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The effect of endogenous endowments: evidence from a mini-ultimatum game

Michael D. Carr
University of Massachusetts Boston

Philip Mellizo
College of Wooster

Abstract

We extend the mini ultimatum game to investigate the effect of two types of endogenous endowments: one created by real effort and one created by subjects' choices in a risky environment. Compared to an exogenous endowment, the probability of rejection for a given size endowment is more than 44% lower when responder effort generates the endowment. However, rejection rates differ across endowment sizes: the probability of rejecting a low offer increases with endowment size when the responder produces the endowment, and decreases with endowment size when the endowment is determined exogenously. The results differ considerably from the only other real-effort ultimatum game experiment, indicating that more research is needed in this area to better interpret why offers are rejected in the ultimatum game.

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Contact: Michael D. Carr - michael.carr@umb.edu, Philip Mellizo - pmellizo@wooster.edu.
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1 Introduction

One of the most exciting applications of the experimental method in economics over recent years has been in illuminating principles of distributive justice that "everyday" individuals follow. For example, when endowments used in Dictator Games arise from pre-play labor of the proposer, average offers drop to near-zero, and when they result from the responder, offers increase (Cherry et al., 2002; Oxoby and Spraggon, 2008). On the basis of this and similar evidence reported in the literature (Fahr and Irlenbusch, 2000; Konow, 2000; Ruffle, 1998), a qualitative story emerges that suggests that when endowments owe to relative or absolute labor inputs, notions of entitlements influence decisions over distributions. We are particularly interested in the effects of responder produced endowments in the ultimatum game, both because they are commonplace in the real world, and because the ultimatum game has played a critical role in the development of theories of distribution. Specifically, the experimental setup is designed to capture ubiquitous principal-agent scenarios wherein a principal's sum depends on the efforts of an agent, and the division of the resulting surplus comes by a take-it-or-leave it offer given to the agent. Examples could include any relationship where work is done before payment, ranging from individuals bringing new products to market, to farmers, to academic researchers. Despite the apparent importance of this observation, real effort experiments are largely absent from the literature.

We use a novel modification of the mini-ultimatum game where the pre-play real-effort of a responder generates the endowment used in the subsequent bargain. A responder can produce a \$10, \$20, or \$40 endowment based on their performance on a set of simple addition problems, where the number of correct answers corresponds to a given endowment size. Based on the observed rates of rejection in ultimatum games (Camerer, 2003; Güth and Kocker, 2014), we limit the range of offers the proposer can make to the responder to either 20% (keeping 80%) or 80% (keeping 20%) to collect data on offers that could be interpreted as unfair to the responder. Using a between-subjects design, we compare bargaining behavior (ultimatum offers and rejections) with responder-produced endowments to a control condition with an exogenous and randomly determined endowment of \$10, \$20, or \$40. We also include an additional treatment where the responder determines the size of the endowment by choosing between \$20 with certainty or a fifty-fifty chance of \$10 or \$40. We include this treatment because it could be that the appropriate control for the responder labor-produced treatment is a random process due to the responder instead of the experimenter.

A priori, it is not obvious whether rejection rates should increase or decrease when the endowment is produced endogenously by the responder. Assuming positive marginal cost of effort, rejecting an offer when the endowment is produced by the respsonder would result in a negative payoff, implying that the probability of rejection should be lower. However, norms of fairness may increase the willingness of a responder to punish the proposer for a low offer, increasing the likelihood of rejecting a low offer. Note that the former implies preferences over absolute gain, while the latter over relative gain. Presumably, both forces are at play, thus our experiment can be interpreted as demonstrating which effect is stronger. We find that the probability of offering 20% to the responder is lower when the endowment is produced by responder labor when compared to the exogenous control for the \$10 and \$20 endowments, but not for the \$40 endowment where the probability of the 20% offer decreases. That is, proposers punish individuals who produce small endowments, and reward individuals who produce large endowments. Further, we find that the probability of rejecting the 20% offer is 44% lower overall when the responder produces the endowment. Importantly, we do not find any statistical differences in bargaining outcomes between the control treatment where endowments are determined by an exogenous random process and the treatment where endowments are created by a responder choosing to engage in a random process.

