University of Zurich, Bocconi University, University of Insubria

Frustration & Anger in the Ultimatum Game: An Experiment
Lecture 16: *Exp Econ & Psychology*

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Motivation

- In social dilemmas, choices may depend on belief-dependent motivations.
- **Anger** is generally held to be a negative social emotion.
  - Appraisal theory: anger arises from the frustration of non-attainment of an expected outcome; as a behavioral consequence, this goal-blockage can lead to aggressive behavior and retaliation.
  - Empirical studies: anger affects economic outcomes such as domestic violence (Card & Dahl, 2011), violent crime (Munyo & Rossi, 2013), pricing (Anderson & Simester, 2010).
  - Psychological game theory: Battigalli, Dufwenberg, and Smith (2019, hereafter BDS) develop a formal framework and a set of models that incorporate frustration and anger in two-stage games.

Theory of Frustration & Anger

Theory of Frustration and Anger (BDS, 2019) predicts outcomes of two-stage (more generally, multi-stage) games based on decision-making of anger-prone individuals and the strategic considerations of their co-players.

- **Anger** is anchored in the frustration from not attaining an expected outcome: we restrict our attention to unfulfilled expectation about material reward.

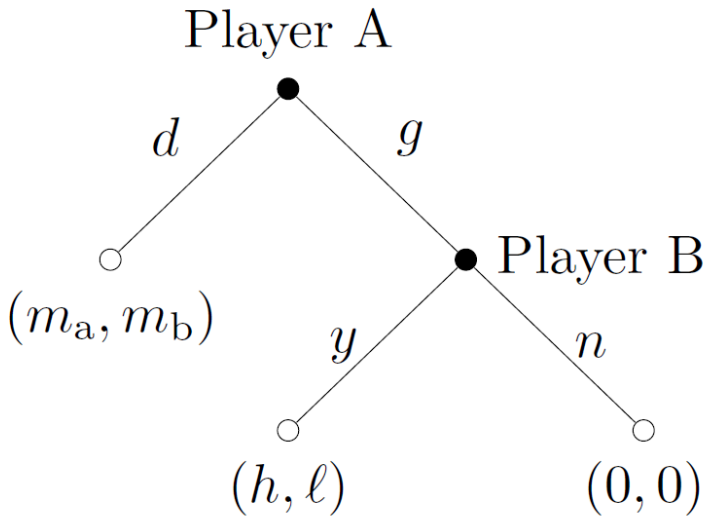
- **Frustration of an agent** is defined as the positive gap between his initially expected payoff and the currently best payoff the individual believes he can obtain given the previous play.

  - ✓ Diminishing expectations
  - ✓ No possibility to close this resulting gap with any available action.

- BDS provide a set of models according to different levels of cognitive appraisal for blame: we will focus on *Simple Anger/ Anger from Blaming Behavior* which are equivalent in leader-follower games.

Research Question

We run an experimental test of BDS theory in the context of the Ultimatum Minigame.



Can rejections be explained by the unfulfilled expectation of a material reward?

Do proposals take such causes of rejection into account?

Experimental Design

2x2 between subject design:

- **Response method**
  Direct response (D) vs. Strategy method (S)

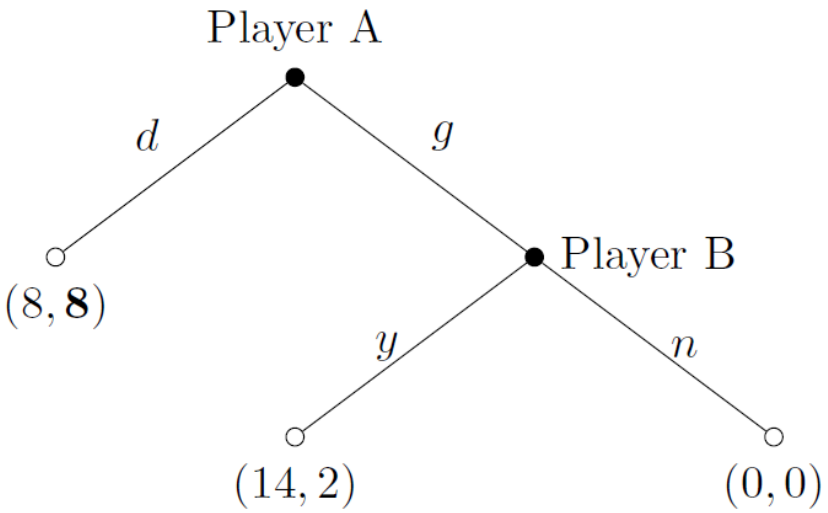
  Why? To switch on and off B's experience of frustration.

