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The willingness to pay-willingness to accept gap: A failed replication of Plott and Zeiler

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Wissenschaftszentrum Berlin
für Sozialforschung



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**The Willingness to Pay-Willingness to Accept Gap:
A Failed Replication of Plott and Zeiler**

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Abstract

The Willingness to Pay–Willingness to Accept Gap: A Failed Replication of Plott and Zeiler

by Dietmar Fehr, Rustamdjan Hakimov and Dorothea Kübler*

We report on experiments to replicate Plott and Zeiler's (2005) findings that the WTP-WTA gap disappears when using procedures that are aimed at reducing misunderstandings, such as training rounds for the BDM mechanism. Following the design by Plott and Zeiler (2005) and Isoni, Loomes, and Sugden (2011) who re-ran the Plott/Zeiler experiments to study the paid practice rounds with lotteries, we replicate the findings from the lottery tasks where a WTP-WTA gap is present in all studies. However, unlike in the two previous studies the WTP-WTA gap does not disappear in the main task where subjects state their WTA or WTP for a mug. We introduce two additional lottery tasks to classify subjects and find that even for the most rational group of subjects who never make dominated choices in the paid practice rounds, the WTP-WTA gap in the mug task exists. The findings are replicated in a similar experiment with USB sticks instead of mugs.

Keywords: endowment effect; WTP–WTA gap; BDM mechanism; misconceptions; replication

JEL classification: C72, C92

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1. Introduction

The disparity between the willingness to accept (WTA) and willingness to pay (WTP) has long been considered as one of the most firmly established results in experimental economics. It documents that a person's perceived value of an item depends on whether the person owns the item or not. This effect is unsettling for economists because it implies that trade is hampered by a status quo bias. The Coase Theorem breaks down and procedures matter for outcomes in a non-trivial way, which has important implications for the design of economic institutions. A large literature dating back to the 1960s has elaborated on the "endowment effect" (see Ericson and Fuster, 2014, for a recent survey).¹

Two papers by Plott and Zeiler (2005, 2007) question the validity of much of the earlier discussions. They demonstrate how the experimental procedures that are typically used to show the "endowment effect" or WTP-WTA gap contribute to or even generate the effect. Plott and Zeiler (2005) [henceforth PZ] show that the WTP-WTA gap disappears when procedures are employed that are aimed at reducing misconceptions of subjects.² In the absence of a theory or a clear definition of misconceptions, PZ propose that these procedures implicitly contain theories of misconceptions. Most importantly, PZ use extensive training and elicit subjects' valuations for lotteries to familiarize subjects with the Becker-DeGroot-Marschak (BDM) mechanism (Becker, DeGroot, Marschak, 1964) before they proceed to explore the WTP-WTA gap for mugs.³ While PZ argue that the data from these paid practice rounds should not be used to measure a WTP-WTA gap because they are contaminated by their training purpose, Isoni, Loomes and Sugden (2012) [henceforth ILS] document the presence of a WTP-WTA gap in the lottery tasks of PZ.⁴ In an effort to add more control to the practice rounds than in PZ, ILS run additional experiments and document a valuation gap in their lottery task data as well. Consistent with PZ, though, they find no gap in their classic mug experiment. Although both PZ and ILS show that the WTP-WTA gap in the classic mug experiment disappears if subjects receive extensive instructions and training, the presence of a gap

¹ The term endowment effect was introduced by Thaler (1980) as a description of the tendency of individuals to overweight opportunity costs. In a seminal contribution, Kahneman, Knetsch, and Thaler (1990) provided experimental evidence of the endowment effect in an environment which carefully controlled for alternative explanations of the endowment effect. Subsequently, their contribution sparked not only a series of new experiments that investigate the robustness of the endowment effect, but also theoretical contributions that try to reconcile the various findings (e.g., Köszegi and Rabin, 2006), provide evolutionary foundations (e.g., Huck, Kirchsteiger and Oechssler, 2005) or use standard economic arguments to explain the gap (e.g., Hanemann, 1991).

² Other research, for example, shows that experience with trading alleviates or eliminates the WTP-WTA gap (see e.g., List, 2003, Engelmann and Hollard, 2010).

³ To be more precise, PZ first identify procedures typically used by experimentalists to control for subject misconceptions and then apply them all simultaneously. This includes employing an incentive compatible mechanism to elicit valuations, explaining the optimal responses to subjects, performing unpaid and paid practice rounds, ensuring the anonymity of decisions and payouts and measuring the gap directly through valuations.

⁴ While the paid practice rounds in PZ could be used to investigate a WTP-WTA gap, PZ emphasize that these rounds were explicitly designed for training purposes. For example, there was no randomization of the order of WTA and WTP tasks and practice rounds were continuously used for mistake corrections, public answers to questions, etc. PZ also note that the lottery data is possibly contaminated by subjects' misconceptions, such as failing to understand the BDM mechanism or failing to understand statistical independence (see PZ, Fn 15, and Plott and Zeiler, 2011).

in the practice rounds in both studies raises the question of whether misconceptions are really responsible for the gap. In fact, the data for the paid practice rounds in ILS reveal substantial heterogeneity in valuations for lotteries, which suggests that misconceptions need not be present for all subjects.

We aim to shed more light on the important but puzzling findings of PZ and ILS and conduct a series of new experiments. More specifically, in these new experiments we are interested in the heterogeneity of subject misconceptions. Our main idea is that if misconceptions about the BDM procedure indeed cause the WTP-WTA gap, then we should be able to see a difference in the gap between those subjects who understand the BDM procedure well and those who do not understand it. In particular, we expect to see no WTP-WTA gap for subjects who do not suffer from misconceptions about the BDM mechanism. To identify these subjects we add two new lotteries and exploit existing features of the 14 lottery tasks employed by PZ. The new lotteries allow us to pin down irrational behavior in the valuation of an uncertain monetary outcome. This is because the two outcomes of these two extra lotteries are quite similar such that the range for undominated bids is quite small and because subjects gained substantial experience with the BDM procedure before playing these lotteries. In addition, we further restrict the subsample by requiring subjects to submit undominated bids for the four degenerate lotteries that pay a known monetary outcome for sure. As the third and strongest criterion, subjects are required to make undominated bids for the two extra lotteries and all 14 lotteries from PZ. Applying these three different conditions, we identify sets of subjects who are unlikely to lack a good understanding of the BDM mechanism.

Just like PZ and ILS, we find a strong WTP-WTA gap in the lottery rounds. In contrast to PZ and ILS, however, we also find this gap in the main task where subjects submit their WTA or WTP for a mug. Although the procedures of PZ (and ILS) eliminate misconceptions about the BDM mechanism in at least some of our subjects, we find that a sizeable share of subjects still lack an adequate understanding of the mechanism even after extensive training and several paid practice rounds. Our main result is that we find a gap for both groups of subjects, those who do not display any signs of misconceptions and those who clearly lack a full understanding of the BDM mechanism. More specifically, subjects who we classify as rational according to the three criteria described above, show an equally strong gap as subjects without a good understanding of the BDM. Thus, we provide evidence that misconceptions about the BDM mechanism are unlikely to be the main driving force of the WTP-WTA asymmetry. In addition, we ran sessions in which the training and paid practice rounds differed slightly from PZ and ILS and where the final task consisted of buying or selling a USB stick. Again, we observe the WTP-WTA gap in the final task.

Not replicating a result is unsettling, especially as both PZ and ILS found that the WTP-WTA gap disappears in the mug task.⁵ However, our findings are in line with Koh and Wong (2012), who attempt to replicate the experiments of PZ without using paid practice rounds but relying on a series of Yes/No questions to explain how to determine the WTP and WTA. They find a WTP-WTA gap that is insignificant in two small samples but becomes significant in the pooled sample. Moreover, they show that when strengthening the reference states of possession or non-possession

⁵ Other studies that apply the PZ procedures, such as Brown and Cohen (2014) and Kovalchik et al. (2005) support the findings of PZ (and ILS) for the mug task.

while using the PZ procedures to clarify the properties of the BDM mechanism, the WTP-WTA gap remains significant. This indicates that the results by PZ are at least in part due to a weakening of the reference state and not only to subject misconceptions. In contrast, our findings reveal that the weaker reference state of the PZ procedures has no bearing on the existence of the WTP-WTA gap.

While writing up our results, we became aware of the contemporaneous and independent work of Bartling, Engl, and Weber (2014). Similar to our paper, they find that subjects for whom it is reasonable to assume that they understood the BDM mechanism, display a WTP-WTA gap for a box of chocolates. While our aim was to replicate the results of PZ and ILS as closely as possible using the features of their experiment to identify subject misconceptions, Bartling, Engl, and Weber (2014) challenge the results of Cason and Plott (forthcoming) who observe misconceptions about the BDM mechanism and argue that such misconceptions are often interpreted as support for theories of framing, such as reference-dependent preferences. Our papers mainly differ in the tasks used to practice the BDM and to classify subjects. Bartling, Engl, and Weber (2014) use the BDM to elicit the subjects' valuation for a card with a known value (as in Cason and Plott, forthcoming). They presented subjects with the payoff consequences of their choices and asked them to compute the gains or losses given their bid and each possible random draw. In contrast, we train subjects as in PZ and ILS by explaining the BDM mechanism at length, going through unpaid practice rounds with them and using paid practice rounds involving lotteries to expose subjects to the consequences of their decisions.