Our results differ substantially from Ruffle (1998), the only other real effort ultimatum game. In Ruffle (1998), responders are given a standardized test prior to receiving an offer from the proposer, similar to our design. There are two endowment sizes, $4 and $10, which are determined either by a tournament – with responders above the median in a given session generating $10, and those below the median $4 – or exogenously by a coin flip. Ruffle (1998) finds that percent offers are higher for the $10 endowment whether or not the endowment is exogenous or endogenous, but percent offers are the highest for the endogenous $10 endowment. Importantly, rejection rates of low offers in the exogenous treatment are well below those typically found in exogenous endowment ultimatum games, and are essentially zero in the endogenous endowment treatment for both endowment sizes. The design of Ruffle (1998), however, makes it very difficult to interpret the behavior or responders because percent offers increase when the endowment is produced endogenously, meaning that it impossible to judge whether the probability of rejection changes when the endowment is produced endogenously because there are no offers in the range where rejections typicall occur.

Our protocol, described in more detail below, differs from Ruffle (1998) in several key respects. First, as mentioned the endowments in Ruffle (1998) are the result of a tournament: high and low endowments are determined relative to the median test score within a given session. In addition, in the subject instructions used in Ruffle (1998), the terms 'winning' and 'losing' are used, reinforcing the notion that subjects are in competition with each other. In consideration of the literature on (a) gendered attitudes towards competition (Niederle and Vesterlund, 2007), and the resulting effects on effort in competitive environments; (b) the role of disappointment aversion as an explanation for effort intensity in tournaments (Gill and Prowse, 2012), which is particularly important given that subjects in our design play multiple rounds of the game; and (c) the fact that effort in tournaments has a much higher standard deviation than effort in piece-rates, the choice of determining endowment size via a tournament may have important but largely unknowable effects on both proposer and responder behavior because the tournament introduces an extra degree of uncertainty between the responders perceived effort and skill level and the result of that effort. Finally, anecdotally it is quite likely that the sample from which our subjects were drawn differs substantially from that used in Ruffle (1998), as our subjects come from a large, urban public university and his come from a somewhat smaller, highly selective private university. The methodological and/or sample differences are born out in our results, which differ significantly from Ruffle (1998).

2 Experimental Design and Procedure

Our experimental design is based on the pre-play procedure from the dictator game in Oxoby and Spraggon (2008) and the structure of the Mini Ultimatum Game in Falk et al. (2008).[1] The mini ultimatum game is identical to the standard ultimatum game except that proposers are limited in the offers they can make. In our case, proposers can choose to offer either 80% of the endowment, keeping 20%, or offer 20% of the endowment, keeping 80%. Again, we choose this structure because one reason why Ruffle (1998) may find no change in rejection rates between exogenous and endogenous endowments is because offers increase. The mini ultimatum game simultaneously encourages a relatively high proportion of low offers and also constrains the possible offers to be identical across treatments within an endowment and across endowments (at least in percent terms).

All interactions in the experiment are anonymous and all pairings are random. The assignment to proposer or responder prior to play is also random, but subjects know what role they have been assigned prior to when any actions are taken. Roles remain fixed throughout the experiment, meaning that proposers are always proposers and responders are always responders, and the design is between subjects so each subject is exposed to only one treatment. Sessions varied in size from 16 to 20 subjects. All interactions were computerized and programmed in Z-tree (Fischbacher, 2007).

A treatment proceeds in the following manner: first, subjects arrive at the lab, are seated, and read a set of instructions along with the experimenter. The subjects learn the full protocol for the entire experiment, thus subjects have full knowledge of the rhythm of play, how many rounds they will play, and the round by round procedures. At the beginning of play, subjects learn the role (proposer or responder) that they each will have for the seven rounds of play. At the beginning of each round, a proposer is randomly matched with a responder. Next, the endowment is determined in one of three ways described below, thus the endowment varies both across pairs within a session and across rounds. After the endowment is determined, the proposer makes an offer to the responder. If the responder accepts the offer, then the endowment is divided in the proposed way. If the responder rejects the offer, then both proposer and responder earn nothing for that round. Using the strategy method, payment is determined based on the results of one randomly selected round at the end of play. During play subjects know they will only be paid for one round, but they do not know which round. Monetary units were denoted in US dollars with an exchange rate of one.

