(In)Transparency of Information Acquisition: A Bargaining Experiment

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Abstract

We analyze how transparency affects information acquisition in a bargaining context, where proposers may choose to purchase information about the unknown outside option of their bargaining partner. Although information acquisition is excessive in all our scenarios, we find that the bargaining outcome depends crucially on the transparency of the bargaining environment. In transparent games, when responders can observe whether proposers have acquired information, acceptance rates are higher. Accordingly, in transparent bargaining environments information is more valuable, both individually and socially.

Key words: Information Acquisition, Ultimatum Experiment, Transparency

JEL Classification: D82, C91

1 Introduction

There is growing evidence that in situations of social learning, individuals tend to overinvest in information because they are overconfident about their own information (e.g., Anderson and Holt, 1997, Nöth and Weber, 2003, Kübler and Weizsäcker, 2004, Kraemer et al., 2006). Does overconfidence also occur in a strategic context when individuals interact with individuals rather than with an anonymous market? Do they also overinvest in information, and if so, how do they use this information in a strategic context?

We address these issues by analyzing a series of experiments in one of the simplest possible strategic environments, the well-known ultimatum bargaining game. Consider a situation when the proposer does not initially know the value of the responder's outside option. She may purchase this information. If her investment can be observed by the responder, we call the environment transparent.[1] Otherwise we call it intransparent. In both cases the incomplete information about the responder's outside option should tend to reduce the first mover advantage of the proposer.[2]

In our experiment proposer participants decide about information acquisition before playing the resulting ultimatum game with (non-)informed proposers. Contrasting the rational choice prediction with experimental behavior reveals that the value of information is grossly overstated by a vast majority of responders. We observe extremely high and, thus, excessive investment in information compared to the equilibrium benchmark and to the actual information value.

Surprisingly, we also find that inefficiencies are aggravated when agents cannot observe whether their counterpart has acquired information. Transparency about the informational endowment of the counterpart seems to affect individual payoffs more than information privately acquired by the responders.[3] People seem to really care about whether it is commonly known which (ultimatum) game they are playing.

This finding is independent of the actual value of the responder's conflict payoff. In particular even, when the outside opportunity is less than half the surplus so that participants could split the surplus evenly without any investing, only 20 % of our subjects would select the fair and cost-efficient solution. Overall, we find very little evidence for fairness concerns in our population of participants.[4] Given the dominance of rational behavior among our participants, the excessive investment in information is all the more surprising.

Our analysis proceeds as follows: Section 2 provides the details of the experimental design. Section 3 discusses the results on bidding behavior and section 4 on information acquisition. Section 5 concludes.

2 The Experimental Framework

To distill most visibly the crucial behavioral determinants of (in)transparent information acquisition, we employ an ultimatum game as our workhorse.

Proposer X and responder Y may share 10 units. Proposer X offers y units which, knowing the offer y, responder Y can accept or reject[5] (y is an integer with $1 \leq y \leq 9$). In either case the game ends. If the responder accepts, both will earn the respective payoffs $(x, y) = (10 - y, y)$, corresponding to X's proposal. If the responder rejects, the agents will earn their conflict payoffs (c_x, c_y).

We assume that c_x is commonly known. However, c_y is known only to Y. For simplicity, $c_y \in \{\underline{c}, \bar{c}\}$ can assume only two values. In the experiment some treatments have $\bar{c} = 3$ and others $\bar{c} = 6$, while $c_x = 2$ and $\underline{c} = 0$ are constant over all treatments. The higher conflict payoff for Y is *a priori* twice as likely as the low conflict payoff of $\underline{c} = 0$.

Since proposer X does not know responder Y's conflict payoff, she may choose to purchase precise information about it. So proposer X can decide whether she wants to be perfectly informed about responder Y's outside option at a certain price, or whether she prefers to bear uncertainty. More specifically, proposers are asked to decide on their willingness to pay for information. Since the actual price in case of trade is randomly determined, the only undominated strategy is to bid one's true value for information (Becker, de Groot, and Marshak (1964)). We do not allow for intermediate cases such as different qualities of information, for example.

Another treatment aspect is whether X's decision on information acquisition is revealed to Y (strategic information acquisition) or not (secret information acquisition). (Not)Knowing c_y, proposer X determines her offer, which responder Y can accept or reject.

