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Charlotte Klempt
Kerstin Pull

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Carl-Zeiss-Str. 3
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www.uni-jena.de

Max Planck Institute of Economics
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D-07745 Jena
www.econ.mpg.de

Generosity, Greed and Gambling: What difference does asymmetric information in bargaining make?

Charlotte Klempt * Kerstin Pull ‡

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Abstract

We analyze the effects of asymmetric information concerning the size of a pie on proposer behavior in three different bargaining situations: the ultimatum game, the Yes-No-game and the dictator game. Our data show that (a) irrespective of the information condition, proposer generosity increases with responder veto power, (b) informed proposers in the ultimatum game try to exploit their superior information and hide their greed by a seemingly fair offer, and (c) uninformed proposers in the dictator game exhibit gambling behavior by asking for more than potentially is at stake. While the results of our experimental analysis are interesting as such, they may also yield interesting practical implications.

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*Max Planck Institute of Economics, Kahlaische Straße 10, 07745 Jena, Germany

†Eberhard Karls Universität Tübingen, Faculty of Economics and Business Administration, Nauklerstr. 47, 72074 Tübingen, Germany

‡Corresponding author. kerstin.pull@uni-tuebingen.de, phone +49 - 7071 - 29 - 78186, Fax +49 - 7071 - 29 - 5077

1 Introduction

A large literature (see Camerer, 2003, for a review) explores how two parties X and Y share a monetary amount, the so called "pie" $\pi(>0)$: While in the dictator game, X unilaterally determines how π is distributed among X and Y (Mikula, 1974; Shapiro, 1975), the ultimatum game (Güth et al., 1982) assigns veto power to Y: Here, X only proposes a distribution of π that then Y can accept or reject with rejection leading to 0-payoffs for both. Subsequent studies varied basic game parameters exploring the effects of

- private information (only X or only Y knows how large π is, e.g. Mitzkewitz and Nagel, 1993, Rapoport and Sundali, 1996, Güth et al., 1996, and Huck, 1999),
- variations of Y's veto power (by border cases like Bolton and Zwick, 1995, and Güth and Huck, 1997, and by continuous variations of bargaining power like e.g. Suleiman, 1996, Fellner and Güth, 2003), or
- variations of Y's information condition concerning X's proposal in the ultimatum game (Y learns X's proposal when deciding whether or not to accept) as compared to the Yes-No-game (Y does not know X's proposal when deciding whether or not to accept, see Gehrig et al., 2007).

In what follows we study the effects of asymmetric information concerning the size of the pie on bargaining behavior in three different bargaining games: the dictator game, the Yes-No-game and the ultimatum game. In our analysis, we analyze two kinds of informational asymmetry: (i) a situation where only the proposer is informed about the size of the pie and the responder is not and (ii) a situation where only the responder is informed about the size of the pie and the proposer is not. To the best of our knowledge, the latter situation has not been analyzed experimentally as yet. Moreover, our experimental design enables us to compare proposer and responder behavior each when either being confronted with a small or with a large pie allowing for a within-subject comparison of offers and acceptance levels in face of different pie sizes. Again, this has not been accomplished in the literature so far. While this is already the case for the otherwise heavily explored ultimatum and dictator game, this is even more true for the Yes-No-Game where the effect of a variation in pie size has not been analyzed at all.

Concerning the underlying questions of our research we are especially interested in the following:

- First, we are interested in whether the well-known effect of responder veto power on offers persists in a situation where only the proposer is informed about the size of the pie and the responder is not. Here, we do not only compare proposer behavior in the dictator and ultimatum setting, but we also explore how the Yes-No-game behavior fits into the context.

- Second, we analyze in how far informed proposers may attempt to exploit their superior information. As already suggested in the literature (see Güth et al., 1996), informed proposers may pretend to offer a small pie division when actually facing a large pie. In the context of our experimental setting informed proposers who know the size of the pie to be large may try to "hide their greed" by offering an amount that would seem to be fair in light of a small pie but that is actually not in light of the large one. Again, we explore the phenomenon of "hiding greed" in the three different bargaining situations and analyze if there are distinct player types to be distinguished in this respect.

- Third, with respect to *un*informed proposers we are interested in how they react to the additional risk of conflict they face, i.e. the risk of having asked for more than is actually at stake. Concerning proposer behavior in the different bargaining games, it is especially important to understand how the *informed* responders react on the proposals.

While the results of our experimental study are already interesting as such, our analysis may also have quite practical implications: Consider e.g. a situation where an employer makes a wage offer and an employee may either accept this offer or walk away and take his outside opportunity (which is assumed to be zero in the experimental settings). The first information condition (i) then would represent a situation where the employer is informed about the size of the "pie" (i.e. the profitability of the firm) and the employee is not - a situation which would seem to be quite typical of wage negotiations. Our first research question would then explore whether employee veto power has an effect on the generosity of wage offers. While in the experimental analysis, the different bargaining games stand for differing degrees of responder veto power, in real-life wage negotiations these would be captured by differing outside opportunities. Our second research question would ask if employers will strategically exploit their superior information and hide their greed behind a seemingly fair wage offer. The third and final research question would concern the second information condition (ii) with the employer not knowing the size of the pie, but the employee knowing its size. Even though this may not seem the typical setting for wage negotiations, we might still think of situations where employees are indeed better informed about the profitability or market potential of what they are accomplishing for the firm. Here it is interesting to see how employers may react to the risk of offering what would seem to be too low in a situation of high profitability versus offering more than is actually there to be distributed in a situation of low profitability and also how informed employees will react to the wages offered.

Before elaborating on our research questions in more detail we first introduce the specific games we are going to study experimentally.

2 Framework

2.1 The experimental games

In all of our game scenarios the pie π is €8 with probability $\frac{1}{3}$ and €20 with probability $\frac{2}{3}$. While one party knows the size of π (€8 or €20), the other only knows the likelihood of a large (€8) vs. a small pie (€20). For each game G with players X and Y we distinguish between

- game $G1$ where only X knows the size of π and Y does not and
- game $G2$ where only Y knows the size of π and X does not.

Applying the strategy method, the informed player in both games, $G1$ and $G2$, can *condition* his choice on the pie size while the uninformed player cannot.

