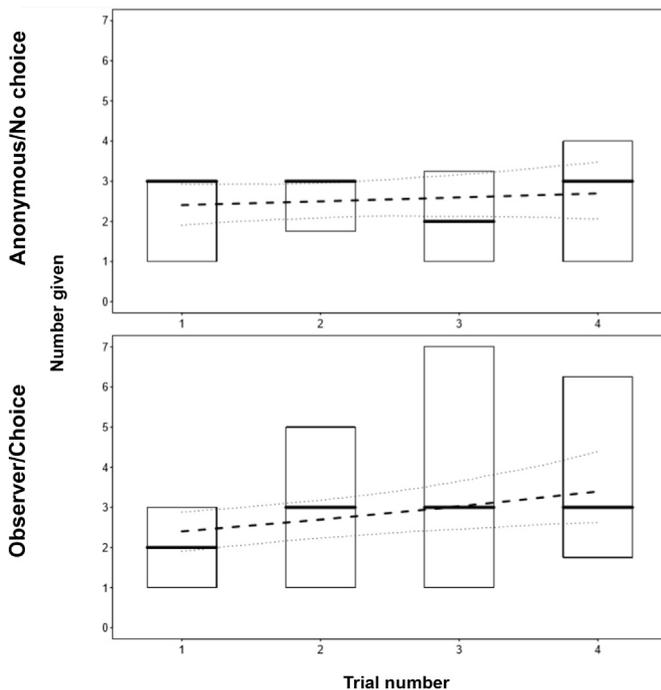

Fig. 5. Results of Study 2. The sharing behavior of 5-year-old children across conditions and trials is shown. The box plots show quartiles and median. The dashed and dotted lines depict the model and its confidence intervals, respectively.

or able to simply reciprocate indirectly as in previous work (Engelmann et al., 2012, 2013; Leimgruber et al., 2012) but also was able to choose one of the two participants for a future game. Thus, the children in the current study needed to keep in mind the immediate relevance of the observer when deciding how many resources to share in order to outcompete each other for being chosen. This more strategic form of reputation management requires an understanding that reputation is relative; that is, the way in which one is viewed by an audience depends as much on one's own generosity as on the benchmark set by others' generosity. Furthermore, this condition required advanced cognitive abilities (e.g., future planning, social perspective taking, memory, self-regulation) and the ability to integrate multiple study demands (e.g., keeping in mind the relevance of the second game while playing the first one). Because such abilities are known to undergo important changes in ontogeny (Banerjee, 2002b; Davidson, Amso, Anderson, & Diamond, 2006; Herrmann & Tomasello, 2015; Herrmann, Misch, Hernandez-Lloreda, & Tomasello, 2015; Selman, 1971; Wellman, Fabricius, & Sophian, 1985), the development of these abilities may have played a role in producing the observed age differences in this study. In addition, in comparison with previous studies (e.g., Benenson, Pascoe, & Radmore, 2007; Smith, Blake, & Harris, 2013), the described differences in methods may also account for different developmental patterns of sharing with a decrease in total sharing rates with age.

General discussion

Taken together, the results of both studies provide evidence of a developmental change between 5 and 8 years of age in children's competitive altruistic behavior. Study 1 shows that by 8 years of age children were more generous in a sharing game when their behavior not only was observed but also could affect the chances of being chosen as a potential partner for a future interaction. Children were willing to incur an immediate cost (thereby strategically investing in their reputation for being generous) in order to outcompete another peer for being selected as a future collaborative partner (Roberts, 1998). In general, such competitive altruistic behavior could function as a costly signal of cooperative intent (Zahavi & Zahavi, 1997) benefiting the signaler in the long run. Results further showed that children strategically and quickly adapted their altruistic behavior depending on context. Children selected after the first game were less generous in the second game where no reputational benefit for being altruistic was provided (for similar findings with adults, see Barclay & Willer, 2007). Our findings extend previous work with adults (Barclay & Willer, 2007; Barclay, 2004; Roberts, 1998; Sylwester & Roberts, 2010) and provide the first evidence of competitive altruism in school-aged children.

The level of generosity observed in the competitive altruism condition was not detected in any of the other conditions. Neither the pure presence of an audience, which could enhance one's reputational concern, nor the prospect of being selected for a future game by a peer who is unaware of previous sharing decisions led to an increase in generosity. Thus, the change in sharing in the competitive altruism condition was a result of the combination of being observed by a relevant future interaction partner and the competition for being selected.

Our second study, focusing on the ontogeny of strategic reputation building, demonstrated that 5-year-old children do not engage in competitive altruism in the same scenario (they did not increase their sharing behavior when competing for being selected by a peer observer). Support for the difference in behavior between the two age groups comes from previous research (Aloise-Young, 1993; Banerjee, 2002a, 2002b; Piazza et al., 2011; Shaw et al., 2014). For example, children from 8 years of age onward show audience sensitivity in their choice of appropriate self-descriptions (Banerjee, 2002a), are increasingly concerned with appearing to be fair to others (Shaw et al., 2014), and are able to resist breaking rules longer than younger children (Piazza et al., 2011). Furthermore, in a partner choice scenario, only by 8 years of age did children exhibit appropriate self-promoting behavior in order to convince another child to select them as a partner for a game (Aloise-Young, 1993). In addition, Banerjee (2002b) argued that although 5-year-olds possess the necessary cognitive prerequisites for reputation management, they lack a concern for being socially evaluated. Such a concern might not play an important role in young children's lives and emerges only as a consequence of various experiences during the course of the primary school years. However, recent research has demonstrated

that by 5 years of age children are already concerned about their reputation for being generous and trustworthy (Engelmann et al., 2012, 2013; Fu, Heyman, Qian, Guo, & Lee, 2016; Leimgruber et al., 2012; Piazza et al., 2011) and even strategically invest in their reputation when the child watching them could reciprocate at a later point (Engelmann et al., 2013). In comparison with previous research, however, the current studies not only investigated children's concern about their reputation as a generous person but also children's concern for the reputation of being the most altruistic individual in order to actively outcompete others. Differences in questions, methodology, and complexity across studies (e.g., alone vs. dyadic context, indirect reciprocity vs. competitive altruism) might have played a key role in the observed age differences.

Conclusion

Overall, this is the first study to investigate the ontogeny of competitive altruism in a partner choice context. As such, it provides evidence that by 8 years of age children engage in costly strategic behavior. Furthermore, our results support the idea that having and investing in a reputation as a generous or good cooperator might benefit oneself in the long run not only through direct or indirect reciprocity (Alexander, 1987; Nowak & Sigmund, 2005; Trivers, 1971) but also through partner choice (Roberts, 1998). Importantly, indirect reciprocity is based on third-party moral evaluations with no incentives of being directly paid back. In contrast, being altruistic in a partner choice scenario directly benefits both the actor, in being selected, and the chooser, in obtaining the best possible partner for future mutualistic cooperative interactions (Sylwester & Roberts, 2010; Tomasello et al., 2012). Future studies should continue to investigate younger children's behavior in different cooperative contexts and also focus on the behavior of the selecting partner. Specifically, it would be of interest to investigate at what age children start to prefer selecting the most altruistic individual for a cooperative interaction, thereby strengthening the incentive for the actor to behave prosocially because the cost of altruistic action would be balanced by the reward of being selected.

Acknowledgments

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