The game theoretic solution is based on commonly known opportunism (maximization of own payoff expectation) of both players. Assuming that the responder accepts in case of indifference,[6] the optimal responder strategy of Y is to accept all offers y of at least c_y. Thus, if the proposer is aware of c_y, she should offer $y^*(c_y) = c_y$. Therefore, there are two candidates for the optimal offer y^* : the minimal offer 1 (which will be accepted with probability $\frac{1}{3}$) or $\bar{c}$ (which will always be accepted). Therefore, the optimal offer is $y^* = \bar{c}$ if $10 - \bar{c} \geq \frac{1}{3}(10-1) + \frac{2}{3}c_x$ if X is risk neutral. Thus, one has $y^* = 3$ for $\bar{c} = 3$ and $y^* = 1$ for $\bar{c} = 6$ (if $c_x = 2$). Finally, in case of $\bar{c} = 3$, information acquisition allows the proposer to adjust the offers, increasing proposer's expected payoff from bargaining by $\frac{2}{3}$, i.e., the whole pie (10) minus the expected minimal acceptable offer in case of exploring information ($\frac{2}{3}\bar{c} + \frac{1}{3} = \frac{7}{3}$) minus the payoff of $10 - y^* = 7$ in case of no information. Similarly, the incentive to inform about c_y in case of $\bar{c} = 6$, which is $\frac{4}{3}$, is determined by the difference between the expected payoff utilizing information $10 - \frac{2}{3}\bar{c} - \frac{1}{3} = \frac{17}{3}$ and the expected payoff in case of no information $\frac{2}{3}c_x + \frac{1}{3}9 = \frac{13}{3}$, due to proposer's risk neutrality.[7]

The participants were recruited at the University of Freiburg. Four sessions implement $\bar{c}_y = 3$ (84 participants), five sessions $\bar{c}_y = 6$ (122 participants). Players are randomly assigned to either the proposer's role X or the responder's role Y.

To study the effects of (in)transparent information acquisition also on the individual level, we use the strategy method,[8] i.e.,

- proposer X chooses an offer for all possible states in addition to deciding whether to buy information, and
- responder Y selects between acceptance and rejection for all possible offers and all cases where she knows what X knows and for both levels of c_y.

This method allows us to categorize participants with respect to several criteria, and by cluster analysis, to reveal the correlations between different behavioral phenomena. For each responder we can, for instance, elicit all acceptance thresholds. We will see that responder behavior is quite central for understanding proposer behavior.[9]

At the end of the experiment we randomly chose a treatment (i.e., informational setup, outside option, price of information) for any cohort and partner for each participant and we paid out the corresponding profits. The average earning was €3.80.

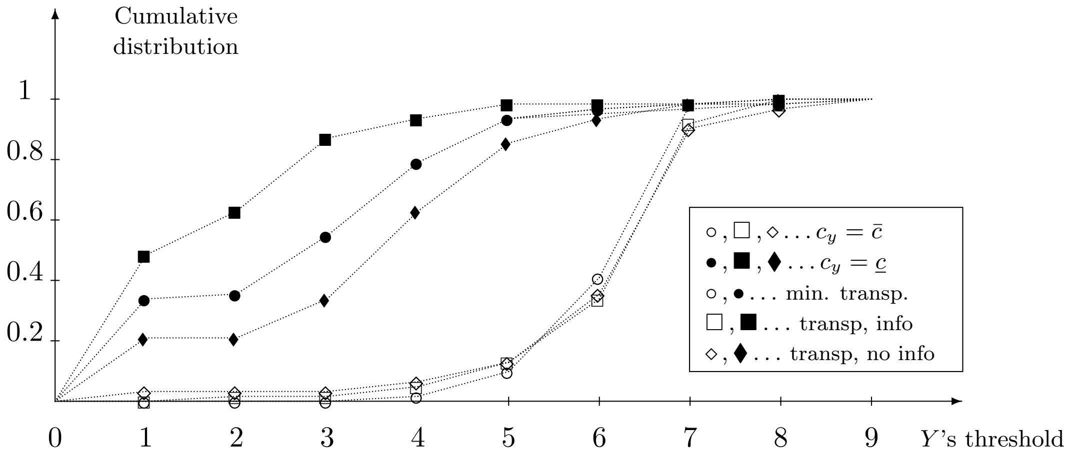

Figure 1: Cumulative distributions of Y's acceptance thresholds, $\bar{c} = 6$

3 Description of Strategies

3.1 Response Behavior

Figure 1 presents the cumulative distributions of responders' acceptance thresholds for $\bar{c} = 6$ and the six scenarios considered. (Figure 4, depicting the patterns for $\bar{c} = 3$, is analogous and deferred to the Appendix.) The vertical axis measures the share of responders with acceptance threshold not exceeding the corresponding offer level of the horizontal axis (cumulative distribution). The black points (●, ◆, ■) represent responders with low outside option ($\bar{c} = 0$), while the white points (○ , ◇ , □ ,) represent the high outside option ($\bar{c} = 6$).

An opportunistic responder would accept any offer that is not lower than her outside option. Formally, the set of acceptance threshold is $\{c_y, c_y + 1\}$. The cumulative distribution of rational responders with a low outside option would reach level 1 directly for offer 1, while the cumulative distribution of rational responders with a high outside option would follow 0 until offer 6 (no rational responder with outside option accepts offer below 6) and jump up to 1 for offer 7. How does the observed behavior correspond to this fact?

