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Children's consideration of collaboration and merit when making sharing decisions in private

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ABSTRACT

Young children share equally when they acquire resources through collaboration with a partner, yet it is unclear whether they do so because in such contexts resources are encountered as common and distributed in front of the recipient or because collaboration promotes a sense of work-based fairness. In the current studies, 5- and 8-year-old children from Germany (N = 193) acquired resources either by working individually alongside or by collaborating with a peer. After finding out that the partner's container was empty, they decided in private whether they wanted to donate some resources to the peer. When both partners had worked with equal efforts (Study 1), children shared more after collaboration than after individual work. When one partner had worked with much more effort than the other (Study 2), children shared more with a harder-working partner than with a less-working partner independently of whether they had collaborated or worked individually. Younger children were more generous than older children, in particular after collaboration. These findings support the view that collaboration promotes a genuine sense of fairness in young children, but they also indicate that merit-based notions of fairness in the context of work may develop independently of collaboration, at least by the beginning of middle childhood and in Western societies.

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Introduction

Young children are not particularly generous in sharing their resources with others. Across a variety of diverse cultures, 3-year-olds who posssess resources in dictator games are still likely to keep everything to themselves or to share only about one third with a partner (Ibbotson, 2014; Rochat et al., 2009). In forced-choice situations, 3- and 4-year-olds across a variety of diverse cultures are more likely to accept distributions that favor themselves over ones that favor a partner (Blake et al., 2015; Fehr et al., 2008). Then, as children become older, they become more generous. By the time they are in middle childhood (∼6 years), they share more consistently in dictator games, (Ibbotson, 2014), begin to divide resources equally (Rochat et al., 2009), and less often prefer benefiting themselves disproportionately (Blake et al., 2015). Beginning at around the same age (5 years), children start to modulate their generosity depending on whether the recipient (or a third party) is observing their act of sharing—sharing proportionally more when they are being observed (Engelmann et al., 2013; House et al., 2013; Leimgruber et al., 2012; McAuliffe et al., 2020; see Warneken, 2018, for a review).

In contrast to these patterns of sharing in scenarios where resources are provided by windfall (e.g., dictator games), even 3-year-old children tend to share more generously when resources are obtained through joint work. In particular, if 3.5-year-old children have worked together with a partner collaboratively, they redistribute the produced resources equally when they accidentally end up disproportionately with one child. In this case, the lucky child tends to transfer resources to equalize the bounty between partners in a collaboration condition more than in a non-collaborative social control (e.g., parallel work condition) (Corbit, 2019; Corbit et al., 2021; Hamann et al., 2011; Ng et al., 2011; Ulber & Tomasello, 2017).

One factor that might contribute to children's greater sense of fairness in collaboration is the way the resources are first encountered. In the collaboration studies, children first encounter them as, in a sense, shared given that they are one package out in the open to be earned by the collaborators together (see, e.g., Corbit, 2019; Corbit et al., 2017, 2021; Hamann et al., 2011; Warneken et al., 2011). Thus, even before collaborators engage in joint work, they may conceptualize the resources as owned by both partners together and thus share them equally irrespective of whether they depend on each other for acquiring the resources.

In addition, in many studies of collaboration and sharing, children distributed resources while the partner was present (e.g., Corbit et al., 2017; Hamann et al., 2011; Warneken et al., 2011), whereas partners are often absent in windfall studies. Because in collaboration studies the partner was usually present in both collaboration and social control conditions, it is perhaps unlikely that this effect is causing children's tendency toward fairness selectively in the collaboration condition. Nevertheless, if they know that partners and third parties expect equal rewards for equal collaborative efforts, then this might encourage children to share more fairly especially, or only, after collaboration in anticipation of the recipient's request in specifically this situation.

If collaboration promoted a more intrinsically motivated sense of fairness by enhancing individual prosocial concerns for collaborative partners, children should share more with them even if partners are not watching and do not know about their resource decisions. Furthermore, if the experience of working together with equal efforts and being interdependent during work underlies the effects of collaboration, children should share more after collaboration even if resources are presented to them in the same way as in most windfall and individual work scenarios, namely as individually owned packages of resources (and not as one package owned by both collaborators together).

One possibility is that being dependent on a partner for reaching one's goals may promote preferences for equality. In this case, children may become increasingly averse to unequal distributions of resources between themselves and their partner when they depended on the partner for collaboration. In fact, when presented with a forced-choice distribution after collaboration, older children (>6 years) prefer equal distributions over unequal distributions—both ones that favor themselves and ones that favor the partner (Corbit et al., 2017). A second possibility is that acting together and physically coordinating one's action with that of the partner during resource production may make the partner's work effort particularly salient and thereby promote preferences for equity. In this case, young

children may be inclined to share equally after collaboration because interdependence made them aware of the equal effort that their partner had invested in the joint endeavor.

In fact, when distributing resources between two coworkers as third parties, already 3-year-old children prefer that the harder-working individual gets more than the less-working individual if the amount to be distributed is unequal (Baumard et al., 2012). With increasing age, children begin to prioritize merit even over friendship or group membership considerations when making third-party decisions about resource distributions (Engelmann et al., 2021; Xiao et al., 2019). When 3- and 4-year-old children worked together with a partner directly (e.g., a peer or puppet) and one of the two needed to work harder than the other (or else produce more resources), they were more likely to share with the harder-working partner compared with the less-working partner (Hamann et al., 2014; Kanngiesser & Warneken, 2012). This suggests a notion of fairness based on merit, according to which children expect those who collaborate with equal effort to receive equal rewards. In the same vein, when 3-year-olds face a partner who has publicly declined to cooperate but then asks to share the spoils (i.e., a free rider), they refuse to share many spoils with the partner (Melis et al., 2013). In terms of the strength of this effect, it should be noted that (a) in studies where children divided resources between third parties and there was an even number to be shared, children often just divided them equally despite work effort, and (b) children in some cultures do not take merit into account in the same way when distributing resources (Schäfer et al. 2015).

Importantly, in the Hamann et al. (2014) study with 3-year-old children, sharing based on merit was observed specifically in situations that involved interdependence between partners, indicating that collaboration might be necessary for young children's considerations of work effort. But as is customary in most collaboration studies, in the merit-based studies children decide on resource distributions in the presence of their partner (and typically an adult experimenter). So again, in this case we do not know whether children consider merit when partners are absent and do not know about the distribution. Furthermore, the children in these studies were only 3.5 years old, and other studies show that the sense of obligation at this age is restricted to collaborative partners (Tomasello, 2020). Thus, it is possible that older children, who view everyone in their group as part of their moral community, would show merit-based fairness even outside of collaboration. In fact, in some studies older school children (>10 years) consider work contributions and merit even when making resource decisions in contexts where they do not depend on their coworkers during resource production (Almås et al., 2010; Hook & Cook, 1979). So it could be that older children's preferences for work-based equity are no longer restricted to collaborative scenarios.