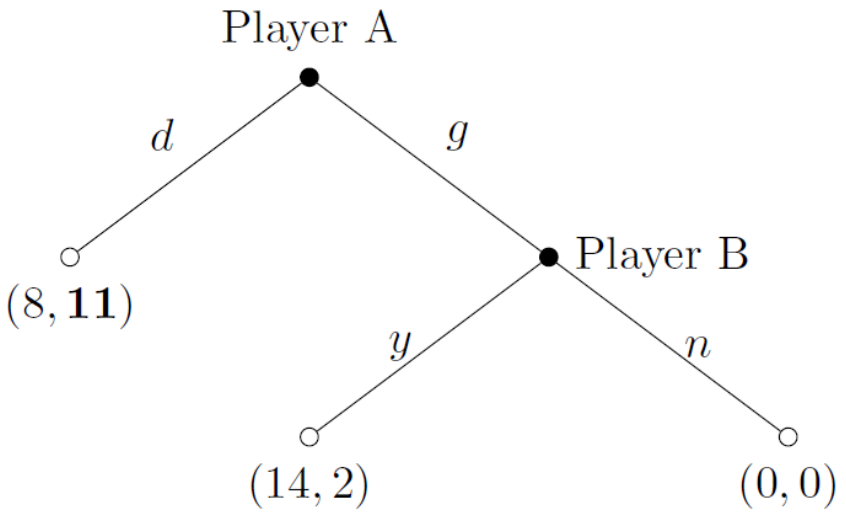
- **Payoff Manipulation:**
  Manipulation of B's payoff from the default allocation: $m_b^2 > m_b^1$

  Why? To increase B's initial expectations and thus his frustration in case of a greedy offer.

	Strategy	**Direct**
$\boldsymbol{m_b^1}$	S1	D1
$\boldsymbol{m_b^2}$	S2	D2

Payoff Manipulation





Theoretical Analysis

We derive *qualitative empirical predictions* across treatments about distributions of actions, assuming that players perform two steps of elimination of non-best replies given plausible beliefs restrictions:

- **Incomplete Information**: preferences cannot be realistically presumed to be commonly known by players.
- **Rationality**: modeled as *rational planning* + *execution of own plan*; rational planning = *intrapersonal equilibrium*, as standard in models with dynamically inconsistent preferences (c.f., Caplin & Leahy, 2001, Battigalli & Dufwenberg, 2009 section 6; Köszegi & Rabin, 2009).
- **Players are rational and confident in others' rationality:** they iteratively eliminate (through at least two steps) non-best replies given plausible restrictions on beliefs about behavior and beliefs (c.f., Battigalli, Charness & Dufwenberg, 2013).

Preferences

We assume (for simplicity) **role-dependent preferences:**

- **Player A**'s utility corresponds to her expected monetary payoff.
- **Player B**'s *psychological* utility, given the method of play P and payoff treatment m_{b}:

$$u_{\mathrm{b}}^{\mathrm{P},m_{\mathrm{b}}}(a_{\mathrm{a}}, a_{\mathrm{b}}; \beta, \gamma) = \pi_{\mathrm{b}}(a_{\mathrm{a}}, a_{\mathrm{b}})$$

$$-\theta \mathrm{F}^{\mathrm{P},m_b}(\beta, \gamma)\pi_{\mathrm{a}}(a_{\mathrm{a}}, a_{\mathrm{b}}) \quad \text{BDS (2019)}$$

$$-\delta \max\{0, \pi_{\mathrm{a}}(a_{\mathrm{a}}, a_{\mathrm{b}}) - \pi_{\mathrm{b}}(a_{\mathrm{a}}, a_{\mathrm{b}})\} \quad \text{Inequity-aversion (Fehr \& Schmidt, 1999)}$$

where:

- $\theta =$ sensitivity to anger, $\delta =$ sensitivity to inequity-aversion;
- $\beta = \mathbb{P}_{\mathrm{b}}(d)$ first-order belief on the default allocation, $\gamma = \mathbb{P}_{\mathrm{b}}(y|g)$ planned probability of acceptance.

B's Behavioral Strategy, incentives

- B's frustration from the greedy offer:

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

- B accepts the greedy offer if his degree of inequity aversion is low enough:

$$\delta \leq \hat{\delta}^{\mathrm{P},m_{\mathrm{b}}}(\beta,\gamma,\theta) \coloneqq \begin{cases} \dfrac{\ell - h\,\theta \max\{0, \beta m_{\mathrm{b}} + (1-\beta)\gamma\ell - \ell\}}{h - \ell} & \text{if P = D} \\ \dfrac{\ell}{h-\ell} & \text{if P} = S \end{cases}$$

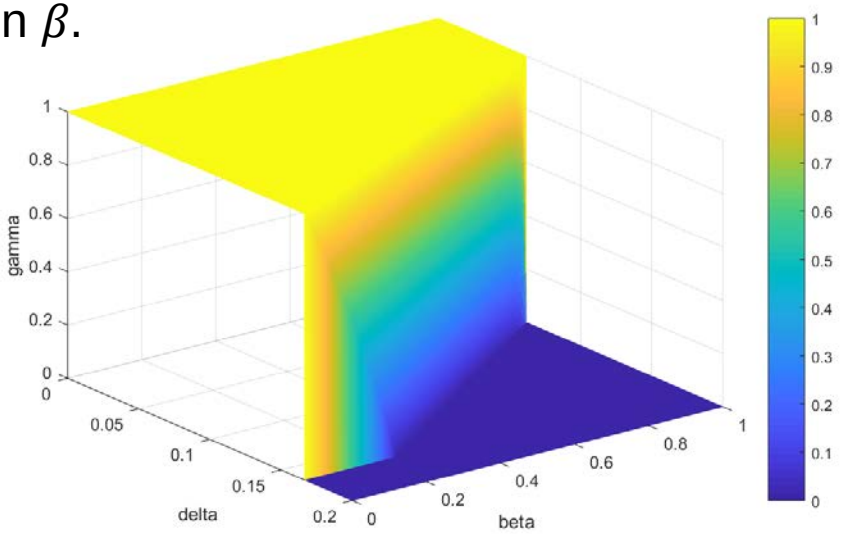
B's Behavioral Strategy, intrapersonal equilibrium