One systematic trend in the response data is the "willingness" to play optimally increases with the outside option in case of intransparency (○, ●). More than 85% of players play "accept" 6 or "accept" 7 in the case of outside option 6. This share is significantly[10] higher than the corresponding 53% in case of outside option 3. The rates are approx. 43% and 36% for the two cases of zero outside option.

A similar behavioral pattern can be observed in case of full transparency with non-informed proposers – $\diamond$, $\blacklozenge$, (or full transparency with informed proposers – $\square$, $\blacksquare$). With non-informed (informed) proposers X , we observed 21 (28) optimal responses out of 41 in the case of outside option 3, compared to 48 (49) out of 62 in the case of outside option 6. Employing an analogous test, as in the intransparency case, we can reject the hypothesis of identical success rates ($p = 0.01$) in the case of non-informed proposers X only. [11]

Another systematic trend is the following new feature of response behavior:

Result 1 *Transparency significantly impacts on acceptance thresholds of responders with low outside options.*

The share of opportunistic and fair play strongly depends on the information status of proposer X (informed vs. non-informed). This phenomenon is particularly clear for low outside options ($\bar{c} = 3$) where the two strategies (fair vs. rational) differ. While on average five of eight responders Y with the low option accept the smallest offer 1 from the informed proposer X , just one of three responders Y accepts it when proposer X is non-informed. A similar behavioral pattern[12] shows up for $\bar{c} = 6$: almost half of responders Y with low outside option accept the offer 1 from informed proposers X , and only approx. one fifth of responders Y accept this offer from non-informed proposers X . The strategies of responders Y with low outside options are presented in Table 5 in the Appendix.

Figure 1 also visualizes the impact of transparency on responder behavior. For the low outside option we observe the highest share of aggressive responders in case of full transparency and non-informed X (line $\blacksquare$). The lowest share occurs in case of full transparency and informed proposers X (line $\blacklozenge$). Here responders Y are aware that proposer X is informed about c_y when making the offer. The case of intransparency (line $\bullet$) rests between the two.

The fact that in the case of high outside option $c_y = 6$, responders Y neither care about proposer X's information nor transparency is demonstrated by the confluence of the "white" lines $\circ$, $\square$, $\diamond$ in Figure 1.

Strategy of X	Outside Option 3				Outside Option 6			
	Bad	Good	$E\pi_x$	# X	Bad	Good	$E\pi_x$	# X
1	**4.87**	2.17	3.07	2	**4.37**	2.00	**2.79**	**5**
2	5.23	2.15	3.17	5	4.13	2.00	2.71	3
3	5.97	**2.49**	**3.65**	**8**	4.74	2.00	2.91	13
4	5.49	**4.24**	**4.66**	**17**	5.16	2.07	3.10	19
5	4.92	4.49	4.63	9	4.81	2.30	3.13	9
6	4.00	3.90	3.93	2	3.94	**2.82**	3.19	5
7	3.00	3.00	3.00	0	2.98	**2.98**	2.98	6
8	2.00	2.00	2.00	0	2.00	2.00	2.00	0
9	1.00	1.00	1.00	0	1.00	1.00	1.00	0

Table 1: Strategies of non-informed X, informational barrier

3.2 Proposals

The behavioral heterogeneity of the responder population, described above, generates a nontrivial decision problem even for a rational proposer who correctly anticipates the true population characteristics. Table 1 presents the expected payoffs of particular proposer strategies against the given population of responders and the number of non-informed proposers that actually used this strategy.[13]

We can deduce from Table 1 that even the heterogeneity of the responder population does not provide strong incentives for proposer X to deviate from opportunism (see similar or closely related findings of Harrison and McCabe (1996), and Güth et al. (2003)). In case of outside option 3, the best offer is 4. In case of outside option 6, basically all offers by proposer X (smaller than 8) yield a similar expected payoff.

According to our data, there is a relatively small range for exploiting the information. In case of outside option 3, the largest expected profit of 4.66 is generated by an offer of 4. When informed about Y's outside option, X should slightly change her strategy and play 3 (yielding the maximal payoff 5.97 in that column) if the outside option of Y is low, and 5 (yielding maximum of 4.49 in that column) if she receives the information that Y's outside option is 3. Thus, her expected payoff is $\frac{1}{3}5.97 + \frac{2}{3}4.49 = 4.98$. Comparing the rational expectation approach[14] with the empirical value of information for the actual population play, we find that those two measures differ by 0.32.

