BRIEF REPORT

A PRELIMINARY TWO-PHASE TEST OF HOW INEQUITY AVERSION IS MODULATED BY PREVIOUS DYADIC INTERACTIONS

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Inequity aversion can be defined as the refusal of gains or strong, negative emotional behavior when there is an unfair distribution of outcomes (Brosnan & de Waal, 2014; Fehr & Schmidt, 1999). Aversion to inequity may be investigated by the use of an inequity game, an experimental procedure derived from the economic games literature (see McAuliffe, Blake, Steinbeis, & Warneken, 2017). In this game, an allocation is distributed between two players (Player One and Player Two) by an experimenter. If Player One accepts the allocation, both players receive their allocated payoffs. If Player One rejects the allocation, neither player receives a payoff. Rejection of an unequal distribution may be used as a measure of inequity aversion. Inequity aversion may occur in situations of disadvantageous inequity (DI), in which one rejects an outcome that is less than that of a partner. Inequity aversion may also occur in situations of advantageous inequity (AI), in which one rejects an outcome that is more than that of a partner.

With respect to the ontogenesis of humans' "sense of fairness", there seem to be important differences between aversion to DI and AI (Blake et al., 2015; McAuliffe, Blake, Kim, Wrangham, & Warneken, 2013; Corbit, McAuliffe, Callaghan, Blake, & Warneken, 2017). Children across diverse societies show aversion to DI as young as 4 years old (Blake & McAuliffe, 2011; Blake et al., 2015; McAuliffe et al., 2013; Shaw & Olson, 2012). In contrast, emergence of aversion to AI is more variable. Blake et al. (2015), for example, found evidence of AI in older children (8 years old) in some countries (the US, Canada, and Uganda), but not in other countries (India, Mexico, Peru, and Senegal). Aversion to AI may be more related to social cues and cultural context than aversion to DI, in that it is strongly observed and varies less between people from different cultures and individuals from different species, such as humans and monkeys (e.g., Blake et al., 2015; Brosnan & de Waal, 2014). In this paper, we ask if flexibility of aversion to DI may be best investigated with experimental procedures with more

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long-lasting opportunities to interact with a partner.

There is interesting empirical evidence showing that more long-lasting opportunities to interact with a partner may have a strong influence on social behavior in test conditions (Abreu-Rodrigues, Natalino, & Aló, 2002; Avalos, Ribes-Iñesta, Ortiz, & Serna, 2015; Marwell & Schmitt, 1975; Ribes-Iñesta, Rangel, Pulido, Valdez, Ramírez, Jiménez, & Hernández, 2010; Schmitt, 1998; Silverstein, Cross, Brown, & Rachlin, 1998). Typically, there is no programmed cost for social interactions, but outcomes can vary due to some aspects of a partner's behavior and the experimental condition. In this kind of experimental strategy, there are usually at least two experimental conditions, and participants may experience repeated interactions with a given partner under stable conditions before there is a change in experimental conditions. For experimental purposes, dyadic interactions may be controlled when one member of the dyad is a confederate.

An example of a procedure that involves a long-lasting opportunity to interact with a partner is a puzzle task that can be shared with another person (Avalos, Ribes-Iñesta, Ortiz, & Serna, 2015; Ribes-Iñesta, Rangel, Pulido, Valdez, Ramírez, Jiménez, 2010). The participant and a partner (who is a research confederate) need to solve puzzles, presented on individual computer screens that show both the participant's puzzle and the confederate's puzzle. The participant and confederate can put pieces on their own puzzle as well as on the other puzzle. If the participant or the confederate places a piece on their own puzzle, he/she receives 10 points. In addition, if the participant or confederate places a piece on the other person's puzzle, they may both receive 10 points (points delivery varied between studies). Participants (college students) rarely put pieces on the confederate's puzzle when confederates put pieces only on their own puzzles in baseline sessions. Across experimental conditions, the percentage of pieces that the confederate placed on the participant's puzzle varied from 0 to 25, 50, 75, and 100%, in ascending or descending order. Results showed that participants placed pieces on the confederate's puzzle in the same proportion as the confederate placed pieces on the participants' puzzle. The flexibility of cooperative strategies has also been investigated by Silverstein, Cross, Brown, and Rachlin (1998). The study used a two-phase procedure with an iterated prisoner's dilemma game. Participants were initially assigned to one of four experimental conditions in which they played with a confederate, and the confederate's strategy varied: (1) tit-for-tat, (2) play randomly, (3) always cooperate, or (4) always defect. In a second phase, participants played the prisoner's dilemma game with each other (instead of with the confederate). During this latter condition, cooperation was the predominant strategy mainly for those participants previously exposed to the tit-for-tat condition.

