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# "I had so much it didn't seem fair": Eight-year-olds reject two forms of inequity

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ABSTRACT

Research using economic games has demonstrated that adults are willing to sacrifice rewards in order to prevent inequity both when they receive less than a social partner (disadvantageous inequity) and when they receive more (advantageous inequity). We investigated the development of both forms of inequity aversion in 4- to 8-year-olds using a novel economic game in which children could accept or reject unequal allocations of candy with an unfamiliar peer. The results showed that 4- to 7-year-olds rejected disadvantageous offers, but accepted advantageous offers. By contrast, 8-year-olds rejected both forms of inequity. These results suggest that two distinct mechanisms underlie the development of the two forms of inequity aversion.



## 1. Introduction

Human adults prefer equal outcomes in a wide range of situations (Loewenstein, Thompson, & Bazerman, 1989). Using experimental games with real rewards, researchers have found that some adults will sacrifice benefits to themselves in order to correct or avoid unequal outcomes, both when they are offered less than a social partner – disadvantageous inequity – and when they are offered more – advantageous inequity (Camerer, 2003; Dawes, Fowler, Johnson, McElreath, & Smirnov, 2007; Fehr & Fischbacher, 2003; Fehr & Schmidt, 1999; Guth, Schmittberger, & Schwarze, 1982). Recent studies of children's sensitivity to inequity have found consistent evidence of aversion only to disadvantageous inequity, and not to advantageous inequity (LoBue, Nishida, Chiong, DeLoache, & Haidt, 2010; Takagishi, Kameshima, Shug, Koizumi, & Yamagishi, 2010). The current study investigated the development of both forms of inequity aversion using a novel game in which children had to sacrifice resources to prevent inequity.

### 1.1. Inequity aversion in economic games

A strong test of inequity aversion requires some sacrifice from the participant. Classic research on distributive justice included several tests in which, given a fixed amount of a resource, children could either give equal amounts to themselves and others or keep more or less for themselves. These studies found that some children begin to propose equal divisions of resources at about 8 years of age but that younger children tended to favor themselves (Damon, 1977; Piaget, 1932; see Hook & Cook, 1979 for a review). More recent research modeled on economic games have produced similar results. For example, in the Dictator Game (DG), children can keep 10 stickers for themselves or give some away to an unfamiliar peer (whom they will never actually meet). Several studies have found that, although equal distributions increase with age, children 6 years of age and younger tend to favor themselves (Benenson, Pascoe, & Radmore, 2007; Blake & Rand, 2010; Gummerum, Hanoch, Keller, Parsons, & Hummel, 2009).

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Other games have used a forced choice method to assess children's responses to specific forms of inequity. In a common game, children must chose between an advantageous allocation (two candies for me and none for you) and an equal allocation (e.g., one candy for me and one for you). Thus, in choosing the equal alternative, children would have to sacrifice one candy, but they would receive some candy in either case. The results from these studies varied primarily depending on recipient. Children between 3 and 6 years of age were more likely to choose the equal option when the recipient was an adult researcher (Thompson, Barresi, & Moore, 1997) or a friend (Moore, 2009). However, when the recipient was a peer who was not a friend (as identified by the participant) or was a stranger, children chose the advantageous option (Moore, 2009). In a similar study, children younger than 8 years of age chose the advantageous option regardless of the recipient (Fehr, Bernhard, & Rockenbach, 2008). By contrast, 8-year-olds preferred the equal option about half the time when the recipient was identified as a member of their classroom but only 12% of the time when the recipient was a member of a different classroom. In sum, when advantageous distributions are possible between oneself and an unfamiliar peer, children tend to favor themselves even at 8 years of age. On the other hand, when the distribution will be shared with a friend or an adult, they are more likely to share equally.

Another kind of economic game, the Ultimatum Game (UG), has been used as a test of inequity aversion, although more sophisticated perspective-taking skills are involved (Takagishi et al., 2010). Here, one player proposes a division of 10 resources such as stickers or candy, but the recipient (or responder) can reject the offer such that neither player receives anything. Thus, recipients face a forced choice when the offer is unequal: they can accept the inequity or reject it and achieve an equitable outcome of zero for each player. However, in the UG, rejections may be motivated by a desire to punish proposers who make unequal offers rather than by a simple aversion to inequity. Although some UGs have used hypothetical rewards with children (Murnigham & Saxon, 1998), the most convincing games are those where children must reject a real reward such as candy in order to achieve equity. In one face-to-face UG, about half of the children (mean age: 5;6 years) who received a disadvantageous offer rejected it (Takagishi et al., 2010). In the same study, only four children received an advantageous allocation, and they all accepted it. In a modified UG, 9-year-olds played with familiar peers from a summer camp and received money based on points from the game (Sutter, 2007). Here, the proposers were also limited to two choices, one of which favored themselves (8 for the proposer, 2 for the recipient). When proposers selected an alternative that favored the recipient (2 for the proposer, 8 for the recipient), 23% of the recipients rejected these advantageous offers, preferring nothing over an unequal outcome (Sutter, 2007). However, given the structure of the game, recipients may have been motivated to reject the advantage in recognition of the unfair options the proposers faced.

