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Rational decision-making process choosing fairness over monetary gain as decision criteria

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Abstract: Objective: This study tests the hypothesis that the decision-making process in humans is often based on the fairness rather than the monetary gain/loss, when they are confronted with a choice between fairness and monetary gain/loss. Methods: The classical Ultimatum Game (UG) is used as the experimental paradigm to quantify the threshold crossover-point to switch the decision from rejection to acceptance. The fairness stimulus-response function is used for quantifying the decision threshold and the co-variation relationship between fairness and monetary gain/loss. Results: The results show that the level of fairness perception is always 27.5% lower for the rejection decision than the acceptance decision, irrespective of the offer-ratio (i.e., monetary gain/loss) or the baseline level of fairness for that decision. The data also show a co-variation relationship between fairness and offer-ratio (monetary gain/loss), but such proportionality relationship is decoupled at the even-split singularity point. The analysis shows that the decision crossover threshold is located at a slightly unfair perception, indicating tolerance to some unfairness in the decision. This suggests that a rejection decision is made when the unfairness perception threshold is reached. Conclusion: These analyses validated the hypothesis that the decision to accept/reject the monetary offer is logically consistent using the fairness criterion as the threshold for decision along the fairness-axis — even for accepting inequitable offers or rejecting hyper-equitable offers, irrespective of the amount of monetary gain/loss. The apparent decision based on the monetary gain/loss criterion is only a side effect of the co-variation between fairness and monetary gain.

Keywords: Decision-Making, Fairness Bias, Equity, Rational Decision, Monetary Gain, Ultimatum Game

1. Introduction

The decision-making process is often studied using monetary gain (in behavioral economics) and fairness (in social justice) as a tool to identify the criteria for making an acceptance or rejection decision, when they are confronted with a choice between fairness and monetary gain or loss. The conventional assumption is that maximizing monetary gain is the criterion for acceptance decision in economic transactions, and maximizing fairness is the criterion for acceptance decision in social transactions. It is often assumed that when faced with a choice between fairness and monetary gain or loss, human will often decide using the monetary gain/loss criterion rather than using the fairness criteria. It is suggested that when they reject money over fairness, it is considered an irrational behavior because they are throwing away free money or rejecting hyper-equitable offers [1-6]. But such assertion may not necessarily be validated without quantitative analyses using experimental data in human subjects. Although there are many other reasons or criteria used by humans to make decisions other than fairness or monetary gain, this paper focuses on the two variables — fairness and monetary gain — as the decision criteria to delineate which of the two variables are the determining variable for the decision-making process. The other decision criteria that were not addressed by the present studies, but were addressed by other many studies, include altruistic punishment [7-17], the motives of the offer by the proposer [7, 18], the intention of the proposer [19], the theory of mind [20, 21], empathy, and the emotional level [22-28].

1.1. Experimental Deduction of the Decision-Making Process using the Relativistic Fairness-Equity Model

Ultimatum Game (UG) [29] is one of the most widely used and established experimental paradigm to study decision and fairness in economic and social transactions in the fields of

decision science, behavioral economics, psychology, social science, neuroscience, and mathematical psychology [29-35]. It is a simple cognitive task used to determine the hidden variables affecting the decision-making process, depending on whether the subject perceives the disparity as fair or not. The task is essentially a split-the-money game, in which a sum of money (such as $10) is divided between a proposer and a responder. The proposer determines how the money is divided. The responder determines whether to accept or reject the offer. The rule is that if the responder accepts the offer, both individuals keep their share of the money. If the responder rejects, both lose the money.

The proposed amount of money to be shared is known (not hidden) to the responder at the time of decision. So this cognitive task, played as a responder, is not a gamble task. A gambling task usually requires risk-taking behavior in the decision-making process, when the outcome is unknown. But, when the human subject plays as the responder, the decision does not require any risk-taking behavior, because all the variables of the proposed offer are known beforehand, and the variables of the outcome of the decision is determined by the responder, not by the proposer. Thus, we can use UG as the experimental paradigm to determine which of the two variables — fairness and monetary gain/loss — are used as the criterion for making a decision by the responder, without involving any risk or uncertainty in making the decision.