	Outside Option 3						Outside Option 6					
	Unknown		Bad		Good		Unknown		Bad		Good	
X	Eπ_x	#X	Eπ_x	#X	Eπ_x	#X	Eπ_x	#X	Eπ_x	#X	Eπ_x	#X
1	3.12	1	**6.20**	**19**	2.34	0	**2.64**	**2**	**5.39**	**26**	2.00	1
2	2.96	2	6.05	8	2.29	1	2.55	3	5.77	17	2.10	0
3	**3.43**	**7**	6.00	3	**2.49**	**6**	2.67	5	6.35	6	2.08	2
4	**4.62**	**14**	5.50	4	**4.93**	**21**	3.01	10	5.74	4	2.19	4
5	4.53	14	4.85	5	4.63	7	3.11	16	4.95	5	2.39	5
6	3.79	3	4.00	3	3.85	2	3.10	18	3.97	1	**2.68**	**14**
7	2.98	0	3.00	0	2.98	4	2.93	6	2.98	0	**2.92**	**33**
8	2.00	2	2.00	0	2.00	2	2.00	0	2.00	0	2.00	1
9	1.00	0	1.00	1	1.00	0	1.00	0	1.00	1	1.00	0

Table 2: X strategies in the case of full transparency

Using the same analysis for the case of outside option 6, we can see that in this case the best strategy 6 yields 3.19 . When informed about Y's outside option, the optimal strategy for X is either 4 or 7, yielding the expected profit $\frac{1}{3}5.16 + \frac{2}{3}2.98 = 3.71$. Consequently, in this case the value of information is about 0.52.

Table 2 presents the strategies of informed proposers. In case of outside option 3, the best offers were 4-5 without information and, 1(4) when knowing that Y's outside option was low (high). X-participants surprisingly often behaved in this way. Basically, two thirds of them played either best or second-best replies to Y-behavior in all three cases. An analogous conclusion holds for the outside option 6, as revealed by Table 2. On average, participants anticipated the empirical population characteristics quite closely. In this sense proposers seemed smart on average.

4 Value of Information

In the previous section, we already discussed how, in principle, proposers with rational expectations about the responders' population could use this information. Let us now compute the empirical value of information.

Setup		Outside Option 3					Outside Option 6				
Tr.	Info	Acc.	π_x	$\sum\pi$	Eq.	Fair	Acc.	π_x	$\sum\pi$	Eq.	Fair
Min	No	0.58	4.19	7.74	3.65-4.66	4.63	0.35	3.01	8.16	2.79	3.13
Min	Yes	0.54	4.10	7.27	3.28-4.45	4.63	0.50	3.20	7.89	3.34-3.44	3.13
Full	No	0.65	4.11	8.31	3.43-4.62	4.53	0.42	2.99	8.35	2.64	3.11
Full	Yes	0.71	4.63	8.27	3.72-5.35	4.70	0.63	3.64	8.56	3.58-3.74	3.24

Table 3: Average payments and acceptance ratios for different strategies

4.1 Social Value of Information

First, we pool all X- and Y-decision data and compare the *per capita* payoff in different scenarios (see Table 3)[15]. In fact, we only compare the average payoffs with and without information, i.e., the information incentives according to the actual strategy profiles of (non)informed proposers and responders.

The left part of the first row of Table 3 refers to an outside option of 3 with the informational barrier. Although the value of information for the "perfect-belief" strategy of X is 0.32 in this case (see the computation in Subsection 3.2), the empirical value of the information is negative for the average proposer. (The payoff to the average informed X is 4.1 in comparison to 4.19 of the non-informed X.) If the outside option of responder Y is 6, information becomes valuable since the proposer's average payoff with(out) information is 3.2(3.01). However, here the actual gain of 0.19 is also far below the "true" beliefs effect (0.52).

Result 2 *The (social) value of information is significantly*[16] *positive in case of transparency.*

The average payoff of the informed proposer increases from 4.11 to 4.63 for $\bar{c} = 3$ and from 2.99 to 3.64 for $\bar{c} = 6$. However, here one also suffers from "non-true" expectations (in case of $\bar{c} = 3$, the information surplus is 0.51 vs. 0.73; in case of $\bar{c} = 6$, it is on average 0.65 vs. 0.95).

Although the value of the information is positive for proposers, in three of four cases, the average pair (of X and Y) is worse off since responders must bear the costs.[17] The loss

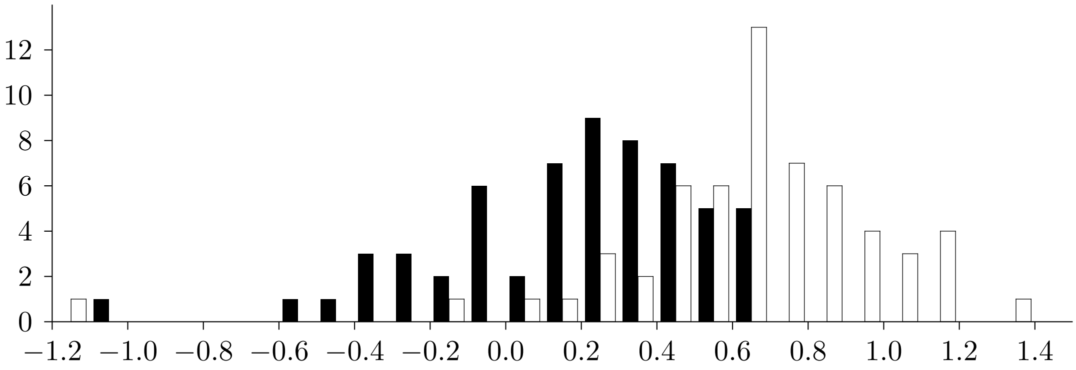

Figure 2: Distribution of empirically realized value of the information, $\bar{c} = 6$

