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Predicting the Gap between Willingness to Accept and Willingness to Pay

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Abstract:

People report much larger willingness to accept (WTA) than willingness to pay (WTP) under a broad range of circumstances. This dissertation tries to answer the question *when* people will report this gap, *how large* the difference between the two answers will be and *what reasons* lie behind this behavior:

We find that uncertainty about the desire to trade a good lies at the heart of the gap measured in experiments. A formal model extending Prospect Theory by "aversion to risk changes" predicts that the endowment effect increases with uncertainty. Data from our own behavioral experiment confirms the uncertainty hypothesis.

When applied to a different phenomenon, so-called "Preference Reversal", the model can predict when different types of the observed reversals occur, closing an explanatory gap that other theories have left open.

In surveys about valuing public goods, a much larger gap between WTA and WTP is found than in experiments with real transactions. Our own survey confirms that the reason for this lies in participants not taking the WTA situation serious and answering like in an opinion poll.

Overview:

The **General Introduction** gives an overview over the experimental evidence and the theories that have been proposed as explanations.

Chapter 1 introduces our own formal hypothesis for the experimental endowment effect. Competing hypotheses are tested in an own behavioral experiment.

Chapter 2 shows how the endowment effect model can help to explain another anomaly, the so-called "preference reversal" phenomenon.

Chapter 3 discusses why the gap between WTA and WTP in the valuation of public goods with the so-called "contingent valuation" method is so much larger than in experiments. A hypothesis is tested with data from our own survey.

To Jörn

To Katya

Acknowledgements

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General Introduction

One of the more important contradictions of conventional economic utility theory is that people often show significantly lower "Willingness to Pay" (WTP[1]) than "Willingness to Accept" (WTA[2]). The effect is also known under the name of "endowment effect"[3] or "status quo bias". This phenomenon casts doubt on the validity of Coase's Invariance Theorem, which states that the initial allocation of ownership rights does not affect efficiency, as well as on the assumption of utility theory that preferences are independent of endowment. The Invariance Theorem is an important principle underlying policies such as the certificate trading resulting from the Kyoto Protocol. If the Invariance Theorem did not hold, distributing pollution rights that are not traded in an efficient way might not be the optimal solution compared to other solutions such as, for example, the government selling these rights.

Employee saving programs are a field where research about "status quo bias" is already leading to new ways of thinking and acting: If employees are given the chance to actively enroll in a company saving program, many choose not to participate, and if they do, they choose a low saving rate and rarely change it. If, on the other hand, employees are automatically enrolled with the possibility to opt out, the participation rate increases dramatically. The latest effort in this direction is a program termed "Save more tomorrow", where the saving rate for voluntary participants increases automatically every year, leading to much higher saving rates than when employees are deciding on this issue alone.

The endowment effect also touches the fundamental question of how people value goods in general. If this value differs in the buy and sell situation, the assumption of a unique and fixed value or preference that underlies microeconomic theory, needs to be revisited, possibly affecting many parts of economic decision theory.

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[1] Also called "compensating loss" in Hicksian theory.
[2] Also called "compensating gain" in Hicksian theory.
[3] Some authors (e.g. Plott and Zeiler, 2005a, and Brown, 2005) call the phenomenon exclusively "WTA-WTP-gap" and use the term "endowment effect" for the explaining theory that we term "loss aversion in riskless choice". We think that "endowment effect" is indeed the correct term for the phenomenon, as it consists of the valuation of an object being higher when it belongs to one's *endowment* (WTA) than when it does not (WTP).

As more and more experimental evidence has emerged that showed the changing nature of the phenomenon, the question arises whether it is possible to predict under which conditions the effect occurs and by how much willingness-to-accept (WTA) and willingness-to-pay (WTP) will diverge. So far, existing theories do not generate satisfying predictions concerning existence and size of the effect.

The following sections shall give an overview over the most important empirical evidence and the proposed theories. A list with all endowment effect experiments known to the author can be found at the end of the general introduction.

