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Young Children Share the Spoils After Collaboration

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Abstract

Egalitarian behavior is considered to be a species-typical component of human cooperation. Human adults tend to share resources equally, even if they have the opportunity to keep a larger portion for themselves. Recent experiments have suggested that this tendency emerges fairly late in human ontogeny, not before 6 or 7 years of age. Here we show that 3-year-old children share mostly equally with a peer after they have worked together actively to obtain rewards in a collaboration task, even when those rewards could easily be monopolized. These findings contrast with previous findings from a similar experiment with chimpanzees, who tended to monopolize resources whenever they could. The potentially species-unique tendency of humans to share equally emerges early in ontogeny, perhaps originating in collaborative interactions among peers.

Keywords

cooperation, sharing, equality, comparative psychology

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One of the most striking features of human societies, in comparison with the societies of other primates, is the egalitarian sharing of resources in many (though obviously not all) situations (Fehr & Fischbacher, 2003; Henrich et al., 2005). Traditionally, it has been thought that this egalitarian tendency emerges in human ontogeny during the school years. The vast majority of studies have investigated young children's sense of equality in interview studies, in which adults have verbally asked children how resources should be divided in hypothetical situations (e.g., Damon, 1977, 1980; Hook & Cook, 1979; Leventhal, Popp, & Sawyer, 1973; Olson & Spelke, 2008; Peterson, Peterson, & McDonald, 1975). In more recent studies, mainly with school-age children, subjects have been asked to divide actual resources between themselves and (usually anonymous) others, often in variations of the dictator and ultimatum games (Benenson, Pascoe, & Radmore, 2007; Blake & Rand, 2010; Gummerum, Hanoch, & Keller, 2008; Gummerum, Hanoch, Keller, Parsons, & Hummel, 2010; Rochat et al., 2009; see Gerson & Damon, 1978, for an earlier study). In a recent paradigm that has been used effectively with preschoolers (3–4 years of age), children can choose to divide resources in one of several predetermined ways that result in selfish, altruistic, or equal outcomes (Brownell, Svetlova, & Nichols, 2009; Fehr, Bernhard, & Rockenbach, 2008; Moore, 2009; Thompson, Barresi, & Moore, 1997). The overall conclusion from all these various studies is that when children are supposed to allocate resources between themselves and others, egalitarian tendencies are initially weak to nonexistent and become predominant only when children reach about 6 to 7 years of age.

There are obvious methodological advantages to these resource-allocation paradigms, because they are typically implemented as an individual choice in a one-shot interaction, in which subject and recipient are anonymous to each other and retaliation or reciprocation is thus impossible. Therefore, these previous experimental paradigms are ideal for studying cooperation in the form of other-regarding preferences and altruism. However, this type of experimental situation might not be representative of all cooperation situations. In particular, these tests of children's active sharing all involve windfall situations, in which resources are given to the children by a third party, with no work or effort involved. Moreover, a forced-choice paradigm with predefined allocation options does not allow for an assessment of how children themselves would actively negotiate over how to distribute resources with another person. Finally, in these forced-choice paradigms, children are supervised by an adult experimenter who asks

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them to make an individual choice regarding an absent social partner, rather than interact with the partner directly.

The present study was guided by the notion that people often do not simply receive new resources, but have to work toward obtaining them, and that they must actively distribute the resources rather than choosing individually between two predefined options. Thus, previous studies have not shown how children will share resources in situations that might be the cradle of equality: actual joint collaborative activities with a social partner.

The connection between joint collaboration and sharing is also of major importance in understanding the evolutionary origins of equality in humans. Specifically, individuals should engage in collaborative efforts only if they can anticipate that the obtained resources will be shared among collaborators. In fact, recent studies with chimpanzees and bonobos (the two closest living evolutionary relatives of humans) indicate that the issue of resource sharing constitutes a major constraint on mutualistic collaboration in nonhuman primates (Chalmeau, 1994; Hare, Melis, Woods, Hastings, & Wrangham, 2007; Melis, Hare, & Tomasello, 2006a, 2006b). To be specific, the stronger the tendency for individuals within a dyad to try to monopolize rewards, the less likely those two individuals are to collaborate. This tendency to monopolize rewards is diminished in bonobos relative to chimpanzees, which raises the possibility that species differences in collaboration can be accounted for, in part, by the proclivity to share resources (Hare et al., 2007). However, researchers have not yet investigated whether or not the opportunity to monopolize resources is an equally constraining factor in young children's peer collaboration.