2. Experimental procedures

The experiment consisted of two parts. In the first part subjects received intensive training of the BDM mechanism followed by several paid lottery tasks which aimed at providing subjects with sufficient experience with the BDM mechanism. The second part of the experiment elicited the subjects' valuations for a good with a subjective value (see Appendix E for pictures of the used goods). Importantly, the choices in the first part allow us to classify subjects according to their understanding of the BDM procedure and to subsequently test for the presence of WTP-WTA gap within these subsamples. If subjects who appear to understand the BDM mechanism show a gap in the WTP-WTA valuation, then misconceptions about the elicitation procedure are unlikely to play a role in our student sample. Thus, this would cast doubt on the explanation that the frequently observed WTP-WTA gap is a product of the experimental procedures.

We ran our experiments with the help of computers using z-Tree (Fischbacher, 2007) and we therefore closely followed the procedures of ILS, who also ran a computerized experiment. This involved all five phases of the experiment in PZ – general instructions, worked examples, unpaid training rounds, paid practice rounds, and payment – as detailed below.

The experiment was conducted by a research assistant who received extensive training before the experiment. Moreover, he used a script in order to keep the sessions as similar as possible and to facilitate the replication for different experimenters or researchers (see Appendix C). On arrival, subjects were randomly assigned to computers, and they received printouts of the written instructions (see Appendix B). These instructions were taken from PZ and translated into

Table 1: Overview of lotteries

		Plott & Zeiler (2005)		Our replication		
		Lotteries A	Lotteries B	Mug sessions	USB sessions*	
Small-stakes	Val. type					
	Small-stakes	WTA	<i>L1</i>	\$0.20, 0.5; \$0.20, 0.5	\$0.20, 0.5; \$0.20, 0.5	€0.20, 0.5; €0.20, 0.5
<i>L2</i>			\$0.35, 0.5; \$0.35, 0.5	\$0.35, 0.5; \$0.35, 0.5	€0.35, 0.5; €0.35, 0.5	€0.35, 0.5; €0.35, 0.5
<i>L3</i>			\$-0.20, 0.7; \$0.70, 0.3	\$-0.20, 0.3; \$0.70, 0.7	€-0.20, 0.7; €0.70, 0.3	€-0.20, 0.7; €0.70, 0.3
WTP		<i>L4</i>	\$0.30, 0.5; \$0.30, 0.5	\$0.30, 0.5; \$0.30, 0.5	€0.30, 0.5; €0.30, 0.5	€0.30, 0.5; €0.30, 0.5
		<i>L5</i>	\$0.45, 0.5; \$0.45, 0.5	\$0.45, 0.5; \$0.45, 0.5	€0.45, 0.5; €0.45, 0.5	€0.45, 0.5; €0.45, 0.5
		<i>L6</i>	\$-0.10, 0.7; \$0.80, 0.3	\$-0.10, 0.3; \$0.80, 0.7	€-0.10, 0.7; €0.80, 0.3	€-0.10, 0.7; €0.80, 0.3
Large-stakes	WTA	<i>L7</i>	\$0, 0.3; \$7, 0.7	\$0, 0.7; \$7, 0.3	€0, 0.3; €7, 0.7	€0, 0.3; €7, 0.7
		<i>L8</i>	\$0, 0.6; \$5, 0.4;	\$0, 0.4; \$5, 0.6	€0, 0.6; €5, 0.4;	€1, 0.5; €1.5, 0.5
		<i>L9</i>	\$-4, 0.5; \$8, 0.5	\$-4, 0.5; \$8, 0.5	€-4, 0.5; €8, 0.5	€0, 0.6; €5, 0.4;
		<i>L10</i>	\$0, 0.7; \$10, 0.3	\$0, 0.3; \$10, 0.7	€0, 0.7; €10, 0.3	€-4, 0.5; €8, 0.5
		<i>L11</i>			€1, 0.5; €1.5, 0.5	€0, 0.7; €10, 0.3
	WTP	<i>L12</i>	\$1, 0.3; \$8, 0.7	\$1, 0.7; \$8, 0.3	€1, 0.3; €8, 0.7	€1, 0.3; €8, 0.7
		<i>L13</i>	\$1, 0.6; \$6, 0.4	\$1, 0.4; \$6, 0.6	€1, 0.6; €6, 0.4	€1, 0.6; €6, 0.4
		<i>L14</i>	\$-3, 0.5; \$9, 0.5	\$-3, 0.5; \$9, 0.5	€-3, 0.5; €9, 0.5	€-3, 0.5; €9, 0.5
		<i>L15</i>	\$1, 0.7; \$11, 0.3	\$1, 0.3; \$11, 0.7	€1, 0.7; €11, 0.3	€1, 0.7; €11, 0.3
		<i>L16</i>			€1, 0.5; €1.5, 0.5	€1, 0.5; €1.5, 0.5

Notes: * Lotteries 1–8 were seller lotteries (WTA) and lotteries 9–16 were buyer lotteries (WTP).

German. The BDM mechanism was explained in detail in the instructions, and we used a short slide presentation using the examples from PZ’s instructions to publicly explain the BDM mechanism and tasks in the experiment (see Appendix D).

After answering any remaining questions, the experimenter guided the subjects through two worked examples on the screen of their computer, just like in ILS. Again the examples were the same as in PZ (and ILS). Subjects did not have to type in any offers, but just went through the examples together with the experimenter. First they were given a WTP task for the lottery (500, 0.7; 1,000, 0.3). After subjects were familiar with the lottery and the interface, the experimenter announced a hypothetical offer of 700, which also appeared on the screen automatically. Then a predetermined “fixed offer” of 551 was drawn, and the feedback appeared on the screen: “You bought the lottery for 551 points, and the outcome of the lottery is 1000.”⁶ The second worked example for a WTA task for the lottery (1,000, 0.3; 1,000, 0.7) followed the same procedures. The predetermined offer was 1,000, and the draw of the fixed offer was 950.

In a next step, subjects went through two unpaid training rounds, exactly as in ILS. In these two rounds they had to make decisions about the offers themselves, though the decisions were not pay-off relevant. First subjects were asked to state their WTP for the lottery (€3, 0.7; €3, 0.3). Then, they were asked for their WTA for the lottery (€2, 0.5; €4, 0.5). In the first lottery the computer did not accept any value apart from 3 and 2.99, and in the second lottery it did not accept anything below 2 and above 4.01. If a subject entered a suboptimal value, he/she received a message indicating why this bid was not optimal. We used the same messages as ILS. For example, if for the

⁶ Note that ILS used a different fixed offer, namely 501. We chose a fixed offer of 551 in order to avoid the fixed offer being equal to one of the two possible payoffs. We conjectured that this might confuse subjects. In order to allow for positive hypothetical earnings, we implemented a lottery outcome of 1000.

WTP in the first lottery, the value entered was below €2.99, for instance €2.95, the computer would indicate: “You’ve just said that you would be willing to pay at most €2.95 for an item which is worth at least €3. This means that if the fixed offer is between €2.95 and €3 you won’t buy and you will get nothing. Had you bought, you would have got at least €3 and paid only the fixed offer.” During these training rounds, subjects could clarify any remaining issues in private with the experimenter.

After subjects had finished the training rounds and after the experimenter had answered some final questions, we started the paid lottery tasks. Table 1 shows the two lottery series used by PZ and the lottery series used in our replication experiment with mugs. A lottery series consists of six small-stake lotteries and eight high-stake lotteries.

The lotteries in PZ were constructed such that for each WTA lottery $S = (x, p; y, 1 - p)$ there is a corresponding WTP lottery $B = (x + c, p; y + c, 1 - p)$ which is obtained by adding 10 cents to the small-stake lotteries $L1-L6$ and adding €1 to the high-stake lotteries $L7-L10$ and $L12-L15$, respectively. Note that x indicates the low lottery outcome and y the high lottery outcome except for degenerate lotteries where $x = y$. For example, $L7$ is a high-stake lottery (€0, 0.3; €7, 0.7), for which subjects had to indicate their WTA, i.e., they were endowed with the lottery. The corresponding WTP lottery is a high-stake lottery $L12$ (€1, 0.3; €8, 0.7) for which subjects were asked to state their maximum buying price. As pointed out by ILS, this design feature is well-suited for making within-subject comparisons of WTP and WTA valuations.

In our replication experiment, we only used PZ’s lottery series A plus two additional lotteries as explained below. Notice that the lottery outcomes in our experiment are in Euro, while PZ’s lotteries were in dollars. In total, subjects had to indicate their WTA or WTP for 16 lotteries and all of them were payoff relevant. Subjects started out by indicating their WTA value for the first three lotteries and then switched from the seller role to the buyer role to indicate their WTP value for the next three lotteries. Four of the six small-stake lotteries ($L1$, $L2$, $L4$ and $L5$) are degenerate lotteries paying an amount $x = y$ with certainty. For the high-stake lotteries subjects again start indicating their WTA ($L7-L11$) and then switched to the buying task for which they had to state their WTP ($L12-L16$). The fixed offers for each lottery and the mug (USB stick) were randomly drawn at the session level before the start of a session. Also, subjects received an initial endowment of €5 to start with (show-up fee).