Here we report two studies that addressed the major outstanding issues in these research paradigms by systematically observing 5- and 8-year-old children's individual fairness considerations in the context of collaboration with a peer. In the first study, we sought to investigate the effect of collaboration on children's private sharing decisions that exclude influences by the recipient and preassigned shared ownership of the rewards. In this study, children were introduced to an apparatus that they knew would yield rewards, but they did not actually see the distribution of the rewards before embarking on the collaboration. This was intended to prevent children from construing the rewards as shared before they started to collaborate. They then worked to produce the rewards in one of two conditions; retrieving the reward containers from the apparatus required either collaboration or independent efforts, that is, parallel individual work. After the children's efforts made the two reward tubes available, one child (and the experimenter) left the room and the other child was left alone to distribute the rewards, all of which (it turned out) were in the tube on her side of the apparatus. So in this study, children were distributing resources that were never seen as shared but were already in their possession, and they were sharing them in private. If children nevertheless shared more after collaboration than after parallel work, this would provide strong support for the hypothesis that collaboration facilitates an individual sense of fairness even when there are no reasons for concerns about the partner's reaction or one's reputation.

In a second study, we sought to investigate further children's sense of equity in the form of merit-based sharing. In particular, we asked whether collaboration was indeed a necessary context for 5- and 8-year-old children's considerations of merit. Here we used the same apparatus—requiring either collaboration or independent parallel work for retrieving two reward containers—only this time the apparatus was set up in a way that one of the two children needed to work with three times as much

effort as the partner. If children distributed more to the harder worker independently of collaboration, that would suggest that they have acquired a more general sense that hard work deserves more resources regardless of whether the recipient is a collaborative partner or not. If children shared more with harder-working partners only in the collaboration condition, this would suggest that concern for equity is promoted specifically in the context of collaboration. In addition, again in this study, the child who distributed the rewards at the end did so in private. So our questions in this study were (a) whether 5- and 8-year-old children distributing resources based on merit would do so differentially for collaborative partners and others and (b) whether they would do so even if the distribution was conducted in private.

In both studies, we tested children who were just 5 years old as the younger age group because this is an age when preschoolers have been shown to begin to care about their reputation with others. Thus, testing children at this age enabled us to test the hypothesis that sharing in private would yield the same results as previous research with public sharing, even though generally children at this age already consider potential consequences for their reputation. In addition, we tested children aged 8 years as an older comparison group because this is when children in Western societies begin to show preferences for equity and even merit-based sharing even in situations where this is in conflict with their self-interests (Blake et al., 2015; Hook & Cook, 1979; Smith et al., 2013). Thus, including older children enabled us to test the hypothesis that school-age children's merit-based sharing is not confined to the collaborative situation as is that of preschoolers. Finally, as compared with other studies, our apparatuses required significantly harder work and coordination for successful collaboration, which could potentially change the distributive calculus for young children.

Study 1

Method

Participants and design

Study participants were 64 kindergarten children (32 girls; mean age = 5.0 years, range = 4.8–5.3) and 64 school children (32 girls; mean age = 8.0 years, range = 7.7–8.3). All children were native speakers of German and came from families with mixed socioeconomic backgrounds living in a medium-sized city in East Germany (Leipzig). Children were selected from a database of parents who gave informed consent for their children's participation in studies of this kind. Interested children were recruited and tested in their kindergartens or schools (after class).

Children participated in the study in dyads (n = 64), randomly paired with a familiar same-sex peer from the same kindergarten group or school class (mean age difference = 1.9 months). One child in the dyad was tested as the allocator in the sharing test, and the other child participated as the stooge partner and recipient. The effect of work mode was tested between participants, with 32 dyads being randomly assigned to the collaboration condition and 32 dyads to the parallel work condition. We had predetermined a sample size of 16 allocator children per test condition and age group based on previous studies using very similar designs (see Hamann et al., 2011, 2014) and stopped data collection when the intended sample size was reached, including replacements for excluded cases. During the training phase, each child was assigned to a color-marked collection box and work side at the apparatus. During the test phase, children participated in 2 identical test trials in the same work mode condition.[1] Work mode condition, age group, gender, and the assigned apparatus side (with the corresponding color-marked sweet collection box) were perfectly counterbalanced in the sample. One additional 5-year-old dyad was tested but needed to be excluded because of an experimenter error (see supplementary online material [SOM] for details on counterbalancing and a sample overview).

[1] Some of the stooge children (n = 48) participated in a second part of the study where they were the allocators. Because the experience as stooge and passive recipient in the first part of the study had an influence, we decided to exclude stooge children from being subsequently tested as allocators.

Materials

Apparatus. The work mode condition was manipulated with the help of an apparatus consisting of a large transparent labyrinth box (120 × 45 × 35 cm). The box was closed except for a wide slot that opened into a wooden balcony at one of its short sides (Fig. 1). At the beginning of trials, one blue tube and one green tube filled with sweets were buried inside the labyrinth box near its closed end ("start" position; see Fig. 1A). To retrieve sweet tubes, children needed to transport them from the start position over 10 barriers (semi-high inner walls, 23 cm high) to the balcony exit. This could be accomplished by manipulating the apparatus at its long sides. One child was assigned to the green reward tube on the green side and the other child to the blue tube on the blue side (side edges were marked

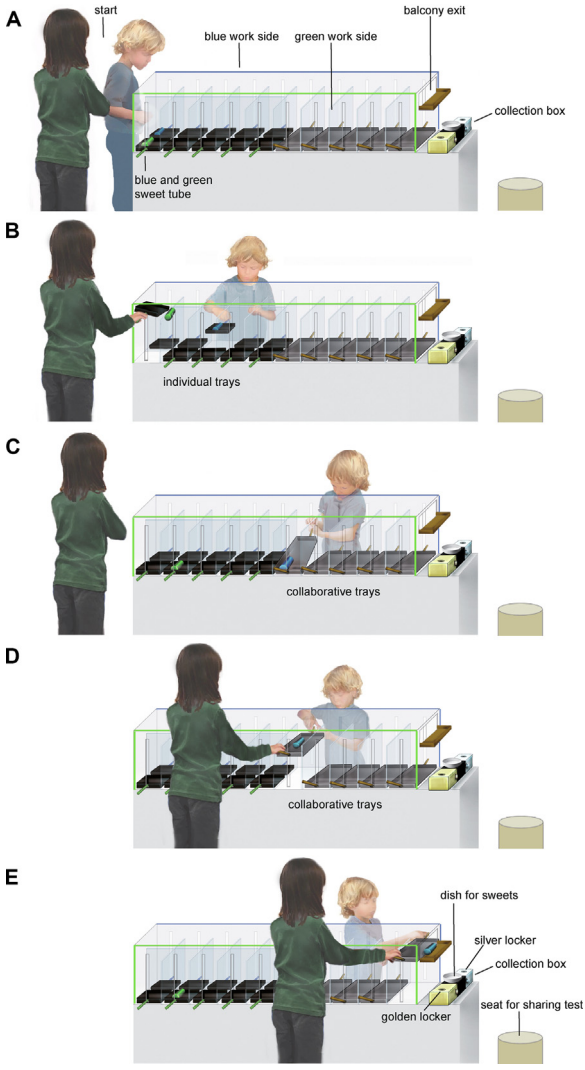

Fig. 1. Apparatus and study setup. (A) Sweet tubes inside the apparatus need to be transported from the start position to the balcony exit. One child is assigned to the blue tube and work side and the other to the green tube and work side. (B) Tubes lying in individual trays can be transported over barriers by each child independently. (C) Tubes in collaborative trays cannot be lifted over barriers by one child alone. (D) Children need to collaborate to lift collaborative trays. (E) When tubes are retrieved, sweets from inside are stored in the collection box.

