Fairness Takes Time: Development of Cooperative Decision-making in Childhood

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A predissertation research project presented to the

graduate faculty of the University of Virginia

in candidacy for the Degree of

Master of Arts

Department of Psychology

University of Virginia

August 2020

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Abstract

Cooperation based on fairness is a key feature of human social behavior. The current study examined the development and cognitive characteristics of this capacity in childhood. Furthermore, we used a developmental perspective to examine a central argument of the intuitive cooperation hypothesis, which is that fast, intuitive decisions are likely to result in more cooperative choices. A large sample of children ($N = 94$), ranging from 4 to 9 years of age, were presented with a novel cooperative decision-making task contrasting fair with selfish choices while measuring reaction times. Our results show that fairness increases during childhood, with selfish choices seen frequently in younger children (4 to 6 years) and fair choices seen frequently in older children (7 to 9 years). Moreover, our reaction time results show that younger children's predominantly selfish choices are fast and intuitive and their rare fair choices are slow and deliberate, whereas reaction times did not differ as a function of choice in older children. In addition, we found that an increase in reaction time was generally associated with a higher inhibitory control score, but children's inhibitory control did not relate to fairness choices during the cooperative decision-making task. These findings stand in contrast to previous work arguing for the fast and intuitive nature of cooperative choices in adults and helping behavior in infants. Together, the current data provide insights into the emergence of fairness behavior, pointing to a protracted development likely requiring extensive learning and experience.

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Cooperation is considered a central aspect of human sociality (Hare, 2017; Silk & House, 2012; Tomasello, 2019). There is considerable evidence to suggest that the capacity to cooperate is deeply rooted in our biology and may thus be considered a core part of human nature. In fact, our closest primate relatives, the great apes, have also been shown to exhibit some forms of cooperative behavior (Horner et al., 2011; Melis, 2018; Muller & Mitani, 2005; Warneken et al., 2007; Yamamoto et al., 2012). Moreover, some cooperative behaviors, such as helping others in need, emerge early in human ontogeny (Dahl, 2015; Svetlova et al., 2010; Warneken & Tomasello, 2006, 2007), further supporting the notion of a strong biological contribution to the development of cooperation.

One important question that is still being debated is what the underlying mechanisms are that lead individuals to make cooperative choices. There currently are two opposing viewpoints with respect to this question. The first viewpoint is that humans are naturally selfish beings, and that in order to behave cooperatively, we must exert self-control to overcome selfish impulses (Achtziger et al., 2015; Piovesan & Wengström, 2009; Steinbeis, 2018a; Steinbeis & Over, 2017; Tinghög et al., 2016). The second viewpoint is that humans are intuitively cooperative, and that we may choose to use reflective control and deliberation to make selfish decisions in order to strategically maximize benefits for ourselves (Cappelen et al., 2016; Isler et al., 2018; Lotito et al., 2013; Rand, 2016; Zaki & Mitchell, 2013). This second viewpoint, also referred to as the 'intuitive cooperation hypothesis', has received support from work in behavioral economics (Bear & Rand, 2016; Rand et al., 2014). For example, adults who make faster and thus more intuitive decisions tend to behave more cooperatively than those who make slower and thus more deliberate decisions (Cappelen et al., 2016; Isler et al., 2018; Lotito et al., 2013; Rand, 2016;

Rand et al., 2012). These, along with other findings that support a link between intuitive cognitive processes and cooperation (Carlson et al., 2016; Schulz et al., 2014; Yamagishi et al., 2017), suggest that intuitive decision-making processes support cooperative decisions (see Kvarven et al., 2020 for a meta-analysis that questions the robustness of the effect). The intuitive cooperation hypothesis provides a valuable framework for thinking about the cognitive mechanisms that support the development of cooperative behaviors because one of the hypothesis' central arguments is that intuitive processes come to favor cooperation over time and particularly when previous experience has shown that choosing to be cooperative is advantageous (Bear & Rand, 2016; Nishi et al., 2016; Rand et al., 2014). Yet the intuitive cooperation hypothesis has been tested almost entirely with adults, and thus leaves open whether the link between intuition and cooperation is present from early in development or if it develops through socialization and learning over time.

In the first study to explicitly test the intuitive cooperation hypothesis in early development using variables comparable to the existing adult literature, Grossmann and colleagues found that by 18 months, and perhaps even as early as 14 months, infants who were faster to instrumentally help others also helped more frequently, providing developmental evidence for the intuitive cooperation hypothesis (Grossmann et al., 2020). While this study represents an important first step in exploring the intuitive cooperation hypothesis in human development, it should be emphasized that instrumental helping seen among infants is only one kind of cooperative behavior, and one that emerges especially early in ontogeny and incurs little to no cost for the infant (Dahl, 2015; Svetlova et al., 2010; Warneken, 2015; Warneken & Tomasello, 2007). It is also important to note that different cooperative behaviors, such as helping and sharing, are often uncorrelated with one another, emerge at different developmental timepoints, impose different levels of cost, and are likely supported by different motives and mechanisms (Dunfield, 2014; Dunfield et al., 2011; Martin & Olson, 2015; Paulus, 2014, 2018; Sommerville et al., 2013; Steinbeis, 2018b). As such, it is critical to extend the test of intuitive cooperation in early development to other forms of cooperative behavior. Furthermore, since much of the relevant work with adults has utilized resource distribution tasks (i.e., economic games) to measure cooperative decision-making, it is important to similarly examine children's resource distribution in cooperative decision-making tasks in order to permit appropriate comparisons with the findings from adults and help elucidate the developmental trajectory of intuitive cooperation.