In addition to using PZ’s lotteries, we included the lottery (€1, 0.5; €1.5, 0.5) for both the WTA ($L11$) and WTP ($L16$). Notice first that the difference between the two outcomes of this lottery is smaller than in all other non-degenerate lotteries ($L3$, $L6-L10$ and $L12-L15$) and that the two strictly positive outcomes allow subjects to under- or overvalue the lottery. Second, the two lotteries are the final WTA and WTP tasks in order to ensure that subjects have gained substantial experience with the BDM in the previous paid practice rounds. Finally, the lottery is exactly the same for the WTA and WTP task. Therefore, these lotteries are well-suited for identifying subjects who likely do not suffer from misconceptions about the elicitation procedure.

In the second part, subjects were asked to state their WTA or WTP for a mug featuring the logo of the Technical University Berlin. The retail price of the mug is €7.50 in the university shop, but subjects were not informed of the price. All subjects received a mug and had some time to

inspect it, as in PZ.⁷ Then we briefly explained that those who own the mug can sell it to the experimenter and those who do not own the mug can buy it from the experimenter. Subjects were informed of their role on their computer screen. That is, we randomly determined seller and buyer roles in each session and accordingly, subjects were told whether they owned the mug in front of them and were able to sell it or whether they could buy the mug in front of them. Note that ILS introduced a second task after the mug task, which we did not implement in our experiments. In this task of ILS, subjects indicated their WTA or WTP for a lottery which offered a box of luxury chocolates with a probability of 0.25 and offered nothing with 0.75 (chocolate gamble – CG).

After subjects completed the second part, they completed a 10-question 2.5-minute version of the Wonderlic Personal Test, which provides a measure of general cognitive ability.⁸ Subjects received 25 cents for each correct answer in the test. In addition we elicited subjects' attitudes toward losses using a hypothetical choice list (see e.g., Fehr and Götte, 2007 or Trautmann and Vlahu, 2013). In this choice list subjects are presented with six risky lotteries that involve an equal chance of gaining €45 and losing € $x = \{5, 15, 25, 35, 45, 55\}$. For each of these six lotteries subjects indicated whether they accepted or rejected the lottery and they were not required to have a single switching point. The expected value for losses smaller than €45 is positive and rejecting lotteries with $x < 45$ can be explained by reference-dependent preferences. Also, the more lotteries a subject rejects, the more loss averse she is (see e.g. Fehr and Götte, 2007).

Finally, we administered a brief questionnaire which included questions about gender, details about the subjects' field of study, and free-form questions about the experiment including the estimated retail price of each of the two goods. At the end of the experiment, subjects were informed of their earnings and were required to fill out their receipt. Subjects were identified through their computer number and received their final payments from a research assistant in a separate room in private.⁹

In addition to our exact replication effort of PZ and ILS, we first ran an experiment where the main task was to sell or buy a USB stick with a retail price of €8.90. This experiment was intended as a baseline treatment for a project that we never carried out in the end because we failed to replicate PZ. Since we were not genuinely interested in the lottery tasks, we slightly adapted the first part. In particular, we used the same instructions and presentation of the BDM mechanism as in our replication of PZ and ILS and we also introduced the two extra lotteries to gain insights into the subjects' understanding of the procedures. However, we did not implement the two worked examples and the two unpaid practice rounds. Moreover, we used a different experimenter, but she followed the same script as in our replication experiment (except for the worked examples). The most important difference is that we changed the order of lotteries in the first part. That is, we implemented the first eight lotteries as seller tasks using lotteries A from PZ and the last eight

⁷ In ILS subjects were not given a mug. They only saw a picture of the mug on their computer screens. However, in their replication of PZ where the mug task comes before the lottery tasks, they distributed the mugs.

⁸ The complete Wonderlic Personal Test lasts 12 minute for 50 questions. The test is well known for assessing the cognitive ability of rookie football players by the National Football League, but it is frequently used by firms for hiring purposes. For more general information about the test see www.wonderlic.com.

⁹ PZ emphasized the importance of anonymity of payments. However, recent evidence by Brown and Cohen (2014) shows that anonymity is not necessary for the results of PZ.

lotteries as buyer tasks using lotteries B from PZ. The details are shown in the last column of Table 1. We implemented these changes because we wanted subjects to gain experience in the more uncommon seller task first, without switching between the seller and buyer role too often, and we wanted subjects to accumulate sufficient earnings before switching to the buyer tasks. Notice that due to these two changes it is not possible to conduct a within-subject comparison of matched lottery pairs as in the original PZ and ILS experiments or in our replication of PZ and ILS, except for our two extra lotteries. These were the last lotteries for each role (lottery *L8* and *L16* in the last column of Table 1). Since we expected to replicate the findings of PZ but failed to do so, we abandoned the planned project and set out to replicate the PZ result using the procedures laid out above.

We conducted the experiments in November 2013 (USB sessions) and November 2014 (mug sessions). Overall, 191 students from various fields of study participated in the experiments, of them 95 in the mug treatment and 96 in the USB stick treatment. Subjects were recruited from a database where students can register to participate in economic experiments (ORSEE, Greiner 2004). The experiment lasted 90 minutes on average, and participants earned on average €18.46 without a mug/USB stick and €16.05 with a mug/USB stick.

3. Results

3.1. Is there a WTP-WTA gap?

Table 2 presents an overview of WTP-WTA valuations for lotteries in both the mug sessions (Panel A) and the USB-stick sessions (Panel B). More specifically, we report in each column of Table 2 the results from a WTA lottery and the matched WTP lottery in the mug sessions. For the USB-stick treatment, this is not possible as we asked subjects to state their WTA in the first eight lotteries and their WTP in the last eight lotteries. In this treatment, only the additional lotteries *L8* and *L16* can be matched. For each lottery, the table shows the expected value of the lottery (EV), the mean, median, and standard deviation of subjects' offers, the ratio of the mean reported valuation to the EV, and the number of observations. Following ILS, we additionally show the mean and median of the WTA/WTP ratio for each pair of lotteries. Notice that the WTA/WTP ratio is calculated on an individual basis. Finally, we report for each lottery the share of subjects who made weakly dominated bids.

The last column in Table 2 displays the results of our mug and USB-stick task. The resulting statistics are based on a between-subject comparison as subjects acted either as a buyer or seller in these tasks. The last row in each of the two panels shows statistical tests for the hypothesis that WTA and WTP valuations for lotteries are the same using paired t-tests (within-subject comparison) and that WTA and WTP valuations are the same for mugs and USB sticks using t-tests corrected for unequal variances across groups (between-subjects comparison).¹⁰ As our alternative hypothesis is that WTA is higher than WTP in both tasks, the tests are one-tailed. To allow for direct comparisons, we display the results of PZ and ILS in Table A1 in the appendix.

¹⁰ All reported test results are robust to using Wilcoxon signed-rank tests for lotteries and Mann-Whitney tests for mugs (USB sticks).

Table 2: Experimental Results

Panel A. Mug Sessions									
WTA valuation	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L7</i>	<i>L8</i>	<i>L9</i>	<i>L10</i>	<i>L11</i>	Mug
N	95	95	95	95	95	95	95	95	48
EV	0.20	0.35	0.07	4.90	2.00	2.00	3.00	1.25	
Mean	0.22	0.35	0.20	4.48	2.32	2.60	3.51	1.12	3.39
Median	0.20	0.35	0.15	4.90	2.00	2.00	3.00	1.15	3.06
Standard Deviation	0.19	0.05	0.18	1.64	1.01	1.93	1.97	0.43	2.56
Mean/EV	1.09	0.99	2.91	0.91	1.16	1.30	1.17	0.90	
Freq. dominated offers	25.3%	27.4%	1.1%	1.1%	0.0%	1.1%	0.0%	21.1%	
Panel B. USB Sessions									
WTP valuation	<i>L4</i>	<i>L5</i>	<i>L6</i>	<i>L12</i>	<i>L13</i>	<i>L14</i>	<i>L15</i>	<i>L16</i>	Mug
N	95	95	95	95	95	95	95	95	47
EV	0.30	0.45	0.17	5.90	3.00	3.00	4.00	1.25	
Mean	0.31	0.43	0.35	4.91	2.91	2.68	4.11	1.14	1.34
Median	0.30	0.45	0.20	5.00	3.00	3.00	4.00	1.23	1.00
Standard Deviation	0.19	0.08	0.57	2.26	1.18	1.64	2.46	0.25	1.21
Mean/EV	1.04	0.96	2.06	0.83	0.97	0.89	1.03	0.91	
Freq. dominated offers	40.0%	41.1%	4.2%	6.3%	4.2%	0.0%	3.2%	10.5%	
WTA/WTP ^a	<i>L1/L4</i>	<i>L2/L5</i>	<i>L3/L6</i>	<i>L7/L12</i>	<i>L8/L13</i>	<i>L9/L14</i>	<i>L10/L15</i>	<i>L11/L16</i>	Mug
Mean	1.15	1.09	1.65	2.09	6.57	9.49	6.11	0.98	2.53
Median	1.00	1.00	1.00	1.07	1.05	1.20	1.06	1.00	3.06
Significance ^b	n/a	n/a		***	***	***	**		***
Panel B. USB Sessions									
WTA valuation	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L4</i>	<i>L5</i>	<i>L6</i>	<i>L7</i>	<i>L8</i>	USB
N	96	96	96	96	96	96	96	96	48
EV	0.20	0.35	0.43	0.30	0.45	0.53	2.10	1.25	
Mean	0.33	0.42	0.47	0.36	0.48	0.54	2.97	1.23	5.60
Median	0.21	0.36	0.50	0.31	0.45	0.55	3.00	1.25	5.28
Standard Deviation	0.42	0.20	0.20	0.17	0.24	0.22	1.74	0.48	2.52
Mean/EV	1.64	1.20	1.10	1.19	1.07	1.02	1.41	0.98	
Freq. dominated offers	68.8%	69.8%	11.5%	76.1%	74.0%	8.3%	1.1%	34.3%	
WTP valuation	<i>L9</i>	<i>L10</i>	<i>L11</i>	<i>L12</i>	<i>L13</i>	<i>L14</i>	<i>L15</i>	<i>L16</i>	USB
N	96	96	96	96	96	96	96	96	48
EV	2.00	2.00	3.00	5.90	3.00	3.00	4.00	1.25	
Mean	2.44	3.08	3.79	5.01	3.14	3.60	4.01	1.16	3.54
Median	2.20	2.03	3.10	5.00	3.00	3.00	3.52	1.10	3.27
Standard Deviation	1.20	2.26	2.19	1.73	1.51	2.31	2.40	0.47	2.41
Mean/EV	1.22	1.54	1.26	0.85	1.05	1.20	1.00	0.93	
Freq. dominated offers	0.0%	0.0%	0.0%	5.2%	8.3%	1.0%	4.2%	31.3%	
WTA/WTP ^a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<i>L8/L16</i>	USB
Mean	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.27	1.58
Median	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.02	1.62
Significance ^b	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*	***

