Additional Analysis on "Frustration and Anger in the Ultimatum Game: An Experiment"

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Disclaimer: the data analysis was designed to extend further the working paper Aina, Battigalli & Gamba (2018). In order not to distribute the original data, this project was run using a dataset with fake data. Hence, comments to the data are omitted.

Experimental Design

We study the implications of the theory of frustration and anger in the strategic context of the UMG (Binmore *et al.* 1995), a simple binary-choice version of the Ultimatum Game (Guth *et al.* 1982). The game form with material payoffs is represented in Figure 1, where $h > m_i > \ell > 0$, $i = \mathrm{a}, \mathrm{b}$.[1] In this highly stylized social dilemma the first-mover can either propose a default allocation (d), whereby both players receive a similar amount of money, or a "greedy" allocation (g). While the default allocation is automatically accepted, the second-mover can either accept or reject the greedy offer.

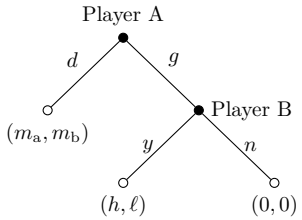


Figure 1: A Ultimatum Minigame Tree

We conduct a two-fold manipulation, informed by the analysis of player B's behavior strategy reported in the previous section. The experimental design was pre-registered on the AsPredicted platform, together with the experimental hypotheses and the analysis plan.[2]

Payoff manipulation. With the purpose of increasing player B's frustration, we manipulate player B's material payoff from the default allocation (m_b), while keeping all the other payoffs constant. Under some assumptions on player B's initial beliefs, such payoff manipulation results in an increase of B's initially expected payoff, and thus of his frustration in case of a greedy offer. Indeed, increasing m_b increases (ceteris paribus) the gap between his initially expected payoff and l, the maximal payoff that he can achieve upon receiving a greedy offer. Notice that when varying m_b, player B's initial beliefs

[1] In the classic version, the two players are given an amount of money to split, thus it has to be the case that $m_\mathrm{a} + m_\mathrm{b} = h + \ell$.

[2] The direct link to the pre-registered document is: http://aspredicted.org/blind.php?x=ij3fg3.

may also change—i.e., beliefs are endogenous to the treatment. Therefore, player B's initially expected payoff actually increases provided that he believes that the default allocation is not less likely when his payoff from this offer is larger.

As player B's best reply does not vary with player A's payoff from the default allocation we keep this payoff constant. At the same time, we do not alter A's and B's payoff from accepting the greedy offer (h and ℓ) in order to keep constant the effect that inequity aversion may have on B's behavior across payoff treatments. Thus, while in a payoff treatment B-subjects obtain m_b^1 from the default allocation, with $m_b^1 = m_a$, in the other payoff treatment they obtain $m_b^2 > m_b^1$.

Method of play manipulation. With the purpose of switching on and off player B's experience of frustration, we manipulate the method of play, i.e., whether UMG is played with the direct response method (P = D) or the strategy method (P = S).

The effect of the method of play has been debated in experimental economics for long time (Brandts and Charness 2011). Experimental studies on the Ultimatum Game have shown mixed evidence of differences across methods of play due to the high potential of the direct response method in triggering emotional responses.[3] According to the standard theory of decision under uncertainty, the method of play should not alter player B's behavior and thus it should not influence the effect of the payoff increase, as, in this framework, B's initial expectations are irrelevant for his decision. Indeed, for an expected utility maximizer strategies that maximize subjective expected utility ex ante are also optimal conditional on any information that the decision maker deems possible. Even in the case of belief-dependent preferences, as long as psychological utility is independent of the agent's own plan, the method of play is unimportant, because the traditional dynamic consistency property of expected utility theory still holds (see Battigalli and Dufwenberg 2009).

According to BDS theory instead the method of play may affect behavior. Indeed, under a psychological perspective, it makes a difference whether player B's choice is the action tendency of an emotion that is triggered by the appraisal of an event whose occurrence is actually observed, as in the direct response method, or only imagined, as in the strategy method. When P = S player B's behavior is invariant to m_{b} since he cannot experience frustration—i.e., the anger component does not bite—and player B's decision only depends on his degree of inequity aversion.