Therefore, we investigated how very young children actively divide rewards after working for them in a collaborative problem-solving task. We chose to study 3-year-old children because previous research has demonstrated that this is the earliest age at which peers are able to collaborate reliably (Ashley & Tomasello, 1998). In our study, peers worked on a problem-solving task in which they had to first simultaneously pull on a rope in order to move a board holding the desired rewards within reach. To investigate whether the opportunity to monopolize rewards had an influence on collaboration, we varied whether all rewards were clumped in one location (so that it was easier for one child to monopolize them) or dispersed across two locations (so that each child could easily access his or her half of the rewards). In addition to varying the reward location, we varied the type of reward by using food items as well as objects.

Experiment 1

Method

Participants. We tested sixty-four 3-year-old children (M = 36 months 17 days; range = 33 months 27 days to 38 months 8 days) in dyads with a same-sex partner; equal numbers of boys and girls participated. Children were paired with a familiar partner from the same day-care center, where they were tested in a quiet room in a single session (typically 30 min in length). We collected teachers' ratings to assess whether the children in each dyad were equal in status or whether one child was considered to be dominant over the other (Strayer & Strayer, 1976). Fourteen dyads were rated as equal in status, and 18 dyads contained a dominant individual.

Apparatus. The collaboration test was adapted from studies with chimpanzees (Hirata & Fuwa, 2006; Melis et al., 2006a, 2006b). The apparatus consisted of a transparent box (180 × 60 × 15 cm) in which rewards were placed on little plates mounted onto a board. A 370-cm rope was looped around wheels on the corners of the board, with the ends of the rope sticking through holes at the front of the apparatus. The space between the ends of the rope was approximately 130 cm, so neither child could grasp both ends of the rope at the same time. At the beginning of each trial, the board was located at the rear of the box, and the children had to pull simultaneously to move the board. Once the board was moved toward the front of the box, the children could access the rewards either by reaching through one of two windows (dispersed condition; Fig. 1, top panel) or by reaching through a single window that was located in the center of the box, equidistant from the two children (clumped condition; Fig. 1, bottom panel).

Design and materials. We employed a 2 × 2 design with reward (gummy bear, sticker) as a between-dyads factor and location condition (clumped, dispersed) as a within-dyads factor. In each

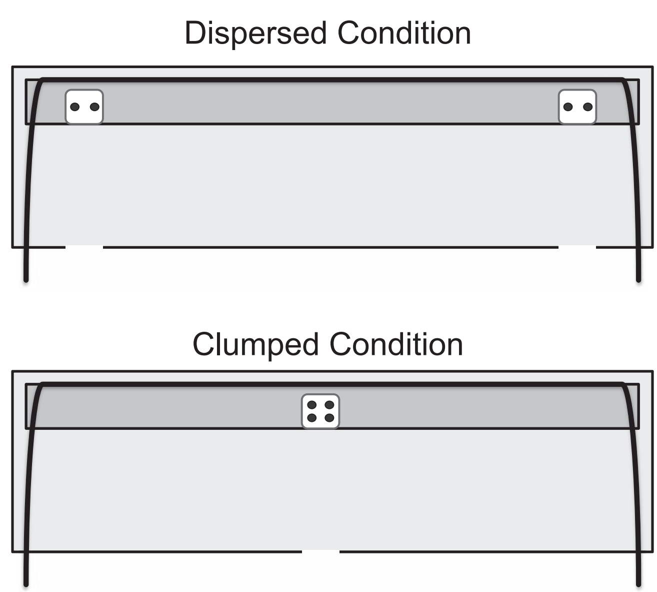

Fig. 1. The problem-solving apparatus. In the dispersed condition, half of the rewards could be reached from each of two windows when the board was moved to the front of the box. In the clumped condition, all of the rewards could be reached from a single centrally located window when the board was moved to the front of the box. During the demonstration, all three windows were open.

trial, four identical rewards were used, either all in the center (clumped) or two on each side (dispersed). Each session consisted of one block of three trials in the clumped condition and one block of three trials in the dispersed condition (six trials in all), with the order of blocks counterbalanced across dyads.

