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How 18- and 24-month-old peers divide resources among themselves

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ABSTRACT

Young children are often considered "selfish" with resources because they are reluctant to give up things already in their possession (e.g., as in dictator games). In the current two studies, we presented pairs of 18- and 24-month-old toddlers with various situations involving resources that no one possessed ahead of time. We observed very few instances of individuals attempting to monopolize the resources; rather, the pair peaceably divided them such that each child got something. Equal divisions—even involving one child sacrificing his or her own resources to establish equality—were especially pronounced when children were acting together jointly even in the absence of active collaboration. Children's divisions were also influenced by cues to ownership such as a spatial pre-division of resources and resources marked by color (and originally spatially associated with one individual). These results suggest that young children are not selfish, but instead rather generous, with resources when they are dividing them among themselves.

Introduction

When young children are in possession of resources, they are not very generous in giving them away to others. This is apparent both in natural observations in which preschool children are mostly

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reluctant to share their toys with others (e.g., Eisenberg-Berg & Hand, 1979; Levitt, Weber, Clark, & McDonnell, 1985; McGuire, Manke, Eftekhari, & Dunn, 2000) and in experimental situations resembling a dictator game in which preschool donators across many different cultures tend to keep the majority of resources for themselves (e.g., Benenson, Pascoe, & Radmore, 2007; Blake & Rand, 2010; Fehr, Bernhard, & Rockenbach, 2008; Rochat et al., 2009; Thompson, Barresi, & Moore, 1997). This is despite the fact that, when asked, 3-year-olds explicitly endorse the principle of egalitarianism (Smith, Blake, & Harris, 2013). In general, it is only by school age (5–9 years) that young children share resources that have been given to them equally or generously with others (e.g., Benenson et al., 2007; Fehr et al., 2008; Gummerum, Hanoch, Keller, Parsons, & Hummel, 2010; Kogut, 2012; Lane & Coon, 1972; Malti, Gummerum, Keller, Chaparro, & Buchmann, 2012; Rochat et al., 2009).

Obviously, in dictator game-type situations there is some kind of competition between children's selfish and generous or egalitarian motives. This is clear from two other situations of resource division. First, in some experiments children are asked to divide resources among third parties. In these scenarios, there is a strong tendency toward equal distributions (Frydman & Bryant, 1988; Peterson, Peterson, & McDonald, 1975; Rochat et al., 2009). In fact, in a number of studies preschool children must be given uneven numbers of resources to do anything other than allocate resources strictly equally among others (e.g., Olson & Spelke, 2008; Svetlova & Brownell, 2015). Even infants seem to expect equal distributions among third parties (Geraci & Surian, 2011; Schmidt & Sommerville, 2011; Sloane, Baillargeon, & Premack, 2012; Sommerville, Schmidt, Yun, & Burns, 2013).

The second situation in which preschool children are generous and/or egalitarian involves collaboratively produced resources. Hamann, Warneken, Greenberg, and Tomasello (2011) had pairs of 3-year-olds encounter a situation in which one of them had three rewards (the lucky child) and the other had only one reward (the unlucky child). What differed across three experimental conditions was what led to this asymmetrical distribution. In one condition, the unequal distribution resulted from participants simply walking into the room and finding three rewards versus one reward at each end of a platform. In this situation, the children were selfish; the lucky child almost never shared with the partner. In a second condition, each child pulled his or her individual rope to obtain the rewards. Here the lucky child shared approximately one third of the time. But in a final condition, the asymmetrical rewards resulted from an equal collaborative effort on the part of the two children pulling one rope together. To begin, children saw a clump of resources (as well as their partner seeing the clump of resources), and there was no sense that the resources were "mine"; either they were no one's or else they were "ours" as they worked together to obtain them. Here the lucky child shared one reward with the unlucky child (to create an equal 2:2 split) nearly 80% of the time. This is by far the youngest age at which children have been shown to respond to an advantageous inequity by correcting an unequal outcome requiring a sacrifice on their part.

What is common to these two situations in which preschool children are generous and/or egalitarian is that they do not begin in possession of any objects. In third-party situations, the children have no stake in the distribution at all, and so their selfish motives are not relevant. In the sharing after collaboration situation, each peer sees the same clump of resources without thinking of them as "mine"; thus, there is no issue of them needing to relinquish resources that are already in their possession. A related reason why preschool children appear to be selfish in most resource distribution studies is that they typically make their distributional decision unilaterally. That is, a child decides how to allocate resources between himself or herself and a passive or absent agent. The few studies that have found infants keen to share goods with others generously have elicited this generosity via an adult's direct request (Brownell, Svetlova, & Nichols, 2009; Dunfield, Kuhlmeier, O'Connell, & Kelley, 2011; Schmidt & Sommerville, 2011). Arguably, however, the most "natural" situations for children in dividing resources—for most of human evolution and in most human societies—are situations in which children must decide among themselves how to divide up resources (Hamann et al., 2011; see Hay, Caplan, Castle, & Stimson, 1991, for natural observation; see Warneken, Lohse, Melis, & Tomasello, 2011, for experimental studies). These observations raise the possibility that even younger preschool children might act generously and/or fairly in situations in which they decide with a partner, bilaterally, how to divide up non-owned resources between themselves.

In the current three studies, therefore, we looked at how pairs of 18- and 24-month-old children divided resources when neither child possessed any of the resources at the outset. In a first study, we simply observed children's spontaneous division of resources as they encountered a clump of divisible resources simultaneously. In two subsequent studies, we explored various factors that might influence children's behavior in the situation, for example, whether or not the resources were produced via collaboration and whether or not the resources were provided with some cues of pre-possession.

Study 1

The first study was designed to be as simple as possible. We provided 18- and 24-month-old peers with a windfall of identical resources—which they approached simultaneously—and we then looked at how they divided them.

Method

Participants

Participants were 24 18-month-old children (range = 17–19 months) and 24 24-month-old children (range = 23–25 months). Children were tested in same-sex and mixed-sex dyads (7 female, 8 male, and 9 mixed pairs). One additional dyad needed to be excluded due to shyness. All children were native German speakers, were recruited from urban day-care centers, and came from mixed socioeconomic backgrounds.

Design and materials

The experimenter (E) sat behind a small table (55 × 55 × 55 cm) with one child to her left and one child to her right (see Fig. 1). A small container with a lid containing four identically colored marbles (diameter = 2 cm) was placed in the center of the table. In addition, a box with a xylophone inside and a tube attached to it, the "jingle box" (see Warneken, Hare, Melis, Hanus, & Tomasello, 2007), was placed opposite E and within reaching distance of the children. When marbles were thrown into the jingle box, they produced a fun sound and disappeared.