Obviously, we can in principle admit that player B is to some extent able to anticipate the negative emotion that he would experience in case he received a greedy offer. Yet, it is rather implausible that this emotion can be so strong to trigger an action that makes him forego a private gain for the goal of retaliating against player A's hypothetical move. Thus, in the strategy method player B's frustration is expected to be at least attenuated with respect to the direct method and so it is the effect of the payoff increase.

Table 1 summarizes our 2×2 design, reporting our four treatments and the corresponding labels.

We implement a *between-subjects* design, so that subjects play only one of the treatments D1, D2, S1, and S2. Figure 2 illustrates the UMG game form for the two payoff treatments, that differs only for player B's payoff from the default allocation, which is 8 in payoff treatment m_{b}^1 and 11 in payoff treatment m_{b}^2.

Before subjects play the UMG we elicit their first-order beliefs with a procedure that we will explain in detail below. In our context, eliciting beliefs is particularly important for two reasons. The first is that

[3] With some common features with our design, Guth *et al.* (2001) find that varying the payoff distribution of the outside option affects proposers' behavior only in the direct method, while, probably due to the few observations, they do not find any effect of the method of play on rejections. Brosig and Weimann (2003) find that the direct method of play affects the behavior of both responders (increased punishments) and proposers (more fair offers) in an Ultimatum Game. Finally, Oxoby and McLeish (2004) find that the direct method increases rejections of small offers in an Ultimatum Game, despite no differences in mean offer levels and acceptance rates.

Table 1: Experimental design

		Payoff treatment	
		m_{b}^1	m_{b}^2
Method of play	Direct response method	D1	D2
	Strategy method	S1	S2

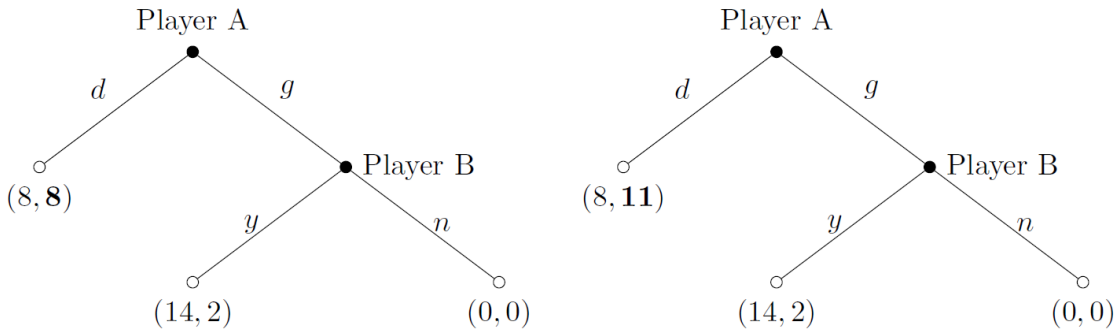


Figure 2: UMG game form in payoff treatment m_{b}^1 (left) and m_{b}^2 (right)

by doing so we can verify whether B-subjects initially expected payoff is actually larger in treatment D2 than in treatment D1. Secondly, it enhances our understanding of subjects' strategic reasoning.

B's Preferences in a Nutshell

We denote the initial first-order belief of player B about player A choosing the default allocation, i.e., $P_b(d) = \beta$, and B's initial first-order belief about himself accepting the greedy offer, i.e., B's planned probability of acceptance $P_b(y|g) = \gamma$. According to BDS theory, frustration is anchored in the appraisal of a negative event, which is, in this context, the greedy offer. Thus, player B can be frustrated and blame player A only after actually observing the greedy offer. Notice that, when UMG is played with the direct method (P=D), player B observes the greedy offer before taking his decision. Instead, when UMG is played with the strategy method (P=S), player B commits to a decision rule that selects the reply conditionally on the *hypothesized* greedy offer, hence he cannot be frustrated. Therefore, while in the strategy method frustration is equal to zero, in the direct method it is the gap between player B's expected payoff at the root of the game—determined by his beliefs—and the maximal payoff that he can achieve after the greedy offer:

$$F^{\mathrm{P},m_{\mathrm{b}}}(\beta,\gamma) = \begin{cases} \max\{0, \beta m_{\mathrm{b}} + (1-\beta)\gamma\ell - \ell\} & \text{if P=D} \\ 0 & \text{if P=S.} \end{cases} \tag{1}$$