The three game types which we consider are

- the ultimatum game UG:
  - (i) Y learns about X's offer before accepting and thereby implementing the by X proposed allocation or rejecting it and
  - (ii) Y's rejection leads to 0-payoffs for X and Y,
- the Yes-No game YNG: unlike it is the case in (i), Y does not learn about X's offer when deciding on acceptance vs. rejection, but just as is the case in (ii) Y's rejection leads to 0-payoffs for X and Y, and
- the dictator game DG where whatever X decides is being implemented.

What proposer X can decide differs in games $G1$ and $G2$. In games $G1$, player X allocates both pies, i.e. he chooses

$(\underline{x},\underline{y})$ with $\underline{x}, \underline{y} > 0$ (both being restricted to integers) and $\underline{x} + \underline{y} = 8$ as well as

$(\overline{x},\overline{y})$ with $\overline{x}, \overline{y} > 0$ (both being restricted to integers) and $\overline{x} + \overline{y} = 20$

When player Y learns about X's choice as he does in $UG1$, he is only informed about y, i.e. about how much X has offered to him but not whether y corresponds to $\underline{y}$ or $\overline{y}$. Any offer $\overline{y} \geq 8$, of course reveals that the pie is large, i.e. that y corresponds to $\overline{y}$. Concerning X, this allows him to "hide his greed" behind an offer which would seem to be fair in light of the small pie, but which would be considered rather small when the pie is large.
In games $G2$ where X does not know the size of π, X can determine only one integer x with $0 < x < 20$. If the actual pie is $\underline{\pi} = 8$ and $x \geq 8$, this automatically leads to conflict with 0-payoffs for both players. Hence, we rule out acceptance in case of $\pi - x < 0$ and impose rejection with 0-payoffs for both players instead. Only if X chooses x such that x does not exclude $\pi - x > 0$, Y is asked for acceptance (in case of YNG2 and UG2). If then Y accepts, Y receives $y = 8 - x$ or $y = 20 - x$ respectively, depending on whether the pie size is 8 or 20.

2.2 Experimental design

The experiment has been run in the computer laboratory of the Max Planck-Institute for Economics in Jena with students from various faculties of Jena-University. For each of the six games $UG1$, $UG2$, $YNG1$, $YNG2$, $DG1$, and $DG2$ we have run two sessions with 32 participants each (no participant has been employed more than once). Thus for each of the six games we have 32 X- as well as Y-participants. Participants received a show-up fee of €2.5 and earned on average €6.57 with a session lasting approximately 40 minutes.

Upon arrival, the instructions were read aloud to the participants, and participants also received a hard copy of the instructions (see Appendix A) which they were asked to read carefully. After answering a control questionnaire checking whether they understood the rules of the game they were randomly assigned to the X-or Y-role. Then they played the respective game only once with one randomly assigned partner.

For the sake of complete data sets we have employed the strategy method meaning that

- the informed player had to decide for both pie sizes and
- responder participants Y in $UG1$ and $UG2$ had to decide for each possible proposal whether or not they were willing to accept it.

Of course, one can argue that using the strategy method may have an effect (see e.g. Brandts and Charness, 2000). As none of our research questions would seem to depend much on such an effect the advantage of a richer data set would clearly seem to dominate.

2.3 Research questions and hypotheses

In the literature, the main question concerning proposer behavior in ultimatum experiments refers to proposer generosity: Are proposers intrinsically fair or do they merely react strategically to responder behavior? Comparisons with dictator experiments have shown that both reasons apply with dictators typically refraining from giving nothing ("unconditional fairness"), but still giving less than proposers in ultimatum games (i.e. part of responder generosity in ultimatum games may be attributed to strategic considerations). In comparison, the Yes-No-Game does grant veto power to player Y, but it offers no strategic incentives for responder rejection and hence no strategic reason for proposer generosity (Gehrig et al., 2007): By his offer to Y, X cannot influence the acceptance decision. Taken together, this suggests the following hypothesis:

Hypothesis 1: Proposer behavior in YNG corresponds to dictator behavior in DG whereas proposer participants in UG are generally more generous than proposers in YNG and dictators in DG.

While hypothesis 1 has been supported in numerous experimental settings, it is not yet clear if it also holds true in the context of varying information conditions: Will proposers in UG be more generous than those in YNG and DG - also in a situation where either the proposer himself ($G2$) or the responder/recipient ($G1$) is not informed about the size of the pie?

One further question concerns the stake dependence of offers. Rejection of material opportunism in ultimatum and dictator experiments (see Camerer, 2003, for a recent survey) has regularly led to the question whether such findings would also hold for high stakes (see e.g. Cameron, 1999, Henrich, 2000). In our experimental setting we are not only able to analyze how behavioral patterns vary in a situation when a relatively small pie $\underline{\pi} = 8$ or a comparatively much larger pie $\overline{\pi} = 20$ is at stake. We can also explore in how far X-participants in $UG1$ may try to exploit their superior information and strategically "hide their greed" by offering an amount y that may "signal" only a small pie being at stake (e.g. $y \sim 4$) even in a situation where the pie is large. Unlike an informed responder who knows the size of the pie to be large, an uninformed responder may not dare to reject such a potentially fair offer. As "hiding greed" only applies to the strategic interaction between proposer and responder in $UG1$ and not to the situation in $YNG1$ and $DG1$, a potential difference between what X-participants in the $YNG1$ or $DG1$ ask for themselves when either being confronted with a large or a small pie, will be much smaller and can only be attributed to a general stake dependence of offers. We hence derive the following hypothesis:

Hypothesis 2: In $UG1$, X-participants will ask for relatively more when faced with a large pie than when faced with a small one, i.e.: $\frac{\underline{x}}{\underline{\pi}} < \frac{\overline{x}}{\overline{\pi}}$. For X-participants in $YNG1$ and $DG1$, the effect (if any) will be much smaller.

