‘Fairness Informs Social Decision Making in Infancy’ - Replication

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ABSTRACT

Fairness plays a significant role in children's decision making and also carries meaningful social implications. In this study, our objective is to examine whether sensitivity to fairness develops before infants explicitly show fairness preferences. To further understand this, we replicated Lucca and Pospisil's (2018) research to test whether infants (13- and 17- month-old infants) prefer to engage with individuals that exhibit fair or unfair behavior. In their study, infants were presented with a novel experimental paradigm in conjunction with video stimuli. Their results suggest that after infants witnessed an individual distribute goods to third parties equally and unequally, infants, both 13 month olds and 17 month olds, actively chose to engage with individuals who distributed goods equally. Given their data, we completed statistical analyses and data manipulation techniques to identify any patterns about inclination towards fair or unfair actors. The Exact Binomial Statistical Test revealed statistical significance in data pertaining to both 13- and 17-month-olds between age and infant's decision to socially engage with fair actors. Taken together, these findings are consistent with Lucca and Pospisil's (2018) research. Infants demonstrate the expectation of fair distribution and prefer to interact with fair actors. This is important, as it gives greater insight into the timeline of fairness development over early years of life and may help explain behavior patterns seen during this age.

Keywords: fairness, decision making, infancy, equal, unequal, distribution, development

INTRODUCTION

Social decision making can be defined as the manner in which we choose individuals to interact with in a social setting. The reasoning underlying this process relates to self-preservation and trust. One behavior that has a significant impact on which individuals are favored is fairness--the level of fairness exhibited by an individual has an effect on whether that individual will be socially favored. Given the universal preference for fair individuals, studying infants' perceptions of fairness is crucial. Not only does this research allow us to understand the concept of fairness as perceived by humans, it also allows us to track the emergence and development of the preference for individuals who act fairly. Previous research has demonstrated that infants expect people to act fairly. Children as young as 9 months old expect resources to be distributed equally (Ziv, 2017). 18-month-olds spontaneously divide resources equally and 3-year-olds will verbally correct situations in which an equality norm is violated. By 6 years of age, children will dispose of resources rather than distribute them unequally (Lucca, 2018). Young children also prefer people who have acted fairly. Fifteen-month-old infants select social partners on the basis of prior fair versus unfair behavior (Burns, 2014). At the age of 12 to 15 months, the presence or absence of siblings predicted infants' fairness expectations. Infants with siblings showed enhanced attention to unfair outcomes relative to unequal outcomes whereas those without siblings did not (Ziv 2017). When fairness and race are pitted against one another, the response is more complex and varies more (Burns 2014). Humans perform comparatively better than computers in their evaluation of fairness. In a study based on the Ultimatum game, where one player proposes a split of a sum of money and the other player accepts or rejects the offer, all fair offers were accepted, and acceptance rate decreased as offers became less fair. In fact, humans' unfair offers were more frequently rejected than the computer's 60.56% versus

47.22% respectively (Sanfey, 2003). This paper expands upon research completed by Ulber, Hamman, and Tomasello that found that 18-month-olds spontaneously divide resources equally. It also follows up on research completed by Smith, Blake, and Harris revealing that 3-year-olds verbally correct situations when equality is breached.

Previous research by Blake and McCauliff reveals how 6 year old children 'dispose of resources rather than distribute them unequally." In *Fairness informs social decision making in infancy*, the authors assess the role of fairness in infants' preferences for individuals, testing whether infants select fair actors over unfair ones across three age groups: 6 months, 9 months, and 12-15 months. In our paper, we focus on the unexplored milestones of 13 month old and 17 month old infants. Collectively, this research narrows down the specific developmental phases during which children's perception of fairness is shaped.

Specifically, our paper explores how infants at 13 months and 17 months utilize fairness information in selecting social partners. This research is particularly important in connection to Cognitive Science because it analyzes fairness perception, an important aspect of cognitive development and children's psychology. The specific topic of this study addresses whether 13 and 17 month old children prefer to engage with fair or unfair actors. We primarily investigate the likelihood of infants to choose certain actors through binomial tests and R analysis tests.