with colored tape). The sweet tubes were lying on plastic trays between the barriers. To transport a tube over a barrier, one needed to lift the respective tray up to the upper edge of the barrier by moving up the tray handle sticking out through a thin vertical slot at the apparatus side. Thereby, the tube could roll over the barrier and fall into the next tray (Figs. 1B–1D).

To create the two work conditions, the 10 compartments between barriers could be set up with two different tray types: Individual trays were short black trays that had a fixed handle sticking out at one apparatus side. These trays could be easily lifted by one child alone. Two individual trays were placed side by side, with each one being handled independently from one apparatus side. Thereby, sweet tubes lying in these trays could be transported individually and in parallel toward the exit (Fig. 1B). Collaborative trays were long gray trays with two handles, one sticking out at each apparatus side. The handles were attached to the tray via a flexible chain link. Thereby, collaborative trays could not be lifted by one person alone; pulling up the tray handle on only one side resulted in a sloping position (Fig. 1C). The tray could be lifted only in a straight position, allowing the sweet tubes to roll over the barrier if two children lifted up the tray together by pulling up the handles at both sides simultaneously (Fig. 1D).

During the training phase, the apparatus was set up with five rows of individual trays and five rows of collaborative trays (as in Fig. 1) so that children could be familiarized with both tray types. During the test phase, the apparatus set up depended on the work mode condition (see Fig. 2). In the parallel work condition, all 10 compartments were filled with individual trays that the two children could lift independently from each other so that they simply worked alongside when retrieving their sweet tubes (Fig. 2A). At the start of a trial, both sweet tubes were placed in the trays farthest away from the exit so that both children needed to transport their tubes over 10 barriers. In the collaboration condition, all 10 compartments between barriers were filled with collaborative trays that children needed to lift together so that they depended on each other for retrieving their sweet tubes (Fig. 2B). To make interdependence during collaboration more salient, at the start of a trial one tube was placed in the last tray and one tube in the penultimate tray. Thereby, children were forced to actively coordinate their first actions.

Rewards. The sweet tubes consisted of opaque, green, or blue plastic tubes (length = 10 cm, diameter = 5 cm) that were tightly closed and could be opened only with a stick tool by the experimenter. In test trials, the allocator's tube was filled with seven Smarties (sweets), whereas the unlucky stooge partner's tube was empty. The sweets from the retrieved tubes were placed in the collection box standing on the table near the balcony exit (see Fig. 1E). The collection box consisted of a block ($48 \times 13 \times 11$ cm) of two conjoint mini lockers (one golden and the other silver). The locker doors were locked with small padlocks that could be opened only with keys by the experimenter. There was a small hole in the upper shell of each locker through which sweets could be inserted, yet it was too small to take sweets out or see anything inside. Within dyads, the child working on the green side was assigned to the golden locker and the child on the blue side to the silver locker. Children could identify their lockers and knew that they could keep all sweets they put inside. Sweets for the collection box were first placed on a small plastic dish standing on top of the collection box in the middle between the insertion holes (Fig. 1E).

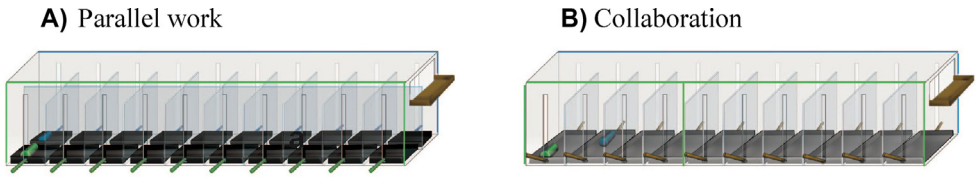

Fig. 2. Apparatus setup and start positions for sweet tubes in Study 1. In both work mode conditions (parallel work and collaboration), the two children need to lift 10 trays to transport the two sweet tubes to the balcony exit. In the parallel work condition (A), each child lifts trays on his or her side and thus transports his or her sweet tube individually. In the collaboration condition (B), children need to lift all trays and transport their sweet tubes together.

Procedure

Study sessions were conducted by three different teams, each consisting of one female main experimenter (E1) and two assisting experimenters (E2 and E3). Sessions lasted about 45 min, including training and a test phase. The procedure during both phases was exactly the same for all children; the work mode conditions differed only in terms of the initial apparatus setup during the test phase (Fig. 2).

Training phase. The goal of the training phase was for children to learn how to retrieve sweet tubes from the apparatus, that they depended on a partner for transporting tubes lying in collaborative trays, and that their decisions during the sharing test would be completely concealed and private. For this purpose, the two children were first introduced to the collection box together and each child was assigned to a locker, and then each child was individually familiarized with the apparatus in 2 training trials of retrieving tubes together with the experimenters (while the partner child was waiting outside). In the first training trial, children learned to use the different tray types by transporting a tube together with E1 to the exit. In the second training trial, children needed to demonstrate that they understood that they depended on help to lift the collaborative trays by recruiting E2 as a collaborator. To familiarize children with the privacy of their decisions in the sharing test, children were given a trial run of the sharing test situation in which they were left alone in the room to insert 2 sweets in the collection box (for a detailed training procedure, see SOM).

Test trials. After the training, children retrieved sweet tubes together in 2 identical test trials. In each trial, the two children entered the room together with E1 and took their assigned start positions at the apparatus. E1 instructed the children to retrieve the sweet tube to which they were assigned and to call her when they had finished. E1 then left the room. When tubes were retrieved, E1 came back together with E3. E3 asked the stooge child to come with her outside to finish another game. E1 and the remaining child (the allocator) took a seat in front of the collection box. E1 opened the tube that the partner had retrieved, which proved to be empty. Then, she opened the tube that the allocator had retrieved, which contained 7 sweets inside. E1 put the sweets in the dish on top of the collection box (between the insertion holes) and gave the following instructions: "I will go outside. But you can put the sweets in the collection box. The silver [golden] locker is yours. The sweets for yourself, you can put in here [E1 points to the allocator's locker]. The golden [silver] side is [partner name]'s locker. If you want to give some sweets to [partner name], you can put them in here [E1 points to the partner's locker]. You can do this as you like! When you have finished, just come outside." E1 left the room. When the child came outside, the apparatus was re-baited with tubes for the next trial. After the second trial, E1 opened the collection box and gave each child a closed bag with the collected sweets.