Our final hypothesis applies to one specific feature of our experimental design: In $G2$-games where the proposer does not know the size of the pie, any $x \geq 8$ faces the risk of conflict. Any offer $x \geq 8$ hence incorporates an element of "gambling" with proposers facing an exogenous probability of $1/3$ to end up with a 0-payoff (in addition to the risk of responder rejection in $UG2$ and $YNG2$). One would expect that proposers asking for $x \geq 8$ will try to compensate this risk by demanding for even more than they would when knowing the pie to be large. While this behavior would seem rational in case of $DG2$ and - if not anticipated by the responder - also in $YNG2$, this holds not true in $UG2$ where such an attempt might be detected and then sanctioned by the responder. This leads us to the following hypothesis:

Hypothesis 3: In $DG2$ and $YNG2$, X-participants with demands $x \geq 8$ ask for higher amounts as compared to X-participants in $DG1$ and $YNG1$ confronted with a large pie. In $UG2$, however, we will not observe such an effect.

3 Results

3.1 Description of the data

Due to idiosyncratic random pie generation for each pair of X and Y the relative shares of $\pi = 8$ and $\pi = 20$ can differ from the expected ones. In Table 1 we list the average earnings of X- and Y-participants for each pie size. The fact that earnings in $YNG1$ and $DG1$ as well as earnings in $YNG2$ and $DG2$ are quite close compared to $UG1$ and $UG2$, respectively, already speaks in favor of Hypothesis 1.

Game	UG1	UG2	YNG1	YNG2	DG1	DG2
Avg. earning						
Player X ($\underline{\pi}$)	4.30 (n=10)	2.14 (n=14)	5.62 (n=8)	1.17 (n=6)	5.75 (n=8)	0.78 (n=9)
Player Y ($\underline{\pi}$)	3.70 (n=10)	0.71 (n=14)	2.38 (n=8)	0.17 (n=6)	2.25 (n=8)	0.11 (n=9)
Player X ($\overline{\pi}$)	13.23 (n=22)	8.50 (n=18)	16.12 (n=24)	12.65 (n=26)	15.92 (n=24)	13.65 (n=23)
Player Y ($\overline{\pi}$)	5.86 (n=22)	9.28 (n=18)	3.88 (n=24)	7.35 (n=26)	4.08 (n=24)	6.35 (n=23)
Player X	10.44 (n=32)	5.72 (n=32)	13.50 (n=32)	10.50 (n=32)	13.38 (n=32)	10.03 (n=32)
Player Y	5.19 (n=32)	5.53 (n=32)	3.50 (n=32)	6.00 (n=32)	3.62 (n=32)	4.59 (n=32)
Conflict rates						
x>8	-	0.57	-	0.83	-	0.89
Rejection rate ($\underline{\pi}$)	0.00	0.07	0.00	0.00	-	-
Rejection rate ($\overline{\pi}$)	0.05	0.11	0.00	0.00	-	-

Table 1: Average actual earnings and conflict rates

The bottom part of Table 1 lists the conflict rates and their causes. Conflicts rates due to $x > \underline{\pi} = 8$ in $G2$ are high, revealing a strong gambling incentive of X-participants, especially in $YNG2$ and $DG2$. This sheds first evidence on Hypothesis 3. Otherwise, rejection rates are rather low and in line with former experiments (see e.g. Güth and Tietz, 1990). The conflict rates, of course, depend on the randomly matched pair, but are rather similar to those resulting from matching each X-participant with all Y-participants in the same session.

Table 2 contains the average x-choices by X-participants and - in brackets - their standard deviations as well as the medians and modes for all games, separately for both pie sizes in the games of type 1. The closeness of X-behavior in YNG and DG, compared to UG, as claimed by Hypothesis 1, is obvious. Similarly, Hypothesis 2 predicting on average more generous proposals for $\pi = \underline{\pi}$ than for $\pi = \overline{\pi}$ seems qualitatively in line with the data for the games of type 1 where the proposer X is the informed party. In what follows, we will systematically analyze the data with respect to our research questions and the hypotheses derived above.

Game		UG1	UG2	YNG1	YNG2	DG1	DG2
Choices							
$\underline{\pi}$	avg.	4.59		6.00		5.88	
	std	(1.24)		(1.19)		(1.16)	
	median	4		7		6	
	mod	4		7		7	
$\overline{\pi}$	avg	13.34	9.91	15.94	12.84	15.66	14.09
	std	(3.31)	(3.86)	(3.34)	(5.44)	(3.05)	(5.39)
	median	13	10	17.5	13.5	16.5	17
	mod	10,13	7	19	7	19	19

Table 2: Averages (standard deviations), medians, and modes of X-choices, separately for $\underline{\pi} = 8$ and $\overline{\pi} = 20$ in $UG1$, $YNG1$, and $DG1$ for all games

3.2 Proposer generosity (Hypothesis 1)

In this subsection we investigate the differences in demands between all the different treatments. Table 3 shows the frequencies of demands subdivided into four sections. While X-participants' decisions in $G2$ with $x \geq 8$ involve the risk of losing the whole stake in case the small pie is realized; X-participants' demands with respect to $\underline{\pi}$ in $G1$ are restricted to $x < 8$.

Game	UG1		UG2	YNG1		YNG2	DG1		DG2
	$\underline{\pi}$	$\overline{\pi}$		$\underline{\pi}$	$\overline{\pi}$		$\underline{\pi}$	$\overline{\pi}$	
$x < 7$	29 (91%)	1 (3%)	6 (19%)	15 (47%)	0 (0%)	1 (3%)	19 (49%)	0 (0%)	0 (0%)
$7 \leq x < 8$	3 (9%)	0 (0%)	8 (25%)	17 (53%)	0 (0%)	11 (34%)	13 (41%)	0 (0%)	10 (31%)
$8 \leq x < 17$	–	26 (81%)	15 (47%)	–	15 (47%)	8 (25%)	–	16 (50%)	6 (19%)
$x \geq 17$	–	5 (16%)	3 (9%)	–	17 (53%)	12 (38%)	–	16 (50%)	16 (50%)

Table 3: Frequencies and percentages of X-demands subdivided into four sections, $x < 7$, $7 \leq x < 8$, $8 \leq x < 17$, and $x \geq 17$

Table 3 clearly shows Y-participants' veto power in UG. When comparing choices in UG to those in YNG and DG, demands are more generous in the former confirming Hypothesis 1. In case of $\underline{\pi}$, in $UG1$ only 9% choose the maximum demand of 7 as opposed to 53% in $YNG1$ and 41% in $DG1$. X-participants' choices regarding $\overline{\pi}$ show the same pattern: Only 16% choose 17 or more in $UG1$ whereas such choices are more frequent in $YNG1$ and

$DG1$ (53% resp. 50%).