Notes: *a.* The ratio is computed as $(WTA + c)/WTP$ for the lotteries while for the mugs and USB sticks it is simply the ratio of means and medians. The constant c is €0.10 for small-stake lotteries (*L1–L6*), €1 for high-stake lotteries (*L7–L10* and *L12–L15*) and $c=0$ for the extra lotteries *L11* and *L16* (mug sessions) and *L8* and *L16* (USB stick sessions). Lotteries in the USB stick session cannot be matched, except for lotteries *L8* and *L16*.

b. Tests based on paired t-tests for lotteries and on t-tests corrected for unequal variances for mugs and USB sticks. Tests are not reported for degenerate lotteries *L1*, *L2*, *L4* and *L5*.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level.

We first consider the mug sessions. In line with ILS and the PZ data reported therein, we find pronounced gaps between the WTA and the WTP for lotteries. That is, WTA values significantly exceed WTP values in four out of the five pairs of non-degenerate lotteries. ILS also find that WTA values are higher than WTP values in four out of five non-degenerate lottery pairs while for the PZ data WTA values are higher than WTP values in all five pairs. We find no gap for our extra lottery pair (*L11* and *L16*) for which the mean valuations of the WTA and the WTP are 1.12 and 1.14 respectively. In the sessions with USB sticks where it is only possible to compare the two extra lotteries, the average WTA for the extra lottery *L8* is 1.23 and the average WTP for the extra lottery *L16* is 1.16. There is a marginally significant difference between the two valuations.

In sharp contrast to the results for the mug task of PZ and ILS, we find a pronounced gap in the valuations for mugs and for USB sticks. On average, subjects are willing to pay €1.34 for a mug, but the subjects' minimum selling price is, on average, €3.39. Similarly, we find that subjects ask for a higher amount to part with their USB stick (€5.60) than they are willing to pay for it (€3.54).¹¹

We can reject the hypothesis of equal valuations for selling and buying mugs (t-test, $t = 5.01$, $p < 0.01$) and USB sticks (t-test, $t = 4.08$, $p < 0.01$). Moreover, we find little evidence that WTP or WTA valuations are affected by individual characteristics, such as gender, field of study or the number of semesters enrolled at the university and accumulated earnings in the lottery rounds. However, we find that a subject's estimated retail price is positively associated with her WTA, but not with her WTP offer. This could indicate that to determine the WTP, people consider their own private value while for the WTA they take the estimated retail price into account as if considering reselling the item elsewhere. (For details of the regression results see Table A2 in the appendix.) In summary, we are therefore not able to replicate the results on the valuations of mugs by PZ and ILS.

3.2. Do subjects make undominated bids in the lottery rounds?

The lottery data provides important insights about subjects' understanding of the BDM mechanism. In the following, we present a summary of the behavior in the lottery tasks.

The last row in each panel of Table 2 provides the share of bids for lotteries that are dominated. As bids and fixed offers were discrete (1 cent increments), an offer z is consistent with a weakly dominant bidding strategy if $x \leq z \leq y + 0.01$ in WTA tasks and $x - 0.01 \leq z \leq y$ in WTP tasks, where x and y denote the low and high lottery outcome, respectively. We first look at the degenerate lotteries (*L1*, *L2*, *L4* and *L5*). Panel A of Table 2 reveals that a substantial share of subjects made bids which are not consistent with weakly dominant bidding. About 25 percent of subjects made dominated offers for *L1* and *L2* (as a seller) and about 40 percent made dominated bids for *L4* and *L5* (as a buyer). Only about 47 percent of subjects made weakly dominant offers for all four lotteries, while about 15 percent always made dominated offers.¹² Compared to the mug

¹¹ Subjects' valuations for the two items are considerably lower than their retail prices (€7.50 for mugs and €8.90 for USB sticks), but valuations are closer to the retail price for USB sticks.

¹² In comparison, 60 percent of subjects in ILS made weakly dominant offers for all four degenerate lotteries and only 6 percent made dominated bids throughout (see Table A1 in the appendix). The share of violations of weak dominance in PZ is not directly comparable because PZ intervened during the lottery tasks in an effort to reduce misconceptions about the elicitation mechanism. For the sake of completeness Panel B and C of Table A1 in the appendix report the shares from PZ.

sessions, the share of violations of weak dominance is substantially higher in the USB sessions.¹³ Between 69 to 76 percent of subjects failed to obey weak dominance in *L1*, *L2*, *L4* and *L5* (all as a seller), and only 11 out of 96 subjects (11 percent) made undominated offers for the four degenerate lotteries. Recall that an important difference between the two treatments is that subjects received a more intensive training in the mug sessions. Therefore, the lower share of violations demonstrates the effectiveness of the additional worked examples and unpaid training rounds in the mug sessions.

There are less violations of dominance in the non-degenerate lotteries than in the degenerate lotteries, with the exception of our two extra lotteries. For the non-degenerate lotteries (except the extra lotteries), the share of subjects who made an offer outside the boundaries of a lottery varies between 0 and 6 percent in the mug sessions and between 0 and 12 percent in the USB sessions. In the two extra lotteries of the mug sessions, in total 26 percent of subjects made a bid outside the bounds of both lotteries. In the USB sessions the share of dominated bids for *L8* (34 percent) and *L16* (31 percent) is substantially higher, again providing evidence of the effectiveness of the additional training in the mug sessions. As hypothesized, the share of dominated bids for the two extra lotteries is higher than in the other non-degenerate lotteries in both the mug and the USB sessions. This is due to the possibility of underbidding, which is impossible in most other non-degenerate lotteries, and due to the smaller range of weakly dominant bids.¹⁴ Considering all 16 lotteries together, 44 percent of subjects never made dominated offers in the mug sessions, whereas this share is only 8 percent in the USB sessions.

3.3. Do rational subjects show a WTP-WTA gap for mugs?

With the help of the lottery data we can identify those subjects who show a good understanding of the BDM mechanism (and call them “rational”) in order to explore whether these subjects display a WTP-WTA gap. If there is no gap for these subjects, there is support for the argument by PZ that the gap is generated by confusion about the elicitation procedure. More specifically, we can identify three subgroups of rational subjects for the mug sessions: (i) subjects who make undominated bids for the extra lotteries, (ii) subjects who make undominated bids for the extra lotteries and for the four degenerate lotteries, and (iii) subjects who make undominated bids for all lotteries. As a robustness check, we use these three criteria and require in addition that subjects submit the same bid for both extra lotteries.¹⁵ That is, we not only focus on subjects for whom we have evidence that they understand the BDM mechanism, but also on subjects who do not display a WTP-WTA gap in the final pair of lotteries.¹⁶

¹³ Notice that the shares in the mug and USB sessions are not directly comparable as the lotteries are not in the same order and some lotteries differ.

¹⁴ In line with this argument, the share of violations is higher in those non-degenerate lotteries with a lower bound that is not zero (*L12–L15*, see Table 2).

¹⁵ Because bids are in 1 cent increments, we also allow $WTA(L11)$ to be 1 cent higher than $WTP(L16)$.

¹⁶ Notice that in both PZ and ILS subjects display a pronounced gap in valuations in the final pair of lotteries, indicating little learning over time.