Coding and data analysis

All sessions were videotaped, and the number of sweets that allocators put inside their partner's locker when left alone in the room in the 2 sharing trials was coded from video. For establishing reliability, a second observer (blind to conditions and hypotheses) coded 19% of sessions (24 trials). The two coders were in 100% agreement in all cases.

To analyze the effects of condition and age group, we fitted a generalized linear mixed model (GLMM) in R using the packages *lme4* and *car* (Bates et al., 2014; Fox & Weisberg, 2022; R Core Team, 2021). Our dependent measure in the model was the proportion of sweets (out of 7) that children put in their partner's locker in each of the 2 test trials. Therefore, we fitted a logistic GLMM with a binomial error structure and a logit link function (Baayen, 2008), in which we included a vector with the number of shared sweets and the number of nonshared sweets as response. In the GLMM, we tested the effects of condition (collaboration vs. parallel work), age group (5- vs. 8-year-olds), and the interaction between these two factors while controlling for children's gender (girls or boys), trial number (1 or 2), experimenter team (the three teams who took turns in conducting the study), and random effect of participant's identity (because children allocated sweets repeatedly in 2 test trials). Prior to testing single effects, we verified that assumptions were met (e.g., absence of overdispersion) and established model stability. To test the significance of single effects, we compared models with and without the respective term using likelihood ratio tests (Dobson, 2010). Effect sizes were calcu-

lated as odds ratios based on model estimates, and confidence intervals were obtained through bootstrapping (N = 1000). To control for multiple testing, we established the overall significance of the combined test effects first by comparing models with and without all test variables (Forstmeier & Schielzeth, 2011). The nonsignificant interaction was removed from the model before interpreting main effects.

Results and discussion

In total, 50 of the 64 allocator children (78%) put 1 or more sweets into their partner's collection box when finding out that the partner's sweet container was empty. In the collaboration condition the majority of children gave 3 or more of their 7 sweets to the partner (median = 3, mode = 3, mean = 2.1), whereas in the parallel work condition the majority of children gave 0 or only 1 or 2 of their sweets (median = 1.5, mode = 0, mean = 1.5). The logistic GLMM analysis confirmed a significant main effect of work condition on children's allocations (estimate ± *SE:* 0.55 ± 0.27; likelihood ratio test: χ^2 = 3.904, df = 1, p < .05). Based on the model estimates, the odds for children to share a sweet were 73% higher in the collaboration condition than in the parallel work condition. This effect did not significantly depend on children's age (effect of removed Condition × Age interaction; likelihood ratio test: χ^2 = 0.696, df = 1, p = .404). However, age had a significant main effect on children's allocations (estimate ± *SE:* −0.68 ± 0.27; likelihood ratio test: χ^2 = 5.940, df = 1, p < .05); across conditions, the 5-year-old children were generally more generous, and the odds for them to put a sweet into the partner's box were 100% higher than those for the 8-year-old children (see Fig. 3 and Table 1 for a summary of all test effects, including confidence intervals).

A pre-analysis check revealed that the control variables (trial number, experimenter team, and children's gender) did not significantly influence the effects of work condition and age and that only gender had a significant main effect on children's allocations; girls generally shared more generously than boys (estimate ± *SE:* −0.74 ± 0.28; likelihood ratio test: χ^2 = 7.07, df = 1, p < .01) (see SOM for details on model results).

Thus, taken together, the results of Study 1 support the hypothesis that collaboration promotes sharing in young children. When depending on their partner for retrieving their sweet tube, both 5- and 8-year-old children placed more of their acquired sweets in their empty-handed partner's collection box than when merely working alongside and retrieving their sweet tube individually. This finding is in accordance with previous studies showing that when depending on each other for pulling a rope together in order to obtain rewards, 3.5-year-old children were more likely to hand over one reward to the disadvantaged child when the four rewards were accidentally distributed unequally (three rewards ended up on one child's side and only one reward on the other child's side; Hamann et al., 2014). The current study extends this finding by showing that this effect of interdependent work is not restricted to a context in which children work for a pooled resource (one visible pile of rewards to be collected by both children together) and in which they interact and negotiate a redistribution of the resources in person. In the current study, the allocator child was alone when deciding whether to share with the partner (even the experimenter was not present), and the partner did not see the number of rewards that were available and how much the allocator decided to place in each collection box. Furthermore, all the obtained rewards came out of the allocator's sweet tube, so they were clearly assigned to the allocator child. Nevertheless, children, in particular the younger children (5-year-olds), decided to place some of their acquired sweets in their partner's box and did so more when they had collaborated with their partner than when they had worked individually. This shows that collaboration or interdependence can promote individual concerns for the other's outcome in the context of joint work leading to more generous donations even in situations where the risk of negative reactions by the partner or any reputational concerns is minimal.

Arguably, more sharing after collaboration in Study 1 could be motivated by increased concerns with work-based fairness (the partner deserves resources because of his or her equal work contribution) or by increased generosity and prosocial concerns independently of the invested effort. In Study 2, we asked whether increased motivation to share after collaboration was based on a sense of work-based equity. In doing so, we used the same apparatus and study design to investigate children's merit-based sharing by observing how children allocate resources when their partner has worked