Developmental research has recently focused a great deal on the development of sharing and fairness behavior in infants and children (Ibbotson, 2014; McAuliffe et al., 2017; Sommerville & Enright, 2018). This work shows that the foundations of fairness behavior are present remarkably early in development. By the second year of life, infants can distinguish between fair and unfair distributers and show a preference for fairness. For example, 15- to 19-month old infants look longer when items are divided unequally, suggesting this violated their expectation of equality (Schmidt & Sommerville, 2011; Sloane et al., 2012; Sommerville et al., 2013), and more recently this same behavior has been observed in infants as young as 10 and 12 months (Meristo et al., 2016; Ziv & Sommerville, 2017). At 16 months of age, infants look longer when they see an agent approach a fair distributer compared to an unfair distributer and are more likely to reach for the fair distributer in a manual choice task, showing a preference for the more prosocial agent (Geraci & Surian, 2011). Towards the end of the second year, infants become more reliable in their sharing behavior and will spontaneously share items with adult recipients who express desire (Brownell et al., 2009, 2013), and children's willingness to share increases with age (Benenson et al., 2007; Blake & Rand, 2010; Fehr et al., 2008; Ibbotson, 2014). By age 3, children have also begun to develop an understanding of equality and fairness norms. For instance, 3-year-old children explicitly state that both they and their peers should share resources equally (Smith et al., 2013), and react negatively to inequitable distributions, particularly when they are the one who is at a disadvantage (LoBue et al., 2011). Children's disadvantageous inequity aversion continues to develop during early childhood, and by age 4 children often refuse to accept offers where they receive less than their peer (Blake & McAuliffe, 2011; McAuliffe et al., 2013). It is not until age 7 or 8 that children start to show aversion to advantageous inequity as well, which they demonstrate by rejecting offers where they receive more than their peer (Blake & McAuliffe, 2011), favoring fair distributions of resources (Fehr et al., 2008; Smith et al., 2013), and even choosing to throw away a resource rather than receive more than their peer (Shaw & Olson, 2012). Overall, this work indicates that even though the foundations of fairness are present from early in ontogeny, the development of explicit fairness behavior occurs over many years, making fairness behavior one of the later emerging forms of cooperation.

This mismatch between young children's understanding of fairness and their actual fairness behavior has been referred to as the 'knowledge-behavior gap' (Blake, 2018; Blake et al., 2014). Even though it is evident that from a young age children are sensitive to equality and know that they ought to behave fairly, they nevertheless behave selfishly in resource distribution tasks and do not share equally until 7 or 8 years of age (Blake & McAuliffe, 2011; Brocas et al., 2017; Fehr et al., 2008; Kogut, 2012; Smith et al., 2013). There are likely several factors contributing to this shift from selfish to fair behavior in middle childhood. One is that this is the age when children develop a more norm-centered sense of morality, and so their actions become increasing influenced by social norms and they are better able to successfully align their behavior with cultural fairness norms (House, 2018; House & Tomasello, 2018; Ibbotson, 2014; Tomasello & Vaish, 2013). In addition, the resolution of the knowledge-behavior gap is also likely due to an increase in self-regulation that is occurring concurrently during middle childhood (Blake, 2018; McAuliffe et al., 2017; Steinbeis, 2018b). Specifically, behavioral control is known to improve during this developmental period (Davidson et al., 2006; Herrmann et al., 2015; Simpson & Carroll, 2019), and there is evidence to suggest that differences in behavioral control capabilities are related to differences in children's sharing behavior (Aguilar-Pardo et al., 2013; Steinbeis et al., 2012). In general, developmental studies have found that better behavioral control is related to increased sharing behavior, with work suggesting that taxing or priming behavioral control can either decrease or increase sharing behavior, respectively (Steinbeis, 2018a; Steinbeis & Over, 2017). However, other studies have failed to find an effect of behavioral control on children's sharing behavior (Liu et al., 2016; Smith et al., 2013), suggesting that the relation between behavioral control and fairness during childhood is not yet fully understood.

While the developmental emergence of fairness behavior is relatively well mapped out, the underlying cognitive mechanisms remain elusive. We propose that applying the intuitive cooperation hypothesis to the developmental study of fairness will help address this gap. Studying children's fairness behavior and decision-making from the perspective of the intuitive cooperation hypothesis is particularly interesting because the protracted development of fairness already implies that learning and socialization likely play a role in shaping children's decisions about fairness. The intuitive cooperation hypothesis suggests that intuitive decision-making processes comes to favor cooperative choices through positive experiences with cooperation, and because of this, it is an ideal framework for studying the development of a cooperative behavior that is known to be highly influenced by socialization, such as fairness (House, 2018). In addition, the existence of a known, well-defined shift in children's fairness behavior from being more self-centered in 4- to 6-year-olds to being more norm-centered in 7- to 9-year-olds (McAuliffe et al., 2017) makes this age range the ideal target for studying a potential shift in the cognitive mechanisms that underlie cooperative decision-making during development.

The main purpose of the current study was thus to examine the cognitive processes involved in children's emerging fairness behavior from the perspective of the intuitive cooperation hypothesis. Specifically, we tested whether children's choice to behave fairly was fast and intuitive or slow and deliberate by measuring their reaction times during a cooperative decision-making task. We chose to use reaction time as a proxy for how intuitive children's decisions were, presuming that intuitive decisions occur more quickly than deliberate ones (Kahneman, 2011; Rubinstein, 2007; see Evans et al., 2015; Evans & Rand, 2019; Krajbich et al., 2015 for discussion of important considerations where inferring intuition from reaction time). The relation between children's reaction times and their fairness choices has only occasionally been discussed in the literature (Blake & McAuliffe, 2011; Rêgo et al., 2016), but it has yet to be the main focus of a developmental study or to be considered within the context of the intuitive cooperation hypothesis. In the current study, we examined cooperative decision-making in children ranging in age from 4 to 9 years using a modified, forced-choice Dictator Game. In the modified Dictator Game, children were shown two pre-set distributions of a valued resource (stickers) and had to decide whether to behave fairly and choose the distribution that would split the stickers evenly between themselves and another child (2:2, or 2 for self, 2 for the other child) or to behave selfishly and choose the distribution that would let them keep more stickers for themselves (3:1, or 3 for self, 1 for the other child). We also measured children's inhibitory control in order to examine whether and how it contributes to the development of and individual variability in children's cooperative decision-making.

From a developmental perspective, based on prior work (Blake & McAuliffe, 2011; Fehr et al., 2008; McAuliffe et al., 2017; Smith et al., 2013), we hypothesized that children's fairness behavior would increase with age, such that older children were predicted to make fair choices, whereas younger children were predicted to make selfish choices. From a cognitive mechanistic perspective, we tested between two competing hypotheses: 1) if fairness behavior, like instrumental helping, is intuitive, then children should make fair choices more quickly than selfish choices, whereas 2) if fairness behavior is deliberate and requires cognitive control, then children should make fair choices more slowly than selfish choices. Testing between these competing hypotheses across age in childhood further affords the opportunity to shed light on the nature of the cognitive processes at play as fairness behavior first emerges in development. In other words, the current approach also allowed us to map out whether the cognitive processes involved in cooperative decision-making—intuitive or deliberate—change as a function of development. Finally, we hypothesized that children's inhibitory control would increase with age (Davidson et al., 2006), and that children with greater inhibitory control would have longer reaction times, particularly when making less intuitive choices (whether fair or selfish). Taken together, the current study presents a close developmental and cognitive examination of a key behavior in the human cooperative repertoire.