Procedure. *Introduction*. First, during a demonstration, while the two children sat on chairs beside the apparatus, Experimenters 1 and 2 knelt in front of the apparatus. Experimenter 1 gave each child a little color-marked bowl and explained that the children could put things in their bowls to take home. Experimenter 1 then pointed out the openings at the front of the apparatus and demonstrated how to move the board so that it came within reach: Without any rewards in the apparatus, Experimenter 1 pulled one end of the rope a few centimeters, drawing attention to the movement of the other end of the rope, and then Experimenter 2 repeated the same action on her side of the box. Finally, the two experimenters pulled together to move the empty board closer, after which Experimenter 1 reached into all three openings and touched the board. Afterward, in individual pretests, each child performed the task once with Experimenter 1, reaching through all three openings after a successful pull (again without rewards). Sixty of the 64 children were successful in the first trial of the individual pretest; only 4 needed a second attempt.

Test phase. At the beginning of each trial in the test phase, the children waited outside the testing room, where Experimenter 2 first showed them the rewards in a transparent plastic bag. She then went into the room to bait the apparatus. After Experimenter 2 returned, Experimenter 1 gave the children permission to play with the box, at which time the children entered the room, while the experimenters stayed outside. A trial began when the children entered through the door and ended either when the children retrieved and distributed the rewards (by placing them into the bowls to take home or, in the case of the gummy bears, by eating them) or when 60 s had passed and the children had failed to retrieve the rewards.

Coding and dependent measures. Coding was done from video by the second author, and all trials were also independently coded by a research assistant who was unaware of the research question. We distinguished three types of sharing: *active giving* (one child actively transferring an item to the other by handing it over or by placing it into the partner's container), *active communication* (one child prompting the other, by pointing, to take an item), and *passive sharing* (each child taking his or her items, without communication or active transfers). Interrater agreement (κ) was .74. Moreover, we coded for potential conflicts during sharing episodes by recording either *verbal protest* (e.g., "Mine!" or "Me too!") or *nonverbal protest* (taking an item from the other child, or soliciting sharing either by stretching out an arm to the other child with a palm-up gesture or by holding out the bowl to the other child as a request). Interrater agreement (κ) for conflict coding was .83. Preliminary analyses showed that there was no effect of gender, dominance, trial number, or task order on any of these measures. Analyses were thus collapsed across these factors.

Results

First, we analyzed the children's collaborative problem-solving skills by computing the mean percentage of trials in which children successfully moved the board to within reach (Fig. 2). An analysis of variance (ANOVA) showed that the rate of success was not influenced by location condition (clumped vs. dispersed) or reward (gummy bear vs. sticker), all $Fs(1, 30) < 0.3$, all $ps > .6$, all $\eta_p^2 s < .01$. Thus, children were able to solve the task in the majority of trials. Neither the reward type nor the opportunity to monopolize rewards in the clumped condition interfered with the children's collaboration.

Second, we analyzed the children's tendency to share the rewards after collaboration. As dyads did not always successfully pull the board within reach to access the rewards, we used the mean percentage of successful trials in which children divided the rewards equally (2:2) as the dependent measure. As shown in Figure 3, children shared equally in the majority of trials (M = 70% of successful trials). Of particular importance are the results for the clumped condition, in which all four reward items had to be obtained through a single window in the apparatus, which made the rewards easier to monopolize. (In the dispersed condition, by contrast, the children simply retrieved the rewards in front of them, almost always receiving equal shares.) Assuming that the 2 children in a dyad had equal probabilities of monopolizing each item, the binomial probability of an equal split in a given test trial with four items was .375. One-sample t tests revealed that in the clumped condition, children produced equal shares significantly more often than expected by chance, $t(29) = 4.5$, $p < .001$, $d = 0.8$. Thus, even when rewards could be monopolized more easily, the children shared rewards equally most of the time.

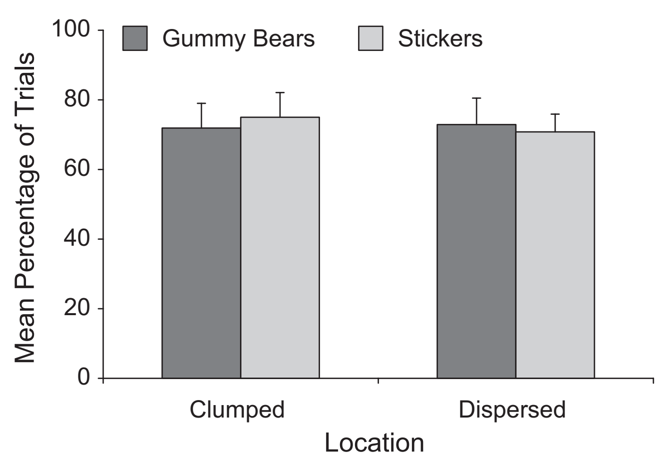

Fig. 2. Mean percentage of trials with successful collaboration as a function of reward and location condition in Experiment 1. Error bars represent standard errors.