B *plans rationally* ("rational expectations" about himself, i.e., he correctly predicts he is going to choose the best reply, which in turn depends on his pre-determined plan γ), thus rational planning satisfies a fixed-point condition (intrapersonal equilibrium). The resulting behavioral strategy is:

$$\Gamma^{\mathrm{P},m_{\mathrm{b}}}(\beta,\theta,\delta)=\begin{cases}1 & \text{if } \delta<\hat{\delta}^{\mathrm{P},m_{\mathrm{b}}}(\beta,1,\theta)\\ \dfrac{\ell-h\,\theta(\beta m_{\mathrm{b}}-\ell)-\delta(h-\ell)}{h\;-\ell} & \text{if } \delta\in\left[\hat{\delta}^{\mathrm{P},m_{\mathrm{b}}}(\beta,1,\theta),\hat{\delta}^{\mathrm{P},m_{\mathrm{b}}}(\beta,0,\theta)\right]\\ 0 & \text{if } \delta>\hat{\delta}^{\mathrm{P},m_{\mathrm{b}}}(\beta,1,\theta)\end{cases}$$

which is decreasing in β.

$\mathrm{P}=\mathrm{D}$
$\theta=0.015$



Behavioral Predictions: payoff manipulation, player B

Assumption 1

(i) Every player is subjectively rational, i.e., he plans rationally given his beliefs about the other and implement his plan, and
(ii) B's beliefs distributions in D1 and D2 satisfy $\boldsymbol{\beta}^{\mathrm{D2}} \geq \boldsymbol{\beta}^{\mathrm{D1}}$.

Prediction 1

In the Direct method, the frequency of acceptance of the greedy offer in D1 is larger than in D2.

Intuition: the increase in B-subjects' payoff from the default allocation makes their initially expected payoff higher in D2 than in D1, and thus, we can expect a lower probability of accepting the greedy offer in D2 than in D1, due to frustration and anger.

Prediction 2

In the Strategy method, the frequency of acceptance of the greedy offer is constant across payoff treatments.

Behavioral Predictions: payoff manipulation, player A

Assumption 2

(i) A is certain that B is subjectively rational, and
(ii) the distributions of A's beliefs in the two treatments satisfy the following stochastic dominance restriction: for all β,

$$\mathbb{P}_{\phi^{\mathrm{D2}}}\left(\boldsymbol{\beta}^{\mathbf{D2}} \leq \beta | \boldsymbol{\theta}, \boldsymbol{\delta}\right) \leq \mathbb{P}_{\phi^{\mathrm{D1}}}\left(\boldsymbol{\beta}^{\mathbf{D1}} \leq \beta | \boldsymbol{\theta}, \boldsymbol{\delta}\right)$$

Prediction 3

In the Direct method, the frequency of the default allocation is larger in D2 than in D1.

Intuition: A-subjects are expected to attach a higher probability to B-subjects accepting the greedy offer in D1 relative to D2, thus they have more incentives to choose the default allocation in D2 than in D1.

Prediction 4

In the Strategy method, the frequency of the default allocation is constant across payoff treatments.

Behavioral Predictions: method of play

Given that anger can occur only in the Direct method:

Prediction 5

For all payoff treatments, the frequency of acceptance of the greedy offer in the Strategy method is larger than in the Direct method.

Since only in the Direct method A expects B to be affected by frustration:

Prediction 6

For all payoff treatments, the frequency of the default allocation in the Direct method is larger than in the Strategy method.

Experimental Procedures

- BELSS Lab (Bocconi University)
- 11 pairs (A, B) per session
- 3 sessions for each payoff treatment in Strategy (n. 33 obs. per role); 5 sessions for each payoff treatment in Direct (n. 55 obs. for A; unknown ex ante for B);
- Belief elicitation (before choices):
  - B-subjects guess the exact number of default allocations in the other 10 pairs;
  - A-subjects guess the exact number of acceptances in the other 10 pairs in Strategy; percentage of acceptances conditional on greedy in Direct.
- Psychological tests at the end:
  - B: STAXI II Trait and State Anger elicitation (Spielberger, 1999)
  - A: Aquino (moral scale) and GASP (guilt and shame scale)