Methods

Participants

We tested 135 children (64 girls) between the ages of 4 and 9 years from a medium-sized university town in North America. The study took place either in the university lab (*M* = 101) or through our partnership with the Living Laboratory at a local children's museum (*N* = 34). Of the 135 children, 41 (15 girls) were excluded based on our established exclusion criteria, including not passing comprehension checks (*N* = 6; 5 4-year-olds, 1 5-year-old), not completing both test trials (*N* = 7; 3 4-year-olds, 1 5-year-old, 2 7-year-olds, 1 8-year-old), and exhibiting behavior that made it difficult to calculate their reaction time, such as needing to be prompted during the decision part of the test trials (*N* = 26; 12 4-year-olds, 5 5-year-olds, 2 6-year-olds, 3 7-year-olds, 1 8-year-old, 3 9-year-olds). Additionally, two more participants were found to be statistical outliers using inter-quartile range in SPSS (reaction time > 3 *SD* above the mean) and were also excluded (*N* = 2; 1 4-year-old, 1 8-year-old). Our final sample thus consisted of 94 children (49 girls), including 15 4-year-olds (*M* = 52 months 16 days, or 52;16, *SD* = 104.9 days), 16 5-year-olds (*M* = 66;25, *SD* = 120.9 days), 16 6-year-olds (*M* = 77;4, *SD* = 133.2 days), 16 7-year-olds (*M* = 90;19, *SD* = 107.1 days), 16 8-year-olds (*M* = 102;4, *SD* = 102.9 days), and 15 9-year-olds (*M* = 113;8, *SD* = 91.1 days). In the final sample, 76 were tested in the lab, and 18 were tested at the museum. Of the families who provided information about race (*N* = 78), 84.6% of participants were White, 2.6% were Black or African American, 3.8% were Asian, and 9.0% were mixed-race or chose "Other". Of the families who provided information about parental education (*N* = 70), 95.7% of participants had at least one parent who attended a 4-year college or beyond.

Procedure

Modified Dictator Game

We created a modified, forced-choice Dictator Game paradigm that would allow us to measure both children's cooperative behavior and their reaction times. Participants were asked to make a forced-choice decision between two different distributions of stickers for themselves and another child, one that was fair (2:2, or 2 for participant, 2 for the other child) and one that was selfish (3:1, or 3 for participant, 1 for the other child). Similar to previous work with adults (Cappelen et al., 2016; Lotito et al., 2013; Rand et al., 2012), we measured the speed at which children made their decisions (reaction time), starting from the moment the participant was presented with their two choice options to the moment they indicated they had made their decision by pointing to their choice. The entire procedure was recorded on video so that participants' behavior could be coded offline.

Setup. The experiment began with the participant sitting across from the experimenter (E) at a table with two boxes on it. The participant was asked to draw a picture of themselves, which was then placed on one of the boxes to indicate that it was the participant's box. The other box had a photograph of a neutral-faced, gender- and race-matched child on it, and the participant was told that this other box belonged to the child in the photograph (Figure 1A). Whether the child's box was on their left or right was counterbalanced across participants.

Comprehension Phase. The experimenter (E) explained the rules of the game to the participant by presenting them with a plate that was half red and half blue. E told the participant that they would be shown plates just like this one but with stickers on it, and that any stickers on the red (or blue) side would be the participant's stickers and would go in their box, and any stickers on the blue (or red) side would be the other child's stickers and would go in the other child's box. The color assigned to the participant (red or blue) was counterbalanced across participants, and the plates were always presented to the participant such that their assigned color was on the same side as their box. To check comprehension, E placed a sticker on one side of the plate at a time and asked the participant who would get the sticker (Figure 1B). If the participant answered incorrectly, E would repeat the rules and asked again.

Next, E explained that in the game, the participant would be shown two plates at the same time with different amounts of stickers on each plate, and that the participant must touch the one plate that had the number of stickers they wanted for themselves on their side and the number of stickers they wanted for the other child on the other side. The participant was also shown that the plates would first be set up behind a wall that E placed in front of the participant on the table (Figure 1C). Once the plates were set, E would lift up the wall so that the participant could see the two plates and make their decision. The purpose of the wall was to control when the participant first saw the two distribution options, allowing us to have a clear starting point for when the participant began to make their decision.

Again, to check comprehension, E presented the participant with two plates with different distributions of stickers on them, one fair (1:1) and one selfish (1:0) (Figure 1D). E asked the participant how many stickers they and the other child would get if they picked each plate. If the participant answered incorrectly, E would repeat the rules and asked again. These distributions were chosen to mimic the fair and selfish options that the participant would see during the test trials but with a different number of stickers.

Test Trials. E then set up the first of the two test trials (T1), during which the participant chose between two plates, one with a selfish distribution of stickers (3:1) and one with a fair distribution (2:2) (Figures 1E and 1F). E set up the two plates behind the wall, repeated the instructions, and then removed the wall and waited for the participant to choose one of the plates by touching or pointing to it. Once the participant had made their choice, E asked them why they made that choice and distributed the appropriate number of stickers into the participant's and the other child's boxes. This procedure was repeated in the second test trial (T2), with the only differences being that 1) the sides that the fair and selfish plates were presented on were switched across the test trials, and 2) the other child's box was replaced with a new box with a different neutral-faced, gender- and race-matched child. This second change was made in order to mimic a one-shot setup as closely as possible and minimize the strategizing that may occur when there are multiple trials. After the second test trial, the participant was able to retrieve their stickers from their box to take home.

Parent Questionnaire

We created a 40-question parent questionnaire by combining the three most relevant subscales of the Children's Behavior Questionnaire: inhibitory control, impulsivity, and empathy (Rothbart et al., 2001). We asked parents to rate how true each statement was of their child's behavior using a 7-point Likert scale ranging from "extremely untrue of your child" to "extremely true of your child", plus a "not applicable" response option. Parents completed the questionnaire on a tablet through Qualtrics (Qualtrics, Provo, UT) during their visit.