In sum, there is scattered evidence that children will reject both advantageous and disadvantageous inequity at different ages and under different circumstances. However, in most of previous research, inequity aversion was not the focus. Dictator Games assess generosity and altruism and Ultimatum Games test strategic responses to the proposer's intentions. The other forced choice games test preferences for equality, but are difficult to interpret as direct evidence of inequity aversion. For example, children may choose a 1–1 option over a 2–0 option out of a belief that everyone should get something in the game. If they were truly inequity averse, children would also choose 1–1 over a 2–1 option, but that alternative was never presented. To our knowledge, no direct tests of inequity aversion exist in the developmental literature where children must pay a cost to avoid inequity.

### 1.2. Anonymity and indirect reciprocity

A second issue with existing economic games concerns the relationship between the players. In most of these games, children play against an unknown peer that they do not actually meet. This anonymous design eliminates any expectations of eventual reciprocity by the peer and also minimizes proposers' concerns about their reputation (Nowak, 2006; Nowak & Sigmund, 2005). However, as other researchers have noted, real life interactions are mostly face-to-face and reputation is commonly a concern (Dreber, Rand, Fudenberg, & Nowak, 2008). This is particularly true during development when children have few anonymous interactions and are almost always being watched by adults. In addition, children may find it easier to accept inequity when the recipient is not present and is unknown. In face-to-face interactions, some forms of inequity make children visibly upset. For example, in Lobue et al. (2010) pairs of 3-, 4- and 5-year-olds were given an unequal allocation of stickers by an experimenter. The spontaneous emotional reactions of both children (the child who received more and the child who received less) were coded on a five point scale, from clearly unhappy to clearly happy. The results revealed a significant aversion to disadvantageous inequity at all ages and a significant positive reaction to advantageous inequity. Watching a peer enjoy a larger reward may make it more difficult to accept a disadvantageous offer. By contrast, when preschoolers receive a larger reward in front of a peer, they are content with this advantageous inequity (Birch & Billman, 1986; LoBue et al., 2010).

In the current study, we introduce a novel game for children, the Inequity Game, where participants could either accept an unequal offer or reject it while facing the recipient. Children were partnered with an unfamiliar peer and played the game while parents and others watched.

This game was similar to a forced choice mini-UG done with adults and older children in that the decision maker could either accept an unequal outcome or reject it so that both players received zero (Sutter, 2007; Falk, Fehr, & Fischbacher, 2003). We built a game toy appropriate for preschoolers with an intuitive mechanism for accepting and rejecting offers such that the consequences of decisions were obvious (Fig. 1). The allocations of candy were presented by an experimenter in order to ensure that the

deciders were not responding to intentions of the other player, i.e., negative reciprocity (Blount, 1995; Falk & Fischbacher, 2006).

Our method allowed us to compare children's responses to equal offers (1–1), offers advantageous to the decider (4–1) and offers disadvantageous to the decider (1–4). We anticipated that this intuitive, face-to-face game would increase the likelihood that children would reject an offer that was disadvantageous to themselves. More specifically, in the disadvantageous inequity condition (DI), we predicted that children would forego a modest reward for themselves given that its acceptance meant that their peer would obtain a greater reward. By contrast, in the advantageous equity condition (AI) we predicted that most children would accept the larger reward for themselves. In addition, the handle-pulling mechanism of the apparatus allowed us to measure children's reaction times for different kinds of offers. Reaction times offer insight into the decision making process, and this is the first study to capture this measure for children in an inequity task. We did not have specific predictions for the reaction time results, but use this measure to assess the possible cognitive mechanisms that underlie children's decisions when faced with inequity.

## 2. A novel test for inequity aversion in children

### 2.1. Method

#### 2.1.1. Participants

Children 4–8 years of age were recruited in public parks in Boston and surrounding towns. Parents were told that participation was voluntary and that their children would receive candy in the game. Those who consented were brought to a testing area – a portable table with the game apparatus. The majority of the children who participated was Caucasian. For each session, two unfamiliar children, similar so far as possible in terms of age and height, were paired and assigned to the decider and recipient roles. A total of 178 pairs was tested in one of two conditions: disadvantageous inequity (DI), $N = 86$, 41 females; age range: 4;0–9;1; and advantageous inequity (AI), $N = 92$, 54 females; age range: 4;0–8;11. Sessions were videotaped if the parents gave consent (92% of sessions).

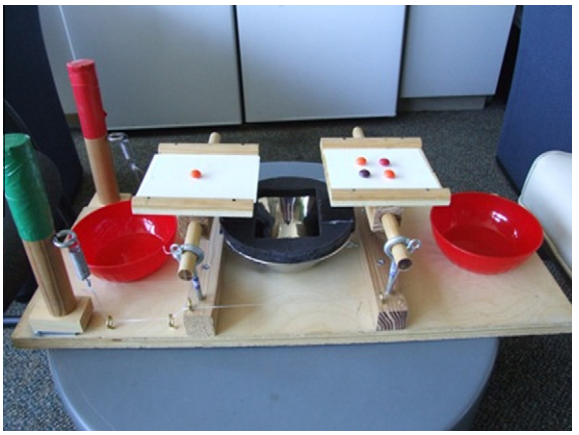

**Fig. 1.** Apparatus. Children sat face-to-face with one, the decider, controlling the two handles. Pulling the green handle caused the trays to tip outward, dropping the candies into the bowls for each player. Pulling the red handle caused the trays to tip inward, dropping the candies into the center bowl for rejections. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

#### 2.1.2. Procedure

The decider and recipient sat face-to-face at the game apparatus (Fig. 1); an adult allocated candy on trays designated for each child. For each session, the children were assigned to one role: the decider, who could accept or reject the allocation of candy, and the recipient, who played a passive role. Children only played one role in the game and participated in only one condition (DI or AI). Having the experimenter allocate the candies focused children's attention on the unequal amounts so that deciders would not reject in order to punish the partner for making an unequal offer, as is the case in the Ultimatum Game.