Traditionally, UG paradigm is used to determine the decision-making process, because it is often assumed that the decision to accept or reject an offer is determined by the monetary gain, which sometimes competes (or conflicts) with the desire for fairness [7, 20-22, 36-40]. Due to the simplicity and powerfulness of the paradigm, there is a proliferation of studies using UG to delineate the neurobiological circuitry involved in the dependence of decision on fairness perception [15, 16, 19, 41-43]. The decision to reject unfair offers occurs not only in humans, but also monkeys [44], which suggests that the neural circuitry in decision-making is similar for human and non-human primates. This shows that the observable behavioral outcomes (acceptance/rejection to the proposed offer) in response to the perceived fair/unfair treatments are conserved across species in humans and non-human primates in evolution. Thus, the neurobiological mechanisms governing the decision-making process can be generalizable across species, and across population of the same species. Thus, we can deduce the underlying mechanisms involved in human decision-making by studying the decisions made by a sampled population in human subjects, as shown in this study.

Most of the studies assumed that the decision to reject an unfair offer in UG is an irrational decision, because such a decision would only punish oneself by losing the money without gaining any benefits, other than the benefit in altruistic punishment of the proposer [1-6]. This assumption is based on the behavioral economics in which maximizing monetary gain is the criterion to make the decision to accept or reject a monetary offer, rather than including fairness as a criterion in social interactions. Given that there are competing criteria for making a decision, the paper will determine which of the two criteria is the determining criterion for the decision-making process, when the human subjects are given the choice between fairness and monetary gain to decide.

1.2. Objectives

We will use the UG as an experimental tool to test the hypothesis that the decision-strategy in human subjects is to optimize the relativistic fairness level rather than optimizing the monetary gain or loss, based on the computational relativistic fairness-equity model [45]. This will provide experimental evidence that the decision to accept or reject an offer is based on the perceived fairness level, but not on the amount of monetary gain or loss.

1.3. Rationale

This paper poses the hypothesis that the decision to reject a fair or unfair offer is based on the fairness perception in its reasoning to reject the offer without being logically inconsistent. That is, the decision is not made based on the monetary gain or loss criterion, but on the perceived fairness level as the criterion, regardless of the amount of monetary gain or loss. The main difference between this research and previous studies is that previous studies assumed that monetary gain is the decision criterion; therefore it would be logically irrational to reject free money.

Furthermore, most studies that used fairness as the criterion for decision assumed the equivalence between equity in the offer and fairness. That is, an equitable offer is assumed to be fair, and inequitable offer is assumed to be unfair. But this assumption is not necessarily valid, because there is a decoupling between equity and fairness, as predicted by the relativistic fairness-equity model [46, 47] and confirmed by experimental evidence [46, 47]. That is, under certain circumstances, a person can perceive an inequitable offer as fair, and an equitable offer as unfair. This does not create any logical inconsistency in the fairness assessment, but rather a reflection of the leniency phenomenon when a person considers an inequitable offer as fair, and the greediness phenomenon when a person considers an equitable offer as unfair [47]. These phenomena are merely fairness biases rather than logically inconsistency.

Thus, the assumption that other UG studies made in labeling the decision as irrational when humans reject an equitable offer as unfair or an inequitable as unfair is not valid, according to the relativistic fairness-equity model [45]. It is because a shift in the fairness bias will change the baseline fairness level to either a more fair or less fair level in their perception, without contradicting the logical reasoning using the level of fairness as a criterion for decision, even when the level of fairness is shifted from fair to unfair or from unfair to fair in a continuum of the fairness-axis.

Therefore, if fairness is used as the decision criterion, then as the level of fairness increases from unfair to fair, then the likelihood of making the acceptance decision also increases.

Thus, the decision threshold to accept an offer can be located at an unfair level, as long as the perception of unfairness changes from a more unfair level to a less unfair level, because the likelihood of making an acceptance decision increases as fairness perception increases from an extreme unfair level to a lesser unfair level. Similarly, the decision to reject a fair offer is still logically consistent with using fairness level as the decision criterion, because as the perception of fairness decreases from a highly fair level to a less fair level, when a specific fairness threshold is crossed, so that the person can decide, "this is it, I will not take it any more," and reject the offer, even though the offer is perfectly fair and equitable. Thus, the perceived fairness level itself is a logically consistent rationale, without being irrational when a decision is made to reject any money offered using fairness as the decision threshold, independent of the amount of monetary gain or loss, or a present level of fairness. The threshold level of fairness can change in the decision criteria when the human subject adjusts the perception from leniency to greediness. This can resolve the paradox without violating the logical consistency in the decision-making process.