Next, we specify B's belief-dependent psychological utility of replying with action a_b to the greedy offer g as %as a function of his choice when A chooses the greedy offer. It is sufficient to consider this case only because in the strategy method B's choices is immaterial when A chooses the default allocation, while in the direct method B chooses only upon observing the greedy offer. The general formula is:

$$u_{\mathrm{b}}^{\mathrm{P},m_{\mathrm{b}}}\left(g,a_{\mathrm{b}};\beta,\gamma\right)=\pi_{\mathrm{b}}\left(g,a_{\mathrm{b}}\right)-\pi_{\mathrm{a}}\left(g,a_{\mathrm{b}}\right)\theta F^{\mathrm{P},m_{\mathrm{b}}}\left(\beta,\gamma\right)- \\ \delta\max\left\{0,\pi_{\mathrm{a}}\left(g,a_{\mathrm{b}}\right)-\pi_{\mathrm{b}}\left(g,a_{\mathrm{b}}\right)\right\}, \quad (2)$$

where $\pi_i(g, a_b)$, $i = a, b$, is the monetary payoff of player i after the greedy offer and B's choice a_b, (θ, δ) are B's personal traits which measure his sensitivity to anger and his inequity-aversion, that is the distributive component of his preferences.

Some Results

In this section, we report the frequency of default allocation and acceptance of the greedy offer in the different treatments. In each graph, the pvalues for the difference in means by a Mann-Whitney U test are shown comparing: (i) the payoff treatment effect in the Strategy method, (ii) the payoff treatment effect in the Direct method, and (iii) the method of play effect. Moreover, results by gender are illustrated.

B-subjects

Figure 3 illustrates the share of B-subjects accepting the greedy offer by treatment.

Figure 3: B-subjects' behavior, by treatment

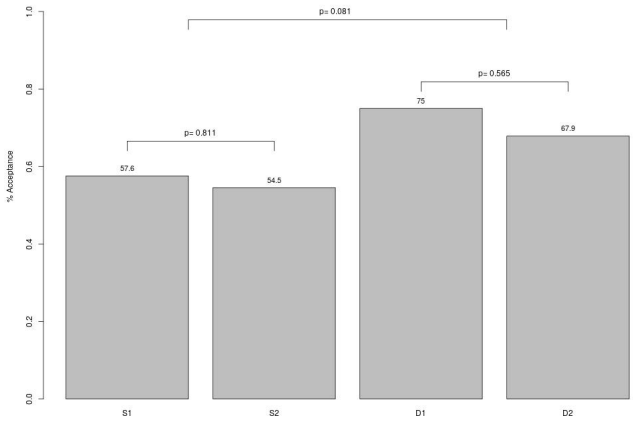
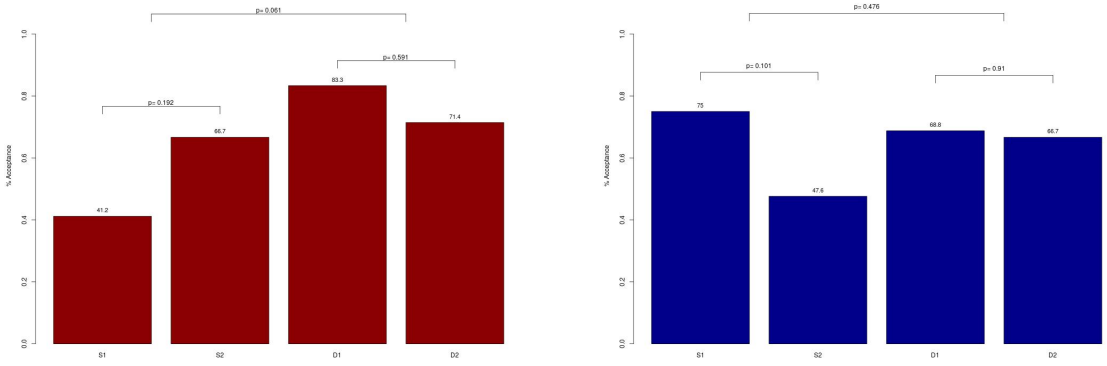