Coding

We used video to code children's choices during the two test trials, their reaction times, and their justifications for their choices. Participants' choices during the test trials were recorded as either choosing the fair or the selfish option, and these choices were numerically recoded as the number of stickers children received (2 and 3, respectively). Reaction times were coded using the INTERACT video coding software (Mangold International, Arnstorf, Germany), and were defined as starting from the moment the child saw the two choices (after the wall was lifted) and ending the moment they made their decision by touching one of the plates. If the child only pointed to but did not physically touch a plate, they were coded as having made a decision when they reached the fullest extension of their point. A secondary coder coded all videos to establish reliability. Intraclass correlation coefficient (ICC) estimates and their 95% confidence intervals were calculated using SPSS statistical package version 26 (SPSS Inc, Chicago, IL) based on a single rater, consistency, 2-way mixed-effects model. Interrater reliability for reaction times on T1 (*ICC* = 0.999, *95% CI* = 0.999-1.000) and T2 (*ICC* = 0.999, *95% CI* = 0.998-0.999) were determined to be excellent (Koo & Li, 2016). All reaction time scores were $\log_{10}$-transformed in SPSS to correct for positive skew, and these transformed values were used in all further analyses.

Children's justifications were transcribed and then coded as falling into one of three categories: 1) fairness: the child expressed desire for things to be fair, even, the same, or equal (e.g., "I wanted it to be fair"), or talked about how the other child would feel about their decision (e.g., "So the other boy can be happy with his two stickers"); 2) desire: which included both explicit desire where the child talked about what they wanted, but not in reference to fairness (e.g., "I wanted three stickers"), or about getting more stickers (e.g., "It has more stars"), and implicit desire where the child stated how many stickers each person would get (e.g., "I get three and she gets one"), or how many stickers were on their side (e.g., "It has three stars"); or 3) other: the child's response did not fit into any of the other categories (e.g., "I don't know", "Because I'm four"). All justifications were first categorized by two researchers independently; if there were discrepancies, the researchers discussed and came to an agreement.

Data from the parent questionnaire were used to calculate participants' mean scale scores for inhibitory control, impulsivity, and empathy (Rothbart et al., 2001). Impulsivity and empathy did not relate to children's reaction time or choice, and so we chose not to include them in the rest of our analyses.

Results

We first present findings of developmental effects on our main variables of interest, including reaction time, selfish vs. fair choice, children's justification of their choice, and inhibitory control. We then present the relation between reaction time and choice and its changes with age.

As a preliminary check, we tested for a main effect of gender on our main variables of interest. Only parent-reported inhibitory control showed a significant effect of gender such that girls were reported to have greater inhibitory control than boys ($M_{Girl} = 5.412$, $SD_{Girl} = 0.949$; $M_{Boy} = 4.953$, $SD_{Boy} = 0.849$; $t(83) = -2.341$, $p = .022$, $d = -0.51$, *95%CI* (-0.85, -0.07)). This result is supported by previous findings of gender differences in inhibitory control measures (Else-Quest et al., 2006), including when using the CBQ (Gagne et al., 2013). However, because this gender effect was not predicted, limited to inhibitory control, and unrelated to our main questions of interest, we chose not to include gender in our analyses.

Developmental effects on reaction time and choice

We assessed how children's reaction times and selfish vs. fair choices differed in relation to their age. The correlation between age and reaction time on T1 was not significant ($r = .067$, $p = .52$, $r^2 = .004$), but there was a small positive correlation on T2 ($r = .250$, $p = .015$, $r^2 = .063$), suggesting that older age was associated with a longer reaction time during the second test trial. We obtained significant negative correlations between age and choice on both test trials (T1: $r = -.410$, $p < .001$, $r^2 = .168$; T2: $r = -.342$, $p = .001$, $r^2 = .117$), which we explored further in follow-up analyses. Specifically, using a chi-square test, we compared how many children chose either selfishly or fairly at each age on each test trial. Children ages 4, 5, and 6 were more likely to choose the selfish option, while children ages 7, 8, and 9 were more likely to choose the fair option on both trials (T1: $X^2[5, N = 94] = 19.514$, $p = .002$, $V = .456$; T2: $X^2[5, N = 94] = 12.630$, $p = .027$, $V = .367$) (Figures 2 and 3). Based on these results, as well as evidence from previously published work showing a similar developmental effect regarding fairness behavior (Blake & McAuliffe, 2011; Fehr et al., 2008; McAuliffe et al., 2017; Smith et al., 2013), we split the sample into two age groups for the remaining analyses: younger (ages 4 to 6) and older (7 to 9).

Justifications in relation to choice and age

Next, we assessed if the type of justifications children gave matched the choices they made during the test trials and if the types of justifications changed with age. A chi square test revealed that, across both test trials, children's justification types aligned significantly with their choices (T1: $X^2[2, N = 92] = 66.229$, $p < .001$, $V = .848$; T2: $X^2[2, N = 94] = 54.756$, $p < .001$, $V = .763$), with children's justifications for choosing the fair option falling mainly into the fairness category, and their justifications for choosing the selfish option falling mainly into the desire category. Furthermore, a chi-square test exploring the distribution of justification types across the younger and older age groups revealed that older children were more likely to justify their choices with reference to fairness, while younger children's justifications were more likely to reflect desire (T1: $X^2[2, N = 92] = 20.130$, $p < .001$, $V = .468$; T2: $X^2[2, N = 94] = 20.490$, $p < .001$, $V = .467$). This suggests that not only did children's choices shift from selfish to fair with age, but the reasons they provided for their choices mirrored this shift by changing from focusing on desire to focusing on fairness.

Relation between reaction time and choice

Taking into account the developmental effect on choice reported above, we examined the relation between reaction time and choice within the younger and older age groups separately. We used a binary logistic regression to examine if reaction time was predictive of children's choice (fair vs. selfish) for both younger and older children on both test trials. We found that reaction time did predict choice for our younger age group on the first test trial ($B = -6.200$, $p = .045$, $OR = 0.002$) such that children who made faster decisions were more likely to choose selfishly than those who made slower decisions. We did not find an association between reaction time and choice in our older age group on the first test trial ($B = -0.804$, $p = .65$, $OR = 0.448$), nor did we find an association between reaction time and choice for either age group on the second test trial (Younger: $B = 0.118$, $p = .96$, $OR = 1.13$; Older: $B = 1.305$, $p = .50$, $OR = 3.69$). Additionally, when inhibitory control was included in the model as a covariate, it was not predictive of children's choice (all *p*-values > .28).