Collectively, experimental results indicate that different cooperative behaviors may be flexible in social situations, which requires a special analysis regarding the learning mechanisms involved when one person's decisions may be affected by the other person's behavior. The main aim of the present study was to devise a two-phase experiment to investigate flexibility of aversion to DI in young adults as a result of dyadic interactions with AI. We investigated whether aversion to DI could be modulated by a previous experimental history in which a confederate acted in a "friendly" manner that produced AI. We compared this situation with two control situations: one in which participants interacted with an "unhelpful" partner who did not permit AI and one in which participants did not have previous experience with a partner (they were exposed directly to the DI test).

METHOD

Participants

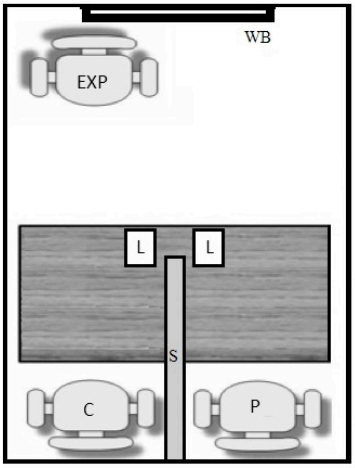
Fifty-nine college students, ranging in age from 18 to 27 years, were recruited from a university campus: 33 were female and 26 were male. All participants signed informed consent forms that had been approved by a Brazilian research ethics committee (process CAAE: 19646713.4.0000.5561).

Experimental Environment and Materials

The experiment was conducted in a research room at the University of São Paulo. In the room, there were two tables and two chairs, a folding screen, and a whiteboard (Figure 1). The experimenter was stationed next to the whiteboard and had visual access to the participant and

confederate. The participant and the confederate sat at separate tables, and visual contact between them was limited by a folding screen positioned between them. They could only see each other's hands, which card the other person played on each trial, and the outcome presented by the experimenter on the whiteboard. The participant and confederate each had a blue and a green card, and there was a space marked on each table indicating where they needed to place the chosen cards on each trial. They also had access to a pencil and notepad, on which they could write whatever they wanted. In a pre-experimental phase with four trials, all participants learned general rules about choosing cards, combinations of cards and outcomes, and the payoff matrix for different combinations of cards.

Figure 1



Note. An overhead illustration of the experimental setting.

Procedure

The participants were randomly assigned to one of three experimental groups: friendly confederate (FRICON), unhelpful confederate (UNHCON), or control/no previous history (NOHIST). Fifteen participants in the FRICON group and all participants in the UNHCON group completed two experimental phases: In the first phase (labeled Phase AI), a history with a friendly or unhelpful confederate was manipulated. In the second phase (labeled Phase DI), the production of DI was tested.

There were 29 participants in the FRICON group, 15 participants in the UNHCON group, and 15 participants in the NOHIST group. In the FRICON group, 14 participants were excused from the experiment before Phase DI due to failure to meet the Phase AI criterion (see below). Data from these participants were not included in the overall data analysis. Participants in the NOHIST group only completed the test for DI (Phase DI).

Experimental Task and Payoff Matrix

On each trial, the outcomes for the participant and confederate were determined by the combined choices of blue and/or green cards. When the participant and confederate both chose the blue card, there was an inequitable outcome. When one or both choose a green card, there was an equitable outcome. In Phase AI, inequity was advantageous to the participant; in Phase DI, inequity was disadvantageous to the participant (Table 1).