Statistical analysis support these findings. A Wilcoxon rank sum test confirms that X-participants demand significantly less in $UG1$ than in $YNG1$ and $DG1$ with respect to $\underline{\pi}$-decisions (UG vs. YNG and UG vs. DG: $p<0.01$). The same test shows that these differences do not exist when comparing $YNG1$ and $DG1$ ($p>0.1$). These behavioral patterns also hold for demands with respect to $\overline{\pi}$-decisions (UG vs. YNG: $p<0.1$, UG vs. DG: $p<0.01$ and YNG vs. DG: $p>0.1$).

Turning to X-demands in $G2$ we can distinguish between demands involving risk, $x \geq 8$, and demands allowing for secure gains, $x < 8$. Again, demand behavior in UG is more generous than in YNG and DG with respect to both risky and riskless decisions. X-participants choosing a secure gain in $G1$ ask for the maximal possible demand of 7 in 57% of the cases in $UG2$, in 92% of the cases in $YNG2$ and in 100% of the cases in $DG2$. Concerning demands of 17 or more, only 9% of $UG2$-participants choose demands $x \geq 17$ as opposed to 38% resp. 50% in $YNG2$ and $DG2$.

To support these differences in demands between the $G2$-treatments shown in table 3, we again run a Wilcoxon rank sum test that confirms that $UG2$-demands are smaller than $YNG2$-demands and $DG2$-demands (UG vs. YNG: $p<0.05$, UG vs. DG: $p<0.01$). The same test, however, does not hold for differences between $YNG2$ and $DG2$ ($p>0.1$).

We hence can state

Regularity 1: Proposers in UG make systematically higher offers than proposers in YNG and dictators in DG - irrespective of varying information conditions (G1 and G2). Proposers in YNG and in DG, on the other hand, show no systematic behavioral disparities between the two information conditions.

3.3 Hiding greed (Hypothesis 2)

When deciding what to choose in case of $\underline{\pi} = 8$ and $\overline{\pi} = 20$, participants may easily do the obvious, e.g. playing fair, when only little is to be distributed but asking for more when relatively much more is at stake. Besides this general stake dependency of offers, in case of $UG1$ one further argument applies: Proposers may be tempted to "hide their greed" when faced with a large pie behind an offer $y \sim 4$ that would seem fair in light of a small pie but that is actually very low. As a result we expect X-participants in $UG1$, but not those in $YNG1$ or $DG1$, to choose $\frac{\underline{x}}{\underline{\pi}} < \frac{\overline{x}}{\overline{\pi}}$. In Figure 1 we have plotted from top to bottom the relative demands $\frac{\underline{x}}{\underline{\pi}}$ (dark gray) and $\frac{\overline{x}}{\overline{\pi}}$ (light gray) for $UG1$, $YNG1$, and $DG1$. Relative demands are rounded in order to classify them into the nine sections depicted in figure 1.

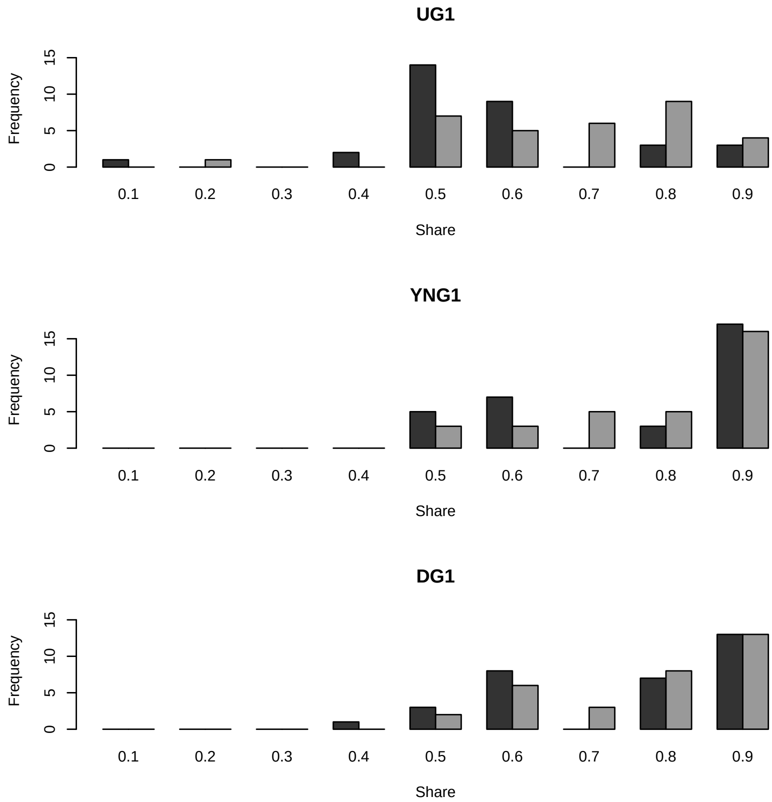

Figure 1: Frequency of demands $\frac{\underline{x}}{\underline{\pi}}$ (dark gray) and $\frac{\overline{x}}{\overline{\pi}}$ (light gray) in $UG1$, $YNG1$, and $DG1$

To statistically substantiate hypothesis 2, we have tested if for $\overline{\pi} = 20$, the relative demands by X-participants are larger than for $\underline{\pi} = 8$, separately for $UG1$, $YNG1$, and $DG1$. The Wilcoxon signed rank tests indeed confirm this relation only for $UG1$ ($p < 0.05$), but not for $YNG1$ ($p < 0.29$) and $DG1$ ($p < 0.9$). We thus can safely state

frequency of X-types (rel.)	$\frac{\overline{x}}{\overline{\pi}} \sim \frac{\underline{x}}{\underline{\pi}}$	$\frac{\overline{x}}{\overline{\pi}} >> \frac{\underline{x}}{\underline{\pi}}$	$\frac{\overline{x}}{\overline{\pi}} << \frac{\underline{x}}{\underline{\pi}}$
UG1	18 (56%)	13 (41%)	1 (3%)
YNG1	29 (91%)	3 (9%)	0 (0%)
DG1	27 (84%)	4 (12%)	1 (3%)

Table 4: Classification of X-types by relative demands $\frac{\underline{x}}{\underline{\pi}}$ and $\frac{\overline{x}}{\overline{\pi}}$, separately for $UG1$, $YNG1$, and $DG1$.