The experimenter explained the game to the children and demonstrated the apparatus. The decider could pull one of two handles on each trial: a green handle to accept the offer – this tilted the trays toward each child so that the candy fell into their respective bowls; or a red handle to reject the offer – this tilted both trays to the middle so that the candy dropped into a covered bowl and "nobody gets the candy." The experimenter demonstrated how the handles worked with two trials, each with one candy on both trays. The experimenter pulled the green handle on the first demonstration trial stating the outcome to the children – "you each get one candy" – and pulled the red handle on the second trial stating – "no one gets candy." The children were then given three practice trials to ensure that the decider understood how each handle worked. For the practice trials, the experimenter placed different allocations of candy on the trays and prompted the decider by asking, "which handle do you want to pull?" The allocations were (a) 1 candy each (1–1), (b) 0 for the decider and 1 for the recipient (0–1; disadvantageous), and (c) 1 for the decider and 0 for the recipient (1–0; advantageous). The decider's actions in these trials were spontaneous and not re-enforced. The purpose of the practice trials was to familiarize the deciders with how the handles worked. Thus, if a child never pulled one of the handles (either green or red), an additional 1–1 trial was added and the experimenter prompted the child to pull the handle not used "just to see how it works." For each of the practice trials, and all experimental trials, the experimenter stated the outcome of the decision – e.g., "You (decider) get one candy and [recipient's name] gets none."

Between trials, the experimenter placed a flat stick across the trays while allocating the candies. Children were told that they should wait for the experimenter to lift the stick before pulling one of the handles. This procedure marked the start of a trial and was used for coding reaction times (described below). Parents and others watched the game, but prospective participants were told that they could not watch the game so that it would be a surprise.

Children in each condition received two blocks of trials with six trials in each: an equity block and an inequity block. The equity block, consisting of one candy each for

the decider and the recipient (1–1), was used to control for any general tendency children might have to reject allocations. The inequity block was different for each condition. In the DI condition, the inequity trials consisted of 1 candy for the decider and 4 for the recipient (1–4); in the AI condition, the inequity trials consisted of 4 for the decider and 1 for the recipient (4–1). For both conditions (DI and AI), the order of the equity and inequity blocks was counterbalanced across pairs of players within each age group. During the game, accepted rewards accumulated in bowls visible to both players. At the end of the game, the players received the candy that had accumulated in their respective bowls.

Pilot testing revealed that some children had preferences for different colors of the candy used (Skittles®) and would sometimes reject offers because they did not like that color or flavor. Rather than use only the color that the decider liked, which the recipient may not have liked, we blindly pulled the candies from a bag throughout the session. This random selection was the same in all conditions. Thus, we expected some level of rejections for both equity and inequity trials, but this noise would be consistent in both blocks. We used six trials per block to ensure that differences between the blocks could be detected above the noise.

### 2.1.3. Coding

The decider's action on each trial – accept or reject – was coded in the field by the experimenter. The actions were entered into a spreadsheet and the first author checked the codes against the videos. Videos were available for 92% of the sessions. The practice trials were also checked for 90% of the sessions – some videos did not capture the practice trials.

For the experimental trials, a reaction time analysis was performed using Interact v.9. Research assistants coded the beginning and end of each trial. Each trial began when the experimenter lifted the stick which held the trays in place between trials and ended when the decider began to pull the handle which resulted in the decision to accept or reject. Occasionally, the decider was distracted or appeared unsure of when to start and the experimenter prompted the child to "pull one of the handles." In these cases, the verbal prompt was used as the start of the trial. On trials when the decider touched one handle and then changed his or her mind and pulled the other handle, the pull that resulted in the final action was used as the end of the trial. The research assistants also recorded the action (accept or reject) for each trial and checked these codes against the main data spreadsheet.

Two research assistants each coded about half of the videos. As a reliability check, 20% of the videos were randomly selected for double coding. The average trial duration from each coder was 1.99 and 2.06 s, respectively, an average difference of less than one tenth of a second per trial. The intraclass correlation coefficient for these data was .989, $P < .001$, indicating strong consistency between the coders. The accept/reject codes were 100% in agreement, which is not surprising given that this was the second verification of those codes.

## 2.2. Results

For each decider, the number of rejections in each block of trials (range = 0–6) was summed for a within-subject measure. All tests of significance reported are two-tailed and effect sizes were calculated using partial eta-squared ($\eta_p^2$). For each condition, we carried out a 3-way ANOVA of Age (five groups) × Trial Type (equity or inequity) × Order (equity block first or second). We also carried out ANOVAs for each condition to assess four other variables: Gender and three sibling variables (Any, Younger, Older). These were 3-way ANOVAs of Age × Trial Type × Gender, for example. None of the four variables, or any interactions with them, was found to be significant in any of the analyses and are therefore not reported below.