Results: B-subjects' beliefs

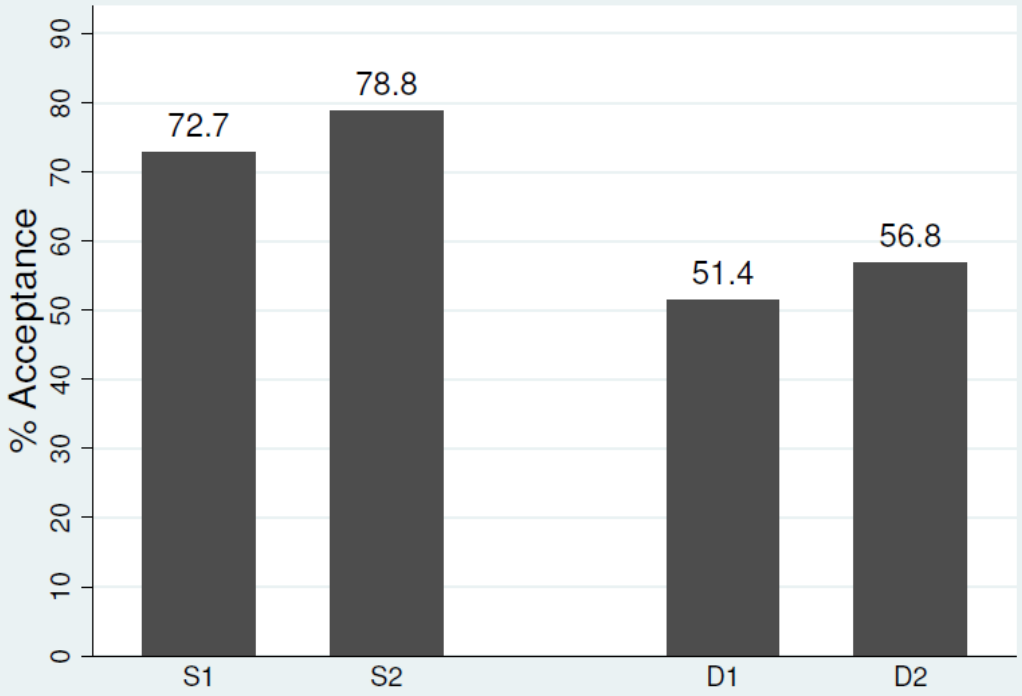
B-subjects' expectations of the default allocation

Mean β	m_b^1	m_b^2	Diff.	p-value (t-test)	p-value (MW)
Direct	0.54	0.54	0.00	1.00	0.92
Strategy	0.62	0.48	0.15	0.04	0.06
Diff.	-0.8	0.6			
p-value (t-test)	0.14	0.31			
p-value (MW)	0.10	0.41			

Initial beliefs in D1 are not higher than in D2 ✓

Results: B-subjects' behavior

Frequency of acceptance by payoff treatment & method of play



Method of play ✓

The frequency of acceptance is higher in Strategy than in Direct (p-value 0.01).

Payoff treatment

The frequency of acceptance in D2 (high default payoff) is not lower than in D1 (p-value 0.65). ✗

The frequency of acceptance is not significantly different in S1 and S2 (p-value 0.57). ✓

▶ Probit

Results: B-subjects' initial expectations

Mean expectation of the default allocation conditional on B-subject's action

Mean β	Accept	Reject	Diff.	p-value (t-test)	p-value (MW)
Direct	0.42	0.62	-0.20	0.00	0.00
Strategy	0.51	0.67	-0.16	0.05	0.08
Diff.	-0.09	-0.05			
p-value (t-test)	0.16	0.25			
p-value (MW)	0.17	0.17			

B-subjects' initial expectation of the default allocation is higher for those who reject the greedy offer ✓

▶ Graph

Results: A-subjects' beliefs

A-subjects' subjective probability of acceptance

Mean α	m_b^1	m_b^2	Diff.	p-value (t-test)	p-value (MW)
Direct	0.70	0.73	-0.03	0.59	0.46
Strategy	0.82	0.79	0.03	0.58	0.39
Diff.	-0.12	-0.06			
p-value (t-test)	0.03	0.23			
p-value (MW)	0.01	0.37			

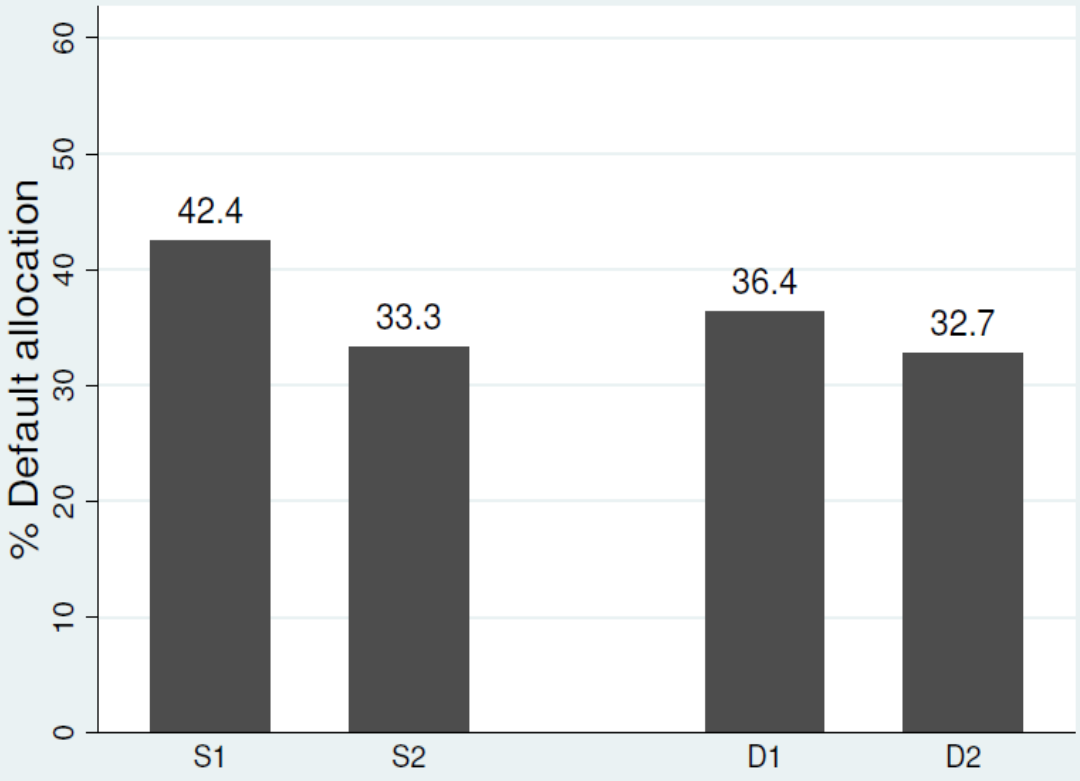
Not significant difference
in A's initial first-order beliefs across payoff treatments in both:

- Direct method ✗
- Strategy method ✓

Higher A's initial first-order beliefs in Strategy with respect to Direct ✓

Results: A-subjects' behavior

Frequency of the default allocation by payoff treatment & method of play



Method of play ✗

The frequency of the default allocation is not higher in Direct than in Strategy (p-value 0.65).

Payoff treatment

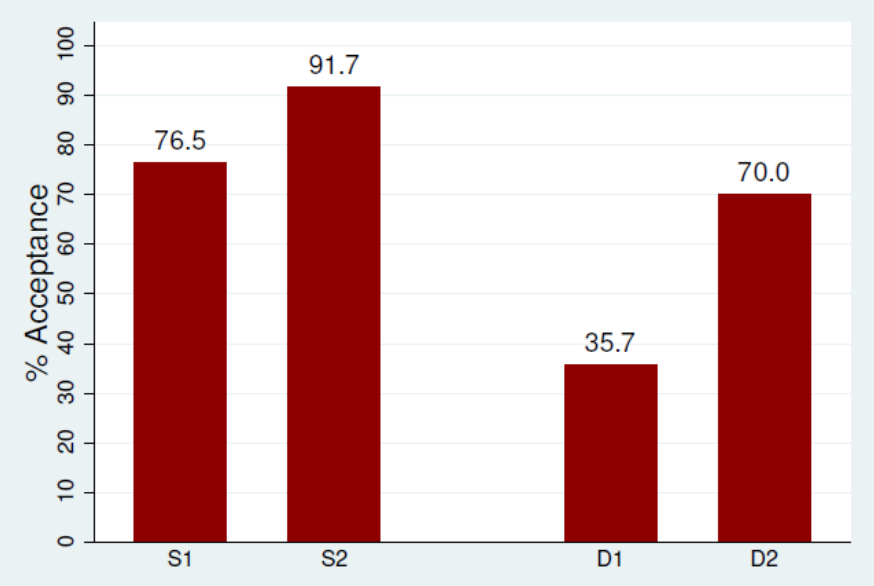
The frequency of the default allocation in D2 (high default payoff) is not higher than in D1 (p-value 0.69). ✗

The frequency of the default allocation is not significantly different in S1 and S2 (p-value 0.45). ✓