Regularity 2a: X-participants in $UG1$, on average demand relatively more in case of $\overline{\pi} = 20$ than in case of $\underline{\pi} = 8$.

As receivers in the $DG1$ have no veto power and as responders in the YNG have a lower strategic incentive to reject the offer, this effect is not to be detected in $DG1$ and $YNG1$. I.e., the general stake dependence-argument does not seem to play a role here (e.g. because of difference in stakes being too low).

In a second step we investigated X-participants more closely by comparing their relative demands $\frac{\underline{x}}{\underline{\pi}}$ on an individual level and distinguished between

- individuals X in $UG1$ for whom $\frac{\underline{x}}{\underline{\pi}}$ is equal to $\frac{\overline{x}}{\overline{\pi}}$,
- individuals X in $UG1$ for whom $\frac{\overline{x}}{\overline{\pi}}$ is larger than $\frac{\underline{x}}{\underline{\pi}}$, and
- individuals X in $UG1$ for whom $\frac{\overline{x}}{\overline{\pi}}$ is smaller than $\frac{\underline{x}}{\underline{\pi}}$.

Table 4 presents the frequency of the respective X-types. Here, equality of relative demands $\frac{\overline{x}}{\overline{\pi}} \sim \frac{\underline{x}}{\underline{\pi}}$ is approximated by tolerating deviations within $\epsilon = 0.1$, i.e. $\frac{\overline{x}}{\overline{\pi}} \in [\frac{\underline{x}}{\underline{\pi}} - \epsilon, \frac{\underline{x}}{\underline{\pi}} + \epsilon]$. Correspondingly, relative large pie demands are considered to be larger than relative small pie demands ($\frac{\overline{x}}{\overline{\pi}} >> \frac{\underline{x}}{\underline{\pi}}$) when $\frac{\overline{x}}{\overline{\pi}} > \frac{\underline{x}}{\underline{\pi}} + \epsilon$ is given. Similarly, relative large pie demands are considered to be smaller than relative small pie demands ($\frac{\overline{x}}{\overline{\pi}} << \frac{\underline{x}}{\underline{\pi}}$) when $\frac{\overline{x}}{\overline{\pi}} < \frac{\underline{x}}{\underline{\pi}} - \epsilon$ is given.

A two-sample test for equality of proportions reveals whether the fraction of proposers within each class differs across games. This test confirms that the fraction of proposers demanding approximately the same with respect to both pie sizes $\frac{\overline{x}}{\overline{\pi}} \sim \frac{\underline{x}}{\underline{\pi}}$ is significantly (p<0.01) smaller in $UG1$ than in $YNG1$ and in $DG1$. The same test does not hold for differences between $YNG1$ and $DG1$. The test also shows the fraction of proposers demanding relatively more in case of $\overline{\pi}$, i.e. proposers with $\frac{\overline{x}}{\overline{\pi}} >> \frac{\underline{x}}{\underline{\pi}}$ is significantly larger (p<0.05) in $UG1$ than in $YNG1$ and in $DG1$. There are no such differences between these games comparing fractions of proposers with $\frac{\overline{x}}{\overline{\pi}} << \frac{\underline{x}}{\underline{\pi}}$. The results of Table 4 hence reveal the following:

Regularity 2b: While in $YNG1$ and $DG1$, the vast majority of proposers do not condition the share of their offer on the size of the pie, in $UG1$ more than 40 percent of proposers offer a lower share in face of the large pie. Hardly nobody offers a higher share in light of a large pie - irrespective of the game played.

Taken together, our results hint at the empirical relevance of "hiding greed" for a significant proportion of proposers in $UG1$. As there is no such effect in $YNG1$ and $DG1$, the result would rather not seem attributable to the general stake dependence of offers.

3.4 Gambling (Hypothesis 3)

But how do proposers act when they themselves do not know the size of the pie ($G2$)? For $UG2$, $YNG2$, and $DG2$ we illustrate proposer behavior in Figure 2 showing the absolute frequencies of demands x for the three different games and compare it with large pie demands in $G1$-games.

To reveal the effect of risk on $G2$-choices $x \geq 8$, we compare these risky decisions with the x-choices in $G1$ in case of a large pie. A Wilcoxon rank sum test shows that proposers ask for more when choosing a risky division $x \geq 8$ in $DG2$ than when dividing the large pie in $DG1$ (p<0.01). In $YNG2$ and $UG2$, proposers do not ask for such risk compensations, i.e. they do not demand more compared to the respective $G1$-choices (Wilcoxon rank sum test YNG: p<0.3, UG: p>0.8). While the observation for $UG2$ corresponds to the theoretical expectation, the one for $YNG2$ does not. We hence state

Regularity 3 In $DG2$, X-participants who engage in gambling when confronting an informed Y-partner by asking for $x \geq 8$ systematically ask for more than those who are confronted with a large pie in $DG1$. In UG and YNG there is no such behavioral disparity.