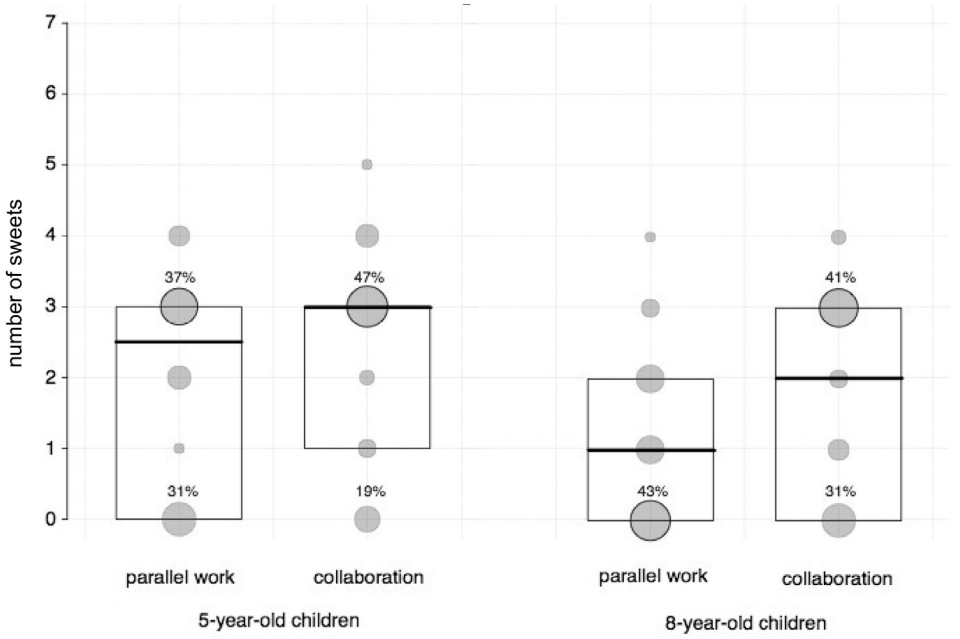

Fig. 3. Children's allocations after equal work (Study 1). The bubble plot shows the number of sweets (out of 7) that children shared with their partner according to age group and work mode condition. Bubble sizes are proportional to the percentage of trials in which the respective number of sweets was shared. Bubbles with black borders represent the mode; the numbers at the mode and zero bubbles show the respective percentage (and serve as a reference for bubble sizes). The solid bars and boxes show the medians and quartiles, respectively.

Table 1
Test effects of the logistic generalized linear mixed model, including logit transformed model estimates, confidence intervals, and likelihood ratio test results (comparing models with and without the respective effect)

	Model estimates				Likelihood ratio test		
	Estimate	*SE*	Lower CI	Upper CI	χ^2	*df*	*p* Value
Intercept	−0.75	0.37	−1.51	−0.03			
Work mode (collaboration)	0.55	0.27	0.04	1.09	3.9	1	.048
Age group (8 years)	−0.68	0.28	−1.22	−0.16	5.9	1	.015
Removed interaction:							
Work Mode × Age Group					0.7	1	.404

Note. The model included the test variables of work mode (reference level = parallel work), age group (reference level = 5-year-olds), and their interaction and the control variables gender, trial number, experimenter team, and random effect of participant ID. The interaction between work mode and age group was tested first and removed from the model (because it was not significant) in order to test main effects. CI, confidence interval.

with either more or less effort than them in the collaboration and parallel work conditions. In particular, we tested whether collaboration was a necessary context for children to consider unequal merit in their resource decisions and thus promote work-based fairness.

Study 2

Method

Participants

Study participants were 130 kindergarten children (98 girls; mean age = 5.0 years, range = 4.7–5.3) and 128 school children (96 girls; mean age = 7.9 years, range = 7.7–8.3). Children were recruited in the same way as in Study 1 and again participated in dyads, paired with a familiar same-sex peer from the same kindergarten group or school class (mean age difference within dyads = 1.7 months). The effects of work mode (collaboration vs. parallel work) and work effort (partner works harder versus less) were tested between participants, and as in Study 1 we aimed at a sample size of 16 children per age group, work mode, and effort condition. In total, 65 dyads participated in the collaboration condition and 64 dyads in the parallel work condition; in half the dyads the allocator child was assigned to the high effort apparatus side and in the other half to the low effort apparatus side in the 2 test trials.[2] Work mode condition, effort condition, age, gender, assigned apparatus side, and color were perfectly counterbalanced in the sample. An additional 6 dyads were tested but excluded because of an experimenter error (2 dyads), because one child stopped participating (1 dyad), or because children manipulated the apparatus in an unintended way that interfered with the test manipulation (3 dyads) (see SOM for details on counterbalancing and a sample overview).

Materials

The apparatus and setup during the training phase were the same as in Study 1. During the test phase, the apparatus was set up differently in order to create unequal work effort for the two children: Only the three compartments before the exit were filled with trays reachable from both apparatus sides (see Fig. 4). The sweet tube for the child assigned to the low effort side was placed on the third of these trays (or on the second tray in the collaborative work mode, again making interdependence more salient), and the remaining compartments behind the third tray remained empty on that side. On the high effort side, the remaining seven compartments were filled with individual trays, with the tube placed in the last tray, farthest away from the exit. Thus, whereas the child at the low effort side needed to lift only 3 trays to transport his or her tube to the exit, the child at the high effort side needed to lift 10 trays. In the parallel work condition, children could transport their tubes independently because the last three compartments before the exit were filled with individual trays (Fig. 4A). In the collaborative work condition, children depended on each other for retrieving tubes given that the last three compartments before the exit were filled with collaborative trays that they needed to lift together (Fig. 4B). All other materials and the rewards were the same as described in Study 1.

Procedure

Study sessions were conducted by the same three alternating experimenter teams and followed the precise training and test procedure as described in Study 1.

Coding and data analysis

We used the same approach and statistical methods as described in Study 1 to analyze the portion of sweets that allocators put in their partner's box. A second observer coded 21% of sessions in order to establish reliability. For 94% of trials the two coders were in complete agreement, and in the remaining three cases their counts differed by only one sweet, resulting in a strong correlation (Spearman's rho = .97) and no notable difference (Wilcoxon rank test, $N = 1445$, $p = .937$) between the two observations. The three cases of disagreement were resolved by a third observation. We fitted a logistic GLMM testing the effects of the partner's effort (low vs. high), work mode (collaboration vs. parallel work), age group, and all interactions between these three factors while controlling for gender, trial

[2] Some of the stooge children ($n = 48$) participated in a second part of the study where they were the allocators. Because the experience as stooge and passive recipient in the first part of the study had an influence, we decided to exclude stooge children from being subsequently tested as allocators.

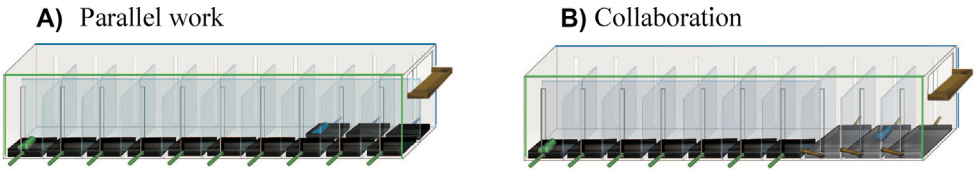

Fig. 4. Apparatus setup and start positions for sweet tubes in the unequal work scenario. In both work mode conditions (parallel work and collaboration), the high effort child needs to lift 10 trays to transport the sweet tube to the balcony exit (here, the child retrieving the green tube on the green side), whereas the low effort child needs to lift only 3 trays (here, the child retrieving the blue tube on the blue side). In the parallel work condition (A), each child lifts trays and transports his or her sweet tube individually. In the collaboration condition (B), children need to lift the last 3 trays before the exit together in order to retrieve the sweet tubes.

number, experimenter team, and the random effect of participant's identity (see Study 1 for details on statistical procedures).