### 2.2.1. Disadvantageous inequity

Results for the DI condition are shown in Fig. 2. Inspection of Fig. 2 shows that irrespective of age, children rarely rejected equitable (1–1) allocations. Rejection of inequitable (1–4) allocations was more common and increased with age. The ANOVA confirmed main effects for Age ($F(4, 76) = 7.74$, $P < .001$, $\eta_p^2 = .29$), Trial Type ($F(1, 76) = 164.53$, $P < .001$, $\eta_p^2 = .68$), Order ($F(1, 76) = 4.65$, $P = .034$, $\eta_p^2 = .06$), and a significant interaction of Age × Trial Type ($F(4, 76) = 6.50$, $P < .001$, $\eta_p^2 = .26$). Tests of the simple effect of Trial Type for each Age (using a Bonferroni adjustment) showed that children rejected significantly more inequity than equity trials at all ages: 4-year-olds ($F(1, 76) = 9.15$, $P = .003$, $\eta_p^2 = .11$); 5-year-olds ($F(1, 76) = 39.61$, $P < .001$, $\eta_p^2 = .34$); 6-year-olds ($F(1, 76) = 15.98$, $P < .001$, $\eta_p^2 = .17$); 7-year-olds ($F(1, 76) = 68.22$, $P < .001$, $\eta_p^2 = .47$); and 8-year-olds ($F(1, 76) = 45.61$, $P < .001$, $\eta_p^2 = .38$). In addition, post hoc tests for the interaction of Age and Trial Type revealed no significant differences between ages for the 1–1 trial type, $F(4, 76) = 1.35$, but a significant increase in rejections with age for the 1–4 trial type, $F(4, 76) = 8.17$, $P < .001$, $\eta_p^2 = .30$. A closer examination of Order revealed that children rejected more trials overall when the equity trials came first (mean: 2.32) compared to when the inequity trials came first (mean: 1.84). The increased rejections occurred primarily for the inequity trials.

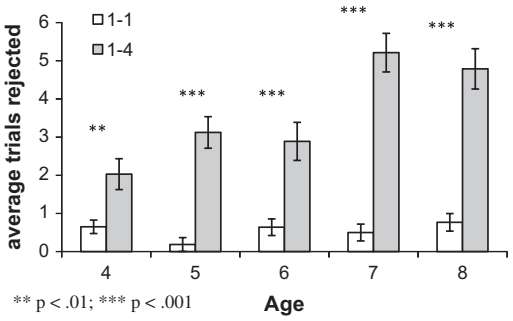


**Fig. 2.** Disadvantageous inequity. Average trials rejected (out of 6) for each trial type and age; error bars are s.e.m.

To further explore the developmental change for DI, a second test examined the proportion of children within each age group who rejected inequity trials more often than equity trials. This proportion was greater than would be expected by chance for all age groups except 4-year-olds: 4-year-olds (12 out of 22 children; binomial probability: $P = 0.262$); 5-year-olds (15 out of 21 children; binomial probability: $P = 0.013$); 6-year-olds (12 out of 15 children; binomial probability: $P = 0.004$); 7-year-olds (14 out of 14 children; binomial probability: $P < .001$); and 8-year-olds (13 out of 14 children; binomial probability: $P < .001$). In sum, children rarely rejected an equitable (1–1) allocation. By contrast, the majority of 4- to 8-year-olds rejected inequitable (1–4) allocations frequently.

### 2.2.2. Advantageous inequity

Results for the AI condition are shown in Fig. 3. Inspection of Fig. 3 shows that 4- to 7-year-olds rarely rejected equitable (1–1) or inequitable (4–1) allocations. Only 8-year-olds were more likely to reject inequitable as compared to equitable allocations. The ANOVA revealed a main effect for Trial Type ($F(1, 82) = 10.48$, $P = .002$, $\eta_p^2 = .11$) and a significant interaction of Age × Trial Type ($F(4, 82) = 7.82$, $P < .001$, $\eta_p^2 = .28$). Tests of the simple effect of Trial Type for each Age (using a Bonferroni adjustment) confirmed a significant difference for 8-year-olds ($F(1, 82) = 30.80$, $P < .001$, $\eta_p^2 = .27$) but not for the other age groups. Post-hoc tests of the effect of Age for each Trial Type revealed decreasing rejections with age for the 1–1 trial type, $F(4, 82) = 5.08$, $P = .001$, $\eta_p^2 = .20$. In addition, rejections increased with age for the 4–1 trial type, $F(4, 82) = 3.65$, $P = .009$, $\eta_p^2 = .15$; specifically, 8-year-olds were significantly different from 4-, 5-, and 7-year-olds but not 6-year-olds. No significant effects were found for Order.

To confirm the developmental pattern for AI, we examined the proportion of children within each age group who rejected inequity trials more often than equity trials. Only the 8-year-olds showed a significant sensitivity to inequity (10 out of 13 children; binomial probability: $P = 0.011$). No other age group showed a significant sensitivity to inequity: 4-year-olds (0 out of 21 children); 5-year-olds (4 out of 21 children; binomial probability: $P = 0.99$); 6-year-olds (6 out of 17 children; binomial probability: $P = 0.83$); and 7-year-olds (8 out of 20 children; binomial probability: $P = 0.75$). In sum, children rarely rejected either equitable (1–1) or inequitable (4–1) allocations in this condition. The only exception to this overall pattern occurred among 8-year-olds, who frequently rejected the inequitable allocations.