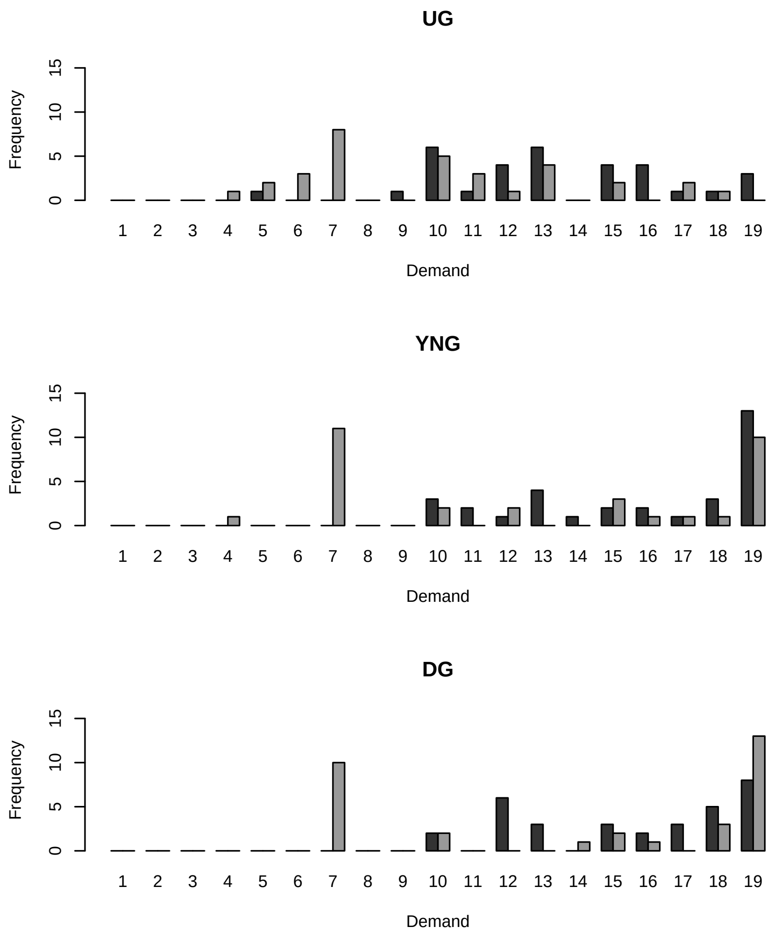

Figure 2: Frequency of demands x in $UG2$, $YNG2$, and $DG2$ (light gray) compared to large pie demands in $UG1$, $YNG1$, and $DG1$ (dark gray).

3.5 Responder behavior: Explorative evidence

While our research questions focus on proposer behavior, the data we collected also shed light on the use of responder veto power. In what follows we briefly comment on a few of our results that might be of interest. Since Y-participants in YNG almost always accepted the (unknown) proposed division (29 out of 32 responders said "Yes"), we focus on responder behavior in $UG1$ and $UG2$.

In a first step we compare responder behavior in UG between the two treatments. Table 5 shows absolute and relative frequencies of rejections in $UG1$ and $UG2$. Y-participants' rejections with respect to $\underline{\pi}$ in $UG2$ are restricted to $x < 8$. We also state the percentage of responders who rejected at all.

Game	UG1	UG2	
		$\overline{\pi}$	$\underline{\pi}$
$y < 4$	51 (81%)	57 (65%)	34 (100%)
$4 \leq y < 8$	8 (13%)	29 (33%)	0 (0%)
$8 \geq y$	4 (6%)	2 (2%)	–
Sum	63 (100%)	88 (100%)	34 (100%)
rejectors	22 (69%)	19 (59%)	16 (50%)

Table 5: Frequencies and percentages of Y-rejections subdivided into three sections and the fraction of responder who rejected at all (bottom line).

One can easily see that rejection behavior differs across treatments. 50% of $UG2$-responders in case of $\underline{\pi}$ reject at least some of the offers. All of the offers rejected concern offers below 4 - the equal split. The percentage of rejectors in $UG2$ in case of $\overline{\pi}$ is considerably higher (59%). Here, 65% of rejections concern offers below 4, and no one rejects the equal split ($y = 10$). The highest percentage of rejectors is to be found in $UG1$ (69%) where responders do not know if the offer belongs to a $\underline{\pi}$- or $\overline{\pi}$-division. 81% of rejections concern offers $y < 4$, 13% concern offers $4 \leq y < 8$. While responders in $UG2$ do not reject any offer $4 \leq y < 8$ in case of a small pie, 33% do so in case of a large one. A Wilcoxon rank sum test confirms that rejections in $UG1$ are generally lower than $\overline{\pi}$-rejections and higher than $\underline{\pi}$-rejections in $UG2$ ($p<0.05$ in both cases). Hence, veto power in $UG1$ seems to be relatively weak in comparison to $\overline{\pi}$-veto-power in $UG2$ leaving room for the observed "hiding greed" behavior in $UG1$.

Concerning a potential non-monotonicity of responder behavior in $UG1$, Figure 3 indicates the acceptability of offers y in $UG1$.

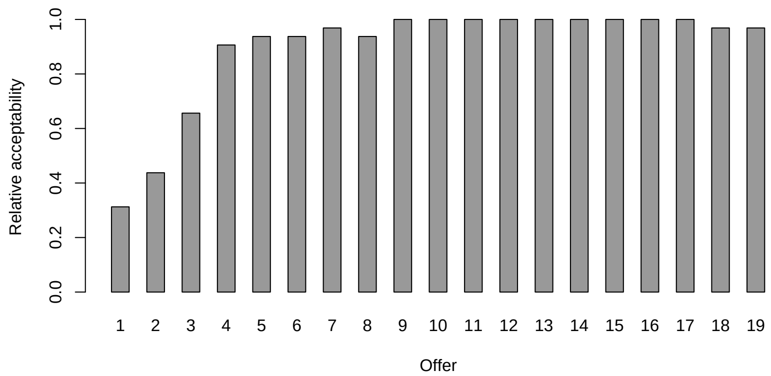

Figure 3: Relative acceptability of offers y in $UG1$

Regarding the results displayed in Figure 3, there seems to be tentative experimental evidence for non-monotonic responder behavior in $UG1$ around $y = 8$ on an aggregate level: With increasing offers y, the rejection rate first goes up, but then goes down again at $y = 8$, even though $y = 8$ clearly signifies the presence of a large pie. I.e., as far as responder behavior is concerned, hiding greed by offering $y = 7$ instead of $y = 8$ would seem to be a good strategy for X (in terms of a higher payoff in case of acceptance *and* a higher probability of acceptance). Six of the 22 proposers who reject at all show non-monotonic responses. Four of these responders use non-monotonic responses to avoid rejecting potentially fair small pie offers (E.g they show a pattern of rejecting $y \geq 3$ and again rejecting $5 \geq y \leq 7$). As far as non-monotonic responses in the sense of not being ready to accept an overly generous offer are concerned, this type of behavior only manifests itself for two individual responders rejecting $y > 17$ (see Güth et al.,..., and Gehrig et al., 2007, for such a comparable effect with respect to more than fair offers).