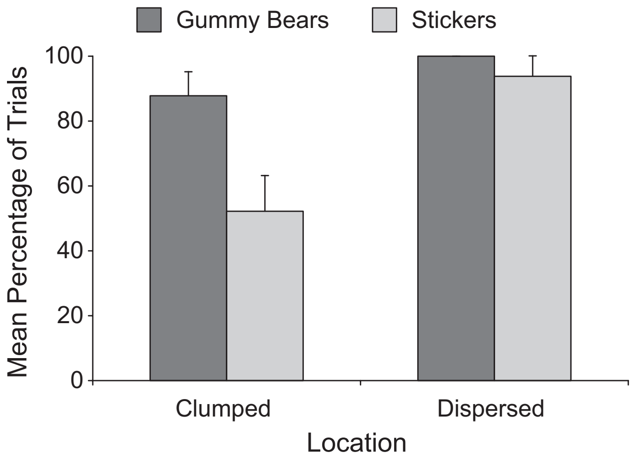

Fig. 3. Mean percentage of successful trials with equal sharing (2:2) as a function of reward and location condition in Experiment 1. Error bars represent standard errors.

In a somewhat surprising finding, children in the clumped condition were more likely to share equally when the rewards were gummy bears than when the rewards were stickers, $t(28) = 2.68$, $p < .05$, $d = 0.9$.

In addition to the number of rewards that the children shared, we were interested in *how* the children shared them. Did the children share spontaneously, or was sharing mainly the outcome of bouts of negotiation or potential conflict? In a majority of clumped trials (M = 81.5%, SD = 25.6), children shared passively—that is, one child retrieved two rewards and left the other two for the other child. In the remaining trials, a child either actively gave a reward to the other child (M = 10.6%, SD = 22.1) or actively communicated (by pointing) that the other child should take a reward item (M = 8.9%, SD = 22.6). In both the clumped and the dispersed conditions, conflicts and protest were nearly absent. There was a single instance of nonverbal conflict, and on only 11 of 138 trials (8%) did a child protest verbally.

Discussion

The first experiment produced two major findings. First, young children collaborate successfully in situations in which resources can be monopolized. This finding indicates that the collaborative abilities of young children, compared with those of chimpanzees, are not constrained to the same extent by a tendency to monopolize resources.

Second, we found that children predominately produce equal shares. They do this at an age when they are just beginning to reliably collaborate with peers and at a much younger age than shown in previous studies, in which equality became the dominant strategy at around 6 to 7 years of age. Strikingly, even in the clumped condition, when rewards could be monopolized more easily, children shared rewards equally most of the time. Experiment 1 also produced the unexpected result that gummy bears were shared equally more often than were stickers. However, as we used only one type of food reward and one type of nonfood reward, it remains unclear whether this difference was due to the specific rewards or to the general relative appeal of food and nonfood items. Moreover, it is possible that this result was due to differences in the value attributed to the rewards. We addressed this issue in Experiment 2 by introducing sets of different food and nonfood items and by including a preference test to assess how 3-year-olds value these items. Moreover, we wanted to probe the robustness of children's equal sharing by focusing exclusively on the clumped condition, in which rewards were easier to monopolize.

Experiment 2

Preference test

To determine the potential effects of reward type and reward value on children's tendency to share, we first created a set of four food items (cookie, gummy bear, piece of rye bread, and piece of crispbread) and a set of four object items (piece of cardboard, colorful cube, plastic frog, and sticker) and conducted a preference test with a sample of twenty-seven 3-year-old children. All eight items were paired against each other in 28 different choice trials per subject. On each trial, two rewards were placed in front of the child, who had to indicate which of the two he or she liked better. Trials were presented in a predetermined randomized order, with the side (right vs. left) of a given reward counterbalanced within subjects.

We calculated the mean number of trials in which a given item was chosen (i.e., the average number of "victories" in the seven matchups of each item). Thus, scores could range from 0 to 7. The mean scores were 3.9, 3.5, 3.2, and 1.9 for the frog, sticker, cube, and cardboard, respectively, and 4.9, 4.4, 3.2, and 2.9 for the gummy bear, cookie, crispbread, and rye bread, respectively. Friedman tests showed that within each type of reward, items differed significantly from each other—food: $\chi^2(3, N = 27) = 27.8$, $p < .001$; objects: $\chi^2(3, N = 27) = 13.0$, $p < .01$. Overall, children preferred the food items over the object items, exact Wilcoxon matched-pairs test ($N = 27$), $T+ = 15$, 2 ties, $p = .027$.