Developmental effects on inhibitory control

Of the 94 participants, parents of 85 completed the inhibitory control questionnaire. The mean inhibitory control score was 5.190 out of 7 ($SD = 0.926$). We found a significant positive correlation between age and inhibitory control scores ($r = .237$, $p = .029$, $r^2 = .056$). Additionally, using an independent samples t-test, we found that the mean inhibitory control score in the younger age group ($M = 4.977$, $SD = 0.921$) was significantly lower than the mean inhibitory control score in the older age group ($M = 5.409$, $SD = 0.890$, $t(83) = -2.195$, $p = .031$, $d = -0.48$, *95%CI* (-0.82, -0.04)). Thus, as predicted, we found that parent-reported inhibitory control increased with age.

Inhibitory control in relation to reaction time and choice

Because mean inhibitory control scores differed for the younger and older age groups, we chose to examine their relation to reaction time and choice in each age group separately. Inhibitory control scores were slightly positively correlated with T1 reaction times for younger, but not older children, although this correlation did not reach significance ($T1_{Younger}$: $r = .295$, $p = .06$, $r^2 = .087$; $T1_{Older}$: $r = .108$, $p = .5$, $r^2 = .012$). Interestingly, the opposite was true for T2, such that inhibitory control scores were positively correlated with T2 reaction times for older, but not younger children ($T2_{Younger}$: $r = .212$, $p = .17$, $r^2 = .045$; $T2_{Older}$: $r = .372$, $p = .015$, $r^2 = .138$). These findings indicate that increased inhibitory control is somewhat associated with taking more time to make a decision, although the relation is dependent on age and test trial. However, for both age groups, inhibitory control did not differ based on whether children made a selfish or fair choice on either test trial (all *p*-values > .66). This finding does not support our hypothesis that children with greater inhibitory control would specifically take longer to make less intuitive decisions (i.e., fair choices for younger children and selfish choices for older children).

Discussion

The current study tested the intuitive cooperation hypothesis from a developmental perspective by examining the development and cognitive characteristics of children's emerging fairness behavior. By using a novel cooperative decision-making task that allowed us to measure how long it took children to make a forced-choice between a fair and a selfish distribution of valued resources, we were able to compare children's reaction times with their decisions to help elucidate which choice is more intuitive for young children. Overall, we found that, consistent with prior work, younger children (ages 4 to 6) were more likely to choose the selfish distribution while older children (ages 7 to 9) were more likely to choose the fair distribution.

Interestingly, we found that a faster reaction time predicted a selfish choice for the younger, but not for the older children. This result stands in contrast to the intuitive cooperation hypothesis and indicates that there may be some kinds of cooperative behavior that are not initially intuitive. Instead, our findings suggest that a fundamental shift occurs around 7 years of age such that children of this age begin to transition away from the fast and intuitive selfish responses that are present at younger ages. Additionally, we found that inhibitory control increased with age and was associated with longer reaction times, but was not associated with either fair or selfish choices. This suggests that older children's increasing cognitive control is related to their reaction times such that they take more time to make a decision, particularly on the second test trial.

Developmental effects on reaction time, choice, and justifications

We assessed developmental changes in fairness behavior by exploring the relations between children's age, reaction times, and choice. We did not find a strong relation between reaction time and age, with the only significant association being that older children had slower reaction times on the second test trial. However, in assessing the relation between age and choice, our results provide clear evidence for a developmental effect on cooperative decision-making, such that younger children were more likely to choose selfishly in a forced-choice Dictator Game, whereas older children were more likely to choose fairly. This pattern is in line with our prediction that fairness behavior increases with age, and bolsters previous work showing that children's resource distribution behavior shifts from aligning with self-interest to aligning with a more general sense of fairness and equality around age 7 (Blake & McAuliffe, 2011; Brocas et al., 2017; Fehr et al., 2008; McAuliffe et al., 2017; Smith et al., 2013). Our findings thus replicate and extend previous work by showing a similar developmental effect on fairness behavior using a different experimental paradigm.

In addition to children's overt behavior, their justifications for their choices provided further evidence in support of the shift in fairness behavior from the younger to the older age group. We found that children's justifications overwhelmingly aligned with the choices they made, such that expressions of desire for resources were mostly used to justify selfish choices, whereas references to fairness were mostly used to justify fair choices. This finding provides further insight into children's decision-making process and the factors they are taking into account, and supports a clear alignment between children's cognitive decision-making process and their behavior. The fact that children's justifications tended to match their behavior and that they mirrored the developmental shift from self-centered to norm-centered behavior indicates that these measures may tap into the same decision-making mechanism. It also suggests that children's understanding of their own choices regarding fairness aligns well with their observable behavior in this experimental context. Taken together, this alignment between children's justifications and their behavior underscores the potential value in using children's explanations to supplement our understanding of their cooperative decision-making processes.

Relation between reaction time and choice in younger, but not older children

Given that we found a developmental effect on children's choices and we had theoretical reason to think that younger and older children's decision processes would be fundamentally distinct, we chose to explore the relation between reaction time and choice separately for our younger and older age groups. We found that reaction time was predictive of choice only in younger children, such that a shorter reaction time (i.e. making a faster decision) was associated with choosing selfishly for 4- to 6-year-olds. This suggests that for young children, their faster, and therefore more intuitive decisions are predominantly selfish, which further supports the idea that young children's fairness behavior is still largely motivated by self-interest at this age (Blake & McAuliffe, 2011; Fehr et al., 2008; McAuliffe et al., 2017; Smith et al., 2013).

There have been very few studies that have examined the relation between children's fairness behavior and their reaction times, and those that have tend to focus on the speed at which children accept or reject equal and unequal distributions of resources (Blake & McAuliffe, 2011; Rêgo et al., 2016). To our knowledge, Blake and McAuliffe (2011) conducted the only study to date that assessed this relation in preschool-aged children. In this study, the researchers measured how long it took children to accept or reject offers of a specific distribution of resources, and found that, in general, children made faster decisions on equitable trials than on inequitable trials, suggesting that young children may have experienced some internal conflict on trials with an unequal distribution. In contrast with our current findings, Blake and McAuliffe (2011) did not find any differences in 4- to 6-year-old children's reaction times between equitable and advantageous inequitable trials, which is the distribution comparison that is most similar to the structure of the current study, and instead found that only 8-year-old children took longer to make a decision on advantageous inequity trials compared to equitable trials. It is important to note, however, that the experimental paradigm used in Blake and McAuliffe's (2011) study (the Inequity Game) was different from our current paradigm (the forced-choice Dictator Game) in that participants had to decide whether to accept or reject a single distribution of resources rather than compare and choose between two different distributions presented at one time. Therefore, children's decision-making processes were likely different between the two studies. On the advantageous inequity trials in the Inequity Game, the conflict children experienced came from having to choose between receiving more from a selfish distribution or rejecting the offer and receiving nothing. In comparison, the choice in the modified Dictator Game was between receiving more from a selfish distribution or receiving slightly less from a fair distribution. The stakes are higher in the Inequity Game because it involves a take-it-or-leave-it decision, whereas in the modified Dictator Game, the child is guaranteed to receive some resources regardless of the choice they make, and instead they must decide whether to receive fewer resources in order to be fair. The differences in the nature of the decisions required by the two paradigms could therefore be a possible explanation for the inconsistencies in the reaction time results.