The endowment is generated (1) exogenously, (2) by the responder choosing between a

[1] Closely related to the Ultimatum Game is the Power to Take game Bosman et al. (2005); Bosman and van Winden (2002). In the power to take game, one party can claim any part of an endowment that belongs to a second party. The second party then has the right to destroy any part of the endowment. Bosman et al. (2005) find that the second party destroys more of the endowment, and destroys more frequently, with the exogenous endowment. However, the amount of the endowment the proposer takes is the same with an endogenous endowment as with an exogenous endowment. How this maps onto the ultimatum game is unclear. The take authority in the power to take game plays a similar role as the proposer in the ultimatum and dictator games, but in both of those games endogenous endowments generated by the responder/receiver resulted in an increase in offers. Further, while Ruffle (1998) finds no increase in rejection rates in the Ultimatum Game, Bosman et al. (2005) find a decrease in the rate at which the second party destroys the endowment in the power to take game.

Table 1: Endowment Sizes

Endowment	Correct Answers
\$10	0 – 10
\$20	11 – 25
\$40	> 25

sure \$20 or a fifty-fifty chance of \$10 or \$40, or (3) by responder labor. Responders have two minutes to correctly solve as many two digit addition problems as they can (e.g. 15+22+10) to generate the endowment. The addition problems were produced randomly, but presented in a fixed sequence to responders, so all responders in all rounds in all sessions receive the same sequence of problems. Endowments are determined according to Table 1.

It is important to note that the proposer does not see the precise number of correct or attempted problems generated by the respondent. The design reveals step-wise endowment totals for three reasons. First, we would like for the results from our study to be easily compared with the designs in previous experimental research. Notably, both Ruffle (1998) and Oxoby and Spraggon (2008) use discontinuous endowments, and do not inform the proposer of the precise output produced. Second, given our choice to follow precedent in the literature, telling proposers the actual number of questions answered would have introduced an additional source of potential bias in proposer behavior: do proposer's reward or punish respondents who were close to being in the next higher endowment size but did not quite get there? Third, while output is generally observable, the effort needed to produce that amount of output (the endowment) generally is not. In a real-effort task such as this, it is not clear whether effort is the number of correct answers, the number of attempted answers, or the share of answers answered correctly. Without a clear prediction for which measure of effort a responder would use, and how each effects the intepretation of the endowment size, withholding this information is clearly preferred. This choice does imply that, while the unobservable marginal cost of effort may be strictly positive, the marginal return is discontinuous.

3 Results

Table 2 shows the frequency distribution of endowment sizes across treatments and overall. We oversampled slightly in the two responder produces and responder gambles treatments. In the exogenous and responder gambles treatments, the frequency of each endowment is similar. This is by design in the exogenous endowment, and in part a reflection of responder choice in the responder gambles treatment. In the responder produces treatment, the \$20 endowment occurs most frequently, but there are sufficient numbers of observations in all endowment sizes. Note that each proposer/respondent pair contributes one observation, so there are 336 pairs in our sample, or 672 individuals.

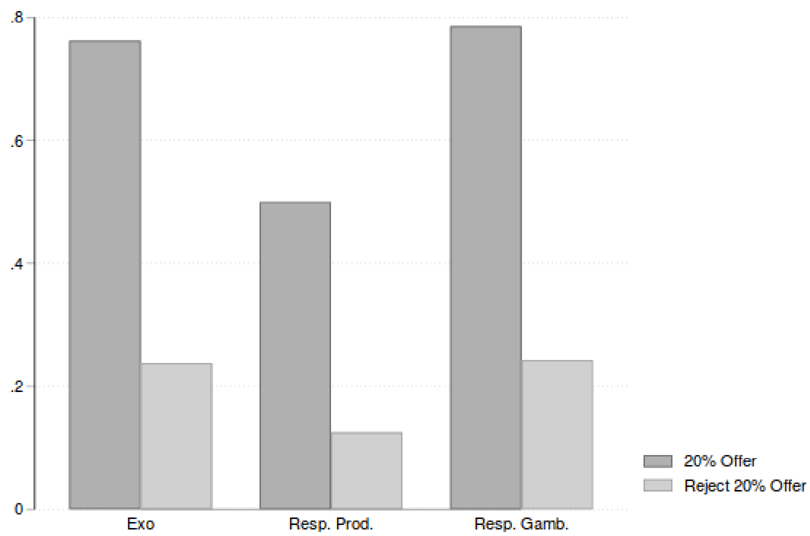
Figure 1 shows the probability that a proposer offers 20% to the responder, and the probability a responder rejects the 20% offer, conditional on having received a 20% offer. Bargaining outcomes in the exogenous and responder gambles treatments are similar. In the exogenous treatment, the 20% offer is made 76% of the time, and just under 24% of those

Table 2: Frequency Distribution of Endowment Sizes

	$10	$20	$40	Total
Exo	31	23	30	84
Resp. Prod.	30	57	25	112
Resp. Gamb.	46	47	47	140
Total	107	127	102	336

offers are rejected. In the responder gambles treatment, the 20% offer is made 78% of the time and just over 24% of those offers are rejected. In the responder produces treatment, the 20% offer is made about 50% of the time, but only 12.5% of offers are rejected. When the 80% offer is made, it is accepted 100% of the time in all treatments.