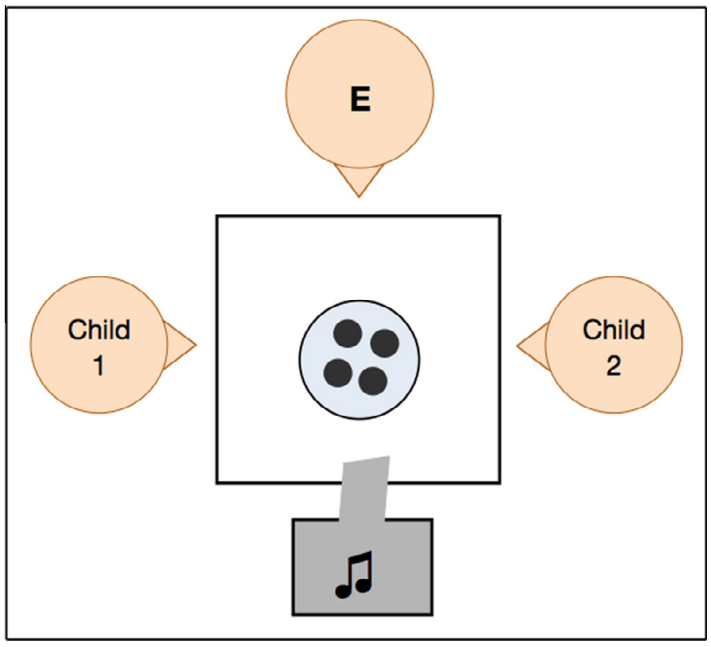

Fig. 1. Bird's-eye view at the test situation in Study 1.

Procedure

Pairs of familiar children were tested in a quiet room in their day-care centers. All testing was done by one female experimenter. After a short familiarization period in their playgroup, children were brought to the testing room. Each session was videotaped and lasted approximately 7 to 10 min.

Once children were present in the test room and in their correct positions at the table, E presented the marbles and pronounced that they are used to play a fun game called the jingle game. She demonstrated the game by throwing two marbles into the jingle box and invited children to play the game too. She opened the container by lifting the lid and revealed four marbles. Then E looked down to the floor, waiting until children had thrown the marbles into the jingle box. Once this was accomplished, the next trial was administered; E hid the marbles in the container, lifted the lid, and again invited the children to play. Overall, four repeated test trials were administered. There were four cases of invalid trials (three because a marble fell down and one because of experimenter error) that were not used in any analyses.

Coding and reliability

Coding was done from video by the experimenter. One quarter (25%) of the sample was randomly selected and coded for reliability by a second observer who was unaware of the hypotheses of the study. They coded which kind of divisions children finally achieved, discriminating *equal divisions* (2:2) and *unequal divisions* (3:1 or 1:3) and, as a special case of the latter, *monopolizations* (4:0 or 0:4). The final division was defined by how many marbles each child eventually threw inside the jingle box. The inter-rater agreement for type of division was perfect ($\kappa = 1.0$).

In addition, we looked at *how* children achieved this division. We distinguished four different categories ($\kappa = .90$): handing over a marble to the other peer, stealing a marble out of the peer's hand, taking turns (one child starts to take out his or her share and pulls back from the container, then the other child is approaching, and so on, until the container is empty), and haphazard behavior (children taking and reaching for the marbles in a chaotic uncontrolled manner, e.g., by simultaneous grabbing).

Results and discussion

Preliminary analyses revealed no effect of age, gender, or trial number (all *ps* > .28); hence, division rates were collapsed across age and gender and averaged over trials for every dyad. As illustrated in Fig. 2, both 18- and 24-month-old children distributed the resources in every manner possible; they distributed them equally 44% of the time, distributed them unequally 37% of the time, and monopolized 19% of the time. Accordingly, general divisions (describing equal *and* unequal splits) were the

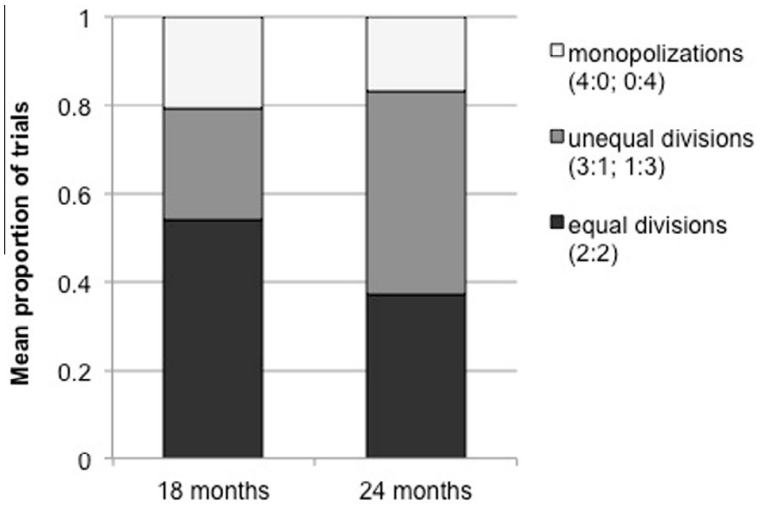

Fig. 2. Relative frequency of the three possible division outcomes in Study 1 by age group.

prominent ways in which to distribute resources. Comparing each outcome proportion with its respective binomial probability with one-sample *t*-tests (with a Bonferroni-corrected alpha level of .016 for multiple testing) revealed that all three divisions (2:2, 3:1, and 4:0) did not differ from the rates expected by chance (all *ps* > .07). Assuming that the two children in a dyad had equal probabilities of monopolizing each of the four rewards in a given test trial, the chance level was .375 for equal divisions, .125 for monopolizations, and .500 for unequal splits. The general outcome, then, was that children quite often split the marbles between each other (fairly frequently in an equal manner), and they seldom monopolized them; thus, children rarely left the game empty-handed.

In a second step, we investigated how children reached the final outcome. There was no difference in behavior between the two age groups ($p = .96$). For monopolizations the pattern was straightforward; usually, one child took all of the marbles while the peer watched passively without interfering and was left empty-handed as a result. Fully 89% of monopolizations were always performed by the same child of the dyad across all four trials. Only one dyad had shared the outcome earlier before one child monopolized the outcome in the last two trials. Shared divisions (either equally or unequally) varied more between trials within a dyad; only 3 of 18 dyads who performed equal splits did so over all four trials, and only 1 of 17 dyads shared the spoils exclusively in a 3:1 manner. Thus, the majority of dyads produced both equal and unequal divisions (almost always with the same child getting the three marbles) over trials. Children reached these divisions mainly by haphazard behavior (64%) or by taking turns picking the marbles (28%). Cases of giving (3%) or stealing (5%) were rare. We observed no cases in which children displayed protest behavior. One reason for that might be that the actual division situation was rather quick (take the marbles out of container and throw them immediately into the jingle box) so that children had little time to protest.

Thus, Study 1 showed that when interacting with a peer, young toddlers rarely monopolized all available resources. Although children divided the pool of resources in a manner that did not differ from chance, their final divisions rarely left one peer empty-handed and, thus, do not match the picture of the selfish toddler. In addition, the behavioral coding suggested that the final outcomes did not result from two selfish children clashing over resources. The children simply took what they wanted either simultaneously or in an alternating manner, with almost no fighting or protesting. At the very least, we may say that they divided the resources in a peaceable and tolerant manner.

Study 2

In the second study, we investigated whether and how certain factors influence how 2-year-old peers divide resources, especially how the resources were acquired (e.g., by windfall or through collaborative efforts). Previous research has shown that children become skillful collaborators, participating effectively in simple joint activities with peers, only at around their second birthday (e.g., Brownell, Ramani, & Zerwas, 2006; Eckerman, Davis, & Didow, 1989). Therefore, we focused on 24-month-old children. Whereas children's familiarity with their partner was uncontrolled in the first study (which might have influenced the ways in which they distributed resources; see Moore, 2009), this time only children who were previously unfamiliar with one another were tested. Furthermore, in some cases we gave children some weak cues of "possession"—for example, having the resources pre-sorted into piles and having children assigned with a particular color of marble before a later act of division—to see whether these factors influenced their division behavior.