of efficiency is $7.74 - 7.27 = 0.47$ ($\bar{c} = 3$ and no transparency), $8.16 - 7.83 = 0.27$ ($\bar{c} = 6$ and no transparency), and only $8.31 - 8.27 = 0.04$ ($\bar{c} = 3$ and transparency). Only in case "$\bar{c} = 6$ and transparency" does the average pair profit increase by 0.21.

The positive efficiency effect of transparency applies to all scenarios. The social gain caused by transparency varies from 0.19 ($\bar{c} = 6$ without information acquisition) and 0.57 or 0.67 ($\bar{c} = 3$ without acquisition, or $\bar{c} = 6$ with acquisition) even to remarkable 1.0 in case "$\bar{c} = 3$ with acquisition." The same behavioral pattern is captured by the acceptance ratio, which increases by 7–17% after removing the informational barrier depending on the particular case.

Result 3 *The impact of transparency on both proposer's and social payoffs is significant for informed proposers.*

4.2 Individual Value of Information

Until now we have only discussed the aggregate data. What does our experiment reveal about individual behavior? Let us examine the individual value of information ν_i resulting from the strategy profile of X_i, as she faces the empirical population of Y. Figure 2 presents the empirical distribution of ν_i for $\bar{c} = 6$. The horizontal axis stands for ν_i. Black columns present the number of participants in the given interval for the case of intransparency, the white columns correspond to the transparency treatment. Figure 6 which applies to the case of $\bar{c} = 3$, is presented in the Appendix.

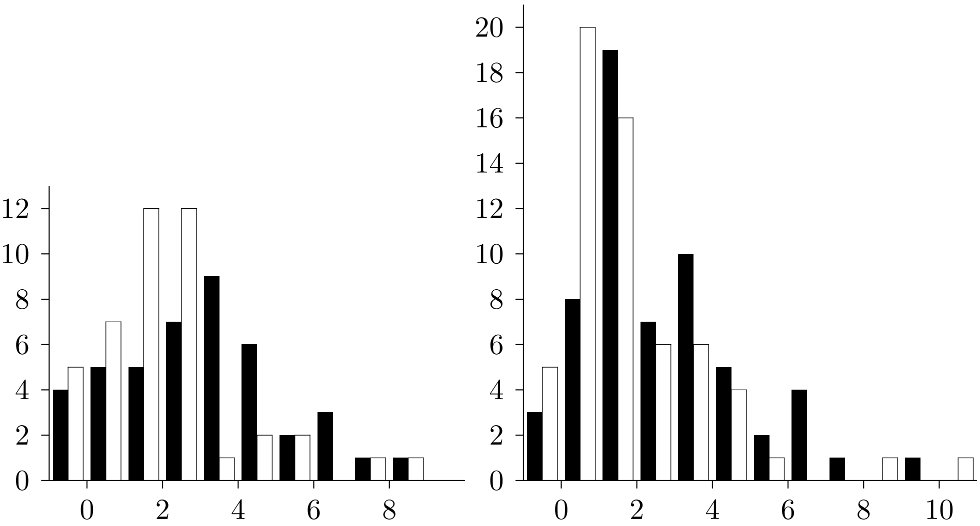

Figure 3: Distribution of information overvaluation

Considering these results and the reservation price p_i of information indicated by player X_i , we define the individual overvaluation of information by $e_i = p_i - \nu_i$. The distribution of e_i in Figure 3 resembles a skewed normal distribution with most participants close to average. Further, we observe an extreme overestimation of the value of information (e.g., in case of outside option 3 and intransparency, more than 50% of proposers are willing to pay at least 3 more than the information yields, given their strategy profile and the empirical population of responders).

Result 4 *Individual overvaluation of information e_i is significantly positive.*

Based on this huge overvaluation of information, the following question seems to be natural: can we characterize a cluster of participants performing significantly better (worse) than average? The following hypothesis is tested: we suppose that agents that perform poorly (i.e., have small ν_i) also fail in their price-setting behavior (big e_i). This intuition is supported particularly well in the case of transparency and outside option 6. Analyzing the median-split of the proposers' population with respect to e_i and ν_i we get the following table:

	adequate ($e_i \leq m_e$)	excessive ($e_i > m_e$)
adequate ($\nu_i \geq m_\nu$)	22	8
excessive ($\nu_i < m_\nu$)	6	24

