The Role of Role Uncertainty in Modified Dictator Games*

Nagore Iriberri+
Universitat Pompeu Fabra

Pedro Rey-Biel**
Universitat Autònoma de Barcelona

First Draft: May 12, 2008
This Version: June 30, 2008

Abstract

We compare behavior in modified dictator games with and without role uncertainty. Costly surplus creating actions are most frequent with role uncertainty while selfish behavior is most frequent without role uncertainty. A classification of subjects into four different types of preferences (Selfish, Social Welfare maximizing, Inequity Averse and Competitive) shows that role uncertainty overestimates (underestimates) the prevalence of Social Welfare maximizing (Selfish and Inequity Averse) preferences in the subject population. Our results have important methodological implications for experiments used to measure the prevalence of interdependent preferences.

Keywords: role uncertainty, role reversal, interdependent preferences, social welfare maximizing, inequity aversion, mixture-of-types models, strategy method, experiments.

JEL classification: C72; C91; D81.

* We thank Miguel A. Ballester, Gary Charness, Rosemarie Nagel, Joel Sobel and Carmit Segal for their comments. We are grateful to Aniol Llorente-Saguer and Natalia Montinari for their help in running the experiments. Nagore Iriberri acknowledges financial support from Ministerio de Educación y Ciencia (SEJ2006-05455 and SEJ2007-64340) and Barcelona Economics-Xarxa CREA. Pedro Rey-Biel acknowledges financial support from Ministerio de Educación y Ciencia (SEJ2006-00538 and Consolider-Ingenio CSD2006-00016) and Generalitat de Catalunya (2005SGR-00836 and Barcelona Economics-Xarxa CREA).

+ Nagore Iriberri. Departament d'Economia i Empresa. Universitat Pompeu Fabra, Ramón Trías Fargas 25-27, 08005 Barcelona (Spain). Tel: (+34) 935 42 26 90. E-mail: nagore.iriberri@upf.edu.

** Pedro Rey-Biel. Universitat Autònoma de Barcelona. Department d´Economia i d´Historia Econòmica. 08193, Bellaterra. Barcelona (Spain). Tel: (+34) 935812113. E-mail: pedro.rey@uab.es.

1. Introduction

Role uncertainty is an experimental method commonly used to maximize the information obtained from subjects. It consists of collecting subjects' responses to tasks assigned to different roles, and letting a random mechanism determine which role's actions are implemented. The justification behind its widespread use is that according to the standard game-theoretic view subjects' behaviour should not be affected.[1]

In simple distribution experiments designed to identify and quantify interdependent preferences, such as Dictator Games, role uncertainty is one available methodological option. A distribution experiment requires at least two roles: a "Dictator" ("Decider" in our experiment), who decides an allocation of payoffs, and a "Receiver" who can only accept that allocation. There are three ways these experiments can be implemented. First, without role uncertainty, subjects are assigned specific player roles before decisions are made. Notice that no behaviour is elicited from half of the subjects despite being paid. Second, using role reversal, subjects play in both roles, once as a Dictator and once as a Receiver, and decisions in both roles are implemented.[2] This method could lead to endowment effects steaming from expectations of what other subjects may have chosen. Third, role uncertainty, described above, offers a cost saving method without endowment effect problems.[3]

There exists however several reasons why role uncertainty could affect observed behaviour, especially in experiments designed to identify interdependent (or "social") preferences. First, forcing subjects to take actions in several roles may familiarize them better with the structure of the experiment. Second, role uncertainty may create empathy among subjects as they may feel equally entitled to similar earnings due to the randomness of the role assignment. More importantly, role uncertainty may add an element of complication in the understanding of experimental instructions such that

[1] Engelmann and Strobel (2004) understand role uncertainty as a reduced form of the strategy method (Selten, (1967)) for normal form games. The strategy method is commonly used in sequential games to elicit responders' choices to all possible decision nodes. Roth (1995) argued that this method transforms a sequential game into a normal form game and suggested future experiments to determine when/if the strategy method may produce differences in observed behaviour. Cason and Mui (1998), Brandts and Charness (2000), Güth et al. (2001) and Oxoby and McLeish (2004) did not find significant effects when the strategy method was used. However, Brosig et al (2003) found the strategy method yielded significant differences in simple bargaining games.

[2] See for example Charness and Rabin (2002), Andreoni and Miller (2002), Andreoni et al (2003), Burks (2003) and Fisman et al. (2007).

