THE EFFECT OF REINFORCEMENT DELAY AVOIDANCE ON HUMAN INEQUITY DECISIONS IN A MINI-ULTIMATUM GAME

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Submitted to the

Faculty of the College of Arts and Sciences

of American University

in Partial Fulfillment of

the Requirements for the Degree

of Masters of Arts

In Psychology

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Date

April 25, 2012

2012

American University

Washington, D.C. 20016
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ABSTRACT

When offered an inequitable money distribution from a proposer, the responder tends to reject the proposal, denying money to both. This primacy of punishing inequity over maximizing income did not appear in Jensen, Call and Tomasello’s (2007) adaptation of this game to apes. Unlike humans, ape responders tended to accept inequitable distributions, thereby maximizing reward. This report adapts their ape procedure to humans. Over trials, the proposer offered a responder equitable or inequitable distributions of dimes. When responder rejection required one minute of inaction, responders tended to reject inequity. When rejection required three minutes of inaction, they tended to accept inequitable distributions. For the three-minute group, the number of rejections during the last five trials significantly exceeded those in the first five. These results show that humans will maximize if the cost of punishment is too high, and that the tendency to punish extinguishes over a session.
ACKNOWLEDGMENTS

I would like to thank my adviser, Alan Silberberg, for his help, guidance, and encouragement throughout this process. I owe special gratitude to my confederates Maria Banis, Kelly Clark, and Lindsey Weller for their consistent help and acting skills. I would also like to thank my committee members for their thoughtful and constructive reviews.
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CHAPTER 1

In the mini-ultimatum game (Falk, Fehr, & Fischbacher, 2003) as adapted by Smith and Silberberg (2010), two people sit across from each other at a table. One of them, the “proposer,” makes a choice between two distributions of money, one of which is intended to be received by the proposer, and the other of which is intended to be accepted by the person on the other side of the table (the “responder”). Several different distributions of money are available to the proposer to split with the responder. For example, the proposer may have the choice of taking five dimes for herself and five dimes for the responder (a 5/5 choice) versus eight dimes for herself and two dimes for the responder (and 8/2 choice). As viewed by the logic of Falk et al. and Smith and Silberberg, a proposer selection of the 5/5 choice is fair to both the proposer and responder, while a proposer who opts for the 8/2 choice is self-serving at the expense of the responder.

As illustrated above, traditional views of equity dictate that some of the choices that may be made by the proposer are fair while others are not. In their version of the mini-ultimatum game, Falk et al. (2003) found that when the proposer chose unfairly, there was an increased likelihood that the responder would reject what was offered. When the responder did this, neither subject was paid. Obviously, responder rejection of an inequitable offer is incompatible with maximizing income.
Recently, Jensen, Call, and Tomasello (2007) used the mini-ultimatum game with chimpanzees in order to see if the propensity to punish inequity rather than maximize income often seen in humans is also in evidence in this species. In the human version of this game, game rules were made apparent to the proposer through language—that is, the proposer was aware that the sole punitive option available to the responder was to reject an offer the responder viewed as unfair, and knew this from instructions given by the experimenter before the experiment began. Obviously, this cannot be done with apes. In order to apply the game to apes, they had to learn what the game’s contingencies were across many trials. In Jensen et al.’s version of this game, the various options used in the human game were offered over successive trials that were separated in time from each other. Instead of offering money sums, they offered different numbers of raisins. To accept a proposal, responders reached for the raisins offered. To reject a proposal, they were required to withhold choice for one minute. They found that ape responders tended to accept all proposals whether they were fair or not. In Jensen et al.’s view, this qualified these apes as “rational maximizers”—subjects for which the primacy of return of raisins was more important than conceptions of equity.