In contrast to the younger age group, we did not find a relation between reaction time and choice in the older age group (ages 7 to 9). Our results suggest that based solely on reaction time, there appears to be no clear intuitive choice for children at this age. However, the high proportion of fair choices made by older children raises an interesting point for consideration. Our results show that at this age, children are predominantly choosing to behave fairly, yet this behavior is not occurring more slowly than selfish behavior, as it is in 4- to 6-year-olds, nor is it occurring more quickly than selfish behavior, as it seems to later in development given the comparable work done with adults (Cappelen et al., 2016; Lotito et al., 2013; Rand et al., 2012). This indicates that, for 7- to 9-year-old children, choosing to be fair is either the predominant but not intuitive choice, or it in fact is the intuitive choice but this is not yet reflected in their reaction times. One explanation could be that this is a transitional period where children's fairness behavior is just beginning to align with a more global understanding of fairness and equality, but choosing to behave fairly may still not be an easy decision that children can make quickly. This is especially important considering that fairness is a particularly costly kind of cooperative behavior and may rely on the maturation of behavioral control (Blake et al., 2014; Steinbeis, 2018b). Moreover, fairness requires one to not only understand but also to abide by the social norm of equality, and the alignment between understanding and behaving in accordance with these social norms is a skill that may still be emerging during middle childhood (Blake, 2018; House & Tomasello, 2018; Smith et al., 2013).

In addition to maturation accounts, the transition to norm-centered fairness in middle childhood is also influenced by and learned through experience with culture-specific fairness norms (Blake, McAuliffe, et al., 2015; Blake et al., 2016; Callaghan & Corbit, 2018; House et al., 2013; Ibbotson, 2014). These cross-cultural studies have shown that children's costly prosocial behavior looks similar across cultures until middle childhood, at which point it starts to diverge and align with the culturally-normative behaviors exemplified by adults. Bringing attention to what is normative can have direct impacts on children's fairness behavior at this age. For instance, House and Tomasello (2018) found that children aged 7 to 9 years shared more after being primed that sharing was normative and the right thing to do. While both the maturational and social norm explanations for the shift in children's fairness behavior in middle childhood are informative, neither can fully explain our finding that there was no relation between older children's fairness choices and their reaction times. More research with a broader age range, including older children and adolescents, is needed to fully map out the development of fairness choices and its relation to reaction time.

As an additional consideration, the association between reaction time and choice in the younger age group was only present during the first test trial, as reaction time was not predictive of choice for either age group during the second test trial. It is possible that different mechanisms are at play during the first and second trials. Previous work on cooperative decision-making has emphasized that single-shot paradigms may produce different results compared to measures with repeated trials, as additional trials allow for the added influences of reputation management and fear of retaliation, as well as the opportunity to learn from previous trials and behave more strategically on future trials (Blake, Rand, et al., 2015; Dreber et al., 2014; Nishi et al., 2016; Rand et al., 2014). It has also been shown that by age 5, children care about their reputation and this influences their prosocial behavior and decision strategies (Engelmann & Rapp, 2018). In the current study, we attempted to highlight the single-shot nature of the test trials by having the participant share with a different child on each trial and by not informing children that there would be multiple rounds. However, while these steps were taken to help minimize children's strategic decision-making, which could interfere and compete with intuitive processes, it is possible that children nonetheless changed their behavior between the first and second trials, and this could help explain the lack of a reaction time-choice relation on the second test trial.

Intuitive cooperation hypothesis

The intuitive cooperation hypothesis has been supported by work examining resource distribution in adults (Isler et al., 2018; Rand, 2016; Rand et al., 2012; Zaki & Mitchell, 2013), but the current study was the first to explicitly test this hypothesis with resource distribution behavior during childhood. We found that younger children (ages 4 to 6), were faster to choose the selfish option, while we found no association between reaction time and choice in older children (ages 7 to 9). There are several possible explanations for why our results did not replicate the previous findings from the adult literature. First, it is important to emphasize that researchers have only recently begun to test the hypothesis from a developmental perspective. While our finding that selfish choices are more intuitive for young children may appear to contradict the claims of the intuitive cooperation hypothesis, they do not necessarily undermine the strength of the hypothesis and instead serve to highlight the fact that it is critical to map out cooperative decision-making across development. The intuitive cooperation hypothesis is already set up to account for the role of learning and previous experience on the link between intuitive decision-making processes and cooperative choices (Bear & Rand, 2016; Nishi et al., 2016; Rand et al., 2014). Even though our findings suggest that young children's intuitions still seem to favor selfishness over fairness and cooperation, this does not rule out the possibility that this pattern will change over time as children learn and have more positive experiences with cooperation. Indeed, cooperation in general has been shown to be impacted by socialization across development (Brownell & The Early Social Development Research Lab, 2016; Capraro & Cococcioni, 2015; Henrich et al., 2001; McAuliffe et al., 2018), and specifically the protracted development of fairness as evidenced by our and others' results (Blake & McAuliffe, 2011; Fehr et al., 2008; McAuliffe et al., 2017; Smith et al., 2013) suggests that learning from and extensive experience with resources being distributed equally is likely essential for this kind of fairness behavior to emerge. It is therefore possible that this same kind of protracted development and learned intuition is present in the shaping of intuitive cooperation more broadly.