Ultimately, the study narrows down the precise developmental ages at which children develop fairness perception, revealing how moral values like fairness arise in people. In order to investigate 13 and 17 month old children's preference for fair actors versus unfair actors, researchers record infant's reactions to an individual distributing goods to parties equally and unequally and assess who infants prefer to engage with. Ultimately, they find that infants chose

to engage with the fair actors, revealing how infants early on have a natural inclination towards fairness.

METHODS

Dataset distributions from Lucca and Pospisil's *Fairness informs social decision making in infancy*

Participants: Fourteen 13-month-old infants (8 females; mean age = 13 months, 11 days; range = 12 months 21 days to 13 months 9 days) and sixteen 17-old infants (10 females; mean age = 17 months, 10 days; range = 16 months 27 days to 18 months 19 days) participated in this study. Infants were typically developing and born at full-term. All participants were White, and parents identified their education level as having a college degree or higher (n = 25) or having some college (n = 7).

Participants were recruited from a database of parents who had volunteered to participate in experimental studies. Parental consent was obtained for each participant.

Exclusions: Data from nineteen additional infants were excluded due to lack of response (n = 11), fussiness (n = 5), failing to reach an attention criterion of an average of 80% to all distribution events (n = 2) or technical errors (n = 1).

Location: Lucca and Pospisil's research took place in a research laboratory at a large university in the Pacific Northwest. After participation, in the researcher's model, each infant received a toy as compensation.

Procedure: During the experiment, the infant sat on their parent's lap approximately 76 centimeters in front of a projector screen. The parent was seated in a rolling chair, such that they could turn away from the screen between trials. Opaque containers were used throughout the

task, consisting of a box with an attached tube. The experiment consisted of practice trials, distribution events, and a test trial.

Practice trials were done to familiarize infants with the action of picking up a toy out of the container, and to increase their likelihood of completing the fairness task. The experimenter showed a toy (a red fish) to the infant then dropped it into the tube of the container. After the toy fell through the tube into the bottom of the container, the parent placed the infant on the ground in front of the container, and the experimenter encouraged the infant to take the toy from the container. The opportunity to grab the toy was done for four trials. In a second set of practice trials, "virtual practice trials", the container was placed underneath a projector screen with a different toy already placed inside (unbeknownst to the infant). The infant watched a video in which a woman showed the toy to the infant and then appeared to drop the toy into the tube of the container. After watching the video infants were prompted to receive the toy.

During the distribution event parents were asked to close their eyes, in order to remain unbiased, while the infant watched the distribution event on a projector screen. Each event involved three Caucasian female actors: one distributor, who had a bowl of crackers, and two recipients, who were seated on each side of the distributor, each with an empty plate. The 'unfair distribution' video showed the distributor giving more crackers to one actor than the other (5:1). The 'fair distribution' showed the distributor giving crackers equally to both actors (3:3).

The test trial evaluated if infants had a preference for the fair or unfair distributor by showing videos of both distributors dropping a toy in a tube and watching which distributor the infants went to, when retrieving the toy. The order of the fair and unfair distribution videos (fair first versus unfair first), the identity of the fair actor, and which distributor was on the infants' right side during the test trial were counterbalanced across participants. After the completion of

each session, the primary experimenter coded infants' duration of looking to the distribution videos, while blind to condition.