Table 3: WTP-WTA gap for subsamples of rational subjects

Panel A:				
Mug sessions: extra lotteries L11 and L16	$1 \leq offer \leq 1.50^a$		& WTA(L11) = WTP(L16)	
	# Obs.	avg. Offer	# Obs.	avg. Offer
WTP mug	N=37	1.29	N=17	1.23
WTA mug	N=33	3.72	N=17	2.64
WTA/WTP		2.88		2.14
<i>p-value</i>		<i>0.00</i>		<i>0.01</i>

Panel B:				
Mug sessions: extra lotteries L11 and L16 and degenerate lotteries L1, L2, L4, L5 (or: all lotteries)	$1 \leq offer \leq 1.50^a$		& WTA(L11) = WTP(L16)	
	$x = offer = y^a$			
	# Obs.	avg. Offer	# Obs.	avg. Offer
WTP mug	N=23	1.48	N=13	1.47
WTA mug	N=19	3.02	N=14	2.67
WTA/WTP		2.04		1.81
<i>p-value</i>		<i>0.013</i>		<i>0.048</i>

Panel C:				
USB sessions: extra lotteries L8 and L16	$1 \leq offer \leq 1.50^a$			
	# Obs.	avg. Offer		
WTP USB stick	N=24	3.02		
WTA USB stick	N=27	5.30		
WTA/WTP		1.75		
<i>p-value</i>		<i>0.00</i>		

Notes: *a.* WTA offers are consistent with a weakly dominant bidding strategy if they are in the interval $[x, y + 0.01]$ and WTP offers are consistent if they are in the interval $[x - 0.01, y]$, where x denotes the low and y the high lottery outcome.

First we consider those subjects who made undominated offers for the extra lotteries *L11* and *L16*. Note that *L11* is the final lottery for which we elicit the WTA whereas lottery *L16* is the final lottery for the WTP elicitation. Therefore, subjects should have gained considerable experience with the BDM mechanism (or at least the same amount of paid practice as PZ subjects) when making offers for these lotteries. By restricting the sample to this subgroup, we allow for dominated offers in earlier lottery rounds, which can then be viewed as paid practice rounds along the lines of PZ. The average offers for mugs of this subgroup are presented in the left column of Panel A in Table 3. This rationality criterion excludes 25 subjects (or 26 percent) from the sample. The average offer in the WTA task in this subgroup was 3.72, and the average offer in the WTP task was 1.29. We can reject the hypothesis of equal WTP and WTA ($p < 0.01$). The WTA/WTP ratio is 2.88, which is higher than the ratio of 2.53 of the entire sample. Note that for this subsample we find a smaller ratio for non-rational subjects, i.e., subjects who submitted offers outside the bounds of the extra lotteries, while

for all other subsamples the ratio is larger for non-rational subjects, albeit not significantly larger (for details see Table A3 in the appendix).¹⁷

In the right column of Panel A in Table 3, we go one step further and require not only that bids are undominated but also that they are consistent, i.e., that WTA valuations are the same as WTP valuations in *L11* and *L16*. In essence this implies no WTP-WTA gap for these subjects as one would expect for money and lotteries over monetary outcomes. In total, 34 out of 95 subjects (36 percent) fulfill this additional criterion. The gap is smaller than in the larger sample because of the lower WTA (on average, 2.64), but the difference remains significant.

As subjects likely differ in their risk attitudes, the non-degenerate lotteries are not well-suited for an exact measurement of whether subjects' stated valuations equal their true valuations. The degenerate lotteries, however, offer the possibility to measure this more precisely as the outcome of the lottery is certain and is known to the subjects.¹⁸ Therefore in the next step, we restrict our analysis to subjects who in addition to submitting undominated bids for the two extra lotteries also made undominated bids for all four degenerate lotteries. This applies to about half of our entire sample, for a total of 42 out of 95 subjects. The left column of Panel B in Table 4 presents the offers for the mug by these subjects. The average WTP offer was 1.48 and the average WTA was 3.02, yielding a WTA/WTP ratio of 2.04. Again, we can reject the hypothesis of equal WTP and WTA ($p < 0.015$). In the right column of Panel B we consider only subjects who made rational bids for the extra lotteries and the degenerate lotteries and consistent bids for the extra lotteries, i.e., $WTA(L11) = WTP(L16)$. While only 27 subjects fall into this category, the valuations of sellers are on average still significantly higher than the valuations of buyers. Our third criterion requires that subjects submit undominated bids for all lotteries. However, all subjects who satisfied the criteria of undominated bids in the extra lotteries and the degenerate lotteries also submitted undominated bids in the remaining lotteries. Thus, the third criterion does not affect the results from Panel B of Table 3.

For each of the three criteria, we find evidence that subjects who fulfill the criteria score on average higher in the Wonderlic test than subjects who made at least one mistake (see Table A4 in the Appendix). This provides further support that subjects who met our rationality criteria understood the elicitation mechanism correctly.

Panel C of Table 3 reports the results of the USB sessions. Here we only look at subjects with undominated offers for the two extra lotteries (€1, 0.5; €1.5, 0.5) in round 8 and round 16 (last WTA and WTP tasks respectively) as all other criteria we employed for the sessions with mugs result in too few observations. For this subsample, the average offer in the WTP task was 3.02 and in the WTA task 5.30, the difference being statistically significant.

¹⁷ Table A3 presents the average WTA and WTP for subjects who do not satisfy our rationality criteria. The differences in WTA or WTP valuations for rational and non-rational subjects are statistically not significant, except that subjects have on average a significantly lower WTA if they made the same weakly dominant bid in both extra lotteries.

¹⁸ This is similar to using a redeemable card with a certain and known value as in Plott and Cason (forthcoming) and Bartling, Engl, and Weber (2014).

Together, these findings show a persistent WTP-WTA gap even for subjects for whom we have evidence that they understood the elicitation procedure. If misconceptions about the BDM mechanism are responsible for the frequently observed WTP-WTA gap, then we should not observe a gap for those who understand the mechanism. Indeed, there is no evidence of a gap for those subjects in ILS who made weakly dominant bids for all 14 lotteries, whereas those who made at least one mistake display a significant gap (for the details see Table A5 in the appendix).¹⁹ However, the ILS data also reveal that subjects who seemingly suffer from misconceptions about the BDM mechanism, display no gap in their second task, the chocolate gamble. In contrast, subjects without misconceptions have, on average, a significantly higher WTA than WTP for the chocolate box. This suggests that misconceptions can both contribute to or decrease the WTP-WTA gap. Given our evidence it is unlikely that misconceptions about the elicitation method are the main source for the observation of a WTP-WTA gap.

4. Conclusion

PZ designed procedures aimed at eliminating subject misconceptions about the BDM mechanism and demonstrated that the WTP-WTA gap for an object can be turned on and off. In spite of utilizing the experimental procedures of PZ (and ILS), we observe a WTP-WTA gap for lotteries over monetary payoffs and for mugs or USB sticks. In particular, we show that the gap does not disappear when considering only subjects who made undominated offers for certain subsets of lotteries or for all lotteries, i.e., subjects who show a good understanding of the BDM mechanism. The difference in the proportion of subjects making dominated bids in our mug and USB-stick sessions which differ in the amount of training, suggests that the PZ procedures succeed in eliminating misconceptions about the BDM mechanism in some subjects. At the same time, however, there is still a substantial share of subjects in our experiments who have difficulties with the BDM mechanism even after extensive instructions and training. Notwithstanding these differences in understanding the BDM, both groups clearly show a WTP-WTA gap for mugs (and USB sticks). Therefore, we find no evidence of the idea that misconceptions about the BDM mechanism are the main source of the WTP-WTA gap.

Unlike PZ and ILS we do not observe a difference between lottery and mug tasks in terms of the WTP-WTA gap but rather behavior that is consistent across the tasks. Given our results and the evidence of a WTP-WTA gap for rational subjects in Bartling, Engl, and Weber (2014), further research about the sources of the exchange asymmetry seems needed in order to better understand the differences in results. Possibly, there are differences between the studies that have not been made explicit yet, but that play an important role. Koh and Wong (2012) have pointed to the role of the strength of the reference state, but this does not explain our data as we used the exact same procedures as PZ, handing out a mug to every participant. Our results indicate that the difference between the perceived retail price and the value that subjects assign to the object could determine the size of the gap.

¹⁹ The same is true for the (weaker) classification according to number of weakly dominant bids for the degenerate lotteries (all versus at least one mistake). Note that it is not possible to identify subjects with and without misconceptions in PZ because the experimenter intervened during the lottery rounds to correct misconceptions.

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Appendix (for online publication)