Although there are many studies using the UG paradigm to address the decision to accept or reject the offer based on the amount of equity in the offer (i.e., the decision is based on whether the offer is equitable or not) [1, 2, 5, 7, 20, 22, 39, 40], they have not quantified how the threshold for decision is related to the perceptual level of fairness, independent of the amount of equity in the offer. That is, the human subjects will reject the offer even when it is hyper-equitable or accept an offer that is inequitable, contrary to the assumption that an equitable offer is fair and an inequitable offer is unfair.

We will show that the decision criterion is not necessarily based on the equity of the offer, when human subjects can reject hyper-equitable offers when they perceived it as unfair or accept inequitable offers when they perceived it as fair. It is the perception of fairness that determines the decision, not the amount of equity in the offer, even though it is more likely to perceive an equitable offer as fair than an inequitable offer, but that perception can change, which will alter the decision.

We have shown that the degree of fairness is directly proportional to the amount of equity in the offer using the fairness stimulus-response function according to the relativistic fairness-equity model [47]; therefore it appears that the decision is based on equity, but in fact, it is based on the degree of fairness when they co-vary together. The relativistic fairness-equity model [46-49] predicts that fairness is computed by the relative disparity between oneself and others. The model is quantified by the fairness stimulus-response function in which fairness is related to the disparity between oneself and others by a proportionality relationship. The disparity based on oneself is a local (self-centered) frame-of-reference, whereas the disparity based on others is a global (other-centered) frame-of-reference.

The model predicts that humans make decisions based on the level of perceived fairness, independent of the sensitivity to fairness or the frame of reference used for incorporating either self-regarding or other-regarding concerns in the decision. That is, the decision is made when a threshold of fairness is reached, independent of the amount of monetary gain or loss. We will show in this experimental study that the criterion used by human subjects is the degree of fairness, independent of the equity of the offer, as long as a specific threshold of fairness is reached (regardless of the amount of equity in the offer).

1.4. Hypothesis

Using the relativistic fairness-equity model [45], we will show that the decision to accept or reject an equitable or inequitable offer is based on the criterion of the perceived fairness level, but not based on the criterion of the amount of monetary gain or loss.

2. Methods

Healthy human subjects were recruited to play the Ultimatum Game (UG) as the responder. The subjects were presented with nine randomized offers sharing $10 between the computerized proposer and the human responder. The monetary offers ranged from an inequitable offer of $1 (offer-ratio of $1 : $9) to a hyper-equitable offer (offer-ratio of $9 : $1), without repeating the same offer twice (i.e., using a one-shot trial paradigm). The subjects were asked to accept or reject the offer. If the subjects accept the offer, both keep the money; if they reject the offer, both lose the money. After they accepted or rejected the offer, they were asked to rate how fair the offer was to them (in a scale of +5 to –5). By design, the same pseudo-random sequence of monetary offers is used for all subjects, so the experimental conditions are uniform across all subjects for comparison in our analysis. The offer-ratio is subsequently sorted in ascending order to be used as the stimulus for the stimulus-response function in the analysis. The fairness rating is used as the response for the stimulus-response function to determine the relationship between fairness and offer-ratio in relation to the decision that the subjects made. The threshold for decision will be quantified with respect to the fairness stimulus-response function to determine the crossover-point where the decision is changed from rejection to acceptance. The study was approved by the University Institutional Review Board (IRB).

3. Results

A total of 425 human subjects participated in this study (275 female, 150 male; age ranging from 18 to 80, median = 21; mean = 22.3; standard deviation = 4.7). Fig. 1 shows the fairness stimulus-response functions for both the acceptance and rejection decisions, combined side-by-side in one single graph. The stimulus is the offer-ratio, and the response is the fairness rating. The left half of Fig. 1 displays the fairness rating for each offer-ratio for the rejection decision trials. The right half of Fig. 1 displays the fairness rating for each offer-ratio for the acceptance decision trials.