For the case of $UG2$, it is interesting to compare the acceptability of $\frac{y}{\pi}$ depending on whether the size of the pie is known to be large or small. In

Figure 4 we distinguish between three different types of responders: (1) those who always accept the respective share regardless of the size of the pie (dark grey), (2) those who never accept (light grey), and (3) those who only accept the respective share in case of a small pie, but not in case of a large one (medium grey) (as there were only two cases in which a responder only accepted a given share in light of a large pie, but not in light of a small one, we do not include this type in our analysis). To the best of our knowledge, there exists no other data set where one can distinguish between these different types of responders.

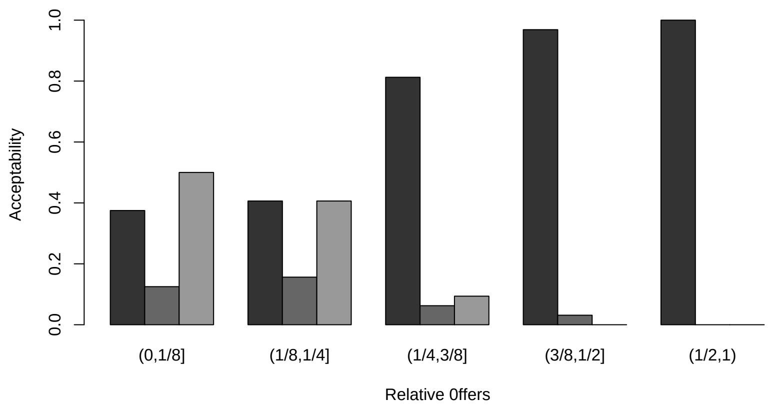

Figure 4: Share of Y-participants in $UG2$ who accept $\frac{y}{\underline{\pi}}$ *and* $\frac{y}{\overline{\pi}}$ (dark gray), who *only* accept $\frac{y}{\underline{\pi}}$ (medium grey) and those who neither accept $\frac{y}{\underline{\pi}}$ *nor* $\frac{y}{\overline{\pi}}$ (light gray).

Figure 4 shows that most of the responders do not condition their rejection behavior on the size if the pie. One might have expected a greater fraction of responders to be more tolerant in face of a small pie in $UG2$ as *any* positive offer in case of $\underline{\pi}$ would actually imply $\frac{\overline{y}}{\overline{\pi}} > 1/2$, i.e. a quite generous offer in case a large pie was to be realized. After all, proposers in $UG2$ made their offers without knowing the pie size, and hence an offer of e.g. $\underline{y} = 2$ in case of a small pie would translate into an offer $\overline{y} = 14$ in case of a large pie and would as such not necessarily have to be sanctioned by an informed responder.

4 Conclusions

In this paper, we analyzed the effects of asymmetric information concerning the size of a pie on experimental behavior in three different bargaining situations: the ultimatum game, the Yes-No-game and the dictator game. Our design allows us to explore the effects of asymmetric information concerning the size of the pie while at the same time systematically varying the veto power of responders. Our analysis reveals the following behavioral patterns:

Generosity: Irrespective of the information condition, an increase in the responders' strategic power position leads to larger offers. This holds in a situation where (a) the responder does not know the size of the pie, and in a situation where (b) the proposer himself does not know the size of the pie.

Hiding greed: Further, our design also allows us to show that in a situation where the proposer is the informed party, he may try to exploit his informational advantage by offering an amount that would seem to be fair in light of a small pie but that is actually embarrassingly low in light of a large pie. A proposer may thus attempt to "hide his greed" by offering just half of the small pie - even when actually being faced with a large one. As theoretically expected, only in the ultimatum game proposers show this behavioral pattern, but not in the yes-no-game or in the dictator game.

Gambling: Concerning *uninformed* proposers we find that in case of the dictator game, these exhibit "gambling" (in the sense of asking for more than may actually be there to be distributed - leading to immediate conflict) and demand a risk premium by asking for even higher shares as compared to a situation where proposers know the pie to be large. Interestingly, proposers in the yes-no-game do not show such a behavioral pattern (even though theoretically we would expect them to do so). Proposers in the ultimatum game, however, behave according to the theoretical prediction and show no risk compensating behavior.

A Appendix

[All] Welcome and thank you for participating in this experiment!

Please read the instructions carefully. They are identical for all participants. For having shown up on time, you receive €2.50. During the experiment, you have the possibility to gain further money. These additional payoffs depend on your own decisions and the decisions of other participants.

We ask you not to talk to other participants throughout the experiment, to switch off your mobile phone, and to remove all non-required material from your desk. We strongly encourage you to follow these rules, otherwise you will be excluded from the experiment and you will not receive any payment. Whenever you have a question, please raise your hand. An experimenter will come to your desk and will answer your questions privately.

All participants in the experiment will be assigned to one of two roles which specify what kind of decisions you will be confronted with. At the beginning of the experiment, the role X or Y you play will be randomly selected.

Each participant X is randomly paired with a participant Y and they interact only once. The pair divides an amount of money among each other, where X proposes the split to his partner Y. [UG1-UG2] Participant Y can accept or reject the proposed amount. In case of acceptance, the proposed amount is paid out. In case of rejection, neither of both will receive any payment (except for payoffs for being on time). [YNG1-YNG2] Participant Y can accept or reject the proposed division without knowing the actual proposal. In case of acceptance, the proposed amount is paid out. In case of rejection, neither of both will receive any payment (except for payoffs for being on time). [DG1-DG2] Both participants are then paid out as proposed.

[All] The size of the monetary amount is not fixed: Either an amount of €8 or €20 is available for a division. The €8-amount is given with probability of one-third and the €20-amount is given with probability of two-thirds. The variable x specifies what participant X proposes for himself. The variable y specifies what participant X offers to Y. Thus, participant X can propose different integer (x, y)- divisions.