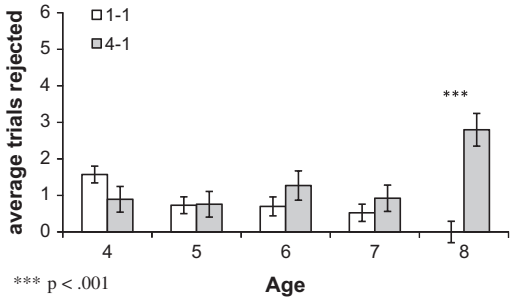


**Fig. 3.** Advantageous inequity. Average trials rejected (out of 6) for each trial type and age; error bars are s.e.m.

### 2.2.3. Combined analysis

To compare the rejections of unequal offers between both experiments, we created a single dependent measure using the difference between equity and inequity trials for each subject. A 2-way ANOVA of Age (five groups) × Condition (DI or AI) revealed main effects for Age ($F(4, 168) = 12.16$, $P < .001$, $\eta_p^2 = .23$) and Condition ($F(1, 168) = 66.88$, $P < .001$, $\eta_p^2 = .29$) and a significant interaction of Age × Condition ($F(4, 168) = 2.66$, $P = .03$, $\eta_p^2 = .06$). Examination of the mean difference scores for Condition showed that rejection of inequitable as compared to equitable offers was greater when the inequity was disadvantageous (1–4) rather than advantageous (4–1). Tests of the simple effect of Condition for each Age (using a Bonferroni adjustment) showed that the difference between the AI and DI conditions was significant for each age group except for the 8-year-olds: 4-year-olds ($F(1, 168) = 11.34$, $P = .001$, $\eta_p^2 = .06$); 5-year-olds ($F(1, 168) = 21.95$, $P < .001$, $\eta_p^2 = .12$); 6-year-olds ($F(1, 168) = 6.76$, $P = .01$, $\eta_p^2 = .04$); 7-year-olds ($F(1, 168) = 38.35$, $P < .001$, $\eta_p^2 = .19$; 8-year-olds ($F(1, 168) = 3.26$, $P = .073$, $\eta_p^2 = .02$). Thus, younger children were more averse to inequity when it was disadvantageous to themselves. By contrast, 8-year-olds were equally averse to both advantageous and disadvantageous inequity.

### 2.2.4. Reaction time analyses

We further assessed children's reactions to equity and inequity by coding how long it took them to decide whether to accept or reject each trial. Specifically, we compared each decider's average trial duration for the equity and inequity blocks. If children reacted automatically in all trials, there should be no difference between the blocks. By contrast, if children had difficulty making decisions on the inequity trials, there should be differences between the two blocks. Trials that were more than five standard deviations beyond the mean trial duration for a given age and a given trial type (equal or unequal) were removed. Using this criterion, three trials were removed from the DI condition and eight trials were removed from the AI condition. To account for individual variability and typical decreases in reaction time with age, we calculated a modified Cohen's $d$ effect size ($D$) for each child, a measure that has become standard for within subjects comparisons (e.g., the Implicit Association Test; Greenwald, Nosek, & Banaji, 2003). Within each age group, the $D$ scores were averaged.

In the DI condition (Fig. 4), $D$ scores were strongly positive, indicating that children at all ages took more time to decide which handle to pull on inequitable (1–4) trials as compared to equitable (1–1) trials: 4-year-olds, $D = 0.36$; 5-year-olds, $D = 0.32$; 6-year-olds, $D = 0.59$; 7-year-olds, $D = 0.71$; 8-year-olds, $D = 0.36$. In the AI condition, $D$ scores were close to zero for the 4- to 7-year-olds, indicating they took no more time to decide which handle to pull on inequitable (4–1) trials as compared to equitable (1–1) trials. Only 8-year-olds showed a strong positive effect, indicat-

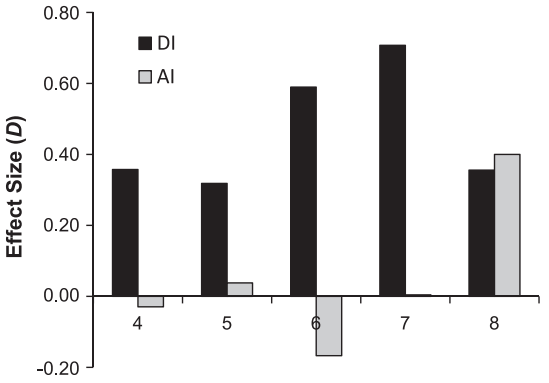


**Fig. 4.** Reaction times. A positive effect size (D) indicates that children took longer to decide which handle to pull in the unequal condition (DI: 1–4 or AI: 4–1) compared to the equal condition (1–1).

ing a longer time to decide on the unequal trials compared to the equal trials: $D = 0.40$.

Children may have taken longer to make a decision on unequal trials only when they ultimately decide to reject the trial. This would suggest an automatic tendency to accept any positive offer which was interrupted when children contemplated rejecting the trial. In order to examine this possibility, an additional analysis was conducted to determine how long it took children to accept and reject the inequitable trials in each condition. For each participant, we calculated the average trial duration for accepted and rejected inequitable trials. Because some participants either accepted or rejected all trials, precluding a within subjects measure, two analyses were performed. First, for each condition, the subset of children who made both accept and reject decisions were analyzed. Second, children who lacked either an accept trial or a reject trial duration were added to the analysis and their missing data was interpolated using averages from the first analysis. Thus, children who were missing an accept trial duration were given the average for accepted trials from the first analysis; similarly, children who lacked a reject trial duration were given the average for rejected trials.