[3] See, for example, Engelmann and Strobel (2004) and Charness and Grosskopf (2007) in their Study 2.

subjects may not fully internalize the fact that only actions taken in the randomly determined role will matter.[4]

Our experimental results, based on modified dictator games with and without role uncertainty, suggest that the use of role uncertainty can have considerable effects. In our setting, Deciders choose among three actions, a selfish action, a surplus creating action and a surplus destroying action. Creating or destroying surplus comes at a cost for the Decider. We show that the distribution of choices changes dramatically. While the surplus creating action is the most frequent action in the treatment with role uncertainty (64%), the selfish action is the most frequent one without role uncertainty (69%). Also, the presence of surplus destroying actions is negligible with role uncertainty but not so without it. Further, we carry out a within subject analysis to classify subjects into four different preferences-types: Selfish, Social Welfare Maximization, Inequity Aversion and Competitive. Role uncertainty clearly affects the preferences-type distribution. The majority of subjects (74%) were estimated to be Social Welfare maximizers with role uncertainty, but without it, Selfish was the most frequent type (44%). Social Welfare maximizers' presence decreased to 21%. Also, the proportion of Inequity Averse individuals switched from 5% with role uncertainty to 25% without it.

This paper contributes to the methodology of experiments. Engelmann and Strobel (2004) conducted control treatments to test whether role uncertainty affects behaviour in three-player modified dictator games and did not find significant differences. Our results in two-player (different) modified dictator games suggest differently. Furthermore, with role certainty we estimate a preferences-type distribution very similar to that of Andreoni and Miller (2002) and Fisman et.al. (2007), who use role reversal in modified dictator games. This suggests that role reversal may not yield significant differences with respect to role certainty in modified dictator games. Our results can be interpreted as a cautionary tale for the use of role uncertainty in some specific experimental environments.

2. Experimental Design and Procedures

Seven experimental sessions were conducted in the Laboratori d'Economia Experimental (LEEX) at Universitat Pompeu Fabra using the Z-Tree experimental

[4] We initially used role uncertainty to maximize information acquisition. However, the strong prevalence of Social Welfare maximizing preferences drew our attention. This led us to question our methodology. Answers in a voluntary questionnaire also hinted that many subjects may not have fully internalized that in the event of being the Receivers, their actions as Deciders simply did not count. This motivated this research.

software (Fischbacher, (2007)) in November 2007 and February 2008. A total of 200 subjects, who had not participated in similar experiments in the past, were recruited using the ORSEE recruiting system (Greiner, (2004)). In November 2007, we performed 4 sessions with 20 subjects each using role uncertainty (RU). In February 2008, we performed 3 sessions of 40 subjects each without role uncertainty (NRU). Apart from this, procedures and design in both treatments were exactly the same.[5]

There are two player roles, "Decider" and "Receiver". Deciders make choices in sixteen different decision tables which affect both Deciders' and Receivers' payoffs. "Receivers" do not take any decision that can affect either the Receivers' or the Deciders' payoffs. In the RU sessions, 20 subjects performed the task without knowing until the end of the experiment whether their role would be that of the Decider or the Receiver, which was randomly assigned by the computer. The exact paragraph explaining the random assignment mechanism says as follows:

> "Please notice that chance uniquely determines whether your role will be "Decider" or "Receiver", once all participants have made their choices. Thus, the option you choose will only be taken into account if chance finally determines that for a particular table it is your option the one being implemented. In case in the chosen table your choice is not the one being implemented, your choice is simply not taken into account and no participant is informed of it. **Therefore, in case your choice is not being implemented, your choice can affect in no way your payment or the payments of any other participan**t".

In the NRU sessions, 40 subjects were recruited and after arrival they extracted a piece of paper from a bag which randomly determined whether they would stay in the laboratory and play as Deciders, or they would go to a different classroom and play as Receivers.

Each experimental session lasted one and a half hours. Throughout the experiment we ensured anonymity and effective separation of subjects. All subjects in the RU sessions and only Deciders in the NRU sessions made choices which determined the payoffs for both Deciders and Receivers. Receivers in the NRU sessions filled in a voluntary questionnaire that had no influence on their payoffs.[6]

[5] Procedures are explained in detail in Iriberri and Rey-Biel (2008a). A translation of the complete instructions for both treatments, with and without role uncertainty, are available at http://pareto.uab.es/prey/Research.htm.

[6] The focus of this paper is the first task in the experiment. For more information about the rest of the tasks, please see Iriberri and Rey-Biel (2008a).