I. Experiments

The endowment effect was first found in surveys that try to elicit money values of public goods with the so-called "contingent valuation" method: Participants of a survey are asked how much they value a certain public good. In one form of this question, they are asked how much they would be willing to pay for an amelioration of a public good. In the other possible form of the question, they are asked what would be the minimum they would accept as a payment if the public good were deteriorated. The answers to these two different forms of questions correspond to a hypothetical willingness to pay (WTP) and hypothetical willingness to accept (WTA). Researchers found that the way in which they asked people to value a public good mattered greatly: hypothetical WTA turned out to be much greater than hypothetical WTP.

These results finally led to economists and psychologists examining the difference between WTA and WTP in an experimental setting where real money and goods changed hands.

Between 1984 and 2005, the phenomenon was examined in at least 83 different experiments involving real payments, presented in 25 articles known to the author (see appendix of this General Introduction). In 60 % of the experiments, a significant WTP/WTA-gap was observed. Therefore, the existence of the phenomenon can hardly be denied, as well as the fact that it is not always present.

An important insight was provided by Brookshire and Coursey (1987) who show that using the hypothetical surveys (the so-called "contingent valuation" method) leads to a much larger WTP/WTA-gap than using an experimental setting. We will focus in the

first two chapters on evidence resulting exclusively from experiments. Chapter 3 then examines the question what different and additional factors might be at work that enlarge the WTA-WTP-gap so drastically in the hypothetical setting.

The most widely known experiments are those conducted by Kahneman et al. (1990). In their very carefully designed experiments, subjects (students) valued objects (mugs and pens) more highly when they owned them than when they did not. The difference is not trivial: Sellers stated an average WTA for a mug of 5.78 $ and buyers an average WTP of 2.21 $, to give only one representative example (Kahneman et al., 1990, experiment 5, p. 1338). Income effects as a source of the gap have been ruled out by Morrison's (1997) experiment, compensating the WTP subjects with a money amount that corresponded to the average WTA of the other group.

To test whether subjects strategically adjusted their answers in an effort to influence trading prices, Kahneman et al. (1990) used the so-called Becker-DeGroot-Marschak (BDM, Becker et al, 1964, cited by Brown, 2005, 371) mechanism (experiment 5, p. 1336 ff). After the subjects had stated their minimum selling prices (respectively their maximum buy prices), the actual trading price was drawn at random out of a certain range of possible prices.

If the price were higher than a seller's minimum sale price (WTA), the individual would sell the good at the randomly drawn price. If the price were lower than a buyer's maximum buy price (WTP), this would mean that the subject would buy at the randomly drawn price. Therefore, a seller could not make a profit by increasing the stated minimum sale price (WTA) beyond the true value. This would only risk situations where the randomly drawn price is lower than the stated WTA, but higher than the true WTA. A trade would not take place, although it would have been profitable for the individual. A corresponding argument is true for decreasing one's maximum buy price (WTP) in comparison with the true WTP. Under this mechanism, truth-revealing behavior is optimal.

The use of the mechanism did not alter the results of the experiments, indicating that no strategic motives lie behind the appearance/disappearance of the endowment effect. All experiments were repeated several times, but no learning effect was seen to reduce the endowment effect.

Kahneman et al. (1990) found *no* endowment effect when the good in question was an "induced-value token" – a token with pre-defined value. In their experiment No. 8 (p. 1340), this value was 3 $ for sellers and 5 $ for potential buyers. Out of 70 participants, 58 decided to trade the token for an average price of 4.09 $. This result was interpreted as "no significant undertrading" in comparison to the consumption good trading experiments, where only between 9 % and 45 % of the expected trades took place (e.g. in experiment 1, p. 1332). In experiment 1, fixed-value tokens (with the same value for all groups) yielded the result WTA=induced value=WTP.

The Kahneman et al. (1990) experiments have even been exactly replicated by Plott and Zeiler (2005a), yielding the same results. There are, however, situations in which experimenters could not measure a significant endowment effect.