Note that the same human subject could accept an offer for an hyper-equitable offer (such as \$9 : \$1) in one trial, but reject an inequitable offer (such as \$1 : \$9) in another trial. Thus, the responses of the same subject can appear in both the rejection fairness stimulus-response function (left-half in Fig. 1), and the acceptance stimulus-response function (right-half in Fig. 1), depending on the decision for that specific offer-ratio. Thus, the graph in Fig. 1 represents the fairness rating per decision for all human subjects in this study. The decision responses of the same human subject can appear in both the left and right stimulus-response functions in Fig. 1. This allows us to generalize the decision-making process for acceptance and rejection, independent of the individuality of any specific human subject. Thus, the result presented here can be generalized as an averaged universal response for all subjects in the experimental sample.

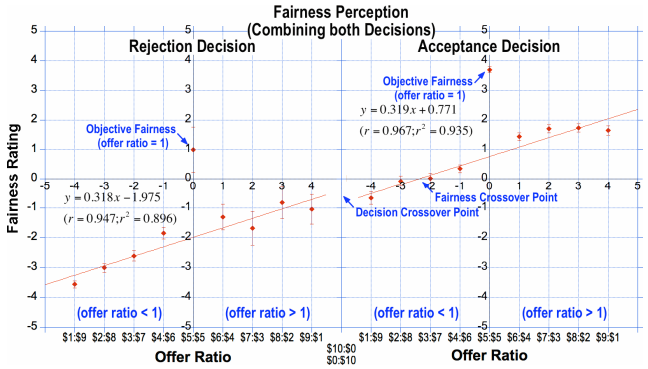

Figure 1. *Fairness stimulus-response functions of the experimental data from human subjects for both rejection and acceptance decisions, displaying side-by-side. The rejection decision trials are plotted in the left stimulus-response function, while the acceptance decision trials are plotted in the right stimulus-response function. Curve-fitting is done by regression for all data points (excluding the singularity-point at offer-ratio = \$5 : \$5). It shows that there is a linear proportionality relationship between fairness rating and offer-ratio, independent of the decisions. The fairness stimulus-response function for the rejection decision is always –2.75 point lower than the acceptance decision by in fairness rating in the scale of +5 to –5. The error bar represents standard error of mean (SEM).*

Note also that most UG studies used the terms "fair offers" for offer-ratios > 1, and "unfair offers" for offer-ratios < 1 [2, 19, 22, 39, 40, 50, 51], which implicitly equate equitable offers as fair offers, and inequitable offers as unfair offers by assumption. But such an assumption is not supported by experimental evidence. Previous studies had demonstrated that it is logical without contradiction to perceive equitable offers as unfair (which indicates greediness by the human subjects), and perceive inequitable offers as fair (which indicates leniency) [46-49]. As demonstrated experimentally, although there is a proportional relationship between equity and fairness (i.e., fairness perception is correlated with equity of the offer); nonetheless, equity and fairness can be decoupled [46-49]. We will also show below that even though the fairness perception is correlated with the offer-ratio, which is revealed by the fairness stimulus-response function. When the stimulus-response function is shifted down, an equitable offer can be perceived as unfair. When the stimulus-response function is shifted up, an inequitable offer can be perceived as fair. Therefore, we will not use the terms "fair offers" or "unfair offers," but rather use the terms "equitable offers" and "inequitable offers," to be precise without confusion or contradiction.

3.1. Proportionality Relationship between Fairness Perception and Offer-ratio Remains Constant for Both Acceptance and Rejection Decisions

Fig. 1 shows that the fairness stimulus-response function is proportional between the fairness rating and the offer-ratio for both acceptance and rejection decisions [47]. The more equitable the offer is, the higher the fairness rating for both decisions. Note that equitable offers (offer-ratio > 1) are not always perceived as fair, nor inequitable offers (offer-ratio < 1) are always perceived as unfair, as revealed in the fairness stimulus-response functions in Fig. 1. In general, the graph reveals that equitable offers are perceived as more fair than inequitable offers. Thus, the relationship between fairness and equity is a relative relationship rather than an absolute relationship.