Figure 4: B-subjects' behavior, by gender



Females Males

A-subjects

Figure 5 illustrates the share of A-subjects choosing the default allocation.

Figure 5: A-subjects' behavior, by treatment

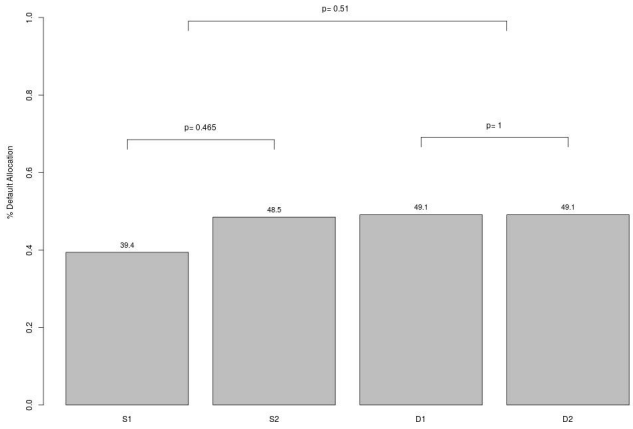
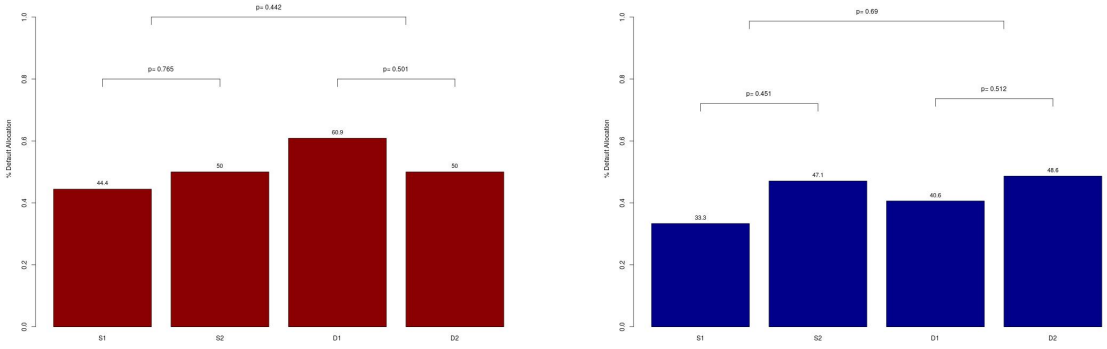


Figure 6: A-subjects' behavior, by gender



Females Males

Response Time

Longer response time are considered good evidence for harder choices. With the following graphs, we want to show that expectations—and frustration—make the choice of accepting the greedy offer harder. Indeed, the higher the expectations,[4] and thus frustration, the lower B's utility of accepting the greedy offer, i.e., he is closer to indifference. Moreover, according to BDS's theoy, this should be the case only in the choices taken playing in the Direct method and not in the Strategy method. This is a new measure to reveal the importance of belief-dependent preferences.

Given the pattern of out results on gender in the paper, we report the average response time in second for all B-subjects and then the splitted sample of males and females. In each figure, it is reported the pvalue of a Pearson correlation test.

[4]The initial expectations are calculated using the subject's belief on receiving the default allocation and, assuming intrapersonal equilibrium, assigning the choice made to his initial plan.