[UG1-YNG1-DG1] In case of having €8 at disposal, participant X can propose one of the following seven integer (x_8, y_8)- divisions:

x_8	1	2	3	4	5	6	7
y_8	7	6	5	4	3	2	1

In case of having €20 at disposal, participant X can propose one the following 19 integer (x_{20}, y_{20})- divisions to participant Y:

x_{20}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
y_{20}	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Participant X chooses a division for both possible amounts. Hence in X's role, you have to propose on the one hand a division of the €8-amount and on the other hand a division of the €20-amount. After your choice, chance decides which of both chosen divisions will define the payoffs, i.e. which monetary amount is given.

[UG2-YNG2-DG2] Due to the fact that participant X is not aware of the exact amount of money given, he only states his own demand x. The stated demand and the given monetary amount then define the proposed division of the €8-amount (x_8, y_8) or the €20-amount (x_{20}, y_{20}) as depicted in the following table:

x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
x_8	1	2	3	4	5	6	7	×	×	×	×	×	×	×	×	×	×	×	×
y_8	7	6	5	4	3	2	1	×	×	×	×	×	×	×	×	×	×	×	×
x_{20}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
y_{20}	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

The table shows that participant X receives his demand x when it does not exceed the amount given ([UG2-YNG2] and participant Y accepts the division). The rest of the money is offered to participant Y. Otherwise, no one receives any payment (except for payoffs for being on time). For example, column $(x = 5; x_8 = 5; y_8 = 3; x_{20} = 5; y_{20} = 15)$ describes the payoffs for both participants resulting from a demand of $x = 5$. For both amounts participant X receives his requested payoff $x = x_8 = x_{20} = 5$. Participant Y receives the rest of the money i.e. he receives $y_8 = 3$ in case of the €8-amount and $y_{20} = 15$ in case of the €20-amount. If participant X demands more than the €8-amount would allow for (e.g. column $(x = 10; x_8 = 0; y_8 = 0; x_{20} = 10; y_{20} = 10)$), no one receives further payment in case of the €8-amount. In case of the €20-amount, both participants receive $x_{20} = y_{20} = 10$.

[UG1] For each possible division, participant Y decides whether to accept or reject it. As participant Y, you take the decision without knowing the exact proposal of your counterpart. In contrast to participant X, you cannot condition your decision on the amount available. Without knowing the amount given, you make a choice for all 19 possible divisions whether to accept or reject them. As participant Y, you therefore either accept a (x_8, y_8)-division of the €8-amount or a (x_{20}, y_{20})-division of the €20-amount. All possible Y-decisions are depicted in the following table:

x_8	×	×	×	×	×	×	×	×	×	×	×	×	1	2	3	4	5	6	7
y_8	×	×	×	×	×	×	×	×	×	×	×	×	7	6	5	4	3	2	1
x_{20}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
y_{20}	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
A																			
R																			

The acceptance of participant X's proposal in column $(x_8 = 3; y_8 = 5; x_{20} = 15; y_{20} = 5)$ implies for participant X a payoff of €3 in case of the €8-amount and a payoff of €15 in case of the €20-amount; participant Y accepts in both cases a payoff of $y_8 = y_{20} =$ €5. In case of the acceptance of participant X's proposal in column $(x_8 = \times; y_8 = \times; x_{20} = 5; y = 15)$, no one receives further payment when the €8-amount is given; in case of the €20-amount participant X receives €5 and participant Y €15. Overall, participant Y takes 19 decisions about acceptance or rejection of the proposals.

[UG2] For each possible division, participant Y decides whether to accept or reject it. As participant Y, you take the decision without knowing the exact proposal of your counterpart. In contrast to participant X, you can condition your decision on the amount available. In case of having €8 at disposal, you make a choice for all seven possible divisions (x_8, y_8) whether to accept (A) or reject (R) them:

x_8	1	2	3	4	5	6	7
y_8	7	6	5	4	3	2	1
A							
R							

In case of having €20 at disposal, you make a choice for all 19 possible divisions (x_8, y_8) whether to accept (A) or reject (R) them:

x_{20}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
y_{20}	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
A																			
R																			

For all possible divisions and for both monetary amounts, participant Y has to choose whether to accept or reject them. After participant Y's choice, chance determines which monetary amount defines the payoffs.

[YNG1] As participant Y, you generally choose whether to accept or reject the proposed division without knowing the exact proposal. Thus, you decide without knowing the division and you cannot condition your choice on the size of the amount available. Hence, you choose whether to generally accept (A) or generally reject (R) of proposals (x_8, y_8) and (x_{20}, y_{20}):

	€8	€20
A	(x_8, y_8)	(x_{20}, y_{20})
R	(0,0)	(0,0)

[YNG2] As participant Y, you choose for both monetary amounts whether to accept or reject the proposed division without knowing the exact proposal. Thus, you decide without knowing the division of your counterpart. You can condition your choice on the size of the amount available. In case of a €8 amount at disposal, you choose to accept (A) or reject (R) the divisions (x_8, y_8); in case of a €20 amount at disposal, you choose to accept (A) or reject (R) the divisions (x_{20}, y_{20}):

	€8
A	(x_8, y_8)
R	(0,0)

	€20
A	(x_{20}, y_{20})
R	(0,0)

Hence as participant Y, you take two decisions about acceptance or rejection of proposals given a particular amount.

[All] After participants have made their decisions, payoffs will be determined: First, chance defines the size of the monetary amount with the €8-amount given with probability of one-third and the €20-amount given with probability of two-thirds. [UG1-UG2] Then, it will be compared whether participant Y accepts or rejects the division proposed by participant X. In case of participant Y's rejection of the proposal, no one receives any payment; in case of acceptance, the division is paid out as negotiated. [YNG1-YNG2] In case of general acceptance of the divisions proposed by participant Y, the randomly selected amount will be paid out according to participant X's proposal; in case of a rejection, no one receives any payment. [DG1-DG2] Then, the division proposed by participant X of the randomly selected amount is paid out.

[All] Please take into consideration that you interact just once with your partner. After your decision, there will be no further trials.

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