A Tables

Table A1: Results ILS and PZ

Panel A. Isoni et al. Replication Experiment									
WTA valuation	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L7</i>	<i>L8</i>	<i>L9</i>	<i>L10</i>	Mug	CG ^a
N	100	100	100	100	100	100	100	51	49
EV	0.20	0.30	0.35	2.10	0.80	1.50	1.20		
Mean	0.23	0.31	0.38	2.16	0.94	1.40	1.57	2.21	2.15
Median	0.20	0.30	0.30	2.10	0.85	1.50	1.20	2.00	1.50
Standard Deviation	0.29	0.14	0.53	0.72	0.43	0.50	0.96	1.80	2.09
Mean/EV	1.17	1.03	1.09	1.03	1.18	0.93	1.31		
Freq. of dominated offers	0.27	0.24	0.04	0.05	0.00	0.01	0.00		
WTP valuation	<i>L4</i>	<i>L5</i>	<i>L6</i>	<i>L11</i>	<i>L12</i>	<i>L13</i>	<i>L14</i>	Mug	CG ^a
N	100	100	100	100	100	100	100	49	51
EV	0.30	0.40	0.45	3.10	1.80	2.50	2.20		
Mean	0.29	0.43	0.35	2.49	1.57	2.31	2.24	1.86	1.75
Median	0.30	0.40	0.30	2.50	1.50	2.25	2.00	1.80	1.00
Standard Deviation	0.07	0.17	0.26	1.11	0.52	0.64	1.12	1.29	1.68
Mean/EV	0.95	1.07	0.78	0.80	0.87	0.92	1.02		
Freq. of dominated offers	0.18	0.22	0.03	0.04	0.05	0.03	0.02		
WTA/WTP ^b	<i>L1/L4</i>	<i>L2/L5</i>	<i>L3/L6</i>	<i>L7/L11</i>	<i>L8/L12</i>	<i>L9/L13</i>	<i>L10/L14</i>	Mug	CG ^a
Mean	1.18	1.02	2.19	1.53	1.37	1.11	1.46	1.19	1.23
Median	1.00	1.00	1.33	1.26	1.16	1.00	1.11	1.11	1.5
Significance ^c	n/a	n/a	***	***	***		***		
Panel B. PZ Experiment – A lotteries (treatments 1, 2 and 3 pooled)									
WTA valuation	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L7</i>	<i>L8</i>	<i>L9</i>	<i>L10</i>		
N	36	36	36	36	36	36	36		
EV	0.20	0.35	0.07	4.90	2.00	2.00	3.00		
Mean	0.20	0.35	0.20	4.81	2.68	2.87	3.86		
Median	0.20	0.35	0.10	4.95	2.15	2.00	3.00		
Standard Deviation	0.02	0.01	0.21	1.48	1.08	1.88	2.53		
Mean/EV	0.99	1.00	2.87	0.98	1.34	1.43	1.29		
Freq. of dominated offers	0.03	0.03	0.03	0.00	0.00	0.00	0.00		
WTP valuation	<i>L4</i>	<i>L5</i>	<i>L6</i>	<i>L11</i>	<i>L12</i>	<i>L13</i>	<i>L14</i>		
N	36	36	36	36	36	36	36		
EV	0.30	0.45	0.17	5.90	3.00	3.00	4.00		
Mean	0.30	0.45	0.23	4.86	2.63	3.45	4.24		
Median	0.30	0.45	0.18	5.15	2.90	3.00	4.00		
Standard Deviation	0.01	0.02	0.20	1.59	0.96	2.04	2.58		
Mean/EV	0.99	1.01	1.33	0.82	0.88	1.15	1.06		
Freq. of dominated offers	0.06	0.06	0.03	0.00	0.00	0.00	0.00		
WTA/WTP ^b	<i>L1/L4</i>	<i>L2/L5</i>	<i>L3/L6</i>	<i>L7/L11</i>	<i>L8/L12</i>	<i>L9/L13</i>	<i>L10/L14</i>		
Mean	1.00	0.99	1.97	1.47	1.66	1.38	1.46		
Median	1.00	1.00	1.23	1.08	1.23	1.00	1.01		
Significance ^c	n/a	n/a	***	***	***	**	**		

continued on next page

Table A1 continued: Results ILS and PZ

Panel C. PZ Experiment – B lotteries (treatments 1, 2 and 3 pooled)							
WTA valuation	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L7</i>	<i>L8</i>	<i>L9</i>	<i>L10</i>
N	38	38	38	38	38	38	38
EV	0.20	0.35	0.43	2.10	3.00	2.00	7.00
Mean	0.20	0.35	0.44	2.67	2.80	2.69	6.78
Median	0.20	0.35	0.45	2.10	3.00	2.00	7.00
Standard Deviation	0.00	0.01	0.17	1.56	0.99	1.81	1.70
Mean/EV	1.00	1.00	1.01	1.27	0.93	1.34	0.97
Freq. of dominated offers	0.03	0.03	0.00	0.00	0.03	0.00	0.00
WTP valuation	<i>L4</i>	<i>L5</i>	<i>L6</i>	<i>L11</i>	<i>L12</i>	<i>L13</i>	<i>L14</i>
N	38	38	38	38	38	38	38
EV	0.30	0.45	0.53	3.10	4.00	3.00	8.00
Mean	0.30	0.45	0.49	2.41	3.10	2.67	7.03
Median	0.30	0.45	0.50	2.48	3.00	3.00	7.41
Standard Deviation	0.00	0.01	0.18	0.76	1.07	1.24	2.11
Mean/EV	1.00	0.99	0.92	0.78	0.78	0.89	0.88
Freq. of dominated offers	0.00	0.05	0.00	0.00	0.00	0.00	0.00
WTA/WTP ^b	<i>L1/L4</i>	<i>L2/L5</i>	<i>L3/L6</i>	<i>L7/L11</i>	<i>L8/L12</i>	<i>L9/L13</i>	<i>L10/L14</i>
Mean	1.00	1.00	1.13	1.67	1.34	1.97	1.20
Median	1.00	1.00	1.07	1.36	1.20	1.34	1.08
Significance ^c	n/a	n/a	**	***	***	***	**

Panel D. PZ Experiment – Mugs			
WTA valuation	Pooled	Mugs last	Mugs first
n	38	24	14
Mean	5.56	5.48	5.71
Median	5.00	5.00	5.10
Standard deviation	3.58	3.40	4.00
WTP valuation	Pooled	Mugs last	Mugs first
n	36	24	12
Mean	6.62	5.99	7.88
Median	6.00	6.00	6.50
Standard deviation	4.20	2.90	6.00
WTA/WTP ^b	Pooled	Mugs last	Mugs first
Mean	0.84	0.92	0.72
Median	0.83	0.83	0.78
Significance ^c			

Notes: *a.* CG denotes Chocolate gamble, which is a lottery which offers a box of luxury chocolates with 25 percent probability and nothing with 75 percent probability.

b. The ratio is computed as $(WTA + c)/WTP$ for the lotteries while for the mugs and USB sticks it is simply the ratio of means and medians. The constant *c* is €0.10 for small-stake lotteries (L1–L6) and €1 for high-stake lotteries (L7–L14).

c. Tests based on paired t-tests for lotteries and on t-tests corrected for unequal variances for mugs and CG. Tests are not reported for degenerate lotteries L1, L2, L4 and L5.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level.

Table A2: Regression results

	dependent variable: offer for mug or USB stick			
	WTP	WTA	WTP	WTA
Mug session = 1	-2.205*** (0.428)	-2.106*** (0.552)	-2.109*** (0.530)	-1.433** (0.549)
Accumulated profits	0.000 (0.036)	-0.018 (0.039)	-0.006 (0.037)	-0.012 (0.034)
Male = 1			-0.225 (0.437)	-0.085 (0.502)
STEM study = 1			0.719* (0.420)	0.200 (0.474)
# of semesters			0.020 (0.036)	0.100 (0.069)
German native speaker=1			-0.390 (0.589)	-1.161 (0.846)
Estimated retail price			0.032 (0.060)	0.314*** (0.108)
Constant	3.538*** (0.589)	5.833*** (0.652)	3.363*** (1.068)	3.893*** (1.345)
<i>N</i>	95	96	93	95
<i>R</i> ²	0.25	0.16	0.30	0.30

Notes: OLS regressions with robust standard errors in parentheses. The variable “Mug session” indicates the item used in the final valuation task, “Accumulated profits” are the accumulated earnings in the lottery rounds, “STEM study” indicates whether a subject’s field of study is in science, technology, engineering, and mathematics and “# of semesters” indicates enrollment time at the university.

* p<0.10, ** p<0.05, *** p<0.01

Table A3: WTP-WTA gap for subsamples of non-rational subjects

Panel A:				
Mug sessions: extra lotteries L11 and L16		Dominated offers		Dominated or WTA(L11) ≠ WTP(L16)
	# Obs.	avg. Offer	# Obs.	avg. Offer
WTP mug	N=10	1.54 ^a	N=30	1.40 ^a
WTA mug	N=15	2.67 ^a	N=31	3.80 ^b
WTA/WTP		1.73		2.71
<i>p-value</i>		0.043		0.00
Panel B:				
Mug sessions: extra lotteries L11 and L16 and degenerate lotteries L1, L2, L4, L5 (or: all lotteries)		At least one dominated offer		At least one dominated offer or WTA(L11) ≠ WTP(L16)
	# Obs.	avg. Offer	# Obs.	avg. Offer
WTP mug	N=24	1.20 ^a	N=34	1.29 ^a
WTA mug	N=29	3.63 ^a	N=34	3.69 ^a
WTA/WTP		3.03		2.86
<i>p-value</i>		0.00		0.00
Panel C:				
USB sessions: extra lotteries L8 and L16		Dominated offers		
	# Obs.	avg. Offer		
WTP USB-stick	N=24	4.07 ^a		
WTA USB-stick	N=21	5.97 ^a		
WTA/WTP		1.47		
<i>p-value</i>		0.011		

Notes: WTA offers are dominated if they are outside the interval $[x, y + 0.01]$ and WTP offers are dominated if they are outside the interval $[x - 0.01, y]$, where x and y denote the low and high lottery outcome, respectively

a. Offers of non-rational and rational subjects (see Table 3) do not differ significantly.

b. WTA for non-rational subjects is higher than for rational subjects at 10% level.

Table A4: Wonderlic test scores and subgroups

		rational L11/L16	rational L11/L16 & L1, L2, L4 & L5 (or all lotteries)	rational & consistent L11/L16	rational & consistent L11/L16 & L1, L2, L4 & L5 (or all lotteries)
avg. Wonderlic score	no	2.04	2.58	2.69	2.72
	yes	3.27	3.40	3.41	3.52
<i>p-value</i>		0.01	0.01	0.02	0.02

Notes: A “yes” indicates that subjects satisfy the subgroup criterion, i.e., subjects who made rational bids for the relevant criterion. The average Wonderlic test score was 2.94 (10 questions). The p-values are based on t-tests corrected for unequal variance.