Results and discussion

Of the 129 allocator children, 95 (74%) shared at least once with their partner in the two test trials. Children were most likely to share with partners who had worked with more effort in the collaboration condition (median = 3, mode = 3, mean = 2.2), followed by partners who had worked more in the parallel work condition (median = 2, mode = 3, mean = 1.8) and partners who had worked less in the collaboration condition (median = 1.5, mode = 0, mean = 1.8), and they were least likely to share with partners who had worked less in the parallel work condition (median = 1, mode = 0, mean = 1.3).

The GLMM analysis did not reveal any significant interaction effects of work mode, partner's effort, or age group on children's allocations (Table 2). In particular, there was no indication that children's consideration of their partner's effort when making sharing decisions depended on collaboration (interaction effect of Work Mode × Partner's Effort; likelihood ratio test: $\chi^2 = 0.01$, $df = 1$, $p = .931$) or that the effects of collaboration and partner's effort depended on children's age (see Table 2). However, work effort had a significant main effect on children's sharing decisions (estimate ± *SE:* 0.43 ± 0.22; likelihood ratio test: $\chi^2 = 3.87$, $df = 1$, $p < .05$); children gave more to partners who worked with higher effort (median = 3, mode = 3, mean = 2.0) than partners who worked with lower effort (median = 1, mode = 0, mean = 1.5). Based on the model estimates, the odds for children to share a sweet were 54% higher when partners worked more than them than when partners worked less than them.

Independently of the partner's work effort, children were generally more likely to share (and gave more sweets to partners) after collaboration (median = 2.5, mode = 3, mean = 2.0) than after parallel work (median = 2, mode = 0, mean = 1.5; main effect of work mode estimate ± *SE:* −0.41 ± 0.22; the odds to share were 51% higher after collaboration). Interestingly, after collaboration children even decided to give the bigger share (4 or 5 sweets out of 7) to their partner in 23 cases (18%), whereas after parallel work they did so in only 4 cases (3%). However, this main effect of work mode approached significance only in the current scenario involving unequal work effort (likelihood ratio test: $\chi^2 = 3.52$, $df = 1$, $p = .061$).

Children's age again had a significant main effect on children's allocations, with younger children sharing more than older children (estimate ± *SE:* −0.53 ± 0.23; likelihood ratio test: $\chi^2 = 5.27$, $df = 1$, $p < .05$). In fact, the 5-year-old children shared very generously with partners who worked with high effort in both the collaboration condition (median = 3, mode = 3, mean = 2.6) and the parallel work condition (median = 3, mode = 3, mean = 1.8), and they also allocated similarly many sweets to partners who worked with less effort in the collaboration condition (median = 3, mode = 3, mean = 2.2). They gave less only to partners who worked with less effort in the parallel work condition (median = 0.5, mode = 0, mean = 1.4) (see Fig. 5A). The 8-year-old children generally shared more with partners who worked with more effort (after collaboration: median = 2, mode = 3, mean = 1.8; after parallel work: median = 1.5, mode = 3, mean = 1.7) and less with partners who worked with less effort

Table 2
Test effects of the logistic generalized linear mixed model in the equal work scenario, including logit transformed model estimates, confidence intervals, and likelihood ratio test results (comparing models with and without the respective effect)

	Model estimates				Likelihood ratio test		
	Estimate	*SE*	Lower CI	Upper CI	χ^2	*df*	*p* Value
Intercept	−0.97	0.34	−1.69	−0.33			
Partner's effort (more)	0.43	0.22	0.03	0.83	3.87	1	.049
Work mode (collaboration)	0.41	0.22	−0.01	0.84	3.52	1	.061
Age group (8 years)	−0.53	0.23	−0.98	−0.09	5.27	1	.022
Removed interactions:							
Partner's Effort × Work Mode × Age Group					0.00	1	.979
Partner's Effort × Work Mode					0.01	1	.931
Work Mode × Age Group					1.48	1	.224
Partner's Effort × Age Group					0.01	1	.920

Note. The model included the test variables partner's effort (reference level = less), work mode (reference level = parallel work), age group (reference level = 5-year-olds), and all their interactions and the control variables gender, trial number, experimenter team, and random effect of participant ID. The interactions between partner's effort, work mode, and age group were tested first and removed from the model (because they were not significant) in order to test lower-order and main effects. CI, confidence interval.

(after collaboration: median = 1, mode = 0, mean = 1.4; after parallel work: median = 1, mode = 0, mean = 1.2) (see Fig. 5B).

Again, a pre-analysis check had revealed that the only significant influence of control variables was a main effect of gender, with girls sharing more than boys (estimate ± *SE:* −0.8 ± 0.22; likelihood ratio test: χ^2 = 12.98, *df* = 1, *p* < .001) (see SOM for details on model results).

Thus, taken together, the results of Study 2 indicate that considerations of both work effort and collaboration have an influence on children's sharing decisions, but we could not find any evidence that collaboration was necessary for children's consideration of work effort. Among the younger children (5-year-olds), allocators shared more with their partners when partners worked with more (rather than less) effort in the parallel work condition, and also they rewarded collaboration with higher donations independently of work effort. Among the older children (8-year-olds), allocators were most influenced by relative work effort and shared more with partners who worked more (rather than less) than them across both work mode conditions. In general, the effect of collaboration was smaller in Study 2 where children worked with unequal efforts than in Study 1 where they worked with equal efforts (e.g., the effect approached significance only in Study 2). One possibility is that children's considerations of merit and effort overwrote the effects of collaboration in Study 2, in particular among the 8-year-old children. However, it should also be noted that children spent a much shorter time actively coordinating their actions for collaboration in Study 2. In contrast to Study 1, where children needed to collaborate to lift all 10 trays together, in Study 2 they needed to collaborate to lift only 3 trays together (whereas the other trays were used by only one child alone). This difference in exposure could potentially have contributed to the weaker effect of collaboration in Study 2.

The results with regard to merit-based sharing in Study 2 differ somewhat from previous findings with younger children using a simpler setup and public sharing. In the study by Hamann and colleagues (2014), 3.5-year-old children shared equally or even generously (giving more than half of the rewards) with collaborative partners only when they first watched them go through the extra effort of disentangling the rope that they needed to pull together in order to reach the rewards. When it was them who had this extra effort, or when partners had this extra effort but they did not depend on them for pulling their own rope (parallel work condition), they tended to keep the bigger share when rewards were distributed unequally. In contrast, in the current study (involving a more effortful and complex work task and private sharing), 5- and 8-year-old children rewarded the higher effort with higher donations no matter if they had depended on their partner for retrieving the rewards or not. In addition, at least among the 5-year-olds, collaboration was rewarded with more sharing, even when the partner had worked with less effort.