Our Verifying Process

Exact Binomial Test, P Values and Directional Prediction

We selected an exact binomial test for our statistical analysis due to the fact that our experiment only had two outcomes: choosing the fair actor, or choosing the unfair actor. Additionally, we chose this method because we had an idea of what the probability of success would be, that is we expected infants to selectively choose fair actors over unfair actors and wanted to see if our observed test results differed from this expectation. We used this method to test out directional prediction, in which the null hypothesis (H_0) was that infants would not selectively choose fair actors over unfair actors; in other words, infants do not have a preference for either actor, and any deviation is due to random chance ($\pi = \pi o$). Our alternate hypothesis (H_A) was that infants will have a preference and will selectively choose one actor over the other, and any deviation is not due to random chance ($\pi \neq \pi o$). Assumptions made for this kind of test to be possible include the use of random samples, independent observations, a binary variable of interest (only two possible outcomes: chose fair actor or chose unfair actor), and a fixed number of trials, n.

$$P(X) = \frac{n!}{(n-X)!\,X!} \cdot (p)^X \cdot (q)^{n-X}$$

Figure 1: Binomial distribution formula

Exact Binomial Tests

For the thirteen-month-olds, 11 out of 14 infants (79% of infants) chose the toy from the fair distributor (p = .03, 95% CI = [.53–1.00]). This led us to the conclusion that thirteen-month-olds chose the toy from the fair distribution over the unfair distributor at test significantly above chance. For the seventeen-month-olds, 13 out of 16 infants (81% of infants) chose the toy from the fair distributor (p = .01, 95% CI = [.58–1.00]). These results helped us conclude that seventeen-month-olds chose the toy from the fair distributor over the unfair distributor at test significantly above chance. In summary, this analysis and results lead to the conclusion that infants across both age groups have a preference for interacting with fair agents over unfair agents.

Fair Actor Choice in Test Trial

- $\chi 2(1) = 0.03$, $p = 1.0$.
- Conclude: **Infants across both age groups have a preference for interacting with fair agents over unfair agents.**

P-Values

We also wanted to account for confounding variables or alternate explanations for these results. For example, the possibility that older infants pay more attention to the distribution event, or the possibility that infants who chose the fair distributor did so because they were more attentive during the distribution events. However, this was not the case. Similar to the original paper, we tested this correlation and found no difference, thus our replication had the same conclusion.

R analysis

```
> dplyr::filter(fairness, Age_Discreet == 13)
# A tibble: 14 x 10
      ID Age_Decimals Age_Discreet   Sex Practice_Trials… Practice_Trials… ChoseFairActor
   <dbl>         <dbl>         <dbl> <dbl>           <dbl>           <dbl>          <dbl>
 1    95          13.0            13     0               0               2              1
 2    97          12.9            13     1               2               2              0
 3   101          12.9            13     1               2               2              1
 4   102          13.3            13     0               2               0              1
 5   103          13              13     0               2               2              1
 6   105          13              13     0               2               2              1
 7   108          13.1            13     1               2               2              0
 8   111          13.0            13     1               2               2              1
 9   112          13              13     0               1               2              0
10   113          13.0            13     0               1               2              1
11   121          12.7            13     0               2               2              1
12   124          13.0            13     0               0               2              1
13   126          13              13     0               2               2              1
14   134          13.2            13     1               2               0              1
# … with 3 more variables: DistVideos_PercentAttend <dbl>, FairDistVid_PercentAttend <dbl>,
#   UnfairDistVid_PercentAttend <dbl>
> sorted13 <- dplyr::filter(fairness, Age_Discreet == 13)
> table(sorted13$ChoseFairActor)

 0  1
 3 11
> binom.test(11,14,0.5)

        Exact binomial test

data:  11 and 14
number of successes = 11, number of trials = 14, p-value = 0.05737
alternative hypothesis: true probability of success is not equal to 0.5
95 percent confidence interval:
 0.4920243 0.9534207
sample estimates:
probability of success
             0.7857143
```

After assessing the data, our group completed an R Analysis shown below.

Figure 2: Exact binomial test results - 13 months

RESULTS

Results showed that infants prefer the fair individual when given a choice between a fair and unfair individual (Fig. 1). This could have occurred to unequal attention distribution between the two fairness events. This was not the case, both age groups were highly attentive to the distribution events whether they chose the fair distributor (M = 98.65%, SE = .64%) or unfair distributor (M = 97.56%, SE = 2.44%), t(28) = -.671, p = .51. These are the exact results that the original study showed.