Our results were also inconsistent with findings that support intuitive cooperation in infancy (Grossmann et al., 2020), raising the possibility that the association between fast reaction times and increased cooperative behavior is present in infancy but not in early childhood. However, we think it is more likely that the inconsistent findings between prior work with infants and the current study with children are due to the different kinds of cooperative behaviors examined in these two studies. Specifically, Grossmann and colleagues (2020) measured infants' instrumental helping, whereas the present study examined children's choice between a selfish or fair distribution of resources. Different cooperative behaviors such as helping and distributing resources are often classified together under the broad category of prosocial behavior, yet there is evidence that they might in fact be more dissimilar than this general classification suggests (Dunfield et al., 2011). For example, previous work shows that different prosocial behaviors develop along distinct developmental trajectories, rely on different motives, and are likely supported by different mechanisms and biological systems (Dunfield, 2014; Knafo-Noam et al., 2018; Martin & Olson, 2015; Paulus, 2018; Sommerville et al., 2013; Steinbeis, 2018b). Additionally, different prosocial behaviors emerge at different points in ontogeny, and fairness behavior emerges substantially later than other cooperative actions such as helping (McAuliffe et al., 2017; Svetlova et al., 2010; Warneken & Tomasello, 2007). A possible explanation for this is that cooperative behaviors like sharing and fairness are more costly because they require the child to give up a valuable resource, whereas behaviors like helping are generally considered to have little to no cost (Warneken & Tomasello, 2007). Another explanation is that these later emerging behaviors rely on greater behavioral control, which is also emerging across childhood and could help explain the changes in fairness behavior observed during this time (Blake, 2018; McAuliffe et al., 2017; Steinbeis, 2018b). These kinds of explanations would not only explain the differences in intuitive cooperation findings between infants and children, but also the differences in fairness behavior between the younger and older children in the current study. It is possible that the younger children have yet to reach this developmental capacity and have difficulty aligning their behavior with fairness norms, whereas older children likely possess improved behavioral control and can better align their behavior with fairness norms.

Inhibitory control

We were interested in the potential influence of children's inhibitory control on both their reaction time and cooperative behavior. We found that parent-reported inhibitory control was positively correlated with age, and that the younger children in our sample scored significantly lower than the older children. This result is in line with what is known about the development of children's inhibitory control capabilities (Davidson et al., 2006; Diamond, 2013; Herrmann et al., 2015; Simpson & Carroll, 2019). We also found that inhibitory control scores were positively related with children's reaction time, with those scoring higher on inhibitory control generally taking longer to make a decision. While this result was somewhat inconsistent across age group and test trial, it was always in the expected direction, as children with more inhibitory control would likely be better able to inhibit the desire to make a quick decision to gain resources and instead make more considered choices. However, we did not find a relation between inhibitory control and children's fairness behavior in the modified Dictator Game. This was further confirmed by the logistic regression models that included inhibitory control as a covariate and indicated that it was not a significant predictor of whether children would make a selfish or fair choice above and beyond the effect of age. These findings contribute to the ongoing discussion about the relation between behavioral control and fairness, but additional research is still needed. In particular, it will be important to incorporate behavioral measures of inhibitory control rather than relying solely on parental report, since there is evidence to suggest that behavioral and scale measure of behavioral control are only weakly correlated and may be tapping into different constructs (Toplak et al., 2013).

Conclusions

In conclusion, the current study demonstrates the developmental changes in fairness behavior during early and middle childhood while simultaneously assessing potential cognitive mechanisms through the lens of the intuitive cooperation hypothesis. This study provides insights into the developmental and cognitive characteristics of fairness, a key behavior in the human cooperative repertoire. Our results suggest that fairness choices are initially rare and deliberate, and become more frequent and less deliberate with development during the school-age years. This points to a more protracted development of fairness behavior compared to other cooperative behaviors such as helping, which appears to be fast and intuitive even early in ontogeny (Grossmann et al., 2020). This informs our understanding of the development of cooperation and supports accounts that distinguish between different forms of cooperative and prosocial behavior as guided by different underlying mechanisms (Dunfield, 2014; McAuliffe et al., 2017; Steinbeis, 2018b). The protracted development of fairness choices also suggests that extensive learning, presumably from observing and practicing equal resource distributions, likely plays a role in the development of this skill. This highly socialized pattern of development has widespread implications for informing how we teach children about fairness, both in formal and informal settings, and how we manage our expectations of what we expect from children at different stages of development. It will be important to continue to study intuitive cooperation from a developmental perspective and use a variety of measures to study different prosocial behaviors to help elucidate how the cognitive mechanisms underlying cooperative behavior change over time.

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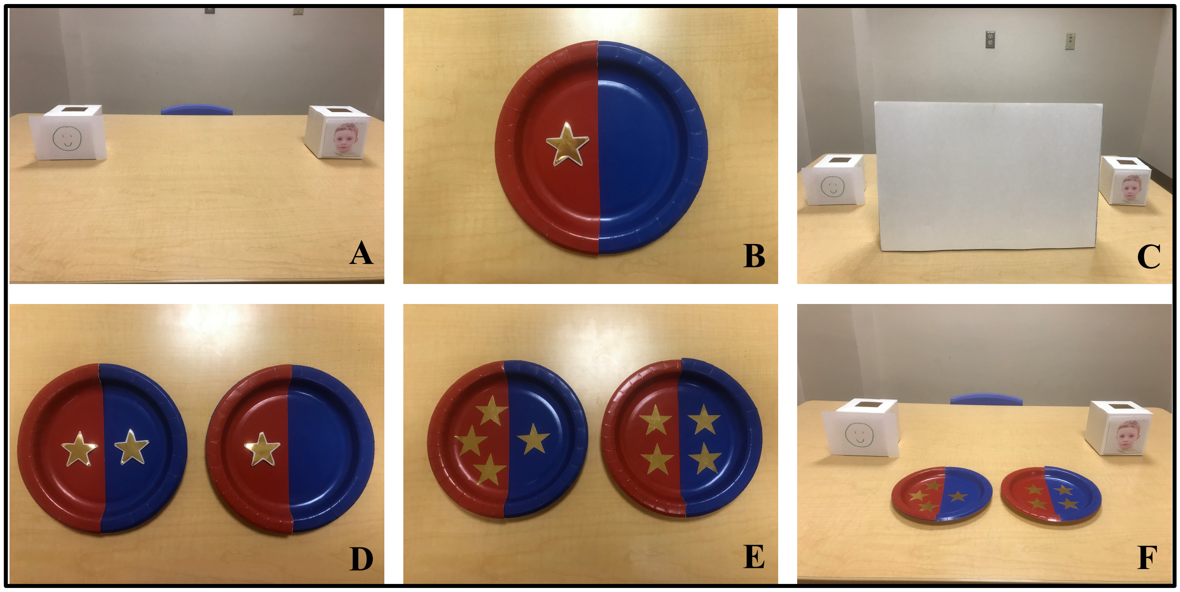
Figure 1