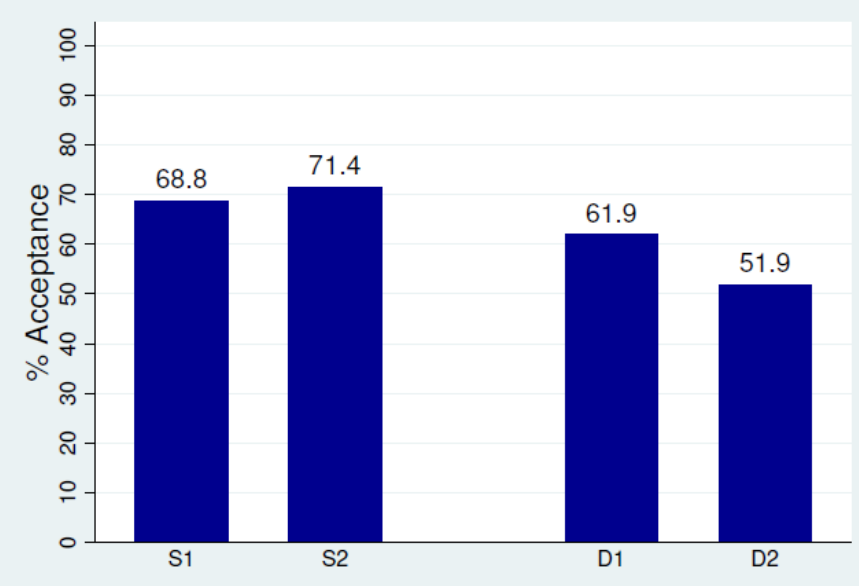
▶ Probit

Results by Gender: B-subjects' behavior

Female



Male



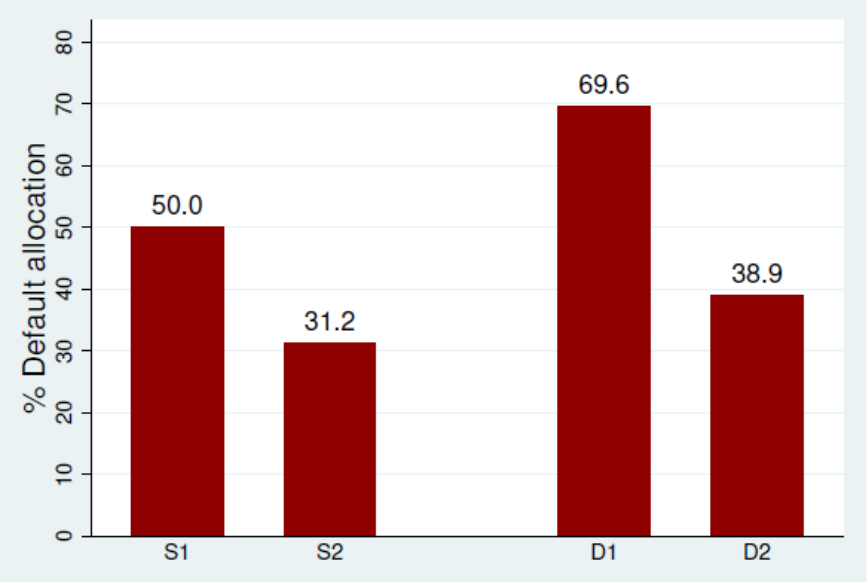
The frequency of acceptance is higher in Strategy than in Direct for females but not for males.

In the Direct method, the payoff manipulation has opposite effects for females and males.