Ortona and Scacciati (1992) find that there is no significant WTP/WTA-gap for "necessary goods". A voucher worth 40,000 Italian Lire (approx. 20 €) in a bookstore was valued around 33,000 Lire (approx. 17 €) in WTP and WTA elicitation experiments – so no gap existed (p. 290-292). The students were actually in need of books, so the authors applied the label "necessary goods".

Plott and Zeiler (2005a) also conducted their own experiments and found no significant endowment effect in valuing a mug when subjects were given extensive training and practice on the mechanism, and anonymity.

List (2003) finds that market experience of the subjects plays a key role in eliminating the endowment effect. No undertrading was found with professional sports memorabilia traders and unique goods like tickets of a famous baseball match. In contrast, amateur collectors of sports memorabilia items exhibit an endowment effect – undertrading is measured.

Although Kahneman et al. (1990) initially claimed that there should not be an endowment effect with "exchange goods" (i.e. goods that are regularly bought and sold), there is a large body of evidence that subjects experience an endowment effect with respect to all kinds of lotteries.

In lottery experiments, the gap has so far been shown to be significant by Knetsch and Sinden (1984), Singh (1991), Van Dijk and van Knippenberg (1996), Van de Ven et al. (2005) and Blondel and Lévy-Garboua (2005).[4]

II. Theories

The most prominent explanation of the endowment effect has been derived from Prospect Theory (Kahneman and Tversky, 1979). Prospect Theory was initially designed to account for a whole set of different evidence concerning choice under uncertainty. As this initial version of Prospect Theory - not the derivation used later to explain the endowment effect – is at the basis of our own hypothesis, it is necessary to explain why and how Prospect Theory was initially designed and later transformed.

The second part of this section will examine how other theories perform in terms of predicting the pattern found for the endowment effect.

Prospect Theory

Overview

In 1979, psychologists Tversky and Kahneman published Prospect Theory. It was intended to account for the following evidence that had been found contradicting Expected Utility Theory:

- The **Allais Paradox** (Allais, 1953): People overweight certain events (see the appendix of this Genral Introduction).
- The **Reflection Effect** (see Table 1 in the appendix): For lotteries involving a single positive payoff, people are risk-averse for medium and large winning probabilities and risk-seeking for small winning probabilities. This contradicts Expected Utility Theory, which predicts that, if an individual is risk-averse, this must hold for all ranges of probabilities that are different from 1 and 0.

[4] Only Harless (1989) finds no gap when using median (rather than mean) answers. Schmidt and Traub (2003) consolidate this with the other findings by showing that median answers do not differ significantly, but mean answers do. The reason for this is that two patterns of answers dominate: One (slightly larger) group giving roughly equal WTA and WTP answers and a second group stating much larger WTA than WTP. The question remains what prompts the latter behavior and how it can be systematically predicted.

For lotteries involving a single negative payoff, people show exactly the opposite preference: For low probabilities of losing, they show risk-averse behavior, while for medium and large probabilities, they show risk-seeking behavior.

- **Framing** of outcomes (see problem 1 and 2 in the appendix): People react differently to the same problem, depending on its presentation ("framing") in terms of possible gains or losses.
- **Probabilistic Insurance** (Kahneman and Tversky, 1979, p. 23-25): In contrast to Expected Utility's prediction, a form of insurance that does reduce, but not eliminate the probability of damage is less attractive to people than the complete elimination of one risk at a proportionally higher price.
- The **Isolation Effect** (Kahneman and Tversky, 1979, p. 25-27): In order to simplify the choice between alternatives, people often disregard components common to all the alternatives, and focus on the components that distinguish them.