Method

Participants

We tested 128 24-month-old children paired in unfamiliar same-sex dyads (64 girls and 64 boys, age range = 23 months 0 days–25 months 0 days). Children were recruited from a database of parents who volunteered to participate in child development studies and came from mixed socioeconomic backgrounds. An additional 14 dyads needed to be excluded because they did not reach the criterion number of valid test trials (see "Procedure" section below for details) due to fussiness ($n = 4$), because they lost motivation in the game ($n = 6$), or because they needed support in handling the apparatus

during testing ($n = 4$). A further 4 dyads did not successfully learn to handle the apparatus during demonstration.

Materials

Rewards. Children received colored marbles as rewards (diameter = 4 cm; non-swallowable and possible to carry at once). In this study, each child got his or her own personal jingle box, which was either blue or red. These jingle boxes were located some distance from the study apparatus to give children more time to react more diversely (e.g., with protest behavior). Depending on the condition, children either faced four green marbles (*one-colored* condition) or two red and two blue marbles (*two-colored* condition). In the latter case, each child was implicitly assigned to one color during the demonstration phase because of the child's blue or red jingle box. However, the colors were never pointed out explicitly. In equal allocation scenarios, each child received two marbles of his or her assigned color. For unequal allocations, the "lucky" child got two marbles of his or her assigned color and one marble of the other color.

Apparatus. The test apparatus consisted of a large transparent box ($60 \times 60 \times 60$ cm; see Fig. 3A), on top of which the experimenter placed marbles that were visible but unreachable for the children. By pushing special boards, children could make the marbles fall through circular openings, roll down marble runs, and eventually end up in accessible trays. There was either one big tray merging both marble runs that caused the rewards to intersperse (*pooled rewards*) or two smaller trays catching the marbles from each marble run separately (*pre-distributed rewards*) (see Fig. 3B).

The boards varied between two *work* conditions. In the c*ollaborative work* condition, both children needed to push their boards jointly in order to make the marbles roll down the marble runs; thus, children contributed mutually. In addition, springs were attached to the boards to ensure that both children needed to keep their board pushed in the very end position simultaneously in order to receive the marbles. In the *parallel work* condition, boards could be operated individually regardless of the peer's action. The experimenter could manipulate the outcome (i.e., which marble rolls down which marble run; see Fig. 3A) without the children's awareness, allowing for equal (2:2) and unequal (1:3 and 3:1) allocations. Hence, in pre-distributed trials, one individual ended up with three marbles ("lucky" child), whereas the "unlucky" child received only one marble.

Design

Children were randomly assigned to one of four conditions (16 dyads in each) resulting from a cross of a two (*work effort:* collaborative work/parallel work) by two (*resource coloring:* one-colored/two-colored) design (see Fig. 4). The number of boy and girl dyads was matched across conditions. Participants were assigned to a side (and hence color) randomly.

Children underwent a demonstration phase and a test phase. The test phase consisted of two blocks: six trials with pooled rewards followed by six trials with pre-distributed rewards. Testing always started with the pooled rewards block because pilot data revealed that if children began with pre-divided resources they tended to simply accept this pre-division and not redistribute marbles. The lucky and unlucky roles were alternated over trials within a dyad.

Procedure

Testing took place in a quiet room in a child laboratory and was done by one female experimenter (E). Each child was accompanied by a caregiver, who remained in the room pretending to read a magazine. The caregivers were carefully instructed to casually encourage their children to keep on playing and to provide comfort if necessary, but not to interfere with the procedure (e.g., they were allowed to praise their children for putting marbles into the jingle boxes but did not get involved in the division process). The testing lasted approximately 20 to 30 min and began with a short free-play period to warm up. As soon as the children were comfortable, the actual testing started.

Demonstration phase. The initial demonstration phase introduced the apparatus employing equal resource distributions presented in separated trays and was identical for both color conditions (except for using either one- or two-colored marbles). First, E positioned the personal jingle box on the floor in

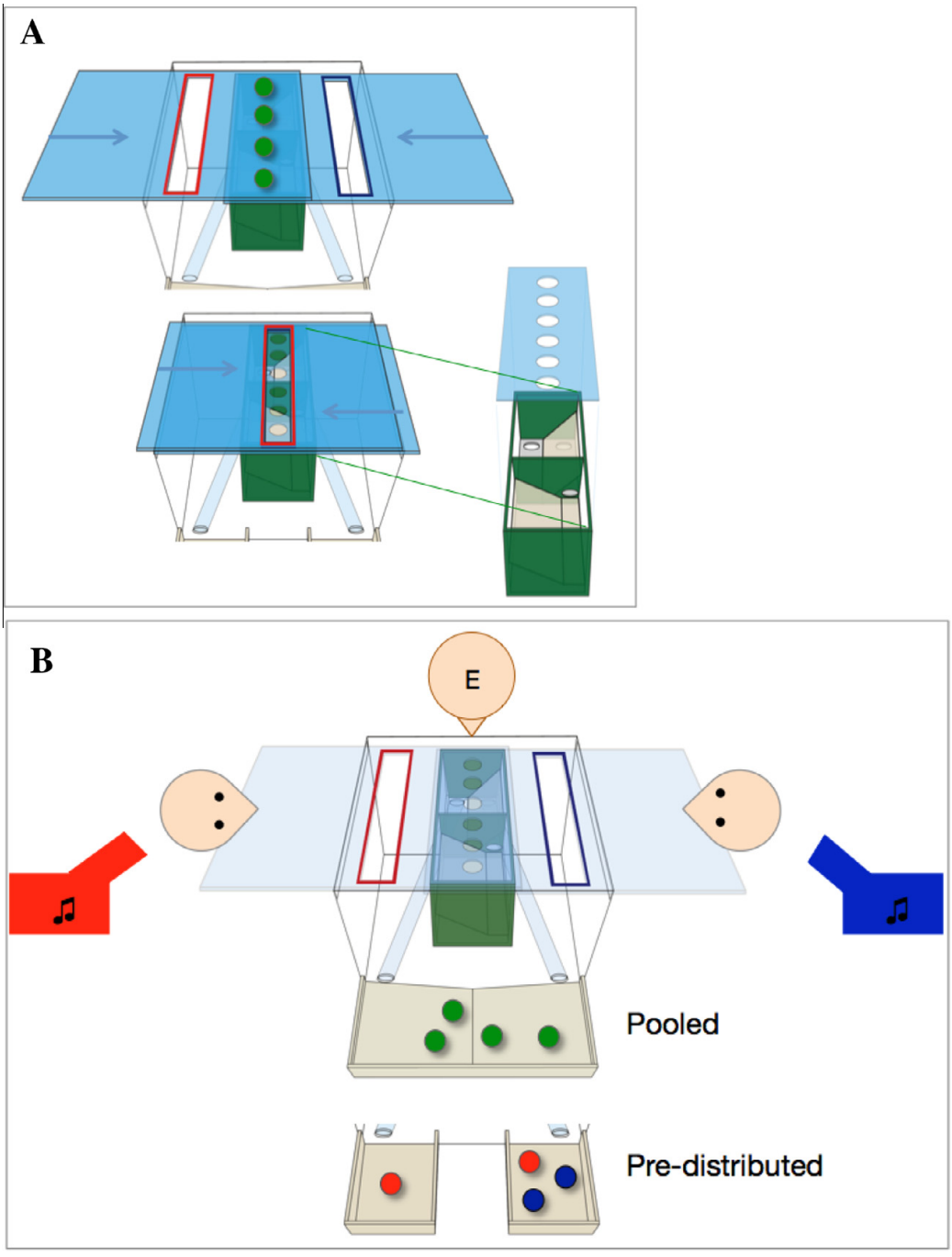

Fig. 3. (A) Study apparatus for Study 2. The mechanism consisted of a table with two boards, one on each side. Each board had openings. By pushing the board inside (either independently, in the parallel condition, or simultaneously with the partner pushing his or her board, in the collaboration condition), these openings superposed and marbles placed on top fell into marble runs. E could surreptitiously manipulate the allocation of marbles without children's knowledge. (B) Children stood on opposite sides of the apparatus. Marbles landed either in one tray (pooled location) or in two trays (pre-distributed location).