Smith and Silberberg (2010) challenged this interpretation, suggesting that procedural, not psychological, differences between the human and ape versions of the mini-ultimatum game accounted for the apparent species difference Jensen et al. (2007) report. They attributed Jensen et al.’s apes’ tendency to accept all offers, and thereby maximize raisin consumption, to the fact that raisin rejection, achieved by one minute of
inaction, lowered the rate and immediacy of reinforcement over trials; and it was these variables and not maximizing reward amounts, that controlled behavior.

To test their results, Smith and Silberberg repeated Jensen et al.'s (2007) experiment with humans using dimes instead of raisins as rewards. They required responders to reject offers by waiting either one or five minutes, depending on the group. They theorized that humans would be inclined to punish inequitable distributions when they had to wait only one minute, but not when they had to wait five minutes, their rationale being that delaying reinforcement for five minutes would be viewed by human responders as too high a price to pay in lowered reinforcement rate and increased reinforcement delay. In accord with their hypothesis, Smith and Silberberg found that subjects were significantly more likely to reject offers when the rejection response was one minute rather than five. In other words, humans were inclined to punish inequitable distributions of dimes, the classic finding in the mini-ultimatum game, when the rate of reward was sufficiently high (every minute), but not when punishing inequity required lengthening session time and delaying reinforcement for five minutes. If one accepts Smith and Silberberg’s thesis that a one-minute delay in the receipt of reinforcement for an ape may be psychologically equivalent to a five-minute delay for a human, then the tendency of ape responders to accept all offers was not a reflection of maximizing reinforcement, but of avoiding a punishing response that they found too costly to administer.

The results of Smith and Silberberg (2010) suggest that reinforcement delay may rationalize the apparent differences between apes and humans shown by Jensen et al. (2007). These authors also suggested that another factor—namely, trial number—may
affect the propensity to punish in an ape version of the mini-ultimatum game, and that
this factor may also have contributed to Jensen et al.'s findings. Their reasoning was that
any propensity to punish that may have been present in ape responders at the beginning
of a game might extinguish over trials if, in fact, there was no evidence that punishing
altered proposer behavior to behave more equitably. That is, if the proposer continued to
choose more raisins over less no matter how the responder behaved, which was the
finding in Jensen et al., the responder's tendency to reject might extinguish over trials
because of its failure to shape the desired behavior of equitable choosing in the proposer.
In addition, responders would learn over trials the price in added delay of reinforcement
that rejection responding produces.

These ideas are amenable to experimental test. If the mini-ultimatum design used
by Smith and Silberberg (2010) is repeated for many trials; and if proposer behavior does
not change as a consequence of responder punishment, it might be expected that the
tendency for responder rejection would diminish over trials due to (a) the failure of
punishment in changing proposer behavior, and (b) the increase in session duration and
delay of reinforcement that attend offer rejection. In consequence, it might be possible to
show that in a trials-based version of the mini-ultimatum game, the propensity to punish
inequity is replaced by a tendency to maximize as a session progresses, and that this
tendency is greater the longer the period of inaction required to punish inequity.

The present study tests these hypotheses by using a modified version of Smith and
Silberberg's (2010) mini-ultimatum game. In the experiment to be reported, there are two
groups, one with a one-minute period of responder inaction required to reject a proposal,
and the other with a three-minute period. By arrangement, the proposer, a confederate of
the experimenter, chose in a way that was independent of the decisions of the responder. Two outcomes should be anticipated. First, responder punishment of inequitable choosing by the proposer should weaken over trials because it is not rewarded by a change toward equitable proposer responding; and second, this effect should be more apparent in the three-minute group than in the one-minute group because the cost to the responder of punishing inequity is larger for that group than for the other.
CHAPTER 2

Methods

Subjects

Eighteen undergraduate psychology students at American University served as subjects. They were randomly assigned to two equally sized groups, one composed of five females and four males (1-minute group) and the other seven females and two males (3-minute group). In exchange for participation, they received course credit and any money earned in the study.