Collaboration test: method

Participants. We tested forty-eight 3-year-old children (M = 35 months 5 days; range = 34 months 0 days to 38 months 5 days) in same-sex dyads; equal numbers of boys and girls participated. None of these children had participated in the preference test. We obtained teachers' ratings of dominance for the 16 dyads that came from the same preschool group. The other 8 dyads were composed of children from different groups, who had thus not interacted with each other on a regular basis prior to the test.

Design and procedure. For each dyad, we administered a block of four trials with food items and a block of four trials with object items. The order of the blocks was counterbalanced across dyads. In each trial, we used four identical items (e.g., four identical stickers). Each trial presented a different reward. The order of the rewards within the blocks was counterbalanced by means of a Latin square.

The apparatus was the same as in Experiment 1. As this experiment focused only on children's sharing after successful collaboration, we made two minor procedural changes to increase the number of trials in which children were able to retrieve rewards. First, we inserted a scaffolding trial during the introduction phase before the actual test. During this trial, the experimenters intervened if necessary, encouraging the children to pull at the same time or stopping a child who was starting to pull before the other child was ready. Second, if the children failed to pull the board so that it came within reach in the test trial, the trial was repeated once. This was seldom necessary (M = 1.3 trials across the 8 trials per session). As in Experiment 1, all demonstrations were conducted with an unbaited apparatus.

Coding and dependent measures. We used the same coding procedure for type of sharing as in Experiment 1 and again obtained a high interrater agreement (κ = .83). Preliminary analyses showed that there was no effect of dominance, familiarity, gender, trial number, or task order.

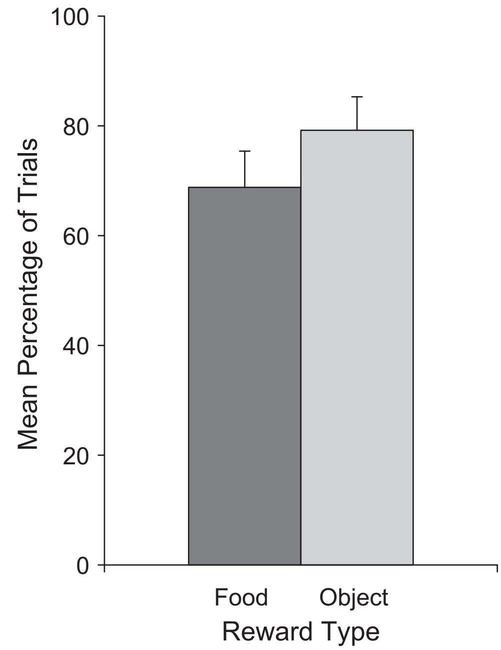

Fig. 4. Mean percentage of successful trials with equal sharing (2:2) as a function of reward type in Experiment 2. Error bars represent standard errors.

Collaboration test: results and discussion

As shown in Figure 4, children once again produced equal shares significantly more often than expected by chance. This was the case both when we averaged across reward types, $t(23) = 6.36$, $p < .001$, $d = 1.3$, and when each reward type was analyzed separately—food rewards: $t(23) = 4.73$, $p < .001$, $d = 1.0$; object rewards: $t(23) = 6.78$, $p < .001$, $d = 1.4$. Thus, in the vast majority of trials, each child received the same number of rewards after collaborating.

A repeated measures ANOVA showed that there was no difference in sharing between the two reward types, $F(1, 22) = 2.25$, $p = .15$, $\eta_p^2 = .093$. Moreover, sharing was not correlated with reward value ($r_s = .02$, $p = .80$). Multilevel logistic regression models confirmed that reward value had no effect, even when controlling for potential item effects (Baayen, Davidson, & Bates, 2008). Specifically, with equal sharing as a binary response, we tested a model including dyad and item as random effects on the intercept and trial number, reward type, and the covariate reward value as fixed effects. None of the factors had a significant effect on the likelihood of equal shares, and neither did the covariate (zs < 1.6, ps > .10). Also, the model did not produce a better fit than a more parsimonious model with reward type and reward value removed, $\chi^2(2) = 2.26$, $p = .32$ (likelihood-ratio test). The tested model also did not differ significantly in goodness of fit from a model in which the effect of reward type was allowed to vary by dyad and item (included as crossed random effects on the slope), $\chi^2(4) = 0.51$, $p = .97$ (likelihood-ratio test). Thus, children's tendency to share equally was not influenced by the type or the value of the reward.