When the participant entered the experimental room, the confederate was already sitting in one of the chairs, behind the screen. Written instructions were given to the participant and confederate simultaneously. The experimenter asked that instructions be read in silence. The instructions were:

> *This study is not about intelligence, and it is not about assessing your intellectual abilities. When you're done, you'll get more explanations. You will be working with a partner, and both of you will have an identical task to perform. You and your partner will receive two cards (one blue and one green). When the experimenter says the word "Attention," you must make a choice: place your hand on the blue card or place your hand on the green card. After your choice, the experimenter will say the word, "Now!" At this point, put the chosen card in the place indicated on your desk so that you and your partner can see each other's choices. On each trial, you will receive a certain number of points. The number of points you will receive depends on your choice and the choice of your partner. The experimenter will notify you when the session is finished. Please remain seated and do not talk to your partner or the experimenter*

Table 1.
Payoff Matrix for Participants and Confederates in Phases AI and DI

PHASE AI Advantageous Inequity to the Participant					
	Card combinations	Points		Confederate's Choice	Trials
		P	C		
FRICON	Blue-Blue*	5	2	Blue	15
UNHCON	Blue-Blue*	5	2	Green	15
NOHIST	(not exposed to this experimental phase)				
PHASE DI **Disadvantageous Inequity to the Participant**					
	Card combinations	Points		Confederate's Choice	Trials
		P	C		
ALL GROUPS	Blue-Blue*	2	5	Blue	12

*Any other combination produced equal outcomes: 2 points to both players.
"P" refers to participant and "C" refers to confederate.

> *during the session. All instructions are contained on this sheet. If you have questions, reread the instructions (do not ask the experimenter any questions). When you're ready to begin, raise your right hand.*

After returning the paper with the general instructions, the participants received the following specific instructions, also printed on paper:

> *If you choose the blue card and the participant beside you also chooses the blue card (combination: blue–blue), you will earn five points and the participant next to you will earn two points. If you or your partner choose the green card (combinations: blue–green, green–blue, or green–green), you both will earn two points.*

Experimental Design

After the participant read the general and specific instructions, there was a pre-experimental phase that consisted of four trials. The confederate alternately chose the green and blue cards on these trials (i.e., green-blue-green-blue). The outcome on these trials was the same as that in the next phase: inequity favorable to the participant in cases in which both players chose the blue card, and equity with any other card combination. The objective of this pre-experimental phase was to permit the participants to test the instructions about card choices and points distributions. After the four trials, the experimental phase was initiated without any notification.

Phase AI: advantageous inequity to the participant. In this phase, the confederate's behavior varied depending on the participants' experimental group. The confederate's behavior was

pre-determined in order to permit or prevent inequity favorable to the participant. In the FRICON group, the confederate used the blue card and allowed the participant to earn five points while the confederate earned two points on every trial. In the UNHCON group, the confederate used the green card and did not allow the participant to earn five points (i.e., both the participant and confederate earned two points) on every trial. There were 15 trials in this phase. For participants in the FRICON group, there was a criterion to finish the phase: Participants were only exposed to the next phase if they played the blue card on at least 10 trials, and the blue card was played on the last three trials.

Phase DI: disadvantageous inequity to the participant. At the beginning of this phase, the experimenter provided additional written instructions to the participant and confederate on how to earn points. These instructions indicated that the payoff matrix was reversed: now blue-card choices resulted in the confederate earning five points and the participant earning two. On every trial for all groups, the confederate always chose the blue card. There were 15 trials in Phase DI. This phase included the NOHIST group that received only the preliminary, general instructions about gains; also, this group was only exposed to Phase DI and thus did not have an experimental history with a friendly or unhelpful partner.

Data Analysis

The data file was organized in long format. Each data file record (each choice for each participant) contained the following variables: participant identification (ID), participant's choice (green, blue) (PC), phase (1, 2) (Phase), group (FRICON, UNHCON, NOHIST) (Group), and block (1, 2, 3) (Block). The total number of records was 1125.

The dependent (outcome) variable was PC, and category Green was the reference category. A full factorial generalized linear mixed model with binomial distribution and logit link function (repeated measure logistic regression) was used to test the main variables. Fixed effects for factors Phase and Group was controlled by random effect of ID.