3.2. Reduction of Fairness Perception for Rejection Decisions Compared to Acceptance Decisions

The difference between the two decisions is the shifting of the baseline level of fairness in the stimulus-response functions. That is, the baseline fairness level is lower for the rejection decision than the acceptance decision, as revealed by the y-intercept. The baseline fairness (y-intercept) for the rejection decision is –1.975 (regression function: $y = 0.318x - 1.975$ in the left half of Fig. 1). The baseline fairness (y-intercept) for the acceptance decision is +0.771 (regression function: $y = 0.319x + 0.771$ in the right half of Fig. 1).

There is a 2.75-point difference (in a 10-point scale) in the baseline fairness level — i.e., the fairness perception is reduced by 27.5% for rejection decision trials compared to the acceptance decision trials. This shows that the human subjects reported 27.5% more unfair when they rejected the offer than when they accepted the offer. This is because the slopes of the fairness stimulus-response functions remain constant for both acceptance and rejection decisions. The slope for the rejection decision is 0.318 (regression function: $y = 0.318x - 1.975$ in the left half of Fig. 1). The slope for the rejection decision is 0.319 (regression function: $y = 0.319x + 0.771$ in the right half of Fig. 1). The only difference is the baseline fairness level, which is quantified by shifting the stimulus-response function down by 27.5%, as evidenced by the lowering of the y-intercept for the rejection decision trials compared to the acceptance trials.

3.3. Same Reduction of Fairness Perception Level for Rejection Decisions for all Offer-Ratios, Independent of the Specific Offer-Ratio

Fig. 1 shows that the difference in fairness perception is independent of the offer-ratio — i.e., it is 27% lower for all offer-ratios from \$1 : \$9 to \$9 : \$1. The fairness rating is

always 27% lower for each of the corresponding offer-ratio from \$1 : \$9 to \$9 : \$1, even for the singularity point at the offer-ratio of \$5 : \$5 that deviates from the regression line of the stimulus-response function. Thus, the decision to reject an offer is always correlated with a reduction of fairness perception (by 27.5%). That is, the subjects seemed to evaluate how fair it is if they accept the offer compared to them rejecting the offer, before making the final decision to accept or reject it. Thus, it suggests that the decision making process is not done in isolation, but with implicit comparison between the scenarios if they accept the offer vs. reject the offer. This is, the subjects appear to consider both alternative decisions first, before making the final decision.

3.4. Same Reduction of Fairness Perception Level Irrespective of Self-Regarding or Other-Regarding Concerns and the Monetary Gain or Loss

Independent of whether the fairness perception considers only self-regarding concerns or considers other-regarding concerns, the result is the same — there is a 27.5% reduction in the fairness perception between the acceptance and rejection scenarios. The inclusion of other-regarding concerns is evidenced by the singularity point at the even-split offer (offer-ratio = 1), where it deviates from the proportional stimulus-response function (see Fig. 1). It represents objective fairness judgment when the subjects considered that an even-split offer is the fairest of all offer, even more fair than any of the hyper-equitable offers. That is, even at this singularity point, there is a 27.5% reduction in fairness level, similar to the same 27.5% reduction in all other offer-ratios. The subjects always perceive the monetary offer as 27.5% less fair, when they decided to reject the offer than when they accept an offer, independent of whether the offer is inequitable or hyper-equitable. Similarly, if they decided to accept the offer, they perceived the offers as 27.5% more fair irrespective of whether the offers are equitable, hyper-equitable or inequitable. Thus, the decision to reject an offer is correlated with a reduction of the perception of fairness level, independent of the amount of monetary gain or loss is at the particular offer-ratio. This suggests that the decision is based on their perceived fairness level rather than the absolute or relative amount of monetary gain or loss.

3.5. Threshold for Decision as Determined by the Decision Crossover-Point for Fairness

When the fairness stimulus-response functions are plotted side-by-side in Fig. 1, it reveals the decision threshold at the crossover-point in the middle of the graph (which crosses over from the rejection decision to the acceptance decision). It shows the decision crossover-point is located at –0.5-point in the 10-point fairness rating scale (at –5%), when the human subjects decided to change their decision from rejection to acceptance. It shows that rather than changing the decision at neutral fairness (at fairness rating of 0), the human subjects responded with accepting a slightly unfair perception (at –5% unfair level) before changing their decision from rejection to acceptance. This shows humans allow for some tolerance for unfairness to accept an offer, rather than using an absolute fair level as the criterion for decision. That is, it does not have to be completely fair in order for an individual to accept an offer. It can be slightly unfair, and one can still accept an offer. If the perception is below the –0.5-point fairness-rating threshold in the fairness scale, then the subjects will reject the offer. If the perception is above the –0.5-point threshold in the fairness scale, then the subjects will accept the offer. Thus, the decision is based on the fairness level rather than the monetary gain or loss value at a specific offer-ratio.