As in Experiment 1, children shared passively most of the time (M = 78.3% of trials with sharing, SD = 29.3). On only a minority of the trials with sharing did a child actively give an item (M = 16.9%, SD = 25.1) or actively communicate that the other child should take an item (M = 4.7%, SD = 9.6).

In summary, once again equal shares predominated. Thus, Experiment 2 replicated the main result from Experiment 1 and showed, in addition, that this tendency is prevalent across different types of rewards and different reward values.

General Discussion

These two experiments demonstrate that at an age when children are just beginning to skillfully collaborate with peers, they already engage in sharing behavior that results in equitable outcomes. The opportunity to monopolize rewards does not pose a problem for human children in their collaborative efforts or in their sharing of resources after a collaborative effort. In this regard, human children present a striking contrast to chimpanzees, whose collaboration is severely constrained by their tendency to compete over the spoils of collaborative efforts (Melis et al., 2006b). In fact, bonobos appear to be more similar to human children than to chimpanzees, at least in their ability to successfully engage in mutualistic collaboration and to refrain from interfering with each other when accessing monopolizable food; however, it is not known whether bonobos, like human children, produce equal shares after collaboration (Hare et al., 2007).

These findings support the evolutionary hypothesis that the emergence of sophisticated forms of cooperation is due not only to cognitive and behavioral skills, but also to a reduction in competition over resources. In fact, it has been proposed that mutualistic cooperation critically depends on the agents' ability to predict future rewards and their tendency to share those rewards at the end of the activity (Tomasello, 2009). Both naturalistic observations and laboratory experiments have shown that chimpanzee cooperation in food contexts is highly constrained by competition over the spoils, because individuals often try to defend a carcass against other individuals, and they tend to give resources under duress rather than to divide up the prey actively (Boesch & Boesch, 1989; Gilby, 2006; Melis et al., 2006b; Stevens, 2003). The present study suggests that competition over resources is mitigated in human children by an emerging sense of equal sharing of the spoils, which enables successful collaboration even early in ontogeny.

It remains an open question why the children in our study produced equitable outcomes at a much younger age than has been previously demonstrated in individual-choice paradigms with absent others (Blake & Rand, 2010; Fehr et al., 2008; Moore, 2009; Rochat et al., 2009). One factor that might contribute to the difference is the situational context of the studies: In our experiments, the two partners interacted directly with each other, whereas in previous studies, one child decided individually about the distribution of resources between him- or herself and an absent partner. In particular, a child who is age 3 or younger may have problems taking the perspective of another (absent) child and imagining his or her potential thoughts and desires. It is known that children at this age have difficulty taking into account the desires of absent individuals—and even their own future desires. Specifically, 3-year-olds have problems making the prudent decision to forgo an immediate benefit in order to gain a greater future benefit for themselves (Thompson et al., 1997). Given that prudence correlates with altruistic decision making (which benefits another person, rather than one's future self), the ability to represent one's own future desires and the ability to represent another person's future desire might follow similar developmental trajectories (Thompson et al., 1997) and share similar cognitive processes (Mitchell, 2009). It is thus possible that children are able to produce equitable outcomes early in development only when the partner is present, and that the perspective-taking skills they acquire in middle childhood enable them to produce equitable outcomes in situations that require them to co-represent the desires of absent individuals.

Another factor that may have facilitated equality in our study is the fact that the children were working toward a common resource. This raises interesting questions about the origins of equality. The situation of peers jointly collaborating toward a mutual outcome might exemplify the fundamental context in which a sense of equality emerges. Piaget (1932) proposed that the interaction among peers provides the genuine basis for equality and fairness, because children of similar status have to balance their own claims with those of their peers until they arrive at a mutually acceptable solution, rather than adopting heteronomous norms from authorities such as parents. Taking this idea one step further, one might speculate that children learn to acknowledge each other's right to gain equal resources in situations in which they collaborate to produce a mutually beneficial outcome that one person acting alone would not be able to achieve.

Future research should investigate when peers begin to share the resources they obtain through mutualistic collaboration according to equity rather than equality (i.e., when they start to divide resources proportionally on the basis of the effort each partner put into the task; Damon, 1977). One interesting avenue of research is the relationship between collaborative effort and group membership, especially the question of how children weigh the role of familiarity and friendship against the claims of other people contributing to the joint enterprise.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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