Table A5: Subgroups in ILS

	Mugs		Chocolate gamble – CG	
	rational <i>L1, L2, L4 & L5</i>	rational <i>all lotteries</i>	rational <i>L1, L2, L4 & L5</i>	rational <i>all lotteries</i>
WTP	1.65 (N=24)	1.70 (N=23)	1.07 (N=24)	1.07 (N=23)
WTA	1.69 (N=24)	1.74 (N=23)	1.94 (N=24)	1.85 (N=23)
<i>p-value</i>	<i>0.46</i>	<i>0.46</i>	<i>0.02</i>	<i>0.03</i>
	at least one mistake <i>L1, L2, L4 & L5</i>	at least one mistake <i>all lotteries</i>	at least one mistake <i>L1, L2, L4 & L5</i>	at least one mistake <i>all lotteries</i>
WTP	2.07 (N=25)	2.01 (N=26)	2.36(N=27)	2.31 (N=28)
WTA	2.68 (N=27)	2.60 (N=28)	2.35 (N=25)	2.41 (N=26)
<i>p-value</i>	<i>0.08</i>	<i>0.09</i>	<i>0.51</i>	<i>0.44</i>

Notes: “Mugs” refers to the standard elicitation of WTA and WTP for mugs while “Chocolate gamble” refers to the elicited valuation for a lottery which involved a 25% chance of winning a luxury chocolate box and a 75% change of winning nothing. The p-values are based on t-tests corrected for unequal variance.

B Written Instructions

This is an experiment in individual decision-making. Our purpose is to study technical issues involved in decision-making.

The instructions are simple, and if you follow them carefully and make good decisions, you might earn a considerable amount of money or other things. What you earn will depend on the decisions you make. You will perform a series of buying tasks and a series of selling tasks.

We ask that you do not communicate with other people during the experiment. Please refrain from verbally reacting to events that occur during the experiment. This is very important.

Buying Task Instructions:

The buying task works as follows. The experimenter will offer an item for sale. Your task is to make an offer for the item and record it on your information sheet. You will be asked to type in your offer. It will be recorded by the computer; your choices will remain anonymous to the other subjects and to the experimenter.

As you will see, your best strategy is to determine the maximum you would be willing to pay for the item and offer that amount. It will not be to your advantage to offer more than this maximum, and it will not be to your advantage to offer less. Simply determine the maximum you would be willing to pay and make that amount your offer.

Your offer will be compared to a fixed offer. The fixed offer will be completely unrelated to your offer and to the offers of all other persons in the room.

If your offer is more than or the same as the fixed offer then you buy the item. You had the high offer, so you are the buyer. But, here's the interesting part. You do not pay the amount you offered. Instead, you pay the fixed offer, an amount equal to or less than your offer.

Buying task examples:

Example: if you offer 1,000 and the fixed offer is 950, you have the high offer. You buy the item but pay only 950.

If your offer is less than the fixed offer then you do not buy the item. Instead, you keep your money.

Example: if you offer 1,000 and the fixed offer is 1,020, your offer is not higher. Therefore, you do not buy the item. You keep your money.

As a buyer, you should offer exactly the maximum amount you would be willing to pay in exchange for the item being sold.

Remember, there are no advantages to strategic behavior. Your best strategy is to determine your personal value for the item and record that value as your offer. There is not necessarily a “correct” value. Personal values can differ from individual to individual.

Selling Task instructions:

The selling task works as follows. The experimenter wishes to buy an item that you own. Your task is to make an offer for the item and record it on your information sheet. You will be asked to type in your offer. It will be recorded by the computer. Your choices will remain anonymous to the other subjects and to the experimenter.

As you will see, your best strategy is to determine the minimum you would be willing to accept for the item and offer that amount. It will not be to your advantage to offer more than this minimum, and it will not be to your advantage to offer less. Simply determine the minimum you would be willing to accept and make that amount your offer.

Your offer will be compared to a fixed offer. The fixed offer will be completely unrelated to your offer and to the offers of all other persons in the room.

If your offer is less than or the same as the fixed offer then you sell the item. You had the low offer, so you are the seller. But, here’s the interesting part. You do not receive your offer. Instead, you receive the fixed offer, a price higher than your offer.

Selling task examples:

Example: if you offer 1,000 and the fixed offer is 1,020, you have the low offer. You sell the item and you receive the fixed offer of 1,020.

If your offer is more than the fixed offer then you do not sell your item. You keep the item.
Example: if you offer 1,000 and the fixed offer is 950, you do not have the low offer.

Therefore, you do not sell the item.

As a seller, you should offer the minimum amount you would be willing to accept in exchange for the item you own.

Just as in the case of the buying task, there are no advantages to strategic behavior in the selling task. Your best strategy is to determine your personal value for the item and record that value as your offer. There is not necessarily a “correct” value. Personal values can differ from individual to individual.

You will perform different tasks in a total of 15 rounds. The earnings will be accumulated during the experiment and will add up to your final payoff. Before we begin, note that the first several rounds involve relatively small payoffs. These rounds are intended to give you practice before you get to the rounds involving higher payoffs.

After the public explanation of the procedures by the experimenter, we will start the experiment. In the first 16 rounds you will perform either a selling or a buying task for lotteries. The last round involves a real item which you will get to see only prior to the beginning of that round. In the case of the lotteries you will either own the lottery ticket to sell (selling task), or you will propose a price to buy the ticket from the experimenter (buying task). In the buying task you can use the €5 with which you are endowed with at the beginning of the experiment, your earned money from the experiment as well as your own money if you want. Each lottery consists of two possible outcomes, A and B, which are realized with different probabilities. For those of you who will own the lottery (those who bought a lottery ticket or did not sell the lottery ticket) the outcome of the lottery will be determined at the end of each round, and will be added to your account.

In order to explain the procedure one more time, the experimenter will go through the explanation of it in public after all subjects have finished reading the instructions.

C Script for running the experiment

Greetings

Welcome to the experiment. You will find your instructions and the receipts on the table in front of you. Please read the instructions carefully. We ask you not to communicate with each other and to not ask questions aloud. If you have any questions, raise your hand and we will come to you to answer them in private. Please turn off your mobile phones and use only the program of the experiment on the computer. Please read the instructions carefully.

Presentation

WTP task

Slide 2:

Imagine that I am a buyer and Item A is up for sale. How do I know which amount is the maximum I'd be willing to pay for Item A?

Start with 1 cent. Would I be willing to pay 1 cent for the item? If so, then increase the amount to 2 cents. If I'm willing to pay 2 cents, then increase further. I keep increasing until I reach an amount that makes me indifferent between keeping the money and getting Item A.

Next example on slides 3–9:

Example: would I pay €1 for A? Yes. Would I pay €2 for A? Yes. Would I pay €5 for A? Yes. Would I pay €6 for A? No, not €6. So I need to decrease the bid. Would I pay €5.50? No, not that much. How about €5.25? I don't care whether I end up with €5.25 or the item. Then that is the maximum I'd be willing to pay for Item A. I'll record that number on the computer.

The key to determining the maximum you'd be willing to pay is remembering that you will not pay the amount you bid. Instead, if you pay anything, you will pay the fixed offer.

Slides 10–11:

Why is my best strategy to bid the maximum I'd be willing to pay? Let's go back to the example:

Say that I decide that the maximum I'd be willing to pay for Item A is €5.25. What happens if I bid less than €5.25? Say I bid €5. If the fixed offer is, say, €5.10, then I won't get the item. Had I bid €5.25, I would have received the item and would have had to pay only €5.10 for an item that I think is worth €5.25. I lose out. What happens if I bid higher than €5.25? Say I bid €5.50. If the fixed offer is €5.45, then I have to pay €5.45 for an item that I really think is worth only €5.25. I lose out.

WTA task

Slide 12:

Imagine that I am a seller and I own Item B. How do I know which amount is the minimum I'd be willing to accept to give up Item B?

Start with €100. Would I be willing to give up item B in exchange for €100? If so, then decrease the amount to €95. If I'm willing to accept €95 to give up Item B, then decrease further. I keep decreasing until I reach an amount that makes me indifferent between keeping Item B and getting the money.

Next example on slides 13–18:

Example. Would I accept €10 to give up Item B? Yes. Would I accept €8 for B? Yes. Would I accept €7 for B? Yes. Would I accept €6 for B? No, not €6. So I need to increase the bid. Would I accept €6.50? I don't care whether I end up with €6.50 or Item B. Then that is the minimum I'd be willing to accept for Item B. I'll record that number on my computer.

The key to determining the minimum you'd be willing to accept is remembering that you will not receive the amount you ask for. Instead, if you receive anything, you will always get the fixed offer.

Slides 19–20:

Why is my best strategy to bid the minimum I'd be willing to accept? Let's go back to the example:

Say I decide that the minimum I'd be willing to accept for Item B is €6.50. What happens if I ask for less than €6.50? Say I ask for only €6. If the fixed offer is, say, €6.25, then I will have to sell my item. I lose out because I have to give up Item B which I think is worth €6.50, but I only get €6.25 in exchange. What happens if I ask for more than €6.50? Say I ask for €7. If the fixed offer is €6.75, then I do not sell. But, had I bid €6.50, I would have sold the item and received €6.75 for an item that I think is worth only €6.50. I lose out.