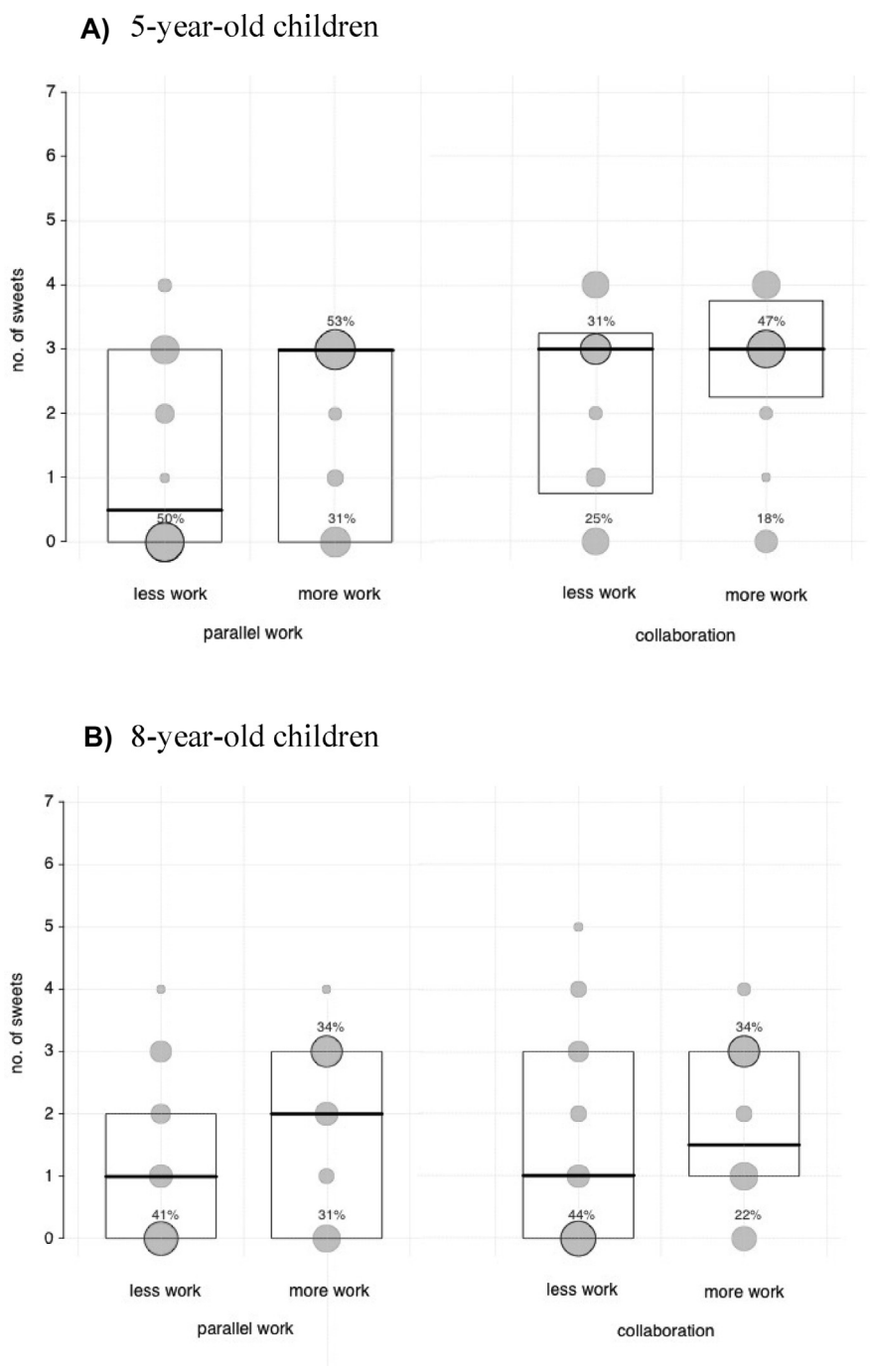

Fig. 5. Children's allocations after unequal work (Study 2). The two bubble plots show the number of sweets (out of 7) that 5-year-old children (A) and 8-year-old children (B) shared with their partner according to work mode and effort condition. Bubble sizes are proportional to the percentage of trials in which the respective number of sweets was shared. Bubbles with black borders represent the mode; the numbers at the mode and zero bubbles are the respective percentage of trials (and serve as a reference for bubble sizes). The solid bars and boxes represent the medians and quartiles, respectively.

The current results are, however, in accordance with previous findings with older children showing that considerations of work effort and work-based equity become increasingly important for children's sharing decisions at late preschool and early school age, at least in Western industrialized societies. Around 3 or 4 years of age, children begin to allocate earned resources based on their coworker's merit and are more likely to share with individuals who produced more or worked with more effort (Kanngiesser and Warneken, 2012). Around 9 or 10 years of age, when children are increasingly able to suppress self-interests and reject even advantageous inequity, children sometimes give more than half of a resource to a partner who worked with more effort than them (Hook & Cook, 1979). Interestingly, these growing considerations of work contributions in older preschool and school children do not seem to depend on interdependence or collaboration given that children in these studies did not actually depend on their coworkers to acquire the resources that they share but simply work alongside. In accordance with these previous findings, children in the current study applied merit-based principles also in the parallel work condition and generally gave more to hard-working partners no matter if they depended on them to retrieve the rewards or not.

General discussion

The current studies provide support for the hypothesis that children's sharing of the spoils after collaboration expresses a genuine sense of fairness. Previous studies have shown that young preschool children share more fairly after collaboration than after parallel work (Hamann et al., 2011) and that this is not just increased generosity but rather a sense of equality between partners, at least by middle childhood (Corbit et al., 2017). The current results show that increased sharing after collaboration is not due to an initial framing of the available resources as shared, that it is also present even when the distributing is done by one partner in private without the other person knowing about the distribution, and that it is also apparent in situations where partners work with unequal merit and the distributing is done by one partner in private.

More specifically, in our first study we found that both 5- and 8-year-old children gave more of their sweets to an unlucky peer partner after collaboration than after individual work when they worked with equal efforts. Contrary to previous studies of collaboration in which children worked for a pooled resource or recipients were watching the resource distribution, in this study children shared rewards that were individually owned by them (i.e., inside a container assigned personally to them) and they decided in private whether to share with the partner without needing to worry about the recipient's harassment or negative reaction. Importantly, we made sure that children knew that their decisions were private and that the partner would not find out about the outcome. This was done by having the two children collect all the sweets that they obtained during the session in separate closed collection boxes where nobody could see what was placed inside. In addition, we familiarized children with the situation of distributing sweets in private by letting them participate in a trial run of the sharing test during the training. By 5 years of age, children have been shown to strategically adapt their sharing decisions in dictator games to an audience and to share less when they feel unobserved than when they are watched (Engelmann et al., 2013; Leimgruber et al., 2012; McAuliffe et al., 2020), suggesting that maintaining a good reputation could also be an important motivation underlying fair sharing after collaboration when partners are watching. The current results show, however, that young children share more after collaboration than after individual work even when no one is watching and thus that collaboration may induce prosocial concerns that go beyond mere reputational concerns. Of course, this does not mean that reputational concerns do not affect children's decisions when sharing resources in the collaborator's presence. Future research could investigate the role of reputation for sharing decisions after collaboration, for example, by comparing children's sharing with coworkers across different private and public settings.