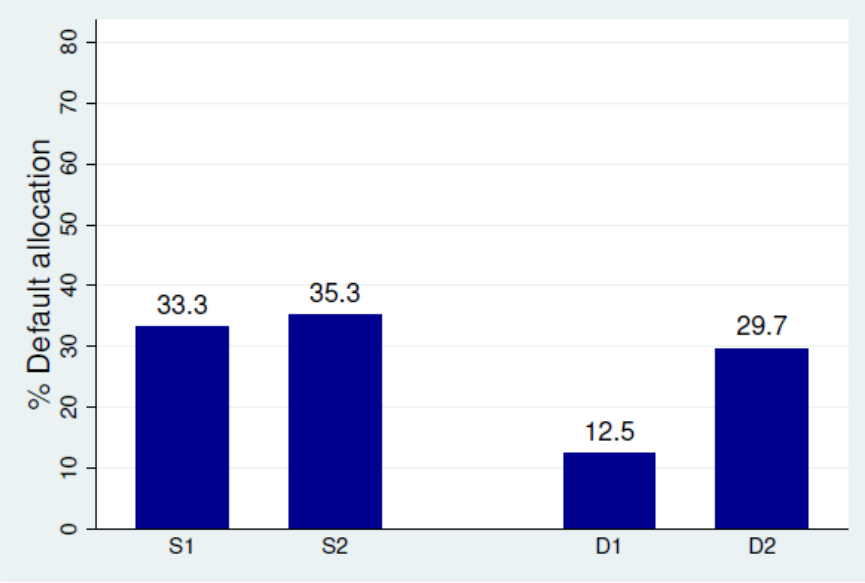
▶ Probit

Results by Gender: A-subjects' behavior

Female



Male



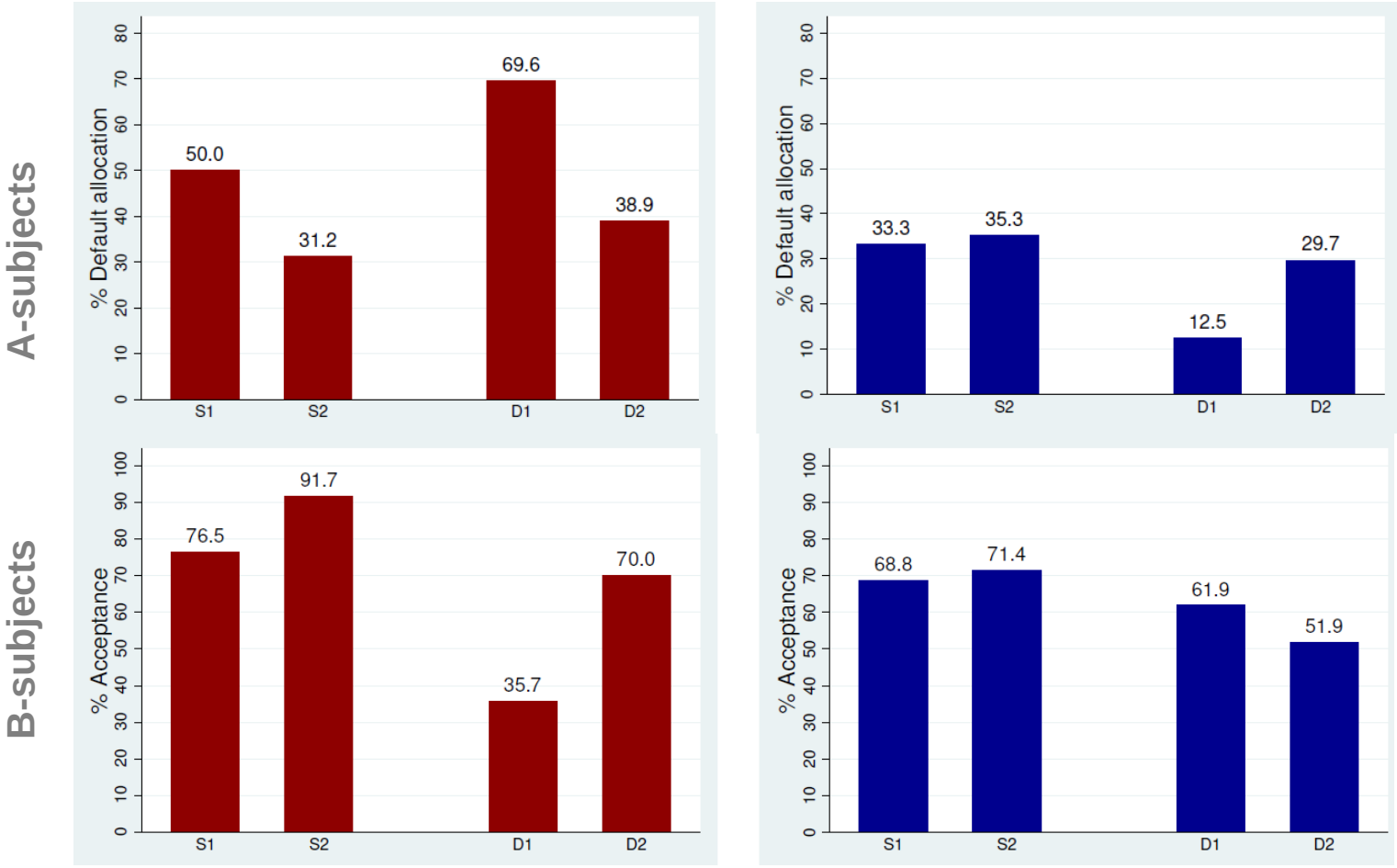
The frequency of the default allocation is not significantly different between the Direct and the Strategy methods for both females and males.

In the Direct method, the payoff manipulation has opposite effects for females and males.

▶ Probit

Results by Gender: Self-projection bias?

A-subjects best respond to actual behavior of co-players of the same gender



Behavior across Gender

- **Females:** *contrary to predictions*, in the Direct method a higher responder's default payoff increases the acceptance rate and decreases the frequency of the default allocation;
- **Males:** *in line with predictions*, in the Direct method a higher responder's default payoff decreases the acceptance rate and increases the frequency of the default allocation.

…What can motivate female behavior?

- Different appraisal of the greedy offer across gender: anger due to moral outrage for women and anger due to unfulfilled expectations for men.
- Social Role Theory (Eagly & Wood, 2011): personal achievement (men) vs. relational consequences (women) → women are more generous in the Dictator Game and reveal preferences for equal split allocations (Eckel & Grossman, 1998; Andreoni & Vesterlund, 2001).
- In our experiment: women have higher guilt and shame (GASP) and higher morality values (Aquino scale).

Conclusions

- We tested the behavioral implications of the theory of frustration and anger of BDS in an UG by varying the responder's payoff from the default allocation and the method of play.
- We found that, while the Direct method increases the frequency of rejections, the payoff manipulation does not have any significant effect.
- Yet, evidence suggests that decision utilities are belief-dependent as predicted by BDS theory.
- The payoff manipulation affects females' behavior in the direction opposite to the theory, while the behavior of males is in line with the theory.

THANK YOU!

Appendix: B-subjects' behavior

Probit estimates of treatment effects on probability of acceptance

	I	II	III
Direct	-0.217***	-0.246***	-0.249***
	(0.079)	(0.072)	(0.071)
Payoff Increase	0.057	0.058	0.069
	(0.079)	(0.074)	(0.074)
Direct × Payoff Increase	-0.007	0.070	-0.037
	(0.157)	(0.145)	(0.153)
Belief		-0.061***	-0.059***
		(0.013)	(0.013)
Belief × Direct		-0.038	-0.034
		(0.025)	(0.024)
Trait Anger			-0.006*
			(0.004)
Age			-0.042*
			(0.021)
Gender			0.064
			(0.077)
Payoff Increase in direct method	0.061	0.020	0.044
	(0.105)	(0.101)	(0.099)
Payoff Increase in strategy method	0.054	0.091	0.089
	(0.117)	(0.104)	(0.104)
Observations	138	138	138