For the DI condition, a repeated measures ANOVA for the subset data revealed no significant differences between the durations of accepted and rejected trials, $F(1, 46) = 1.70$, n.s. For the interpolated data, a repeated measures ANOVA also revealed no significant difference between accepted and rejected trial durations, $F(1, 83) = .09$, n.s. Thus, both analyses confirmed that children were slower to make a decision on disadvantageous trials (1–4) whether they ultimately decided to accept the disadvantageous offer or reject it.

For the AI condition, 8-year-olds were tested separately because they performed differently from the other age groups, i.e., by rejecting more unequal trials. A repeated measures ANOVA on the subset data for 4- to 7-year-olds revealed a significant difference between the duration of accepted trials (mean: 2.01 s) and rejected trials (mean: 2.73 s), $F(1, 27) = 6.13$, $P = .02$, $\eta_p^2 = .185$. Similarly, the interpolated data for this age group also showed a significant difference between accepted (mean: 1.82 s) and rejected (mean: 2.73 s) trials, $F(1, 67) = 37.76$, $P < .001$, $\eta_p^2 = .36$. For the 8-year-olds in the AI condition, no significant differences were found between the durations of accepted and rejected trials, in either the subset data, $F(1, 5) = 4.6$, n.s., or the interpolated data set, $F(1, 9) = 2.32$, n.s. In sum, although 4- to 7-year-olds were not generally slower to make a decision on advantageous (4–1) as compared to equitable (1–1) trials, both analyses confirmed that they were slower to reject such an advantageous offer than to accept it. By contrast, 8-year-olds were slower to make a decision on advantageous trials as compared to equitable trials, but they were no slower to reject such offers than to accept them.

### 2.2.5. Practice trial analysis

Younger children may have been sensitive to advantageous inequity but simply have been unable to inhibit their desire for the four candies on their tray. If the size of the reward prevented children from rejecting AI, and thus endorsing a fair outcome, we would expect children to reject a smaller advantageous reward. The data from the practice trials offered a way of assessing this possibility. Each decider received one advantageous offer during the practice trials – one candy for the decider and zero for the recipient. Given that this distribution is the smallest possible advantageous offer, children who were sensitive to the inequity should be able to reject this offer significantly more than the equal offer in the practice trials. All children in the study received the same set of practice trials before receiving the test trials. This allowed us to combine all of the subjects with practice trial data (on video) into a single analysis ($N = 161$). The percentage of accepted trials for the advantageous practice trial (1–0) and the disadvantageous practice trial (0–1) was compared against the equal practice trial (1–1) (Fig. 5). Chi-squared tests for the advantageous practice trials (AI) revealed no significant difference from the equal practice trials for 4-year-olds, $\chi^2(1, N = 82) = 0.10$, n.s.; 5-year-olds, $\chi^2(1, N = 72) = 0.56$, n.s.; and 6-year-olds, $\chi^2(1, N = 58) = 0.13$, n.s. There were significant differences for the older children: 7-year-olds, $\chi^2(1, N = 60) = 4.36$, $P = .037$; and 8-year-olds, $\chi^2(1, N = 50) = 5.71$, $P = .017$. By contrast, chi-squared tests comparing the disadvantageous practice trials to the equal practice trials revealed significant

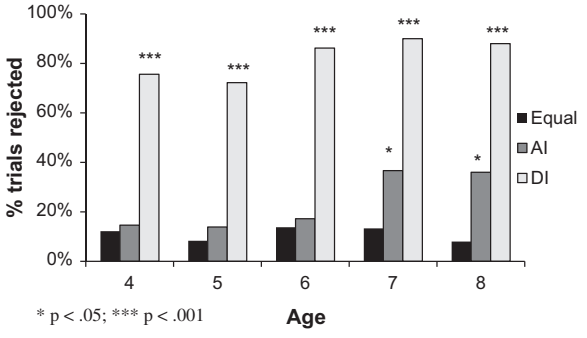


**Fig. 5.** Practice trials. Percentage of practice trials of each type that were rejected by deciders: Equal (1–1), AI (1–0) and DI (0–1). Significance tests shown represent chi-squared tests performed for the AI and DI trials against the Equal trials.

differences at all ages, all $P$ values < .001. In sum, the younger children accepted advantageous offers even when the advantage was very small (one candy) and the desire for the reward should have been diminished.

## 3. General discussion

The current experiment makes three contributions to the literature on inequity aversion in children. First, we show evidence of children rejecting advantageous inequity when paired with an unfamiliar peer. By 8 years of age, children rejected a large relative reward (four candies) to prevent an peer from receiving less than them (one candy). In fact, several 8-year-olds rejected all AI trials, sacrificing 24 candies, and about half of them forfeited at least 16 candies. We believe that this is the first evidence that children paired with an unfamiliar peer will forego a benefit for themselves in order to preserve equity, in this case nothing for both children. Second, we show distinct developmental trajectories for the two forms of inequity aversion using the same method. Children at all ages rejected disadvantageous offers, an effect that increased with age. Specifically, they were willing to sacrifice one candy to prevent a peer from receiving four candies. By contrast, only 8-year-olds rejected advantageous offers; younger children were not willing to sacrifice four candies when their peer was about to receive only one (AI). Thus, by 8 years of age, children rejected both disadvantageous and advantageous inequity.