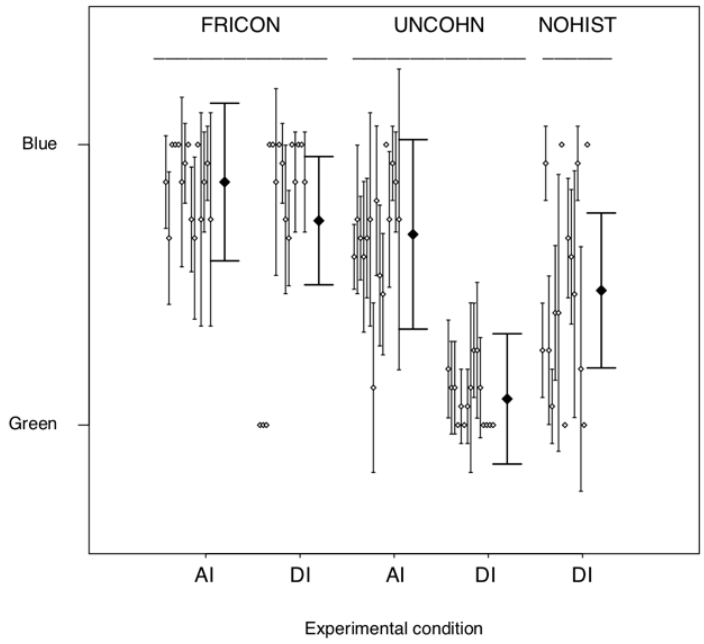
RESULTS

Our main purpose with this experiment was to see if dyadic interactions with a confederate constrain aversion to DI for FRICON participants (compared to participants in UNCOHN and NOHIST groups). Our first analysis compared participants in the three experimental groups in two consecutive phases (AI and DI).

Figure 2 depicts the results from the two phases for participants in FRICON and UNCOHN groups and from Phase DI for participants in NOHIST group. Closed markers show estimated marginal means and open markers show individual participant data in each phase. Considering participants in the FRICON group, there was a small decrease in blue choices in Phase DI. For these participants, blue choices were still more frequent than green choices in the second phase. For Participants in the UNCOHN group, in contrast, the percentage of trials on which participants chose the blue card dropped to close to 40% in Phase DI, indicating an unwillingness to produce DI. The NOHIST group showed strong variability in choices: Some participants choose the blue card on most of the trials, but other participants choose the green card on most of the trials. This result clearly illustrates the importance of previous experience with AI regarding the more consistent data in Phase DI for participants in the FRICON and UNCOHN groups.

For statistical comparisons, we adopted a significance level of 0.05. The interaction effect was significant, $F(1, 1120) = 25.354$, $p < 0.001$. There was a simple main effect of Group for both Phases DI and AI, $F(1, 1120) = 6.691$, $p = 0.01$ and $F(2, 1120) = 46.787$, $p < 0.001$, respectively. Using pairwise contrasts in Phase DI, the differences among the levels for groups FRICON, UNHCON, and NOHIST were significant (FRICON - UNHCON: $t(1120) = 9.373$, Sidak adjusted $p < 0.001$, FRICON - NOHIST: $t(1120) = 2.535$, Sidak adjusted $p = 0.011$, and UNHCON - NOHIST: $t(1120) = 3.639$, Sidak adjusted $p = 0.001$). The estimated marginal means (adjusted proportion of blue card choices) were 0.928 and 0.689 in Phase AI for groups FRICON and UNHCON, respectively, and were 0.799, 0.083, and 0.482 in Phase DI for groups FRICON, UNHCON, and NOHIST, respectively.

Figure 2



Note. Blue and green choices in Phases AI and DI for participants in the FRICON and UNCOHN groups and in Phase DI for participants in the NOHIST. Closed markers show estimated marginal means and open markers show individual participant data in each phase. Error bars indicate confidence intervals of 95%.

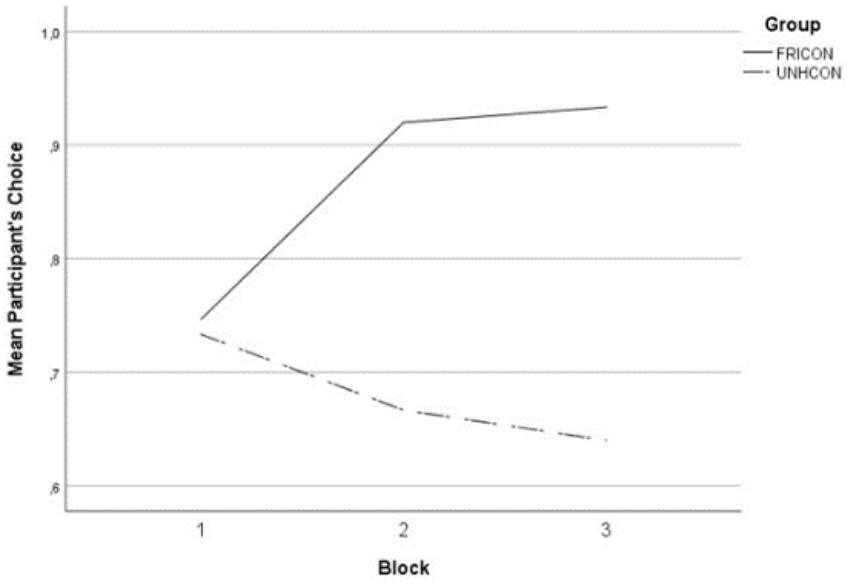
Figure 3 depicts the difference between groups in Phase AI in three blocks of five trials. Examining the data in smaller trial blocks shows whether differences between the FRICON and UNHCON groups in Phase AI occurred at the beginning of the experiment or were established during that phase. At the beginning of the experiment, participants from both groups chose the blue card on a similar number of trials initially, but they differed in the second and third block. Specifically, participants in the FRICON group began to make more blue-card choices, whereas those in the UNHCON group tended to make slightly fewer blue-card choices.