front of each child and encouraged the child to throw marbles inside (Trial 1). Next, E introduced the children to the apparatus, where they found two more marbles laying in each tray (Trial 2). Children were told that there were many more marbles to play with but that they needed to operate the apparatus in order to receive them.

In the collaborative work condition, children experienced (with physical assistance from E) that they were unsuccessful in retrieving the marbles if they pushed the board alone but that they were successful if they operated the board simultaneously (Trials 3 and 4). Subsequently, E encouraged both

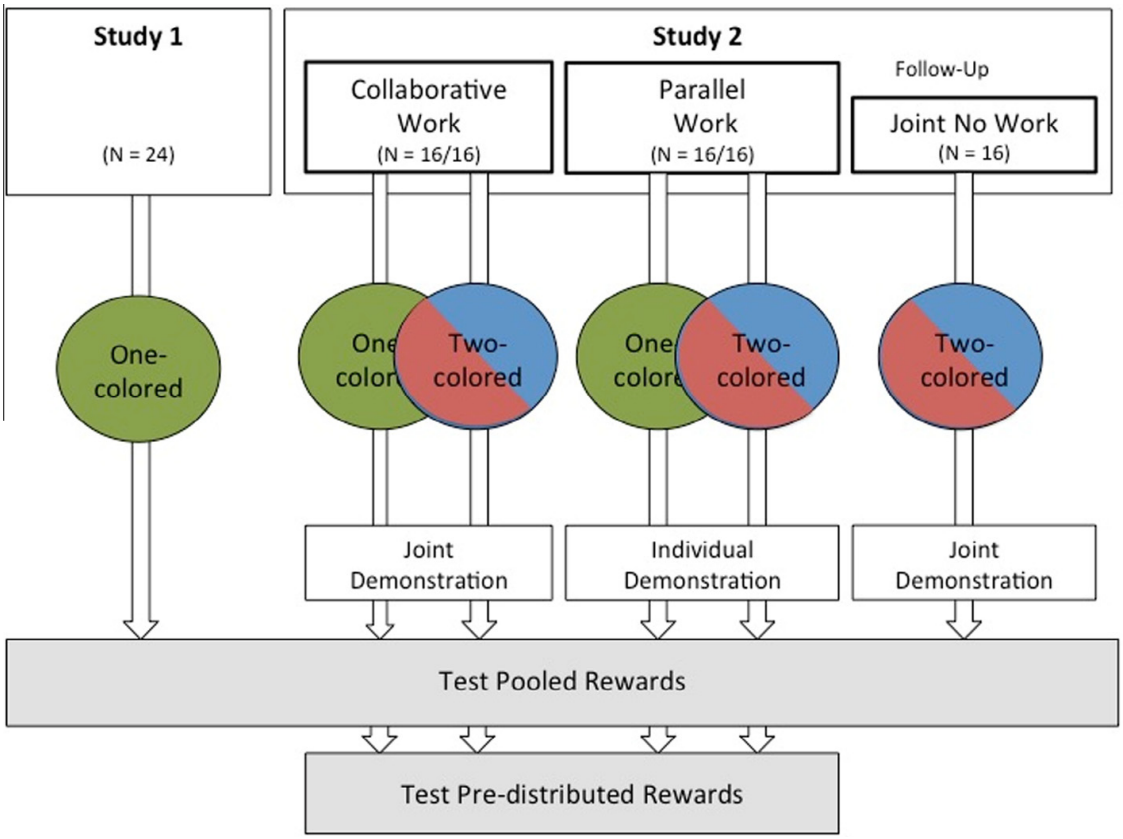

Fig. 4. Overview of experimental conditions and test phases in Studies 1 and 2. *N* values refer to the number of dyads tested in each condition.

children to push in synchrony, providing less and less assistance over time (Trials 5–8). Instructions always referred to the necessity to push the boards jointly in order to receive the rewards ("In order to obtain the marbles, you [plural; German: *ihr*] need to push your boards in together!").

In the parallel work condition, the demonstration was performed individually (i.e., one child at a time). This was done in order to ensure that children understood that no partner was required to retrieve the rewards. Over seven trials, children learned to push their board inside in order to get to their marbles until they finally accomplished the action without E's help. Instructions were similar to those for the collaborative work condition but without reference to a joint action ("In order to obtain your marbles, you [singular; German: *du*] need to push your board in!"). In Trial 8, children were reunited, operating the apparatus individually but at the same time.

Finally, in Trial 9, all children were expected to gain the marbles without E's support to proceed to the test phase. Once all marbles reached the trays, E said, "Get your marbles!" and lowered her gaze in order to avoid eye contact with the children. Subsequently, she stretched out both arms and pointed to the two jingle boxes on each side, also emphasizing verbally that the marbles can be used to play with them.

A total of 58 dyads proceeded to the test phase subsequent to the last demonstration trial. The remaining 6 dyads needed one or two additional trials to enter the test phase. During the course of testing, children were encouraged to continue collecting the marbles and were always praised after they put them in their jingle boxes successfully. Children using the other child's jingle box were praised as well and were reminded where their assigned box was.

Test phase. At the beginning of each test trial, E held up all four marbles visible to both children and placed them on top of the cube. E's verbal instructions and behavior were identical to those for the demonstration phase and given with each trial. Testing was conducted in two blocks. First, all four

marbles ended up bunched together in one tray (pooled rewards). Second, marbles separated unevenly in two trays (3:1 split, pre-distributed rewards).

A test trial was considered as invalid if children needed E's support to handle the apparatus (except for minimal assistance such as verbal repetition of instructions or demonstrating the directions that the board needed to be pushed), if marbles were left in the tray, if parents intervened with the procedure (e.g., by instructing their children or interfering during division), or if children showed no interest in the marbles (e.g., by walking or looking away). Children with less than four of six possible trials per test block were excluded from the analysis (see "Participants" section above). Among the included children, less than 1% of a total of 768 trials were labeled as invalid. There were more invalid trials in the collaborative work condition than in the parallel work condition (32 vs. 16 invalid trials), $\chi^2(1) = 5.69$, $p = .02$, although without relation to color or arrangement.