Setting and Apparatus

The experiment was conducted in a room at American University containing two chairs that faced each other across an intervening table measuring 1 m wide by 0.8 m long (see Figure 1). One chair was occupied by a confederate of the experimenter, and the other was occupied by a subject. On the table were two 9- by 50-cm boards that had 90-cm ropes attached to both of their ends. Two transparent cups 8-cm in diameter were attached to each board. The experimenter stood to the side of the table throughout the experiment.
Figure 1. Outline of experimental setting.

Note: Figure not drawn to scale.

Procedure

The procedures for each group differed only in that for one, responder rejection required one minute of inaction, while for the second group responders need to wait three minutes to reject the proposer’s offering. When the subject entered the office, the proposer, who was the confederate of the experimenter, was already seated. The experimenter instructed the subject to sit down and then read the following script aloud:
“Welcome. You have chosen to play the ultimatum game. In this game, the money you make will be determined by your interactions with the proposer (experimenter points to proposer). The proposer has already heard these instructions so these instructions are just for you.

In each trial, the proposer will select a cup that may contain dimes by pulling one of the two available ropes. You have a choice to accept or reject the remaining cup closest to you. If you choose to accept, pull the rope attached to the closest remaining cup by pulling the rope on the board. You and the proposer will then receive the amounts of money the two of you selected. However, if you choose to reject the proposed distribution of dimes, you must wait for (1 minute or 3 minutes). After waiting for (1 minute or 3 minutes), neither of you will receive any dimes for that trial. Instead, I will remove the money from all cups and the next trial will begin.

There will be 30 trials in this experiment. For each trial I will announce how many dimes I am placing in each cup. Do you have any questions?”

Next, the experimenter simulated how the proposer could choose and how the subject could respond. All four options were illustrated (two possible choices by the proposer and two possible responses by the responder). Again, both subject and confederate were asked if there were any questions. Then, the experimenter commenced dumping the contents of four plastic glasses successively into each cup on the game boards, announcing the number of dimes each cup contained. The proposer was then prompted to make a selection. After a selection was made, the responder was prompted to either accept or reject the offer. If the responder accepted, the coins contained in the proposer’s and the responder’s cups were each dumped into a plastic glass, one beside the proposer and the other beside the responder, as their winnings for that trial. However, if the responder chose to reject the offer by not pulling the rope, the experimenter started timing the required delay period of either 1 minute or 3 minutes. After the delay period was complete, the experimenter removed all dimes from the cups on the boards and
began the next trial by dumping four more plastic glasses of dimes into their respective cups on the boards.

The plastic glasses containing dimes were arranged to present in random order the four types of games used by Jensen et al. (2007)—that is, one choice was always eight dimes for the proposer and two for the responder. The alternative was composed of one of the following: five to the proposer and the responder (5/5 game), eight to the proposer and two to the responder (8/2 game), two to the proposer and eight to the responder (2/8 game), or ten to the proposer and none to the responder (10/0 game).

The proposer’s choices for all trials were listed on a strip of paper taped below the lip of the table out of view of the responder. This list arranged for the proposer to choose the maximizing cup on a random eight of ten trials for each game other than the 8/2 game (for a total of 3 games, equaling 30 trials). That game provided the proposer with no option but to maximize. This 0.8 probability to maximize in games outside of the 8/2 game was intended to approximate the average likelihood of proposer maximizing in Jensen et al. (2007). In that study, the comparable figure was $p = 0.72$. After the session ended, the responder was given any dimes earned and was debriefed.
CHAPTER 3

Results

There were no statistically significant differences in rejection likelihood based on the gender of the responder. In debriefing, no subject suggested that the proposer was a confederate of the experiment or that the choices of the proposer were predetermined in the experiment.

Figure 2 presents the percentage of responder rejections of 8/2 outcomes for all game types for the 1- and 3-minute groups. The capped lines above each bar define one standard deviation in the individual subject data that define the mean. Also presented in the Figure are the 8/2 rejection likelihoods found by Smith and Silberberg (2010) for these games types for the 1-minute rejection group. As can be seen, the present study’s 1-minute group rejection likelihoods for different games are similar to those found in Smith and Silberberg.