Figure 1: 20% Offer and Rejection Rates by Treatment



Figures 2 and 3 show how offers and rejections vary across endowment size between the three treatments, respectively. Table 3 presents logit regressions testing the statistical significance of rejection rates across treatments. Evident from Figures 2 and 3, and Table 3, the overall offer and rejection rates seen in Figure 1 hide considerable variation across endowment sizes. The rate of 20% offers declines as the endowment size increases in both the exogenous and responder gambles treatments. This decline is accompanied by a similar decline in rejection rates. In the responder produces treatment, the rate of 20% offers increases by about 10 percentage points, from 46.6% with the $10 endowment to 56% with the $40 endowment. The rejection rate also rises considerably, from 3% with the $10 endowment to 20% with the $40 endowment.

Table 3 reports logit regressions for overall treatment effects and effects by endowment. Overall the probability of receiving a 20% offer is a statistically significant 26.2 percentage points lower in the responder produces treatment, as demonstrated by the statistically significant negative coefficient on the responder produces dummy in the Overall column. Reading

Figure 2: 20% Offer Rates by Treatment and Endowment

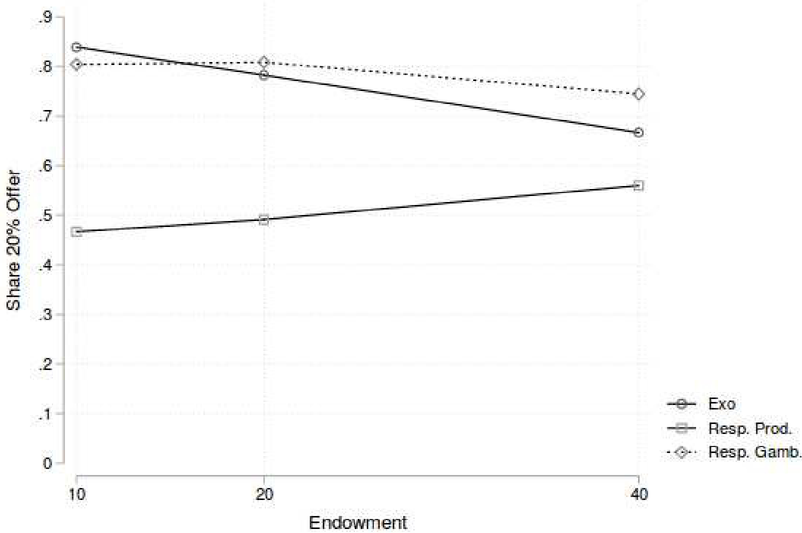
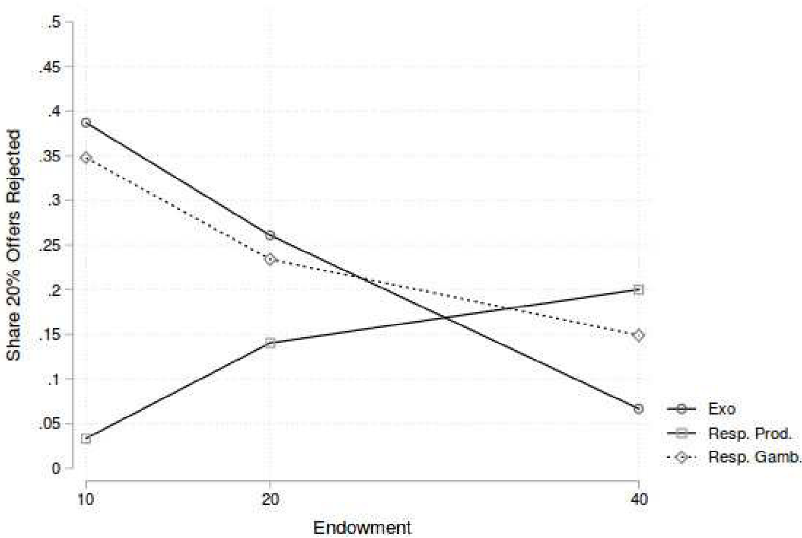


Figure 3: Rejection Rates by Treatment and Endowment



across the row, the rate of 20% offers is also statistically significantly lower in the \$10 and \$20 endowments, but not in the \$40 endowment.