Third, this study provides the first reaction time measures for children in an inequity aversion task. The reaction time analyses reveal further differences between the conditions in the Inequity Game. In the disadvantageous condition, children took longer to make a decision on the disadvantageous trials compared to the equitable trials. Indeed, they took longer whether they ultimately accepted or rejected the disadvantageous offer. In the advantageous condition, the reaction time data were very different. Children younger than 8 years of age took the same amount of time to decide on both advantageous and equitable trials, but they were slower to reject an advantageous offer than to accept it. By contrast, 8-year-olds took longer to act when faced with an unequal offer, but they took the same amount of time regardless of whether they ultimately accepted or rejected the advantageous offer. By implication, unlike younger children, even when 8-year-olds accepted an advantageous offer, they hesitated before doing so.

We use these results to evaluate the possible mechanisms that underlie the development of inequity aversion. The distinct developmental trajectories for advantageous and disadvantageous inequity aversion suggest that different mechanisms underlie each form of inequity aversion. However, more parsimonious explanations are possible. We begin our discussion with two plausible single mechanism accounts – inhibitory control and reputation – before evaluating more complex possibilities.

### 3.1. Inhibitory control

Children may view both forms of inequity as unfair, but be unable to inhibit their desire for the large reward in the case of advantageous inequity. On this account, children want to endorse equity but fail to do so when the reward is too large. Thus, children are able to reject disadvantageous inequity and sacrifice only one candy, but they are unable to sacrifice four candies in the advantageous case. By 8 years of age, children have sufficient inhibitory control to resist their desire for the large reward and reject the advantageous offer.

The results from the practice trials and the reaction time analyses make this inhibition account unlikely. During the practice trials, children faced a much smaller advantageous offer – one candy for the decider and none for the recipient. If children younger than 8 years of age genuinely viewed advantageous inequity as unfair, this small offer should have been much easier to reject than the four candies in the AI test trials. Indeed, children at all ages had no trouble rejecting one candy for the disadvantageous test trials. Yet, 4-, 5- and 6-year-olds accepted the advantageous practice trials as often as they accepted the equal practice trials. Some 7-year-olds rejected the small advantage in the practice trials, but children at this age did not reject the larger reward in the test trials. This pattern could be a sign of improved inhibitory control that is contingent on the size or value of the reward. If this is the case, younger children might be capable of rejecting advantageous offers when the reward is less valuable than one candy (e.g., one pencil). Nevertheless, the inhibitory control account cannot explain why young children reject one candy in the disadvantageous case but not in the advantageous practice trials. Inhibition alone cannot explain this asymmetry.

The reaction time data offer further evidence that inhibitory control alone cannot account for the development of both forms of inequity aversion. Research on self-regulation and executive control uses reaction time measures to assess children's ability to inhibit a prepotent, or impulsive, response. Between 4 and 12 years of age, children gradually become faster and more accurate in tasks requiring this kind of inhibition (Davidson, Amso, Anderson, & Diamond, 2006; Rueda et al., 2004; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). If inhibitory control were the main mechanism governing behavior in the inequity game, we would expect several outcomes. First, because the ability to inhibit a prepotent response gradually increases with age, younger children should gradually reject more advantageous offers with age. This does not occur. Instead, we see a sudden increase in rejections of large rewards at 8 years of age.

Second, we would expect to see evidence of internal conflict increase with age as children struggle to inhibit their prepotent desire for the candy, whether or not they ultimately reject the offer. This conflict would result in a delay in decision-making on the advantageous trials relative to the equal trials (the Cohen's $D$ score in Fig. 4) similar to that found for the disadvantageous trials. However, there is no delay. Rather, the younger children accept the advantageous offer without hesitation; only the 8-year-olds show a delay before deciding. Third, children younger than 8 years of age took longer when they rejected advantageous offers compared to when they accepted those trials. This difference reveals a prepotent

response to accept advantageous rewards. Given that it should become easier with age to inhibit the prepotent response, we should see the difference between accepting and rejecting trials narrow with age. However, this is not the case. Prior to 8 years of age, children were significantly faster when accepting the advantageous trials than when rejecting them. By contrast, at 8 years of age, there was no difference between time to accept and time to reject. In sum, although inhibition is a factor in any reaction time measure, it is not sufficient to account for the different behaviors in the advantageous and disadvantageous inequity conditions.

### 3.2. Reputation

The rejection of any positive offer is considered irrational in many economic models of human behavior (Camerer, 2003). However, rejecting inequity in social transactions can serve a greater purpose. The rejection of offers in a public game can enhance one's future prospects by showing others how you will act in a social interaction (Nowak, Page, & Sigmund, 2000; Nowak & Sigmund, 2005). Those who reject disadvantageous offers may signal that they will not accept a bad deal, whereas those who reject an advantageous offer may signal that they value fairness above personal gain. Either kind of thinking requires an awareness that one's actions contribute to one's reputation with others. For children, a concern for reputation, or self-presentation, appears to develop between 6 and 8 years of age (Aloise-Young, 1993; Banerjee, 2002a, 2002b; Banerjee & Yuill, 1999; Bennett & Yeeles, 1990; Hill & Pillow, 2006). Thus, in the Inequity Game, reputational concerns may help to explain why older children reject some offers. For example, children might reject advantageous offers to signal to their parents or other children that they are fair-minded. In fact, in circumstances where reputation is not a concern (i.e., no one witnesses the decisions), these older children might accept advantageous offers.