Coding and reliability

Division type. Coding for the pooled arrangement block was identical to that in Study 1 and differentiated between *equal divisions* (2:2) and *unequal divisions* (3:1 or 1:3) as well as *monopolizations* (4:0 or 0:4). We excluded trials from coding if a division was physically enforced by one child under strong protest of the other ($n = 3$ trials) because in this case sharing occurred nonvoluntarily. For pre-distributed arrangements, we noted whether the "lucky" child who gained three marbles would share the spoils with the "unlucky" peer, either by giving up one marble (resulting in an *equal* division; 2:2) or by giving up two marbles (resulting in a *generous* division; 1:3), or whether the child would simply leave the initial allocation *unchanged* (3:1). Incidences of monopolizations (4:0 or 0:4) were coded as such. The inter-rater agreement over both blocks was almost perfect ($\kappa = .99$).

Behavior. For pooled arrangements, we distinguished four behavioral patterns identical to the categories of Study 1. Coding categories were different for pre-distributed trials given that their setup allowed for, and actually elicited, different behaviors. First, because roles were not interchangeable anymore, we focused on one child (the lucky child) and not on the dyad. Moreover, we considered only trials in which the pre-distribution of marbles was changed, ignoring all trials in which children simply took what they found in their trays (*unchanged* division type). Three different costly behaviors in which the lucky child released at least one resource were coded: *active transfer* (lucky child actively transfers resources to the unlucky peer by handing it over or by placing it into the unlucky peer's tray), *passive transfer* (lucky child leaves marbles behind in his or her tray and lets the other child pick them up), and *tolerated theft* (unlucky peer steals items). On the other hand, lucky children could maximize their gain (and thus monopolize resources) by either actively *taking* items away from the unlucky peers (or out of their trays) or *accepting* items being given to them. If more than one behavior was observed, only the last behavior that ultimately led to the final division was coded.

Communication. We coded for possessive descriptions ("Mine!", "Julia's!"), protest (children showing distress in relation to the division, e.g., pointing to the peer whining, showing protest, saying "No!" or "That is mine!" in an unhappy manner), and requests (children pointing to, reaching for, or verbally requesting a marble). Overall reliability for children's behavior and communication was very good ($\kappa = .89$).

Analyses

Study 2 featured two distinct ways of resource arrangement. Due to the incomparability of both placement and accessibility of marbles (pooled resources were positioned in one tray equally accessible by each child, whereas pre-divided resources were located in two separated trays, implying varying distances to each child) and their fixed order of administration, pooled and pre-distributed reward blocks were analyzed separately.

The primary analyses for pooled rewards focused on both general divisions (combining equal and unequal split-ups) and equal divisions, addressing the likelihood for *any* distribution versus a strictly *fair* distribution. For pre-distributed trials, analyses focused exclusively on equal division rates, that is, whether lucky children who gained three marbles would share one marble. All analyses were done using general linear mixed models (GLMM; see Baayen, Davidson, & Bates, 2008). Specifically, with

division behavior as the binary response (e.g., equal share yes or no), we tested a model that included the main predictors work effort (collaborative or parallel) and resource coloring (one-colored or two-colored) while controlling for gender and trial number (1, 2, 3, 4, 5, or 6). Dyad identity was fitted as random effect to control for repeated measures. We examined significance using both likelihood ratio tests (LRTs) by comparing the fit of the full model with that of the respective reduced model and the *p*-values provided by the final model. The general procedure was as follows. First, we created a full model that included all possible predictor variables and their interactions. Second, we compared the full model with a null model that included only child identity and trial number to test whether the inclusion of predictors provided a better fit to the data overall. Unless noted otherwise, all full models provided a better fit to the data than null models. Third, the final model was created from the full model by sequentially dropping single terms from the model and testing whether their inclusion improved the model fit.

Results

Pooled rewards

Primary analysis. Children produced equal splits (2:2) in 58% (*SD* = 37) of trials, unequal splits (3:1) in 23% (*SD* = 30) of trials, and selfish divisions in 19% (*SD* = 39) of trials (see Fig. 5). Analysis regarding general divisions (2:2 *and* 3:1 divisions) revealed a significant main effect of work effort (*Estimate* = −1.91, *SE* = 0.83, *z* = −*2.31*, *p* = .02); children were more likely to divide the rewards between each other than to monopolize them after they had worked for the spoils collaboratively (*M* = .89, *SD* = .20) than in parallel (*M* = .72, *SD* = .36). On the other hand, resource color had no effect on how children divided the spoils (*Estimate* = −0.96, *SE* = 0.83, *z* = −1.16, *p* = .25). There was no interaction between the two predictors (*p* = .19; hence excluded from the final model). Further analysis showed that there was no effect of gender (*p* = .32) but that non-monopoly divisions decreased slightly over trials (marginal effect of trial number; *Estimate* = −0.31, *SE* = 0.19, *z* = −1.62, *p* = .10).

Second, we focused on children's tendency to produce equal divisions (2:2). The final model revealed that equal divisions tended to occur more often after collaborative work (*M* = .64, *SD* = .35) than after parallel work (*M* = .50, *SD* = .38); main effect of work effort: *Estimate* = −1.11, *SE* = 0.64, *z* = −1.75, *p* = .08. Significantly more equal splits were accomplished if resources were two-colored marbles (*M* = .72, *SD* = .37) as compared with same-colored marbles (*M* = .43, *SD* = .31); main effect of color: *Estimate* = −2.48, *SE* = 0.64, *z* = −3.87, *p* < .001. Notably, there was no interaction between

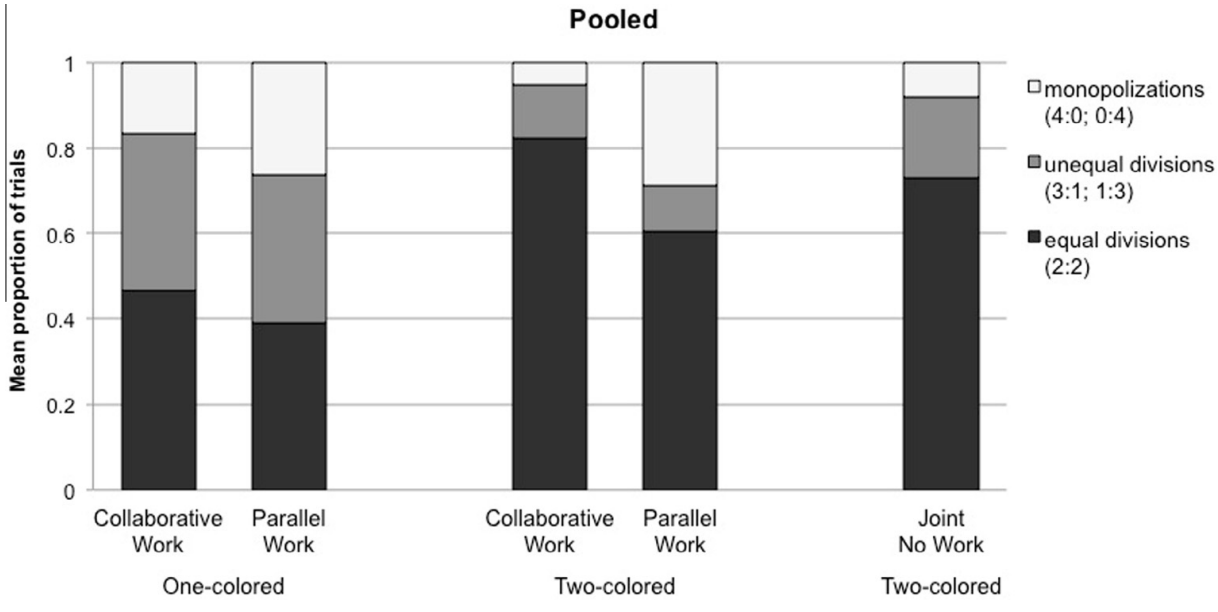

Fig. 5. Relative frequency of the possible division outcomes in Study 2, pooled resource location. The condition "joint no work" was conducted as a follow-up.

conditions ($p = .28$) or gender difference ($p = .18$), but there was a decrease of equal divisions over trials (effect of trial number; *Estimate* = −0.35, *SE* = 0.14, $z = -2.43$, $p = .02$).