Figure 7: Effect of Initial Expectation on Response Time

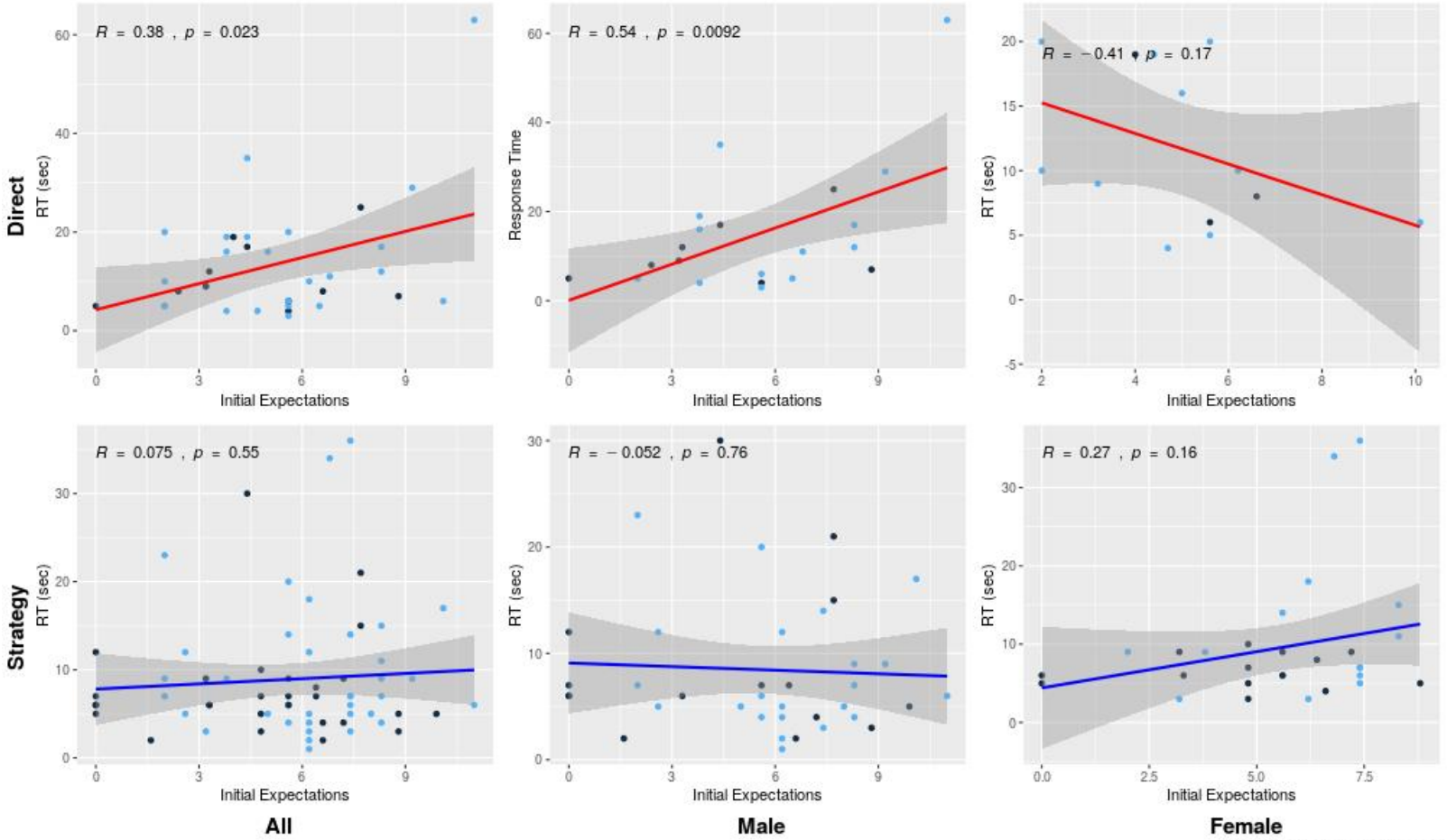


Figure 8: Effect of Frustration on Response Time