The reputation explanation is plausible for advantageous inequity, but it is problematic for disadvantageous offers. First, given that parents were watching, one might expect children to accept rather than reject disadvantageous offers in order to appear generous. Second, although it is possible that children were primarily signaling to other children that they would not accept a bad deal, this explanation seems unlikely for children as young as 4 or 5 years of age given prior research on reputational awareness (Aloise-Young, 1993; Banerjee, 2002a, 2002b; Banerjee & Yuill, 1999). Yet children in these two age groups did reject disadvantageous offers. Lastly, if children earned a positive reputation for being fair by rejecting disadvantageous offers, this clearly did not motivate them to reject advantageous offers. Even in the practice trials where the stakes were much smaller children accepted advantageous offers and rejected disadvantageous ones. In sum, although reputational concerns may be a factor influencing rejections of advantageous inequity, reputation is not sufficient to explain the asymmetry in development between advantageous and disadvantageous inequity aversion.

### 3.3. A two mechanism account

The asymmetry in the development of advantageous and disadvantageous inequity aversion suggests that separate mechanisms may underlie the rejections of these two forms of inequity. We suggest that what children view as fair is biased towards ultimate self-interest. From an evolutionary perspective, what is good for a competitor is bad for oneself. This kind of logic could lead children to reject disadvantageous offers. A bias against disadvantageous inequity need not be innate in the sense of being apparent at birth. If it were, we would not expect children to hesitate before deciding how to respond to disadvantageous inequity, and we would expect the youngest children to reject these offers as frequently as the older children. Rather, children may have a content bias shaped by selective forces (Richerson & Boyd, 2005) which makes it easier to learn to reject disadvantageous offers than to reject advantageous ones.

Around 8 years of age, children demonstrate a more generalized sense of fairness by rejecting both forms of inequity. In comments recorded informally during our study, 8-year-olds often referred to a norm of fairness as the reason they rejected advantageous offers (e.g., "Sometimes I had more and I wanted it to be fair"). It is possible that children possess this generalized understanding of fairness prior to 8 years of age and are driven to act on it by other motivations. For example, as noted above, children may have a better understanding of their reputation and thus reject advantageous offers in public because this is what they are expected to do. However, the ability to act on those reputational concerns depends on an awareness of a social norm of fairness that applies generally and not just to the self. At the very least, the current study shows that 8-year-olds are aware of this social norm for fairness.

Although we see 8-year-olds reject advantageous inequity at significant levels, not all children at this age rejected this form of inequity. Individual variation in the outcome measures likely reflects a complex interaction of experience and biological maturation. Thus, while we argue that different mechanisms underlie the development of advantageous and disadvantageous inequity aversion, we also acknowledge that there may be multiple differences that affect the development of these behaviors. Future experiments will need to assess multiple developmental processes in order to explain the variation in inequity aversion at each age.

### 3.4. Limitations

The results of the current study do not allow us to determine precisely what developmental changes occur at 8 years of age that leads children to reject advantageous inequity. One strong possibility is that children act only to enhance their reputation for fairness in a public setting. In order to assess the role that reputation plays in inequity aversion, several additional experiments are needed to limit the social factors in the game. For example, 8-year-olds may have rejected offers in order to please their parents, or to demonstrate their fairness to the other child or to potential playmates watching the game. In order to

assess the relative effects of these social forces systematically, each must be controlled in separate tests.

Non-social factors may also underlie some of the behaviors in the inequity game. For example, children may reject disadvantageous offers because one candy looks less valuable when placed in relation to four candies. If this kind of reference dependence is at work, we should see children reject disadvantageous offers even when there is no recipient. By contrast, if children are motivated by fairness, they should accept a disadvantageous offer when the social partner is removed. Similarly, if 8-year-olds are motivated by fairness, they should accept the advantageous offer when there is no recipient who will be treated unfairly. These non-social versions of the inequity game will require several modifications to the procedure and the instructions but are a clear priority for future directions.

Despite the limitations presented by using a public game, we believe that this kind of testing is valuable for assessing how children will behave in social settings that resemble real life more closely than the anonymous tasks used in other economic games. With a social baseline established, more traditional forms of economic games can be used to determine the precise mechanisms that underlie social behavior.

## 4. Conclusion

The current study shows a clear asymmetry in the development of two forms of inequity aversion. Children are willing to sacrifice small rewards to avoid disadvantageous inequity with an unfamiliar peer. They will forego a single candy rather than accept a disadvantageous allocation. This decision is not automatic. Rather, children at all ages hesitate before rejecting the offer. A different developmental pattern appears for advantageous inequity. When 4- to 7-year-olds face large rewards relative to a peer, they accept the advantageous allocation without hesitation. Children are not motivated to accept these allocations due to the size of the reward. Even when the advantageous rewards are relatively small (one candy), younger children accept them. By 8 years of age, however, children are willing to sacrifice relatively large rewards in order to maintain equity with an unfamiliar peer. Thus, 8-year-olds reject both advantageous and disadvantageous offers demonstrating a generalized sense of fairness. This behavior is similar to how adults perform in economic games.

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