To be consistent with these phenomena, Prospect Theory was developed with the following key elements:

- **Editing phase**:
  - **Coding**: The representation of outcomes in terms of gains and losses in comparison to a reference point that is usually taken as the current wealth.
  - **Combination**: Probabilities of identical outcomes are combined to form a single outcome (otherwise, probability-overweighting does not work properly).
  - **Segregation**: If a lottery contains a riskless component, i.e. all outcomes have a minimum payoff, the lottery is decomposed into the sure payment (the minimum payoff) and the remaining additional risky payoffs.
  - **Cancellation**: If there are two or more lotteries, payoffs that are common to all lotteries are disregarded.
  - **Simplification**: rounding of probabilities (e.g. the rounding of the lottery (101, 0.49) to (100, 0.5).

- **Detection of dominance**: An option that is inferior in at least one case and equal in all other cases is excluded from the optimization process.

- **Value/utility function:**

(x, p; y, q) is a lottery that pays x with probability p and y with probability q. If no riskless component (minimum payoff or loss) is involved, i.e. either $p+q<1$ or $x \geq 0 \geq y$ or $x \leq 0 \leq y$), then Prospect Theory determines the utility/value in the following form:

$$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y) \qquad (1.)$$

If a riskless component is involved ($p+q=1$ and either $x>y>0$ or $x<y<0$), the lottery is split up into the riskless component y and the remaining risky component x-y that is obtained with probability p:

$$V(x, p; y, q) = v(y) + \pi(p)[v(x)-v(y)] \qquad (2.)$$

The use of the **probability-weighting function *π(.)*** means generalizing Expected Utility by relaxing the expectation principle that states that expected utility is proportional in probabilities. The function π(.) has the following properties (see Figure 1):

- It is increasing in p, π(0)=0 and π(1)=1.
- For small values of p, π is a subadditive function of p, i.e. π(rp)>r π(p)
- Overweighting of small probabilities: π(p)>p for low probabilities (<0.3)
- Subproportionality: $\frac{\pi(pq)}{\pi(p)} \leq \frac{\pi(pqr)}{\pi(pr)}$ with 0<r<1.
- Subcertainty: for all 0<p<1, π(p)+ π(1-p)<1

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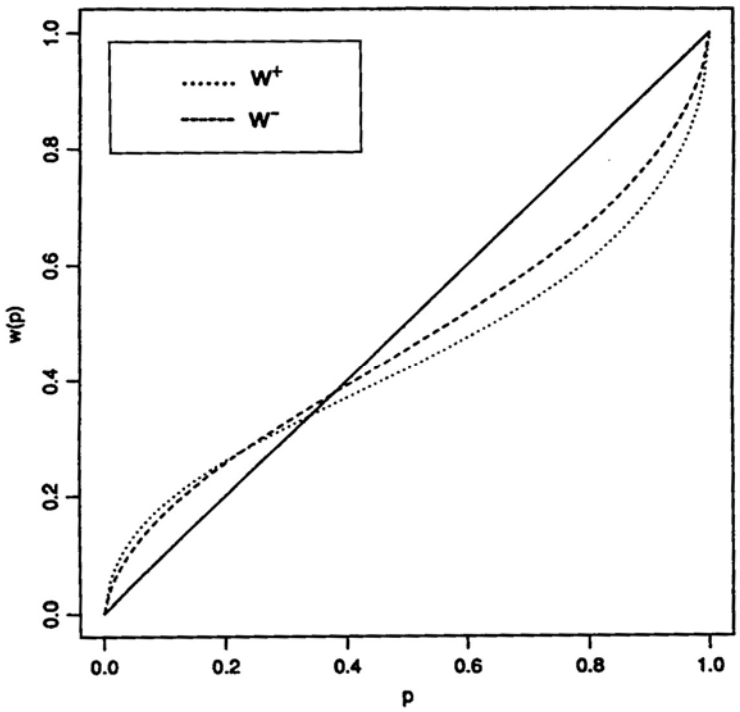

Figure 3.3. Weighting functions for gains (w^+) and for losses (w^-) based on median estimates of γ and δ in equation (12).