In our second study, we looked at merit-based sharing when effort between the two partners was unequal in the same work scenario. We found that children based their sharing decisions on work effort and gave more to the partner when the partner worked three times as much as them than when the partner worked three times less than them. Importantly, merit-based sharing did not depend on collaboration in this context; children did not consider their partner's effort only when they depended

on their partner for obtaining the rewards but also rewarded higher effort with more sweets when their partner had worked individually. Thus, in contrast to previous findings with regard to merit-based sharing in public among 3.5-year-old children (Hamann et al., 2014), we could not find any evidence that collaboration was a necessary context for merit-based sharing in private among older preschool and school children. Collaboration had a small additional effect on children's decisions, in particular among the younger (5-year-old) children who disregarded unequal merit after collaboration and also shared generously with collaborative partners who had worked less than them. However, compared with the scenario of partners working with equal effort, the effect of collaboration in the context of unequal work was smaller, indicating that considerations of work effort may have had a greater influence on sharing decisions, in particular among the older (8-year-old) children.

Our results of merit-based sharing independently of collaboration are in accordance with previous findings showing that considerations with merit- and work-based distributive justice become increasingly important for children's sharing decisions with age, in particular in Western societies. Already by 4 years of age children show considerations of merit in work contexts where they do not directly collaborate or depend on their partners for resource production, and by middle childhood children begin to redistribute rewards based on productivity or work contributions in terms of work units or produced resources (Almås et al., 2010; Hook & Cook, 1979; Kanngiesser & Warneken, 2012). Because such considerations of merit seem to be less important for sharing among children in some non-Western societies, it might be that this development is specific to cultural contexts in which merit-based fairness norms are culturally promoted or in which children are exposed to merit-based distributions from early on (Engelmann et al., 2021; Schäfer et al., 2015). Future cross-cultural research could investigate whether cultural differences in merit-based sharing are less pronounced in the context of collaboration.

It should be noted that, compared with previous studies of collaboration, in the current studies the work task was more effortful and involved a longer interaction between partners, and it is possible that this also contributed to the observed differences in merit-based sharing. In previous studies with 3-year-olds, children only needed to pull one rope (either together or individually) in order to reach their rewards, and it was specifically in the collaboration condition that less-working children needed to wait for their harder-working partner to obtain rewards, which may have made work effort particularly salient and led to more sharing in this specific condition (Hamann et al., 2014). In the current studies, children always spent several minutes working alongside their partner to transport their sweet containers over the obstacles, and even in the individual parallel work condition they could directly see the relative difference in effort by comparing the number of obstacles that they and their partner needed to overcome to retrieve their sweet container. This may have made work effort more salient across conditions, promoting considerations of merit even after individual work.

Whereas in dictator game experiments children become more generous with age (Benenson et al., 2007; Fehr et al., 2008; Harbaugh et al., 2003; Ibbotson, 2014), interestingly it was the 5-year-old children who shared more than the 8-year-old children in the current studies. Different from dictator games with windfall resources, children in the current context spent several minutes working alongside and interacting with their partner before making their sharing decisions. The 5-year-olds spent even more time working with their partner than the 8-year-olds because it took them considerably longer to transport their containers over the obstacles. Previous studies with 3- to 6-year-old children show that participating in a joint work task (but not in a game) can promote sharing in young children even if the resources to share are not earned within the same context (Corbit, 2019; Corbit et al., 2021). Thus, it is possible that also in the current studies the personal contact and interaction with the partner while working together on the task of retrieving the sweet containers promoted prosocial concerns and an appreciation of the partner that went beyond the immediate work context and that this effect was stronger among the younger children than among the older children. In Study 2, this may have even led the younger children to share near equally with their collaborative partners even when the partners had worked with less effort than them.

In accordance with this interpretation of the results, some previous studies with older children and adults have found that a collaborative framing of a task can sometimes lead to disregard of differences in merit and promote concerns with equality rather than with work-based distributive justice (e.g., Lerner, 1974; Miller & Komorita, 1995). In fact, in some collaborative scenarios involving repeated

interactions, differential rewards based on merit can even be disruptive to maintaining cooperation because it can create inequalities, status differences, and competition among work partners (Miller & Hamblin, 1963). The current studies cannot provide conclusive evidence for the hypothesis that collaboration can lead to disregard of merit because we did not observe any significant interactional effect between work effort and collaboration. However, future research could explore this hypothesis further, for example, by comparing how young children react, judge, and reason about differential rewards (based on merit or effort) within individual and collaborative work settings.

The current results contribute to a growing consensus about the development of children's sense of fairness. It seems to first emerge at around 3 years of age and is confined to situations in which children's selfish motives are somehow inoperative or diminished. Thus, 3-year-olds divide resources equally when their self-interest is not an issue, that is, among third parties (Olson & Spelke, 2008). They also do this when they are dividing the spoils of a collaboration in which they were involved. One possibility is that in collaboration children see themselves as part of a "we"—comprising two equally deserving partners sharing a mutual respect for one another (Engelmann & Tomasello, 2019)—that produces the resources together and so should benefit from them together. If they produce them with equal effort and contributions, then the division should be equal, but unequal effort and/or contributions can be rewarded proportionally in some cases (and free riding is not rewarded at all). But 3-year-olds do not generalize this thinking and these attitudes outside of collaborative situations.

During middle childhood, children begin to see themselves as part of a cultural group, with in-group compatriots seen as analogous to collaborative partners in the group, that is, equally deserving of resources and respect as themselves. Their sense of fairness thus generalizes to all in-group members, not just collaborative partners, with out-group members excluded to one degree or another (Fehr et al., 2008; Misch et al., 2021; but see Corbit et al., 2022, and Gonzalez et al., 2020). It is during middle childhood as well that young children begin to adopt the cultural norms of their group with respect to all kinds of prosocial and moral behavior (House et al., 2013), including in some but not all cases the role of merit in various kinds of sharing situations. The underlying theoretical construct in all this is children's growing understanding of when and how they are interdependent with other persons combined with the sense that interdependence creates the senses of obligation and deservingness.

Data availability

Anonymized data has been deposited in the Open Science Framework (https://osf.io/b26wy/).

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Author contributions

M.S., D.B.M.H., and M.T. developed the idea and designed the research; M.S. conducted the research and analyzed the data; M.S. and M.T. wrote the article; D.B.M.H. provided comments and critical feedback.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2022.105609.

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