Scenario		Stat. description						OLS-estimation			Clustering	
Tr.	$\bar{c}$	μ_ν	σ_ν	μ_p	σ_p	μ_e	σ_e	Trend	St.err.	Acc.	Diag.	Off
Min	3	-.081	.570	2.87	3.52	2.96	4.72	-.549	.378	.155	30	13
Min	6	.187	.118	2.88	4.18	2.69	4.36	-.265	.782	.736	38	22
Full	3	.521	.738	2.50	2.82	1.98	3.99	-.295	.302	.334	27	16
Full	6	.644	.138	2.42	3.52	1.78	4.19	-2.04	.601	.001	46	14

Table 4: Information: analyzing value vs. price

More than 75% of the population rest on the main diagonal. This difference is statistically significant for all four scenarios (see the last two columns in Table 4). We conclude that the population of responders is composed of individuals with different abilities when when it comes to stating bargaining offers and valuing information.

It could be that one cluster (large e_i, low ν_i,) is largely motivated to buy information because of ambiguity aversion, while the other cluster values information qualitatively in line with standard rational choice theory. To test this hypothesis, we run a linear regression with reservation prices p as dependent variable and the empirical value of information as an explanatory one. A positive intercept might be interpreted as a measure of intrinsic curiosity or ambiguity aversion, while a positive slope would account for reacting to informational value. By means of standard OLS, we obtain, e.g. for $\bar{c} = 6$ and full transparency,

$$p = \underset{(0.45)}{3.73} - \underset{(0.60)}{2.04}\ \nu\,,$$

where both coefficients are significant $(p < 0.005)$. The negative covariance $Cov(p, \nu)$ applies to all scenarios, but is statistically insignificant. All the relevant statistics regarding ν, p, and e and the results of the OLS and clustering analysis are summarized in Table 4, with "trend" denoting the coefficient of ν and "Acc." its significance, respectively.

Result 5 *Information overvaluation e_i reacts (significantly) antagonistically to overall performance ν_i.*

Overall, we conclude that there is strong intrinsic curiosity or ambiguity aversion. This is particularly true for individuals with a low absolute value, or even negative ν_i, for being informed.

5 Conclusions

In our experiment, the empirical value of proposers being informed about responders' conflict payoffs is positive in case of the high outside option 6, but negative in case of the low outside option 3, when responders do not know whether proposers are informed (intransparency). In such cases proposers seem to play too aggressively, i.e., their offers are too low and are often punished by similarly aggressive responders. In case of low outside options, knowledge of responders about the information type of proposers (transparency) is more valuable for proposers (in terms of average payoffs) than the actual value of information about the responder's outside option. Note that the empirical value of information depends on both, the behavior of proposers and of responders. If one concentrates only on one player (i.e., proposers), one may miss relevant aspects.

Proposers systematically overweight the individual value of information by large margins. Ambiguity aversion or intrinsic curiosity could explain the high degree of individual overbidding (e.g., Salo and Weber, 1995). This systematic overestimation is moderated by transparency in a strategic context.

Our main finding is similar to Kraemer et al. (2006) and Kübler et al. (2004) who also find excessive information acquisition, albeit in nonstrategic sequential purchasing scenarios,[18] where prices are unaffected by individual information. The emphasis of these authors is on social learning, i.e., to test whether individuals take into account social information. They find systematic overvaluation of private signals leading to excessive investment in information acquisition. By contrast, we report excessive overvaluation of information in strategic bilateral bargaining where social learning is not possible, and where (in)transparency of information acquisition seems more relevant than in large markets.

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Notes

[1]Game theoretically, (in)transparency determines whether (or not) ultimatum bargaining qualifies as a proper subgame of the overall interaction.

[2]Güth, Ritzberger, and van Damme (2004) illustrate a similar weakening of ultimatum power for a situation where the pie, the monetary amount to be shared, is randomly determined after the proposer's choice of demand and before the responder's choice of acceptance.

[3]Ambiguity aversion (see Ellsberg (1988) or Salo and Weber (1995)), e.g., suggests that transparency improves the willingness to invest.

[4]Our more general conjecture which is partly based on experimental findings (e.g., from the fair-division game-experiments of Güth at al. (2002)), is that privately known payoffs render equity theory (see originally Homans (1961)) less appealing since its information prerequisites are no longer satisfied.

[5]In the ultimatum game, the responder is aware of the payoff proposal. For the so-called Yes-or-No game where the responder does not know this (Güth, Levati, Ockenfels, and Weiland, 2005), the responder might invest in information about the payoff proposal and thus transform the Yes-or-No game into an ultimatum game (for an experimental analysis see Gehrig, Güth, Levínský, and Uske, 2006).

[6]The benchmark solution when Y rejects in case of indifference can be derived analogously (see the next footnote).

[7]If the responder rejects in case of indifference, X's information incentive is 1 for $\bar{c} = 3$ and $\frac{2}{3}$ for $\bar{c} = 6$.

[8]The English translation of the instructions is available from the authors upon request.