Figure 1: The probability-weighting function of Prospect Theory

(Tversky and Kahneman, 1991, p. 60)

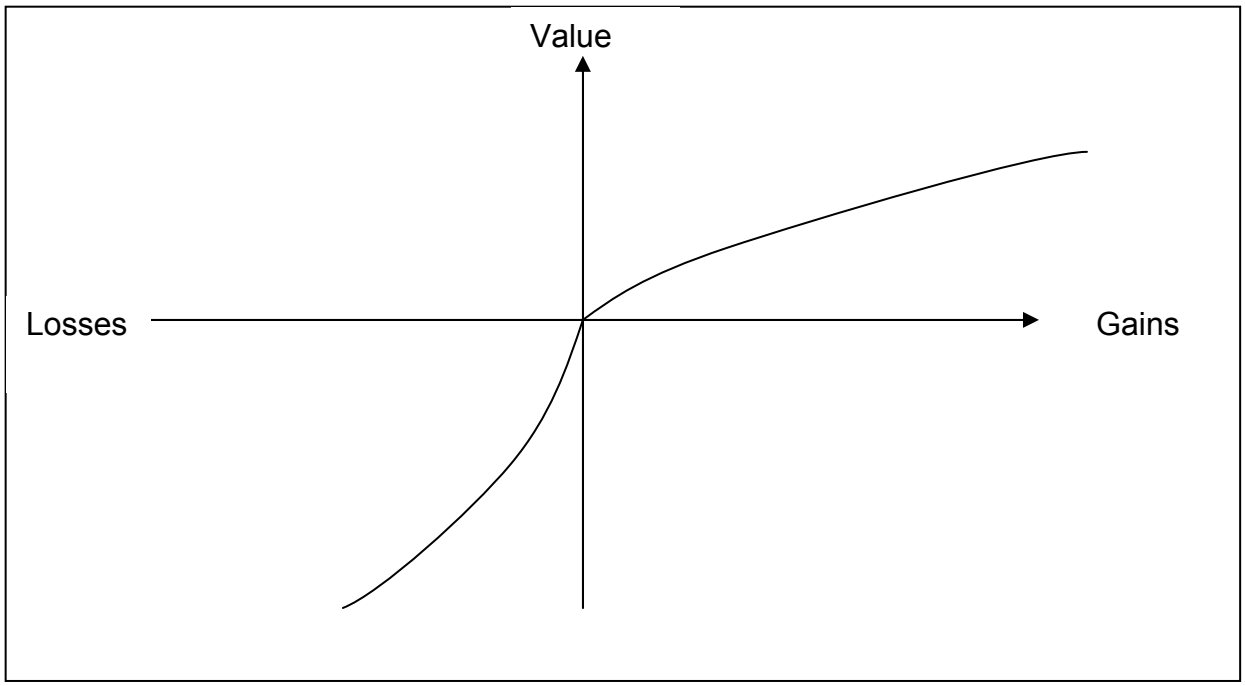

Figure 2: The value function of Prospect Theory

The **value function *v(.)*** itself (see Figure 2) has the following properties:

- **Reference Point**: Carriers of utility are changes in wealth rather than final states. The reference point that serves as comparison is usually the current wealth[5]. There are two ways to include the reference point in the notation:
  - Subscripts: The state variables are still displayed in their absolute level. A subscript for the utility/value function refers to the reference point: $V_x(y)$ is the utility of moving from x to y.
  - Difference notation: The state variable is transformed such that the wealth level of the reference point is subtracted from all states: V(y-x) is the utility of moving from x to y. This notation neglects possible wealth effects, because it treats a difference in wealth with respect to the reference point as having the same effect, regardless of the amount of initial wealth. As

[5] Other theories that adopt a reference point are Regret Theory and Reference-dependent Subjective Utility Theory (see below).

the wealth/income effect measured in experiments appears to be quite weak (Morrison, 1997, Schmidt and Traub, 2003), this simplified notation is adopted throughout this dissertation.

- **Decreasing sensitivity**: The function is concave for gains and convex for losses.
- **Loss Aversion**: steeper for losses than for gains: $v'(x)<v(-x)$ and $v(x)<-v(-x)$ for all $x>0$.