Introduction of the interface on slides and explanation of random nature of the fixed offer

Slide 21–22:

Fixed offers for each round were randomly determined before the experiment. They were drawn for each round from a particular interval. Just to demonstrate what these draws look like we draw, for example, 20 values from each of the intervals: between 0 and 1, between 0 and 5, and between 0 and 10. So you can see that it is the same probability for the fixed offer to be any number of the interval.

Your screen will look as follows: On the top of the screen on the left-hand side you see which round you are in, in the middle whether it is a buying or a selling decision, and on the right-hand side your current account. In the middle of the screen you see the item, in this case the lottery. After you submit your offer for the item, you will be provided with extensive feedback, just like here.

Training

Next we start with two rounds of the experiment under my supervision.

Supervised round 1 (WTP task)

On the top of the screen on the left-hand side you see which round you are in, in the middle whether it is a buying or a selling decision, and on the right-hand side your current account.

In this first example you can buy the lottery ticket with a 70% chance of 500 points and a 30% chance of 1,000 points. All lotteries in the experiment follow this logic. The outcome of the lotteries will be determined by the computer. It means that the computer will draw a number between 1 and 100. In the case of the current lottery, the outcome of the lottery is 500 if the computer draws a number between 1 and 70. If the random number is between 71 and 100, the outcome of the lottery is 1000.

You can write your offer in the box under the lottery. The offer is the maximum you are willing to pay for this lottery. Let's assume for the purpose of the example that you want to pay the maximum of 700 points for the lottery. Then you should put 700 in the corresponding field. In this case we already put the offer in for you. This offer will be compared to the random fixed offer by the computer. Fixed offers were randomly generated for every round before the start of the experiment. Thus you can be sure that fixed offers are independent of your decisions. Please click the button "next."

You will see the results of this round. You see your offer and the fixed offer. In the last line you can see whether you have bought the lottery ticket or not. If you have bought the lottery ticket, the computer randomly determines the outcome of the lottery.

In this round, you have bought the lottery as your offer was higher than the fixed offer of 551, and the outcome of the lottery is 1,000.

Supervised round 2 (WTA task)

In the second example, you see that you own the lottery ticket and that you can sell it. The lottery in this case gives you a 70% chance to win 1,000 points and a 30% chance to win 1000 points. It means that the outcome of the lottery is 1,000 if the computer draws a number between 1 and 70. If the random number is between 71 and 100, the outcome of the lottery is 1,000, too. Again, you can write your offer in the box under the lottery. The offer is the minimum you are willing to accept for this lottery. In this example the lottery yields 1,000 points in any case.

Should you put something higher than 1,000 as an offer, for instance, 1,100? No, because if, for example, the fixed offer equals 1050, then you would not sell the lottery and you would only get 1,000 instead of 1,050. Should you put something smaller than 1,000 as an offer, for instance, 800? No, because if, for example, the fixed offer equals 900, you would sell the lottery and would get only 900 for something which is worth 1,000. So it is in your best interest to offer

exactly 1,000. In this case we have already put the offer in for you. This offer will be compared to the random fixed offer by the computer. Fixed offers were randomly generated for every round before the start of the experiment. Thus you can be sure that the fixed offers are independent of your decisions. Please click the button “next.”

You see the results of this round. You see your offer and the fixed offer. In the last line you see whether you have sold the lottery ticket or not. If you have sold the lottery ticket, you see the selling price which you will get, which is the fixed offer. If you have not sold the lottery, the computer randomly determines the outcome of the lottery.

In this round you have not sold the lottery as your offer was higher than the fixed offer. Your payoff for the round is 1,000 points because the lottery pays 1,000 in any case.

Two additional training rounds (not supervised)

Any questions? You will now complete two training rounds on your own. If you have questions please raise your hand, and I will come to your place and answer your question in private.

Main experiment

Now we start with the main experiment. Please note that now each round counts toward your final earnings.

Announcement before the start of Round 17:

In the next round some of you can sell this mug to me, and some can buy the mug from me. [*Experimenter holds the mug in his hand.*] Whether you can buy or sell the mug is randomly determined by the computer, and is displayed on your computer screen. If you are a seller, and you want to sell the mug, you will get the corresponding selling price. In case you do not sell the mug, you can take it with you after the experiment. If you are a buyer, and you want to buy the mug, the corresponding buying price will be subtracted from your current account and you can take the mug with you after the experiment. We will now distribute the mugs so you can explore them privately and think of the decision you want to make. [*Experimenter distributes the mug to each participant.*]

After everyone has made their offers:

We will now administer two short questionnaires. In the first questionnaire you will have to answer 10 quiz questions. For each correct question you will receive 25 cents. In total you have 150 seconds to answer the 10 questions. Please answer as many questions as possible.

In the second questionnaire you are presented with a series of hypothetical lotteries. Note that we will not pay you for these lotteries. They are hypothetical, so we ask you to answer the questions to the best of your knowledge.

After questionnaires: Final announcement:

The experiment is over now. There is one brief questionnaire in which we will ask you some questions about the experiment. Please complete it. When you are done, you will see on the final screen the amount of money you have earned and whether you can take the mug with you. The amount is rounded to the nearest 50 cents above the sum you earned. Please fill in the receipt. Take your receipt and the wooden chip to the room next door where you will receive your payment. Before you leave your seat make sure you leave all the material on the table. Could you please close the screen by pressing "Alt + F4." While standing in line, please do not talk to each other.

D Presentation


Explanations to the experiment

Buying decision

- Imagine that you are a buyer and object A is for sale. How can you find out the maximum price you ready to pay for it?

2

Buying decision

- How much am I willing to pay?
- 1 € 

3

Buying decision

• How much am I willing to pay?

• 1 € 😊

• 2 € 😊

4

Buying decision

• How much am I willing to pay?

• 1 € 😊

• 2 € 😊

• 5 € 😊

5

Buying decision

• How much am I willing to pay?

• 1 € 😊

• 2 € 😊

• 5 € 😊

• 6 € 😞

6

Buying decision

• How much am I willing to pay?

- 1 € 😊
- 2 € 😊
- 5 € 😊
- 6 € 😞
- **5.50 €** 😞

7

Buying decision

• How much am I willing to pay?

- 2 € 😊
- 5 € 😊
- 6 € 😊
- 5.50 € 😞
- 5.25 € 😞
- 😊

8

Buying decision

• How much am I willing to pay?

- 1 € 😊
- 2 € 😊
- 5 € 😊
- 6 € 😞
- 5.50 € 😞
- 5.25 € 😊

9

Buying decision

- My maximum offer is 5.25 €

What happens if I offer less?

- My offer is 5 €
- Fixed offer: 5.10 € → I do not buy the Object
- Instead of 5.25 € I would have to pay only 5.10 €. Thus I would earn 0.15 €.

10

Buying decision

- My maximum offer is 5.25 €

What happens if I offer more?

- My offer is 5.50 €
- Fixed price: 5.45 € → I buy the object
- I pay 5.45 €, though the object is only 5.25 € worth for me. Thus I lose 0.20 €.

11

Selling decision

- Imagine that you are a seller and you own the object B. How can you find out the minimum price you ready to accept for it?

12

Selling decision

- For which amount would I exchange my Object?
- **10 €** 😊

13

Selling decision

- For which amount would I exchange my Object?
- **10 €** 😊
- **8 €** 😊

14

Selling decision

- For which amount would I exchange my Object?
- **10 €** 😊
- **8 €** 😊
- **7 €** 😊

15

Selling decision

- For which amount would I exchange my Object?
- 10 € 😊
- 8 € 😊
- 7 € 😊
- **6 €** 😞

16

Selling decision

- For which amount would I exchange my Object?
- 10 € 😊
- 8 € 😊
- 7 € 😊
- **6 €** 😞
- **6.50 €** 😊

17

Selling decision

- For which amount would I exchange my Object?
- 10 € 😊
- 8 € 😊
- 7 € 😊
- **6 €** 😞
- 6.50 € 😊

18

Selling decision

- My minimum offer is 6.50 €

What happens if I offer less?

- My offer is 6 €
- Fixed price: 6.25 € → I sell the object
- I give away the Object for 6.25 €, though it is 6.50 € worth for me. Thus I lose 0.25 €

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Selling decision

- My minimum offer is 6.50 €

What happens if I offer more?

- My offer is 7 €
- Fixed price: 6.75 € → I do not sell the object
- I could sell the object for 6.75 €, which would be beneficial as it is worth 6.50 € for me. Thus I would earn 0.25 €

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Determination of the fixed offers

Von 0 bis 1	Von 0 bis 5	Von 0 bis 10
0.07	0.06	0.11
0.22	0.08	1.09
0.27	0.20	1.14
0.29	0.23	3.35
0.31	0.27	4.67
0.38	1.03	4.75
0.45	1.25	4.92
0.46	1.34	5.15
0.51	1.83	5.17
0.56	2.83	5.33
0.58	2.70	6.00
0.61	2.63	6.42
0.67	2.67	7.30
0.70	3.26	7.33
0.72	3.45	7.74
0.72	3.56	7.85
0.73	3.80	8.05
0.75	4.21	8.60
0.84	4.80	8.60
0.96	4.80	9.77

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Screen shot



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E Pictures of items used in the second part

Mug



USB stick



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