Secondary analyses. We also investigated whether the way in which children reached the final outcome followed a certain behavioral pattern. Monopolizations were accomplished in more or less the same way, with one child approaching the tray first and monopolizing all resources while the other child watched passively. Divisions among children (i.e., equal and unequal splits) arose primarily out of haphazard behavior (60%) or were reached by taking turns (35%). Incidences of giving and stealing were rare (5%). This pattern was the same irrespective of work and color condition ($ps > .27$) but differed according to whether equal or unequal divisions were produced, $\chi^2(1) = 19.78$, $p < .001$. Whereas equal splits (2:2) were often accomplished either by haphazard behavior (54%) or turn-taking behavior (41%), unequal divisions (3:1) originated mainly from haphazard actions (81%).

Protest reactions were observed during monopolizations (14% protests and 12% requests) as well as with unequal divisions (12%); they were less frequent with equal divisions (4%). Protest behavior did not differ between work conditions ($p = .86$) but showed a trend to occur more often if resources were two-colored rather than one-colored, $\chi^2(1) = 2.73$, $p = .10$. Possessive descriptions occurred in 13% of trials and were made more often when resources were two-colored (72%) rather than one-colored, $\chi^2(1) = 10.21$, $p < .001$, whereas work effort had no impact ($p = .32$).

Pre-distributed rewards

Primary analysis. Equal splits (2:2) were produced in 36% (*SD* = 37) of trials (see Fig. 6). In nearly half of the trials, distributions remained unchanged (3:1; *M* = .48, *SD* = .35), and generous redistributions (1:3) rarely happened (*M* = .06, *SD* = .30). Here, analysis focused exclusively on equal divisions, that is, whether lucky children who gained three marbles would equalize the outcome by sharing one marble with their peer. Besides dyad identity, we also included individual identity (lucky child) as a random effect into our GLMMs due to the fact that coding was conducted on the individual level rather than the dyad level for the pre-distributed test block. The final model revealed a significant influence of resource coloring (*Estimate* = −2.51, *SE* = 0.72, $z = -3.47$, $p < .001$), revealing that two-colored resources were more likely to be equalized (*M* = .50, *SD* = .42) than same-colored rewards (*M* = .22,

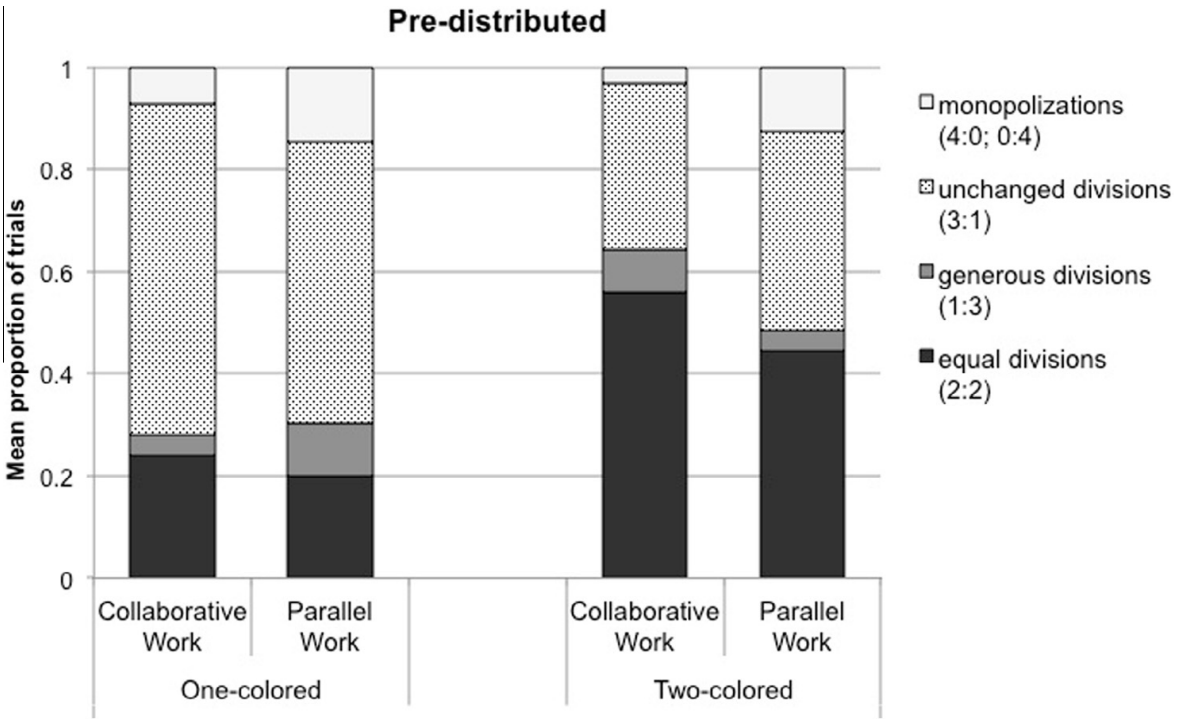

Fig. 6. Relative frequency of the possible division outcomes in Study 2, pre-distributed resource location.

SD = .24). Work effort had no influence on the likelihood of equal splits (*Estimate* = −0.86, *SE* = 0.72, *z* = −1.20, *p* = .23). Again, there was no interaction between conditions (*p* = .54). Equal division rates did not differ across trials (no effect of trial number, *p* = .16), but we found that girls were more likely to share a marble with their peer (*M* = .46, *SD* = .40) than boys (*M* = .26, *SD* = .30); *Estimate* = −1.69, *SE* = 0.72, *z* = −2.35, *p* = .02.

Secondary analyses. Monopolizations were rare (*M* = .09, *SD* = .20) and were initiated equally often by the lucky and unlucky children. Costly divisions (i.e., trials in which the lucky child released one or two marbles) were also initiated equally often by the lucky child (19% active transfer and 37% passive transfer) and the unlucky child (44% tolerated theft) (*p* = .19) and without relation to work effort or resource coloring (*p*s > .74).

Children almost never protested when resources were pre-distributed (only four cases were observed with the unlucky children protesting). Possessive descriptions occurred in 10% of trials and were more prominent if resources were two-colored (70%) rather than one-colored, $\chi^2(1) = 7.17$, *p* = .007, whereas work effort had no impact on their frequency (*p* = .46).

Discussion

Study 2 investigated, for the first time, bilateral resource division in 24-month-old dyads under different conditions. The findings were very clear. When they were interacting with a peer to divide up resources that neither of them possessed ahead of time, 24-month-old toddlers were almost never selfish but were most often rather generous.