All subjects were shown the same sixteen tables with three options describing the allocation of experimental units between two subjects, as illustrated in Figure 1. One of the options contained the highest number of experimental units for the Decider (*selfish* action). Another option was constructed such that the Decider would lose one experimental unit in order to *increase* the Receiver's allocation in $s>1$ units (*surplus creating* action). The third option was constructed such that the Decider would lose one experimental unit but now in order to *decrease* the Receiver's allocation in $s>1$ units (*surplus destroying* action). The sixteen tables, shown in Figure 2, differed in the number of created/destroyed units, s, and on whether the Decider was ahead (better-off than) or behind (worse-off than) the Receiver ($x>y$ or $x<y$). These variations allowed us the identification of different interdependent preferences.

At the end of the experiment one decision table was randomly chosen to determine payments. All subjects received a 3 Euro participation fee. In the RU sessions, subjects also received the experimental units allocated to "Decider" in the randomly chosen table, in case they turned out to be Deciders and the experimental units allocated to "Receiver" by their randomly matched "Decider" in case they turned out to be Receivers. In the NRU sessions Deciders received the experimental units they allocated to "Decider" in the randomly chosen table and their randomly matched Receiver got the units allocated to "Receiver".

3. Results

Table 1 reports the number of times each of the available actions, selfish, surplus creating and surplus destroying actions, were chosen in the RU and NRU treatments, separately for whether the Decider is ahead or behind the Receiver. Two differences are most notable. First, while in the RU treatment the surplus creating action was chosen with highest frequency in all sixteen decision tables (64% on average), the selfish action is most frequent in all decision tables in the NRU treatment (69% on average). Second, surplus destroying actions are barely chosen in the NRU treatment (1%) while they are chosen with low but positive frequency in the NRU treatment, especially when the Decider is behind (11%). Pair-wise comparisons across treatments using Fisher exact probability test show statistical significant differences for all decision tables at 5% significance level.

We now show the classification of subjects into four different preferences-types, Selfish (SF), Social Welfare maximizing (SW), Inequity Averse (IA) and Competitive

(CP). The identification strategy for the preferences-types classification is based on Charness and Rabin (2002)'s piece-wise linear preferences utility function, shown in equation (1). Deciders' utility (u_D) depends on both Decider's own payoff (π_D) and Receiver's payoff (π_R). The two key parameters are the weight on the Receiver's payoff, ρ, when the Decider is ahead the Receiver ($\pi_D > \pi_R$) and, the weight, σ, when the Decider is behind the Receiver ($\pi_R > \pi_D$).

(1) $u_D(\pi_R, \pi_D) = (\rho r + \sigma s)\pi_R + (1 - \rho r - \sigma s)\pi_D$

where $r = 1$ if $\pi_D > \pi_R$, and $r = 0$ otherwise, and $s = 1$ if $\pi_D < \pi_R$, and $s = 0$ otherwise.

Each Decider *i* at decision table *t*, has three available actions, $a=\{S,C,D\}$, referring to selfish, surplus creating and surplus destroying actions respectively. SF Deciders should always choose the selfish action. SW Deciders should choose either the surplus creating or the selfish action regardless of their relative position. IA Deciders should choose either the surplus creating or the selfish action when ahead, but either the selfish or the surplus destroying action when behind. Finally, CP Deciders should choose either the surplus destroying or the selfish action, regardless of their relative position. We also allow individuals to make uniform *iid* errors, ε, which implies that each available action will be taken with equal probability.

Our econometric specification follows a mixture-of-types model as explained in detail in Iriberri and Rey-Biel (2008a). Based on Charness and Rabin (2002)'s piece-wise linear utility function, a preferences-type *k* will be defined by the sign the parameters ρ and σ may take. We estimate a (ρ,σ,ε) for each individual *i* and calculate the preferences-type distribution for the treatments with and without role uncertainty, shown in Table 2. Consistent with the analysis of frequency of actions, the preferences-type distribution is significantly affected with the use of role uncertainty. In the RU treatment the most frequent type is SW (74%), followed by SF (21%), while only 5% of the subjects are classified as IA. No subject was classified as CP. On the other hand, in the NRU treatment, SF type was the most frequent (44%), followed by IA and SW with similar proportions (25% and 21% respectively). Also, 10% were classified as CP.

4. Conclusion

We find that role uncertainty exacerbates the frequency of surplus creating actions and dissipates the choice of surplus destroying actions. This method yields a preferences-type distribution with a significant upward bias on the frequency of Social Welfare maximizing preferences and a significant downward bias on the estimation of the frequencies of Selfish, Inequity Averse and Competitive preferences. Also, our observed distribution of interdependent preferences-types without role uncertainty is similar to those of Andreoni and Miller (2002) and Fisman et al. (2007), obtained with role reversal. Further research on whether and when cost-saving experimental methods affect the empirical relevance of interdependent preferences is thus warranted.