The probability of rejecting a 20% offer is 11.3 percentage points lower in the responder produces treatment, as demonstrated by the negative coefficient on the responder produces dummy in the Rejections panel of Table 3. This effect is driven largely by the fact that the probability of rejecting a 20% offer is 35.4 percentage points lower for the \$10 endowment. Although not statistically significant, the probability of rejecting a 20% offer is 13.3 percentage points higher in the \$40 endowment. There are no statistically significant differences between the exogenous and responder gambles treatments. The fact that the significance

Table 3: Logit Regressions for Probability of 20% Offer or Rejection

Offers

	Overall	\$10	\$20	\$40
Responder Produces	−0.262***	−0.372***	−0.291***	−0.107
	(0.066)	(0.113)	(0.109)	(0.131)
Responder Gambles	0.024	−0.034	0.026	0.078
	(0.058)	(0.088)	(0.103)	(0.107)
N	336	107	127	102
Share 20% Offer	0.685	0.720	0.661	0.676

Rejections

	Overall	\$10	\$20	\$40
Responder Produces	−0.113**	−0.354***	−0.121	0.133
	(0.056)	(0.093)	(0.102)	(0.092)
Responder Gambles	0.005	−0.039	−0.027	0.082
	(0.059)	(0.112)	(0.110)	(0.069)
N	336	107	127	102
Share Rejected	0.202	0.271	0.197	0.137

Notes: Coefficients are average marginal effects. Robust standard errors reported in parentheses. Significance levels: * 10%, ** 5%, and *** 1%.

of the main treatment effect disappears for the \$40 endowment is worth emphasizing, as it suggests that proposers and responders have preferences over both the distribution of the endowment and the absolute payoff, consistent with some models of fairness (Rabin, 1993).

4 Conclusion

Our results demonstrate the sensitivity of rejection rates in the ultimatum game to the source of the endowment, a little studied phenomenon. The key result is the pattern of offers and rejections in the responder produces treatment. Compared to other treatments, Figure 1 shows that the probability of a responder receiving a 20% offer is 38% lower overall, implying that proposers offer more when the responder produces the endowment. However, for the \$40 endowment the probability of receiving the 20% offer is only about 16% lower. So although proposers on average offer more to responders, they continue to consider strongly their own payoffs, as evidenced by the fact that the overall rate of 20% offers remains high and that it rises with endowment size. The probability of rejecting a 20% offer is 44% lower overall when the responder produces the endowment.

Our results also differ considerably from Ruffle (1998), though are largely consistent with Bosman et al. (2005). As mentioned, Ruffle (1998) has a very low rejection rate overall, and no change in rejections between the endogenous and exogenous endowment treatments. The rejection rates found here are substantial, but decrease considerably in the endogenous endowment treatment. This is analogous to the decrease in the willingness to destroy the endowment seen in the power to take game. What neither Ruffle (1998) nor Bosman et al.

(2005) can shed light on is behavior by the responder (the second party in the power to take game) as endowment size changes. Again, this is due to the fact that Ruffle (1998) has too few rejections to analyse rejections, and Bosman et al. (2005) hold endowment size fixed across treatments. We find that rejection rates rise with endowment size in the endogenous endowment treatment, but fall with endowment size in both the exogenous and responder gambles treatments.

Although the pattern of rejections across endowment sizes is quite intuitive for the responder produces treatment, the overall lower rejection rate is not. The results suggest an overall decreased willingness by responders to destroy an endowment that they were responsible for producing. This is consistent with responders having preferences over absolute gain. Additionally, proposers expect responders to be less willing to destroy a large endogenous endowment, as the probability of offering 20% is higher for the $40 endowment than the $10 endowment in the responder produces treatment. This result may be the result of proposers assuming that responders have a strong preference over absolute gain. Proposers were clearly wrong, however, as rejection rates increased with the larger endogenous endowment. To the extent that the division of gains owing to labor systematically differ from the division of gains from other market exchange, the results have implications for a wide range of labor supply, labor demand, and wage determination models.

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