[9]In fact, while the literature concentrates on proposer behavior, relatively little is known about responder behavior. One notable exception is Huck (1999).

[10]The following methodology is used: In the sample of z_3-choices (z_3 equals to one

for the acceptance threshold 3 or 4 and to zero otherwise in case of $\bar{c} = 0$), we observe 22 successes in 41 trials, so z_3 has binomial distribution $b(41, \frac{22}{41})$. Correspondingly, z_6 is $b(61, \frac{54}{61})$. Considering the fact that z_i has approximately normal distribution, the standard test concerning the equality of means can be employed. The zero hypothesis $\mu_3 = \mu_6$ can be rejected ($p < 0.0001$).

[11]With informed proposers X, the difference between the two populations is insignificant even for $p = 0.1$.

[12]Such a pattern is, of course, at odds with sequential rationality of self-centered Y-players who are only interested in their own payoff. It seems as if Y-participants want to punish X-gambling: "Okay, I'am willing to accept an insultingly low offer in case of $c_y = 0$, but only if I know that you know that $c_y = 0$!"

[13]We denote in bold type the optimal behavior in all the tables throughout the paper.

[14]The actual earning difference of (non)informed X-participants is influenced by the random matching of X- and Y-participants which we ruled out when comparing the payoff expectations based on rational anticipation.

[15]In Table 3 "Tr." stands for transparency, with "Min" representing the informational barrier and "Full" full transparency, "Info" whether or not information has been acquired, "Acc." is the acceptance ratio, "π_x," or "$\sum \pi$" the average of all X- or $X + Y$-payoffs, "Eq." compares the payoff in the theoretical equilibrium case (lower bound for offer $\bar{c}$, upper bound for offer $\bar{c} + 1$), and "Fair" in the case of fifty-fifty offer 5.

[16]When comparing the distributions of π_x in case of "Full," one obtains that "Yes" yields significantly ($p = 0.01$) larger profits than "No."

[17]See "$\sum \pi$"="$\pi_x + \pi_y$" in Table 3. Since $\sum \pi$ is 10 whenever y is accepted by Y, the variation of $\sum \pi$ is due to the different acceptance rates in Table 3 and the randomness of $\pi_y = \underline{c}$ or $\pi_y = \bar{c}$ in case of conflict.

[18]Rötheli (2001) made another attempt to explore the possibility of underinvestment in information acquisition in a nonstrategic context.

References

Anderson, L. and Holt, C. (1997), Information Cascades in the laboratory, *American Economic Review* 87, 847–862.

Becker, G. M., De Groot, M. H. and Marshak, J. (1964), Measuring Utility by a Single-Response Sequential Method, *Behavioral Science* 9, 226–232.

Eisenberger, R. and Weber, M. (1995), Willingness-to-Pay and Willingness-to-Accept for Risky and Ambiguous Lotteries *Journal of Risk and Uncertainty* 10, 223–33.

Ellsberg, D. (1988) Risk, Ambiguity, and the Savage Axioms in: Ellsberg, D. (ed.) *Decision, probability, and utility: Selected readings*, 245–69, Cambridge, New York and Melbourne: Cambridge University Press.

Forsythe, R., Palfrey, T. and Plott, C. (1982), Asset valuation in an experimental asset market, *Econometrica* 50, 537–68.

Güth, W., Ivanova-Stenzel, R., Königstein, M. and Strobel, M. (2002), Bid Functions in Auctions and Fair Division Games: Experimental Evidence, *German Economic Review* 3(4), 461–84.

Güth, W., Gehrig, T., Levínský, R. and Uske, T. (2006), I want to know: Willingness to pay for unconditional veto power, *mimeo.*

Güth, W., Levati, M. V., Ockenfels, A., and Weiland, T. (2005), Yes or no or 'buying a pig in a poke'-game: an experimental study of unconditional veto power, *MPI Discussion Papers on Strategic Interaction* 39.

Güth, W., Ritzberger, K. and van Damme, E. (2004), On the Nash bargaining solution with noise, *European Economic Review* 48, 697–713.

Güth, W., Schmidt, C. and Sutter, M. (2003), Fairness in the Mail and Opportunism in the Internet: A Newspaper Experiment on Ultimatum bargaining, *German Economic Review* 4(2), 243–265.

Harrison, G. W. and McCabe, K. A. (1996), Expectations and Fairness in a Simple Bargaining Experiment, *International Journal of Game Theory* 25(3), 303–27.

Homans, C. G. (1961), *Social behavior: its elementary forms* (Routledge & Paul, London).

Huck, S. (1999), Responder behavior in ultimatum offer games with incomplete information, *Journal of Economic Psychology* 20, 183-206.

Kraemer, C., Nöth, M. and Weber, M. (2006), Information Aggregation with Costly Information and Random Ordering: Experimental Evidence, *Journal of Economic Behavior & Organization* 59, 423–432.