Loss Aversion in Choice under Uncertainty

The initial purpose of loss aversion was to sustain the aversion towards symmetric bets (where losing as well as winning is possible) that would otherwise have been lost[6]:

"A salient characteristic of attitudes to changes in welfare is that losses loom larger than gains. [...] Most people find symmetric bets of the form (x, .50; -x, .50) distinctly unattractive." (Kahneman and Tversky, 1979, p. 33)

The possible explanatory power of loss aversion for the endowment effect phenomenon was stressed later by Thaler (1980)[7], Knetsch and Sinden (1984) and Tversky and Kahneman (1991).

Loss aversion states that the utility function has a kink at the current wealth, which is defined as the reference point: The marginal utility of additional wealth is strictly smaller than the marginal utility of the last unit of existing wealth[8].

For this explanation of the endowment effect, it is necessary that at least two goods enter the utility/value function, while risk does no longer play a role – so this concept is different from the original one that involved only one good (wealth) in a risky setting and has therefore been termed:

Loss Aversion in riskless Choice

In the riskless setting and applied to an exchange between two goods, the concept says the following: When giving away a good, its loss ("out-of-pocket expense") is val-

[6] Due to the convexity of the value function in the domain of losses.
[7] Thaler calls the theoretical explanation „Endowment Effect" – here, this label is used for the phenomenon itself.
[8] The value function is *always* steeper for losses than for gains.

ued more highly than the gain of the good that is acquired in exchange, so the exchange rate of the two goods has to be sufficiently large to overcome this loss aversion.

Circumstances, under which *no* endowment effect is observed, are explained in the following way: When subjects buy solely for resale, they know they will not keep the good they have acquired. Therefore, they do not mentally integrate it into their endowment: technically speaking, they do not shift their reference point in the good to the new quantity. By giving away the good again, the utility decreases by the same amount by which it had increased before. The same price renders the individual indifferent to the buy and the sell transaction.

Consistency with empirical Evidence

Loss aversion in riskless choice cannot explain a number of experimental outcomes. The following two examples illustrate the inconsistency with the empirical evidence:

- Lottery tickets are found to induce an endowment effect in several experiments. Subjects hold the lottery tickets for the sole purpose of exchanging them for a prize, if the lottery wins. This should lead to the situation where they do not shift their reference point; there should be *no* endowment effect.
- List (2003) – trading experience in the sports memorabilia market. In List's experiments, 95 percent of all subjects stated that they planned to keep the good[9]. For half of the subjects, namely the experienced traders, no endowment effect was measured, while for the amateur collectors, a strong endowment effect showed up.

Overall, at least 16 of the 83 experiments summarized in the appendix, (11 out of 25 articles) must be seen as inconsistent with loss aversion in riskless choice: Singh (1991), Ortona and Scacciati (1992), Shogren et al. (1994), Van Dijk and van Knippenberg (1996), Morrison (1997), List (2003), Schmidt and Traub (2003), Blondel and Lévy-Garboua (2005), Van de Ven et al. (2005) and Plott and Zeiler (2005a and 2005b)

After Prospect Theory, another theory that influenced many behavioral theories was Regreg Theory.

[9] After one year, 99,3 % of all subjects indeed still owned the good (p. 46).

Regret Theory

In 1982, Loomes and Sugden developed Regret Theory as an alternative to Prospect Theory. It was designed to explain the same phenomena that Prospect Theory explained: the 'Allais Paradox', the 'certainty effect' and the 'isolation effect' while at the same time being simpler and making fewer assumptions. *"We believe that against the complex and somewhat ad hoc array of assumptions required by prospect theory the principle of Occam's Razor strongly favors the straightforwardness of regret theory"* (p. 817).

Unfortunately, later experiments to test the specific predictions of Regret Theory (Loomes et al., 1992) did not show the results the authors had hoped for. In addition, the theory was designed only for pairwise choices. This led to predictions of intransitive choices when more than two options were considered.