When the resources to be divided were in a single pool, neither child monopolized them frequently; indeed, the children divided them quite often equally if they had produced them via collaborative effort rather than as independent agents. Children were especially likely to divide the resources equally if they were color-coded, with color indicating the side of the apparatus they came from (although this "coding" was never pointed out to the children in any way). This color coding could have conceivably been understood by children as a sign of ownership, but if this were true the children should also have divided the marbles equally in the parallel work condition, which they did not. Another possible explanation (and indeed the rationale for the color coding to start with) is that because producing precisely equal splits might be, to some extent, challenging for 2-year-olds for reasons of weak numerical skills (e.g., Mix, Huttenlocher, & Levine, 2002), the use of colored marbles helped the children to discriminate and count the marbles and to assess (equal) resource divisions quantitatively (Frydman & Bryant, 1988). Thus, these findings provide general support for the finding of Hamann and colleagues (2011) and Warneken and colleagues (2011) that collaboration facilitates equal sharing in preschool-age children, although in this case without either child needing to sacrifice anything.

When the resources to be divided were already pre-divided in an unequal way—three in a tray on the lucky child's side of the apparatus and one in a tray on the unlucky child's side of the apparatus—roughly one third of the lucky toddlers equalized the resources by transferring a marble to their unlucky partner. They sacrificed rewards out of their own pool in order to equalize. Indeed, this equalizing of resources was initiated in the majority of cases by the lucky child himself or herself (in the other cases, the lucky child simply allowed the unlucky child to take a marble to equalize). This is the youngest age at which an aversion to advantageous inequity—judging that one has received an undeserved advantage over another—has ever been demonstrated. Surprisingly, this effect was present to a similar degree regardless of whether the resources were produced by collaboration or by individual efforts. This is different from the condition with pooled resources, presumably because in this case the lucky child needed to sacrifice in order to equalize. In addition, the pre-distributed location of rewards already suggested a final split-up, whereas pooled resources were equally accessible for both children, Accordingly, when facing a pool of resources, children needed to interact more with one another to reach a division. Hence, the experience of an earlier collaboration might have had a greater influence on their division behavior here. In line with previous findings (e.g., Blake & Rand, 2010; Gummerum et al., 2010; Kanngiesser & Warneken, 2012), girls were more generous than boys when they faced pre-distributed rewards. Fabes and Eisenberg (1998) suggested that such gender

differences might be due to socialization practices because altruistic behavior is generally more expected from girls, and girls also are more likely to be rewarded for such behavior. Nevertheless, only one statistic model revealed a gender effect in our study, and so strong statements of the role of gender are not warranted.

Almost certainly, one explanation for this surprising degree of largesse on the part of the lucky child, as compared with the traditional picture of the selfish toddler, is that the resources in this study were not pre-possessed by either child. Nevertheless, the color coding made it easier for children to produce equal divisions (which were consistent with the original "coding" in three-thirds of cases). Again, this effect might be the result of children thinking that the marbles of a certain color belonged to a certain child, and the equalization was simply restoring appropriate ownership. (Indeed, although low in frequency, children produced more ownership statements when the marbles were color-coded.) This interpretation is in line with the findings of Hamann and colleagues (2011, Study 1) that 2.5-year-old children will sacrifice own rewards to equalize with a partner when there are strong signs that they inadvertently received one of the partner's marbles (which they did not do if there were no signs of pre-ownership in their Study 2). This suggests that an initial sense of possession facilitates fairness-related behavior in the first place, which is in line with other studies indicating that ownership understanding moderates sharing in 2-year-olds (Brownell, Iesue, Nichols, & Svetlova, 2013; Hay, 2006).

However, it can also be argued that children simply sorted the marbles by color instead of actually dividing them. Children might have thought that certain colored marbles were more likely to work in the color-matching jingle or that organizing the marbles by color was part of (or a rule of) the game. Crucially, throughout the whole experiment, the color of the marbles was never verbalized or explicitly pointed out by either the experimenter or the parents. Moreover, because children were not stopped from using the other child's jingle box, they could have distributed the marbles according to the "color rule" simply by throwing the marbles into the boxes themselves with no need to give them away. The fact that this actually happened in only less than 5% of trials speaks against this hypothesis. In addition, there were some children ($n = 4$) who consistently used their partner's jingle box but also shared the spoils beforehand. Moreover, there were a significant number of children who divided the marbles equally even when no color cues were given (33%) or who produced equal splits without reference to the color they had been assigned to earlier (26%).

Another explanation for why children in the current study acted far more generously than in previous studies is that this time children were interacting with each other in a face-to-face context rather than dealing with anonymous or absent agents (e.g., Fehr et al., 2008; Gummerum et al., 2010; Malti et al., 2012). Furthermore, the degree of this interaction (whether it was collaborative or parallel work) then determined how likely children were to share with each other; collaboration facilitated (equal) sharing, but only if the resources ended up in an undifferentiated pool (with perhaps some effect of color coding as a weak indication of ownership), such that neither partner needed to sacrifice anything. Collaboration did not facilitate equal sharing in children this young when one of the children needed to pay a cost to produce equality. What leads them to equalize by sacrificing some of their own rewards is some sense that they are restoring ownership (as indicated in the current study by color coding).

An open question that remains from these results is whether the effect of collaboration on the division of pooled resources is indeed due to the collaborative effort itself or rather due to joint experience more generally. In line with Hamann and colleagues (2011, Study 2), one could argue that the collaborative work condition engendered a sense of togetherness in the children—at least partly because they experienced the demonstration phase together as a pair, whereas they did not experience the demonstration together in the parallel condition—independent of actually working together. A follow-up study running an additional condition explored this question of joint participation versus shared work effort per se. This time, children did not work for the resources at all, either together or independently. But importantly, as in the collaborative work condition and unlike the parallel work condition, they experienced the demonstration phase together (see Fig. 4). Following the hypothesis of Hamann and colleagues, we speculated that perhaps this feeling of joint participation in the activity would produce a similar amount of equal divisions as actually working together collaboratively to produce the resources.

Follow-up: Joint no-work condition

Method. We tested an additional 32 24-month-old children from the same population (16 girls and 16 boys, age range = 23 months 0 days–25 months 0 days) paired in 16 unfamiliar same-sex dyads. Two dyads needed to be excluded due to fussiness, and one dyad was excluded because the children lost motivation in playing the game.

The warm-up phase and basic procedure were the same as before but had the following two modifications. First, we used only color-coded marbles (two red and two blue) as rewards. Second, the apparatus had no boards attached. The experimenter let the four marbles drop directly into the marble runs, so that children received the marbles without making any effort themselves. Children underwent the demonstration and test phases together. Every trial started with the experimenter asking both individuals to stand on either side of the apparatus and watch her holding up four marbles in her hands. She then let the marbles drop, saying, "Look, new marbles!" The marbles immediately fell through the openings, rolled down the marble runs and ended in a pool. (We actually ran some pre-divided reward trials after this, but because collaboration had an effect only when resources were pooled in Study 2, we focused exclusively on that situation here.)