I conducted two-tailed unpaired t-tests between the 1-minute and 3-minute groups for all games. All tests confirmed my hypothesis that the tendency to reject would be weaker when 3 minutes of inaction was required to reject a proposal than when 1 minute of inaction defined the rejection response (for the 5/5 game, t(16) = 3.28, p < .01; for the 2/8 game, t(16) = 2.89, p < .01; for the 8/2 game, t(16) = 2.29, p = .02; and for the 10/0 game, t(16) = 3.80, p < .01).
Figure 2. Percent rejection of the 8/2 alternative by responders as a function of game type. The vertical line on each bar of the graph defines one standard deviation of the mean.

![Bar graph showing percent rejection of 8/2 alternative across different game types.]

Figure 3 presents the percentage of trials in which responders rejected the 8/2 alternative across all games during the first and last five trials of the experiment for each of the two groups. The lines above each bar define one standard deviation in individual performances defining the mean. By two-tailed paired t-tests, there was no significant
difference in rejection rate across trials for the 1-minute group \((t(8) = 0.53, p = .6)\), but there was for the 3-minute group \((t(8) = 3.41, p < .01)\).

Figure 3. Percent rejection of the 8/2 alternative by responders for trials 1-5 versus trials 26-30 for the 1- and 3-minute conditions. The vertical line on each bar of the graph defines one standard deviation of the mean.
CHAPTER 4

Discussion

Zentall (2000) claimed that except for specialized sensory and behavioral capacities seen in some species, human mental processes are more varied in composition and more capable in function than those seen in other animals. While this claim may seem self-evident to some, several papers have been recently published which violate Zentall’s generalization. A frequent outcome in these reports is that a targeted human behavior that heretofore seemed uniquely human can also be discerned in monkeys or apes. Among the first of these demonstrations was mirror self-recognition in some apes (Gallup, 1970). Since then, the list of claimed equivalences has grown to include altruism; cognitive dissonance; inequity, loss, and risk aversion; risky choice; endowment effects; and self-control, among other (e.g. Brosnan, Jones, Lambeth, Maren, Richardson, & Shapiro, 2007; Brosnan & de Waal, 2003; Lakshminarayanan, Chen, & Santos, 2011; McCoy & Platt, 2005; Warneken & Tomasello, 2006).

Viewing these papers from an evolutionary perspective lends credibility to their conclusions. After all, should not attributions of human cognition be ancestrally connected to mental function in other, related species? In addition, the coherence and import of the theme this work presents—that cognitive similarities between nonhuman primates and humans may be broad and deep—are certainly aided by the consistency with which studies such as those cited above seem to show linkages in function.
Perhaps, then Zentall’s (2000) generalization should be amended to make its claims for human mental function more modest. For example, its application could be limited to human cognitive functions where cross-species demonstrations of like capacities seem improbable (e.g. language). But recent primatological research makes this modification of the Zentall generalization inadequate, for there are now studies that claim not that monkeys and apes share cognitive functions with humans, but for some functions they are, in fact, superior (Inoue & Matsuzawa, 2007; Jensen et al., 2007; Rosati, Hare, & Hauser, 2007).

Several papers have been published in defense of the Zentall (2000) generalization (Hachiga, Silberberg, Parker, & Sakagami, 2009; Roma, Silberberg, Ruggiero, & Suomi, 2006; Silberberg, Crescimbene, Addessi, Anderson, & Visalberghi, 2009; Silberberg & Kearns, 2009; Silberberg, Roma, Huntsberry, Warren-Boulton, Sakagami, Ruggiero, & Suomi, 2008; Smith and Silberberg, 2010). Generally, this work attributes claimed demonstrations in monkeys and apes of cognitive function similar or superior in kind to those seen in humans to errors in experimental design or interpretation. The present study continues this effort with the target being Jensen et al.’s (2007) demonstration that apes, but not humans, will maximize in an ultimatum game.