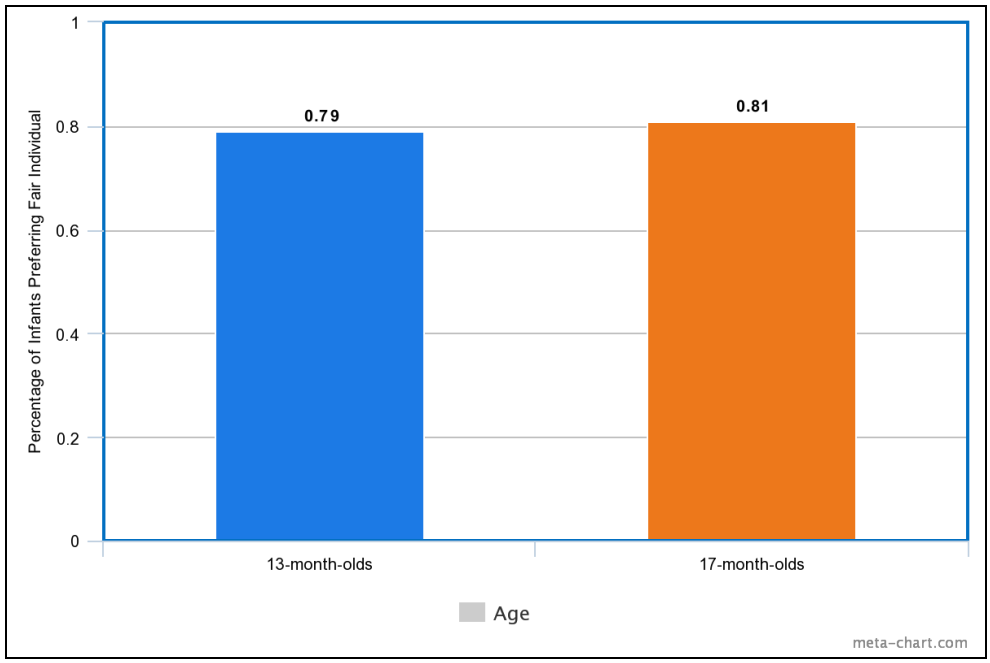

Figure 3: Percentage of 13-month-olds and 17-month-olds that chose the fair individuals

Attention in Distribution Event

Overall, infants' attention to the distribution events was high (M = 98.43%, SE = .68%). Seventeen-month-olds were marginally more attentive to the distribution events (M = 99.81%, SE = .14%) than 13-month-olds (M = 96.85%, SE = 1.36%), $t(13) = -2.16$, $p = .05$. Across age groups, infants were highly attentive to both the fair (M = 98.40%, SE = .51%) and unfair distribution events (M = 97.88%, SE = .64%), $t(29) = 1.55$, $p = .13$. Thus, infants in both age groups successfully encoded the fair and unfair distribution events.