3.6. The Decision to Reject can Occur Even when the Perception is Fair at Absolute Equity (even-split offers)

The only exception to the above rule is at the absolutely equitable offer (offer-ratio = 1 or \$5 : \$5). The human subjects rejected the offer even when the fairness rating is fair (1.0-point in the fairness rating for the stimulus-response function in the left-half of Fig. 1). This is the singularity point, when the subject switched the frame of reference from a self-centered frame of reference to an other-centered frame of reference, by including other-regarding concerns rather than using only self-regarding concerns [46]. In this instance, the subjects considered the offer as fair when the offer is a 50/50 even-split, but nonetheless rejected the offer.

That is, at the absolute equity even-split \$5 : \$5 (offer-ratio = 1), the same 27.5% reduction of fairness perception is reported when they rejected the offer. Thus, the data suggest that when the subjects decided to reject the offer, there is always a reduction of fairness perception by 27.5% (relative reduction of fairness).

One possible explanation is that the subjects decided not to want any money from the proposer (for whatever reasons, including not wanting the dirty money, or the responder is too rich to accept any more money). Regardless of the monetary value, the subjects decided to reject the offer at absolute equity even though they considered the offer as fair. This further supports the hypothesis that the decision to reject is based on fairness level rather than the amount of monetary gain or loss. Thus, the decision is rational and logically consistent, rather than irrational by rejecting the money, because monetary gain or loss is not necessarily a criterion in the decision-making process, but fairness is definitely one of the criteria.

4. Discussions

The analysis shows quantitatively that the decision-making process made by human subjects is relative to the level of fairness perception, rather than relative to the monetary gain or loss. The fairness stimulus-response function provides the definitive quantitative assessment of the underlying decision-making process relative to fairness. It shows that the decision is made independent of the monetary gain/loss or the offer-

ratio in the UG experimental paradigm. The decision to accept the offer is made if the fairness perception exceeds the fairness threshold. The decision to reject the offer is made if the fairness perception is below the fairness threshold. The fairness threshold for decision (decision crossover-point) is a slightly unfair perception (–5% or –5-point in the scale of 10), rather than the neutral fairness (0% or 0-point in the scale of 10). This shows there is some tolerance for unfairness for human subjects to accept the offer, rather than using the absolute fairness as the criterion in their decision-making process.

As the baseline fairness level increases, the perception of the offer also increases as more and more fair, because of the proportionality relationship between fairness and offer-ratio. This means that because fairness perception co-varies with offer-ratio, this gives the appearance that the decision is made based on offer-ratio instead of fairness perception, since fairness and offer-ratio are linked together. In order to uncouple the link between fairness and offer-ratio (i.e., monetary gain or loss), our analysis separates the acceptance decision trials from the rejection decision trials. This allows us to differentiate the variables associated with either the acceptance or the rejection decision. In doing so, it reveals that the fairness perception for the rejection decisions is always 27.5% lower than the fairness perception for the acceptance decisions, independent of the offer-ratio (or monetary gain/loss). This provides the quantitative data that demonstrates definitively that the decision is related to fairness rather than monetary gain/loss.

The most important key to this conclusion is that for the even-split offer-ratio of \$5 : \$5 (at absolute equity), the same reduction of 27.5% still remains, even when the human subjects reported that offer as fair (+1-point in the scale of 10). This suggests that, in general, the decision to reject the offer is a slightly unfair perception. The only exception is that the subject would also reject the offer when the perception is fair at the offer-ratio = 1. This occurs when the objective fairness is taken into account by including other-regarding concerns, when the frame of reference is switched from a self-centered frame of reference to an other-centered frame of reference at the absolute equitable offer.