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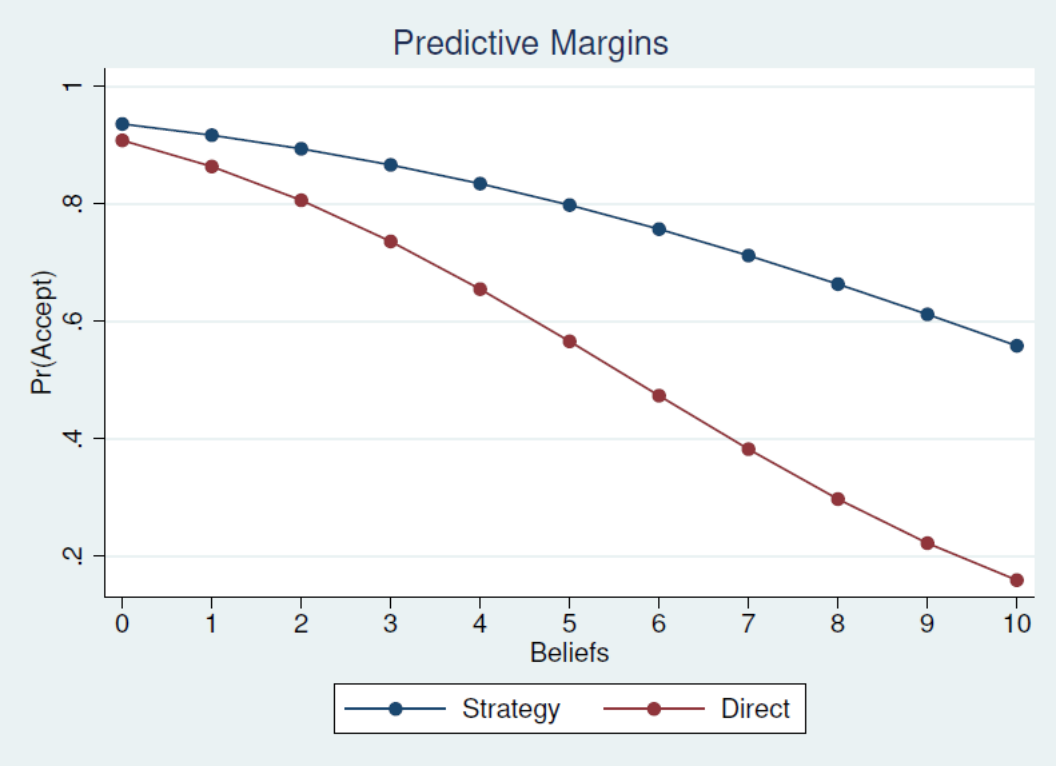
Appendix: B-subjects' initial expectations

Predicted probability of acceptance against beliefs from a probit model

(with beliefs, treatments dummies and their interactions as regressors)



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Appendix: A-subjects' behavior

Probit estimates of treatment effects on the probability of the default allocation

	I	II	III
Direct	-0.033	-0.099	-0.068
	(0.075)	(0.068)	(0.067)
Payoff Increase	-0.057	-0.051	-0.033
	(0.072)	(0.066)	(0.064)
Direct × Payoff Increase	-0.054	0.101	0.101
	(0.149)	(0.136)	(0.131)
Belief		-0.076***	-0.073***
		(0.011)	(0.011)
Morality			0.050
			(0.060)
Guilt aversion			0.014
			(0.031)
Gender			0.188***
			(0.063)
Age			-0.016
			(0.022)
Payoff Increase in direct method	-0.036	-0.014	0.006
	(0.091)	(0.090)	(0.080)
Payoff Increase in strategy method	-0.091	-0.115	-0.095
	(0.119)	(0.110)	(0.105)
Observations	176	176	176

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Appendix: B-subjects' behavior by gender

Probit estimates of treatment effects on probability of acceptance by gender

	Females		Males	
	I	II	I	II
Direct	-0.328***	-0.354***	-0.140*	-0.232***
	(0.118)	(0.113)	(0.103)	(0.093)
Payoff Increase	0.238**	0.195*	-0.045	-0.017
	(0.113)	(0.114)	(0.104)	(0.095)
Direct × Payoff Increase	0.191	0.260	0.127	0.085
	(0.233)	(0.226)	(0.209)	(0.183)
Belief		-0.057**		-0.067***
		(0.027)		(0.015)
Belief × Direct		-0.018		-0.036
		(0.048)		(0.028)
Trait Anger		-0.003		-0.008
		(0.005)		(0.006)
Age		-0.008		-0.070
		(0.029)		(0.028)
Payoff Increase in direct method	0.343*	0.334*	-0.100	-0.054
	(0.193)	(0.185)	(0.143)	(0.125)
Payoff Increase in strategy method	0.152	0.074	0.027	0.031
	(0.130)	(0.136)	(0.152)	(0.132)
Observations	53	53	85	85

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Appendix: A-subjects' behavior by gender

Probit estimates of treatment effects on probability of default allocation by gender

	Females		Males	
	I	II	I	II
Direct	0.141	0.063	-0.127	-0.139
	(0.111)	(0.110)	(0.097)	(0.089)
Payoff Increase	-0.253**	-0.228**	0.124	0.094
	(0.111)	(0.105)	(0.084)	(0.077)
Direct × Payoff Increase	-0.119	-0.029	0.153	0.158
	(0.223)	(0.214)	(0.193)	(0.175)
Belief		-0.055***		-0.075***
		(0.018)		(0.014)
Morality		-0.004		0.024
		(0.100)		(0.072)
Guilt aversion		0.031		0.013
		(0.056)		(0.034)
Age		-0.047		-0.007
		(0.040)		(0.023)
Payoff Increase in Direct	0.307**	-0.244*	0.172*	0.144*
	(0.150)	(0.146)	(0.095)	(0.086)
Payoff Increase in Strategy	-0.187	-0.215	0.020	0.014
	(0.165)	(0.155)	(0.168)	(0.153)
Observations	75	75	101	101

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