DISCUSSION

Our results clearly show that previous personal history (Phase AI) affected decisions in a situation with DI. We clearly constrained aversion to DI for FRICON participants. We were able to see this by comparing FRICON participants with UNHCON participants and also by comparing these groups with the NOHIST group (participants who were not exposed to Phase AI). These results are very strong and consistent, even with a relatively small number of participants in each experimental group. Another way to conceptualize these results is that participants who experienced a friendly confederate in Phase AI (i.e., a partner who permitted AI to the participant) produced DI to themselves in Phase DI.

Our experimental strategy was successful in demonstrating how flexibility in inequity aversion may be produced in a two-phase experiment. The primary contribution of this strategy is that a majority of previous reports in the experimental literature test inequity aversion using just a few trials presented in a single condition that are part of between-group strategies. There are, however, some limitations in our analysis that may be improved in future investigations. The main limitation is related to the criteria for advancing participants in the FRICON group to Phase DI: this criterion was used only for participants in that group, which may have biased the comparisons between groups in the Phase AI. The use of the same criteria for all participants in

Figure 3



Note. Difference between groups in Phase AI in three blocks of five trials

the initial phase may produce more comparable results in different conditions.

The results of Phase DI resemble a "tit-for-tat" situation that is common in behavioral games like the iterated prisoner's dilemma (Axelrod, 1984). Research on reciprocity has created an interesting discussion related to the evolution of cooperation and has contributed to quantitative models of social behavior and cultural evolution (Axelrod & Dion, 1988; Axelrod & Hamilton, 1981; Boyd & Richerson, 1985). Developmental and cultural mechanisms may explain changes in inequity aversion at different age stages or group levels, respectively, but they are less predictive in dealing with the fact that inequity aversion may be established or constrained within the repertoire of a given individual. For this reason, cross-cultural variation about fairness is sometimes hard to interpret and open to discussion about which psychological or cultural mechanisms are at work (Delton, Krasnow, Cosmides, & Tooby, 2010).

Our results may help integrate contributions from learning principles (usually described as content-independent processes) with evolutionary mechanisms that promote sociality (usually described as content-dependent processes; Tooby & Cosmides, 1992). Questions about learning are usually best investigated by using procedures that permit long-lasting interactions between participants in a cooperative task before a test. The literature on associative learning phenomena, for example, has repeatedly illustrated that learning rarely occurs in just one or a few trials and often requires long-lasting interactions (Rescorla & Wagner, 1972). Reciprocity and inequity aversion may be strongly explained by evolved mechanisms. However, at the same time, the results from Phases AI and DI suggest a cumulative effect of learning during the dyadic interactions. This effect may be also partially explained by the principles of stimulus control (Sidman, 2000; Urcuioli, 2013) because in Phase AI the confederate's behavior (blue or green choices) is a condition associated with different rates of point's delivery. The effects of arousal (Killeen, Hanson, & Osborne, 1978) may also aid in understanding differences between participants in FRICON and UNHCON groups: Arousal refers to the cumulative activation of behavior by the presentation of outcomes (e.g., points gained on each trial of a game) that can only be fully observed once participants have had multiple exposures to the same type of trial (Killeen & Sitomer, 2003).

As in other fields of psychology, the question is not about "innate" versus "acquired," but, rather, is a matter of identifying mechanisms and how those different mechanisms work and are integrated (Tooby, Cosmides, & Barrett, 2005). This is an exciting avenue to explore because it permits reconciliation of a genetic disposition to behave in a cooperative manner with the role of personal experience.

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