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6. Appendix

Figure 1. Illustrative Decision Table

	Option 1 (Selfish Action)	Option 2 (Surplus Creating Action)	Option 3 (Surplus Destroying Action)
Decider	*x*	*x-1*	*x-1*
Receiver	*y*	*y+s*	*y-s*

Figure 2. Sixteen Distribution Tables

Table 1 (*s*=7)	Option 1	Option 2	Option 3
Decider	7	7	8
Receiver	10	24	17

Table 2 (*s*=5)	Option 1	Option 2	Option 3
Decider	16	17	16
Receiver	3	8	13

Table 3 (*s*=2)	Option 1	Option 2	Option 3
Decider	20	19	19
Receiver	5	7	3

Table 4 (*s*=7)	Option 1	Option 2	Option 3
Decider	10	10	11
Receiver	21	7	14

Table 5 (*s*=4)	Option 1	Option 2	Option 3
Decider	17	16	16
Receiver	8	12	4

Table 6 (*s*=3)	Option 1	Option 2	Option 3
Decider	8	7	7
Receiver	17	14	20

Table 7 (*s*=3)	Option 1	Option 2	Option 3
Decider	17	16	16
Receiver	8	11	5

Table 8 (*s*=5)	Option 1	Option 2	Option 3
Decider	8	7	7
Receiver	17	12	22

Table 9 (*s*=6)	Option 1	Option 2	Option 3
Decider	13	14	13
Receiver	5	11	17

Table 10 (*s*=4)	Option 1	Option 2	Option 3
Decider	4	5	4
Receiver	24	20	16

Table 11 (*s*=7)	Option 1	Option 2	Option 3
Decider	16	16	17
Receiver	1	15	8

Table 12 (*s*=4)	Option 1	Option 2	Option 3
Decider	20	19	19
Receiver	5	1	9

Table 13 (*s*=2)	Option 1	Option 2	Option 3
Decider	4	4	5
Receiver	22	18	20

Table 14 (*s*=6)	Option 1	Option 2	Option 3
Decider	7	7	8
Receiver	23	11	17

Table 15 (*s*=3)	Option 1	Option 2	Option 3
Decider	13	13	14
Receiver	8	14	11

Table 16 (*s*=5)	Option 1	Option 2	Option 3
Decider	10	10	11
Receiver	19	9	14

Table 1. Actions With and Without Role Uncertainty								
		Decider's Position: Ahead			Decider's Position: Behind			
		Selfish Action	Surplus Creating Action	Surplus Destroying Action	Selfish Action	Surplus Creating Action	Surplus Destroying Action	TOTAL
With Role Uncertainty (RU)	Number of Actions	191	443	6	251	375	14	1280
	Average	2.39	5.54	0.08	3.14	4.69	0.18	16
	Stand. Dev.	(3.23)	(3.23)	(0.35)	(2.88)	(2.99)	(0.71)	
	Frequency of Play	**0.30**	**0.69**	**0.01**	**0.39**	**0.59**	**0.02**	
Without Role Uncertainty (NRU)	Number of Actions	316	142	22	346	80	54	960
	Average	5.27	2.37	0.37	5.77	1.33	0.90	16
	Stand. Dev.	(2.79)	(2.65)	(1.13)	(2.54)	(2.17)	(1.90)	
	Frequency of Play	**0.66**	**0.30**	**0.05**	**0.72**	**0.17**	**0.11**	

Table 2. Interdependent Preferences-Type Distribution With and Without Role Uncertainty								
	With Role Uncertainty (RU)				Without Role Uncertainty (NRU)			
	p_k	$\overline{\rho}_k$	$\overline{\sigma}_k$	$\overline{\varepsilon}_k$	p_k	$\overline{\rho}_k$	$\overline{\sigma}_k$	$\overline{\varepsilon}_k$
SF	**0.21**	--	--	0.04	**0.44**	--	--	0.03
SW	**0.74**	0.33	0.29	0.11	**0.21**	0.25	0.21	0.18
IA	**0.04**	0.25	0.00	0.16	**0.25**	0.24	-0.16	0.21
CP	**0**	--	--	--	**0.10**	-0.34	-0.38	0.07
Log Likelihood	-261.11				-217.99			