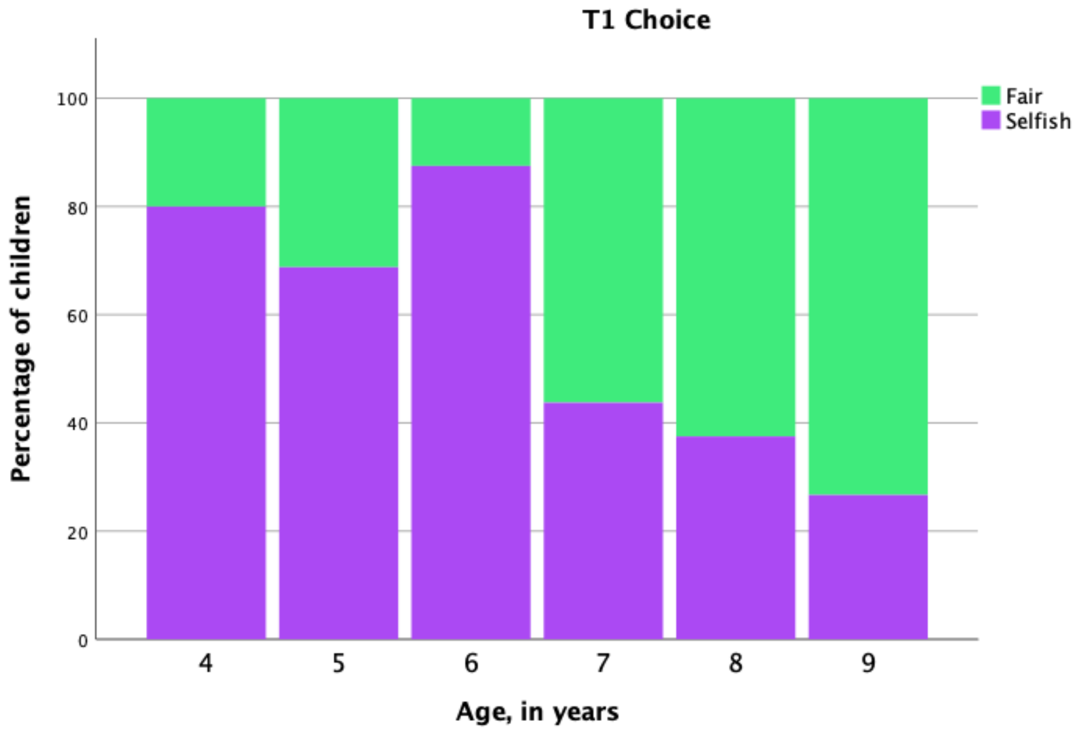
Modified Dictator Game Paradigm



Note. Images depicting the modified Dictator Game paradigm. *A)* The participant's box with their drawing (left) and the other child's box with the photograph (right). *B)* The red and blue plate with a single sticker during the first comprehension check. In this example, the participant is assigned to the red side, and they would need to correctly respond by saying that they would receive one sticker. *C)* The wall, used to conceal the two plates from the participant until the start of the trial. *D)* The distribution of stickers used during the two-plate comprehension check, with a fair distribution (1:1) on the left and a selfish distribution (1:0) on the right. *E)* The distribution of stickers used during the test trials, with a selfish distribution (3:1) on the left and a fair distribution (2:2) on the right. *F)* The presentation of the two test trial plates after removing the wall. The participant could then choose between the two distributions and indicate their choice by touching one of the plates.

Figure 2

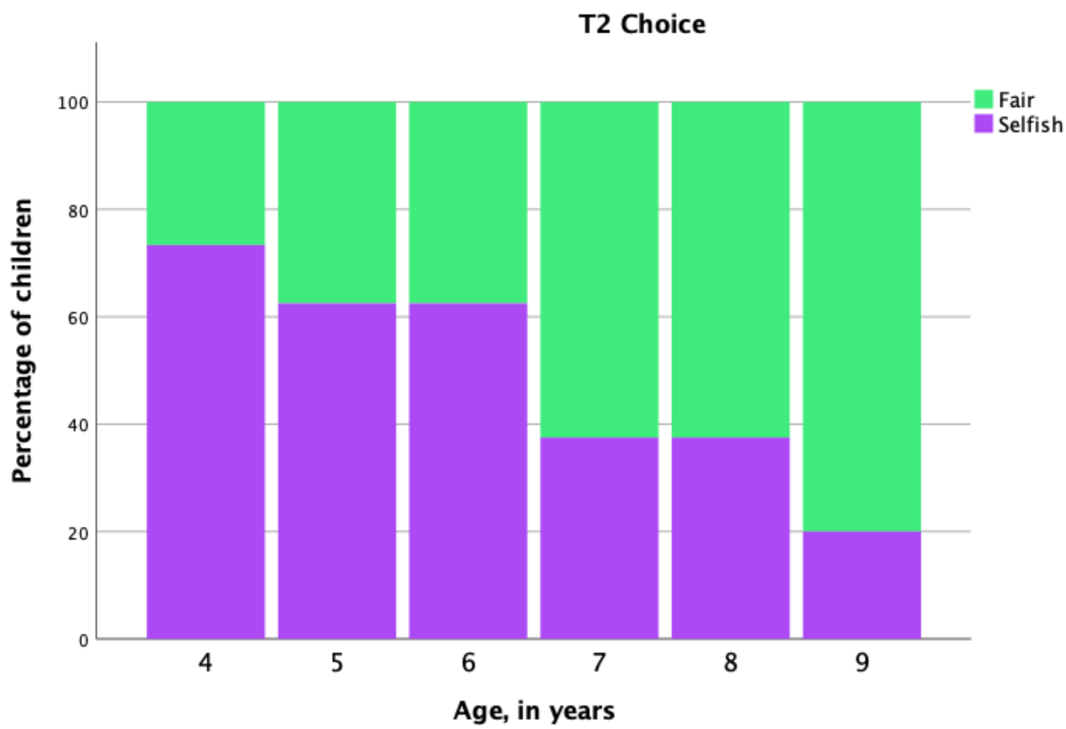
Developmental Effect on T1 Choice



Note. Percentage of children at each age who made fair and selfish choices on T1. Younger children (ages 4, 5, and 6) more often chose to be selfish, while older children (ages 7, 8, and 9) more often chose to be fair.

Figure 3

Developmental Effect on T2 Choice



Note. Percentage of children at each age who made fair and selfish choices on T2. Younger children (ages 4, 5, and 6) more often chose to be selfish, while older children (ages 7, 8, and 9) more often chose to be fair.