Kübler, D. and Weizsäcker, G. (2004), Limited depth of reasoning and failure of cascade formation in the laboratory, *Review of Economic Studies* 71, 425–442.

Nöth, M. and Weber, M. (2003), Information aggregation with random ordering: cascades and overconfidence, *Economic Journal* 113, 166-186.

Plott, C. and Sunder, S. (1982), Efficiency in experimental securities markets with insider information: an application of rational expectation models, *Journal of Political Economy* 90, 663–98.

Plott, C. (1987), Rational choice in experimental markets, in: Hogarth R. and M. Reder (eds.): *Rational Choice: The Contrast between Economics and Psychology* (University of Chicago Press, Chicago).

Rötheli, T. (2001), Acquisition of costly information: an experimental study, *Journal of Economic Behavior & Organization* 1360, 1–21.

Salo, A. and Weber, M. (1995), Ambiguity Aversion in First-Price Sealed-Bid Auctions, *Journal of Risk and Uncertainty* 11, 123–37.

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6 Appendix

	Info vs. No Info X (case 3)									Info vs. No Info X (case 6)								
Y	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1	**11**		6	5	2					**11**		5	6	6		1	1	
2			1	2						1		1	4		2			
3	2		1	1	1					1		2	4	6	1	1		
4			1		2								2	1	1			
5				1		1							1	1	1			
6						1	1											
7																		
8																1		
9																		

Table 5: Responders' behavior vs. informed and non-informed proposers

The lines correspond to responders' behavior against informed proposers X , while columns correspond to behavior facing non-informed X . The behavioral asymmetry is captured by the triangular shape of the table. The majority of participants is located in the upperright triangular which reflects the fact that the acceptance treshold facing informed proposers is smaller than in the case of non-informed proposers. Less than one fourth of players (11) play the equilibrium strategy (1,1). We only observe four outliers below the diagonal.

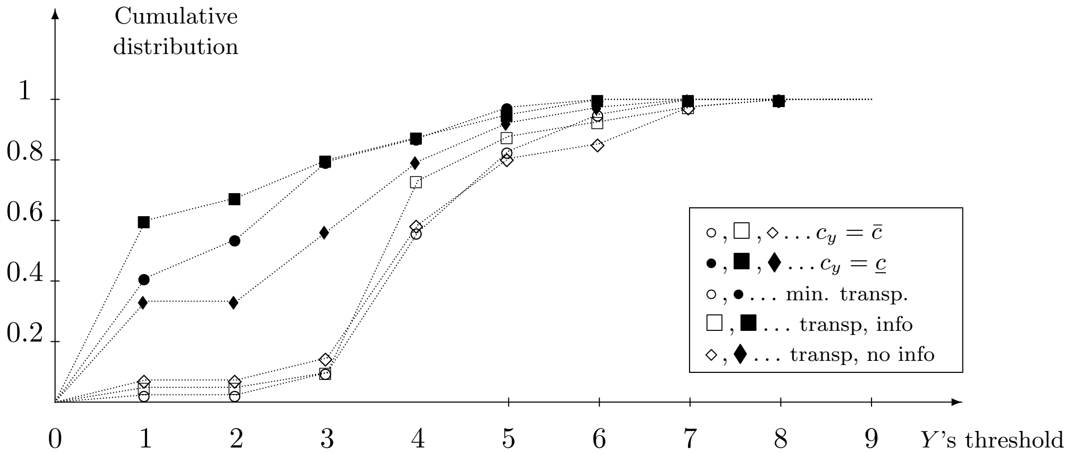

Figure 4: Cumulative distributions of Y's acceptance thresholds, $\bar{c} = 3$

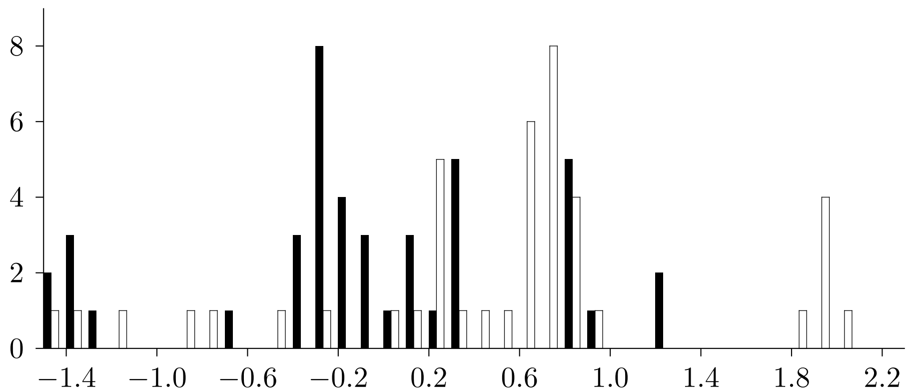

Figure 5: Distribution of empirically realized value of information, $\bar{c} = 3$