The analysis suggests that the decision-making process is not only based on the absolute baseline fairness level of fairness, but on the relative fairness level of a reduction of 27.5% in fairness — independent of the offer-ratio. Nonetheless, the decision is related to the fairness criterion, whether the subjects used an absolute fairness level as the criterion or a relative fairness reduction as an additional criterion. The offer-ratio (or the monetary gain/loss) is not an explicit criterion in the subject's decision-making process, but an implicit dependence on fairness, since it co-varies with fairness.

Thus, it may appear that the decision criterion is made relative to the monetary gain/loss just because fairness perception co-varies with offer-ratio, according to the proportionality relationship between the two variables. The fairness stimulus-response functions in Fig. 1 clearly delineate the dependence of the decision on fairness perception, but not on offer-ratio. For rejection decisions (left-half of Fig. 1), the subjects reported an unfair perception for all of the offer-ratios. But for acceptance decisions (right-half of Fig.1), the subjects reported slightly unfair for offer-ratio < \$2.5 : \$7.5, and more than fair for offer-ratio > \$2.5 : \$7.5. This is quantified by the fairness crossover-point, which is located at offer-ratio = \$2.5 : \$7.5. This perception can be explained by being lenient to unfairness, by regarding inequitable offers as fair. This is graphically quantified by the shifting of the fairness stimulus-response function to the left and up. The neutral fairness stimulus-response function would have been a straight line passing through the x- and y-axes-origin (i.e., 0 fairness rating at offer-ratio = \$5 : \$5), if the fairness perception is not biased toward leniency and acceptance.

Because fairness perception is correlated with the offer-ratio (or monetary gain/loss), as the human subjects are lenient to unfairness or greedy to hyper-fairness, the fairness stimulus-response function would shift to the left or right, respectively. This would increase the perception of fairness to a more fair level, as it shifts to the left and up; and to a more unfair level as it shifts to the right and down. Thus, the monetary gain or loss is directly related to the leniency or greediness in the perceptual biases of fairness rather than the amount of monetary gain or loss.

These quantitative analyses are all consistent with the hypothesis that the decision-making process criteria are related to the relative or absolute fairness perceptual level, independent of the amount of monetary gain or loss. The amount of monetary gain or loss is a side effect of the co-variation between fairness perception and offer-ratio in the UG paradigm. Even though they are linked in the proportionality relationship between fairness and offer-ratio in the self-centered frame of reference for evaluating subjective fairness, this link can be uncoupled in the non-proportional relationship between fairness and offer-ratio in the other-centered frame of reference for evaluating objective fairness at absolute equitable offer (i.e., offer-ratio = 1).

Although there are many other factors that the human subjects could have included in the criteria for their decision-making process other than fairness and monetary gain/loss, this study focuses on decoupling the dependence of fairness on monetary gain/loss, so that the underlying decision-making process can be identified. The other factors that may have incorporated in the decision-making process include personal pride, a lack of need for monetary gain due to personal wealth, a negative perception on what the motive of the individual offering money is, etc., will be addressed in subsequent papers.

5. Conclusion

The quantitative analyses provide the experimental proof that, when confronted with a choice between fairness and monetary gain or loss, the decision-making process made by human subjects often use both relative and absolute fairness

perception level as the criteria for making the acceptance or rejection decision rather than use the monetary gain/loss criterion in the UG paradigm. The amount of monetary gain or loss is only a side effect associated with the fairness perception, rather than it being used as the criterion for making decisions. This is demonstrated by the shifting of the fairness stimulus-response function to the right and down for the rejection decisions, and shifting of the stimulus-response function to the left and up for the acceptance decisions. The fairness crossover threshold quantifies the switch from unfair perception to fair perception. The decision crossover threshold quantifies the switch from rejection decision to acceptance decision. These quantitative analyses definitively prove that the criteria used in the decision-making process are related to the baseline fairness perception levels, independent of the amount of monetary gain or loss. This also provides evidence that the decision-making process is logically consistent with the fairness criteria, without being irrational to reject free money or reject hyper-equitable offers. This resolves the paradox that the decision to reject monetary offer is a rational decision, logically consistent to resolve the conflict — when fairness is used as the decision criterion — without using monetary gain as the criterion in the decision.

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