Coding was conducted as before. The inter-rater agreement was perfect for divisions and almost perfect for behaviors (κ = .97). Our hypothesis was that if it was collaboration per se that encouraged children to divide the spoils more equally, we should find less equal sharing in this no-work condition as compared with the collaborative work condition. If the effect was rather driven by the greater joint experience, we expected that division rates would be similar for both the collaborative and no-work conditions given that the procedure in both conditions caused the same level of jointness (e.g., joint training, joint instructions, joint play scenario), whereas the parallel work condition should have raised no jointness to only minimal jointness (e.g., separate training, individual instructions, parallel play scenario). We applied GLMMs to check for both the potential influence of work effort (three levels: cooperative vs. parallel vs, no effort) and jointness (two levels: no joint experience vs. high joint experience).

Results and discussion. Division rates are illustrated in Fig. 5 (far right bar). The GLMMs revealed no influence of work effort (LRTs, *p*s > .19). However, we found a marginal influence of jointness on both the likelihood to produce equal divisions (2:2; *Estimate* = 2.85, *SE* = 1.72, z = 1.66, p = .09) and the likelihood to produce any division (2:2 or 3:1; *Estimate* = 3.53, *SE* = 2.13, z = 1.65, p = .09). Hence, children tended to divide the spoils more often in conditions that featured greater jointness. But regardless of significance levels, the key finding is that the rate of equal divisions in this no-work condition was very similar to that in the collaborative work condition (and was even numerically higher than that in the parallel condition).

Analysis of the behavioral data revealed that monopolizations (4:0) happened similarly; one child took all marbles while the peer did not interfere. Behavioral patterns differed for equal and unequal divisions, $\chi^2(1) = 3.85$, p = .05; unequal divisions (3:1) arose primarily out of haphazard behavior (75%), whereas equal splits (2:2) were more often reached by taking turns (35%), giving (11%), or stealing (6%). Children almost never protested (only six trials recorded). Possessive statements (five trials) and requests (four trials) were limited to trials featuring equal divisions.

In summary, these results suggest that children's divisions in Study 2 were influenced by the jointness of the procedure rather than by the work effort of the task. Thus, we may conclude that the increased division rates of the collaborative condition might not be related to the collaborative part of the task alone. Rather, we assume that children, irrespective of the condition in which they were tested, developed a feeling of "togetherness," mainly because both were playing the same game at the same time point while facing each other. Thus, both children were jointly attentive to the game itself and likewise motivated to get their hands on the marbles. This was especially pronounced in the collaborative scenario (where the joint motivation was to mutually obtain the resources) but likewise in the no-work scenario (where children were motivated to play together in a simple form), whereas it was undermined when children were trained individually and the task could be solved individually, as was the case for the parallel work condition. Given the fact that "jointness" is a necessary condition in order to create true collaboration, it might be that by 2 years of age, when

collaborative play is just beginning, children do not yet differentiate whether an action is collaborative or not, but they are sensitive to whether they find themselves in a joint situation.

General discussion

Many animal species, including humans, show an "endowment effect" (Kahnemann, Knetsch, & Thaler, 1990); they highly value things already in their possession and are reluctant to part with them. The vast majority of studies of children's sharing behavior investigate precisely this situation—how willing children are to transfer things currently in their possession to others. Moreover, typically these paradigms apply unilateral distributional decisions. The general finding is that in this situation preschool children are rather reluctant to share (e.g., Benenson et al., 2007; Blake & Rand, 2010; Fehr et al., 2008; Gummerum et al., 2010; Kogut, 2012; Rochat et al., 2009; Thompson et al., 1997). In the current two studies, in contrast, we investigated situations in which children interacted directly with one another over resources that no one owned in the first place. The general finding is that in these situations preschool children are much more prosocial.

In the first study, 18- and 24-month-old toddlers simply encountered a pile of marbles. They basically each took what they wanted, with almost no conflicts, in a relatively tolerant and peaceable manner. This ended up in equal shares nearly half of the time, with very few attempts at monopolization. In the second study, 24-month-old toddlers in the pooled rewards condition also encountered a pile of marbles, but in this case they were the result of their labor—either independent (parallel) or collaborative. The finding here was that children divided the resources equally more than 60% of the time when they produced them collaboratively, which was more than when they produced parts of the pile independently. In line with previous studies (Ng, Heymann, & Barner, 2011; Warneken et al., 2011), and also replicating the general results of Hamann and colleagues (2011) but with younger children, collaboration facilitated equal sharing. But different from this previous study, children in the current study were dividing up pooled resources, with no one needing to sacrifice anything already in their possession.

In the pre-distributed condition of the second study, the marbles came out of the apparatus and, apparently fortuitously, ended up with three on the side of the lucky child and only one on the side of the unlucky child. To equalize, the lucky child needed to give up some of his or her own marbles, which the lucky child did approximately one third of the time (most often by actively giving to the other child). This is the youngest age ever observed at which young children make sacrifices in order to equalize resources. It was not just random giving; the unlucky child almost never gave his or her single marble to the lucky child, and the lucky child almost never gave away more than one of his or her three marbles. Importantly, the factor that most affected children's tendency to equalize was when the marbles were color-coded for side of apparatus (with each side associated with one child). Even though this color coding was never pointed out to the children, when the lucky child encountered two marbles from his or her side of the apparatus and one marble from the other child's side, the lucky child quite often gave over the oddly colored marble. This suggests the possibility that children saw the oddly colored marble as belonging to the other child. This finding is consistent with the findings of Brownell and colleagues (2013) that toddler sharing is mediated by an understanding of ownership.

Interestingly, in this pre-distributed condition, there was no effect of collaboration on equal sharing. Combined with the positive results from the pooled condition, the suggestion is that for children this young collaboration cannot overcome the endowment effect experienced by the lucky child. This is in contrast to the findings of Hamann and colleagues (2011) with 3-year-old children, in which the lucky child did hand over the extra (non-color-coded) marble. Indeed, in our follow-up condition, we simply had pairs of 24-month-old toddlers experience everything together leading to the division of resources but without any work whatsoever. Equal divisions in this case happened just as frequently as in the two main conditions of the second study (parallel work and collaborative work). This suggests the possibility that at least part of the effect of collaboration on children's tendency to share equally might simply be the fact that they experience the whole task together as a pair—as a "we" (Tuomela, 2006). If this is true, the effect of collaboration on equal sharing might then be less the

result of "equal pay for equal work" and more the result of "equal sharing between participants" (possibly excluding nonparticipants). Thus, one hypothesis is that a sense of "we-ness" is crucial for motivating young toddlers to share resources with a peer and that as children develop this sense becomes more closely integrated into a more complex sense of collaboration. Later on, this we-ness may emanate from simply being a part of the same social group (Dunham, Baron, & Banaji, 2008; Tomasello & Vaish, 2013).

In any case, the overall thrust of the current findings is that (a) when we neutralize the endowment effect (thereby deemphasizing children's selfish tendencies to hold on to what they already have) and (b) make use of the positive influence of bilateral face-to-face interactions on prosocial behavior (e.g., Fujii, Takagishi, Koizumi, & Okada, 2015; House, Henrich, Brosnan, & Silk, 2012; Leimgruber, Shaw, Santos, & Olson, 2012), even very young toddlers are prone to share resources with their peer, quite often equally.

It is possible that this tendency toward fairness is in many cases less of a moral judgment that we are all equally deserving persons and more of a cooperative attitude that we should both share the resources without conflict. But in the current study we also observed a minority of young toddlers actively sacrificing resources in order to equalize, which would suggest something more than the avoidance of conflict. Future research should be aimed at establishing in more detail the prosocial or other motives that influence the way in which young children divide resources among themselves.

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