The present work offers two theses as to why ape responders accept virtually all proposals in Jensen et al.’s (2007) repeated-trials version of a mini-ultimatum game. First, unlike the Falk et al. (2003) study that their study presumably mimics, responder inaction to punish proposer choices not only fails to maximize responder food consumption, but also imposes a delay in trial rate that decreases immediacy and rate of reinforcement. Second, and also unlike the Falk et al. study that served as the procedural
target of Jensen et al.'s experiment, any propensity to punish proposers' inequitable choices extinguishes across trials because proposers' tendency to choose inequitably did not change as a function of responders' choices. In sum, responder choosing in the Jensen et al. experiment could have been due to any of three factors: maximizing consumption (Jensen et al.'s thesis), avoidance of choice-imposed delays of reinforcement (my first thesis that was also tested in Smith and Silberberg, 2010), and extinction of willingness to punish caused by the failure of responder punishment to affect proposer choice (my second thesis).

To evaluate these confounded theses, one group of humans was exposed to a 30-trial version of Jensen et al.'s (2007) mini-ultimatum game in which responder rejection, like the apes in Jensen et al., was to wait for one minute without action. For a second group, the conditions were identical except that three minutes of inaction were required to reject the proposer's offer. Were responder judgments governed solely by the goal of maximizing, as Jensen et al. imply, there should be no between-group difference in rejection because judgments of maximizing are independent of trial rate. The fact that rejection rates were significantly lower when trial rates were lower in the 3-minute condition violates Jensen et al.'s maximizing notion and is consistent with our idea that responder acceptance or rejection decisions were controlled in part by trial rate. Indeed, these results may be characterized in part as showing that when the cost in terms of added delay was too great, humans opted to maximize. However, that behavior seems due to delay aversion and not to pursuit of maximizing per se. If the reader accepts the idea that three minutes of inaction to a human responder may be akin to one minute of inaction in an ape, responder maximizing in apes can be attributed to avoiding imposing delays in
obtaining raisin rewards. Certainly, the between-group difference seen in Figure 3 is consistent with this thesis.

The result just described is the primary finding from Smith and Silberberg (2010) whose methods were used in this report. As shown in Figure 2, their findings were also replicated here: When choice was between the 8/2 alternative versus 5/5 or 2/8, responders tended to punish or chose the trial delay with no monetary reinforcement; when choice when between 8/2 versus 8/2 or 10/0, tended not to punish. In terms of equity theory, these results may be summarized as showing that when distributions were equitable, they were accepted, and when they were inequitable, they were not.

Aside from whatever value accrues to replication, the present report makes a core addition: When trials are many and proposer behavior is invariant across trials, inequitable proposer choices tend to become more acceptable as the session progresses. This outcome was not significant for the one-minute group, but was for the three-minute group. Both outcomes seem sensible. Just like Jensen et al.'s (2007) apes choosing between small piles of raisins while not really hungry, our subjects who are not really poor should be weary of collecting a few dimes at a slow rate, prolonging a session with uninteresting properties; and the degree to which they grow weary should be correlated, as it is, with the cost of the responder of administering punishment to the proposer.

This latter point may identify a boundary condition to all tests based on Falk et al.'s (2003) procedure. As a thought experiment, imagine replaying their mini-ultimatum game when the values offered to the responder are not a few cents, but tens of thousands of dollars. In a 5/5 game, would a responder reject an offer of, say, $200,000 if the proposer self-served in choosing the $800,000 alternative for himself? Running such an
experiment is not feasible, but it may define a circumstance when human responders would maximize rather than punish because the loss they would impose on themselves would be huge compared to whatever psychic benefit follows from punishing proposers' inequitable actions. Certainly the data from the present report suggest this supposition is plausible.
CHAPTER 5

References