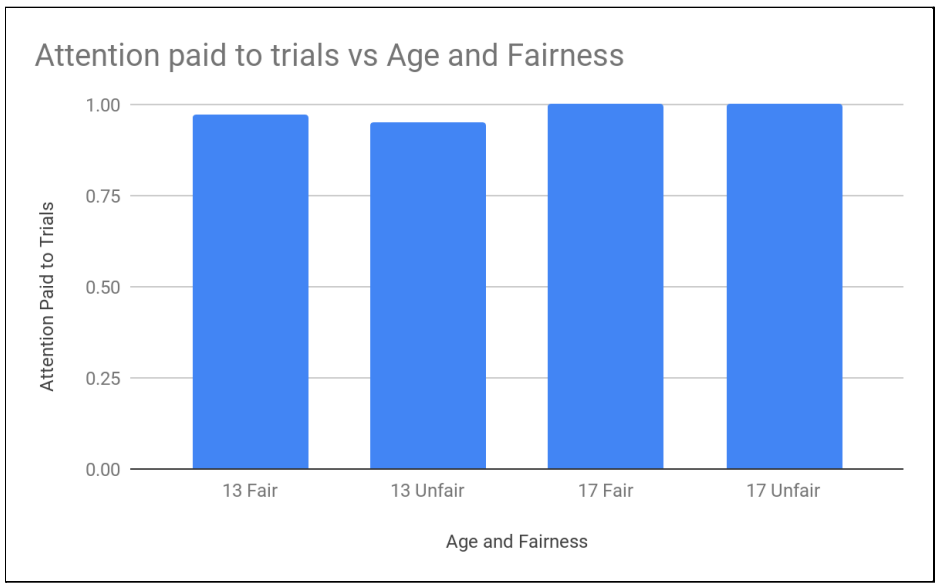

Figure 4: Each participant's attention percentage over the course of the event was measured through

eye tracking in 13- month- olds and 17-month olds during the fair and unfair distribution event.

DISCUSSION

Our data collection is consistent with results shown in the paper, confirming that infants prefer the fair individual when presented with a choice between a fair and unfair individual. Our results showed high attentiveness, observed through length of eye contact, to fair individuals in both groups of infants at 17 months old and 13 months old, with 81 percent of seventeen month-olds and 79 percent of thirteen month olds choosing fair actor over unfair actor. Albeit marginally, seventeen-month-olds' were more attentive to the distribution events than thirteen month-olds. The results of this study greatly contributed to the research community with a better understanding of child cognitive development benchmarks and the ability to pinpoint the age at which children begin to discern between fairness and unfair settings.

We first decided to compare the difference in prevalence of choosing fair actors over unfair actors among both groups of infants. In our first figure, we showcase the percentage of 13-month-olds and 17-month-olds that chose the fair individuals, which as observed is 79 and 81 percent respectively. Thus, albeit a marginal difference, we find a consistent preference for the fair actors starting from as early as 13 months (Figure 3).

We thought that lack of attention could be a possible alternative explanation for why infants preferred the fair individual over the unfair individual. This is why we measured the two distinct distributions for thirteen and seventeen month olds, finding seventeen month olds (99.81 percent) to be marginally more attentive than thirteen month olds (98.40 percent). This showcases high attentiveness across infants groups for fair actors, confirming the research done by authors of the original paper (Figure 4).

CONCLUSION

Ultimately, our results showcase a consistent preference for the fair actor over an unfair actor, with seventeen month olds marginally but insignificantly exceeding thirteen month olds' preference for fair actors. It was confirmed that this was not due to a difference in attention. Thus, our research confirms the data reached in the paper, establishing that infants as early as thirteen months significantly choose to engage with the fair actor over the unfair actor by picking up a toy from them and engaging socially. This study strongly showcases a critical developmental benchmark for infants, as it was demonstrated that infants previously established fairness preferences carry across different age groups and also different contexts. Compared to a simple reaching behavior seen in many previous studies, this experiment had infants walk or crawl to engage with the actor. "The use of a more physically and cognitively demanding measure provides important insights into the nature of infants' fairness representations: it demonstrates that infants have a strong, deliberate, and enduring preference for fair individuals" . As is discussed in the paper we replicated, the current finding that infants are strategic in their selection of social partners is consistent with a "partner choice" model of human behavior, where they engage with those they are most likely to engage with in the future and possibly trust, although more research needs to be done on the role of trust in these results (Lucca, 2018). We can also ask if this preference in partner choice, favoring prosocial individuals, is an adaptation uniquely-human. It is briefly mentioned that the findings overall indicate that there may be a critical period around 10-13 months when this preference starts to occur. Looking at younger infants to see if they are capable of going through a similar experiment to get more precise timelines on when this behavior emerges would be an important future direction in this field.

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