Regret Theory in its original form is not consistent with the endowment effect phenomenon. However, it provided an important change of the reference point concept known from Prospect Theory: In Regret Theory, two options are evaluated by comparing them state-by-state, using the alternative that is not chosen as a reference point. The principle of comparing all possible end-states in a state-by-state manner proved a good idea and can be found in the theoretical backbone of "Reference-dependent Subjective Utility" (Sugden, 2003, see below), Value Uncertainty (Rankin, 1990, see below) and our own theory developed in chapter 1. Yet, instead of using an unchosen alternative option as the reference point, all these theories abandoned this principle and went back to Prospect Theory's principle of using the current endowment as the reference point.

Theories linking the Endowment Effect and Uncertainty

Value Uncertainty (Rankin, 1990)

Microeconomic theory assumes that a good has a fixed and well-defined position in an individual's preference ordering. Cyert and DeGroot (1975) proposed an alternative approach, called "Adaptive Utility": Individuals are uncertain about the utility they will derive from goods. After consumption, this uncertainty decreases, so they update their preferences. Based on this approach and Regret Theory, Rankin (1990) has tried to

explain the endowment effect as a consequence of this uncertainty. Individuals compare the consequences of every possible action like in Regret Theory. These consequences are not compared with each other like in Regret Theory, but with the initial state, the reference point, as known from Prospect Theory. For any state that is worse than the reference point, individuals feel additional regret. "Rejoicing", the opposed feeling in cases when the consequence is better than in the reference point, is assumed to be zero[10].

Rankin tests his model with data from the so-called 1984 Sandhill study where both experimental methods and contingent valuation survey methods are used to value a deer hunting permit (also analyzed by Bishop et al., 1986). He finds that, with a realistic regret coefficient, his model can explain a large part of the WTA-WTP-gap in the experimental situations, but not the enormous gap in hypothetical "contingent valuation" situations. This is true also for the similar theory of imprecise preferences by Dubourg et al. (1994), which was only and not successfully tested with hypothetical data.

Reference-dependent Subjective Utility (Sugden, 2003)

Sugden proposed a theory that expands subjective expected utility theory to a reference-dependent setting. Preferences between so-called *acts* depend both on final outcomes and on reference points (which may themselves be uncertain acts). The theory is characterised by a set of axioms in a Savage-style framework and is consistent with the endowment effect for lotteries and the preference reversal phenomenon (Lichtenstein and Slovic, 1971, see chapter 2).

Sugden's theory follows the same modification of regret theory as Rankin (1990): applying a regret-style "satisfaction" function to the differences between end-states and current endowment as the reference point with greater weight on negative changes ("regret") than positive changes ("rejoicing") can explain the endowment effect for lotteries and "preference reversal" (see chapter 2). Concerning a systematic relationship between the characteristics of a lottery and the measured endowment effect, Sugden does not propose any quantifiable predictions.

[10] which is not a strong assumption – regret is seen as more important than rejoicing, whether it is zero or positive, but smaller than the regret term, does not matter.

Cognitive Consistency Theory (Blondel and Lévy-Garboua, 2005)

Blondel and Lévy-Garboua (2005, citing Lévy-Garboua, 1999, as the origin of the theory) propose a psychologically founded theory to explain the endowment effect for lotteries:

"Let us consider that, prior to making a choice, the individual has a normative, i.e. procedure-invariant, preference under risk which can be represented by an EU function.[Whatever] this prior preference, it raises doubt when the subsequent choice of one lottery against another raises a visible objection. […] The possibility of finding an objection to one's normative preference, which characterizes most decisions under risk or uncertainty, means that the decision-maker demands information. In seeking additional information, she must perceive the available objection to her normative preference. Thus she must sequentially perceive, first her normative preference, then the available objection to the latter. Since the objection is dissonant with the prior preference, the individual experiences cognitive dissonance and must feel uncertain of her true preference." (p. 6)

The theory is tested with data from a lottery experiment together with a choice experiment replicating the "preference reversal" phenomenon (see chapter 2). While the theory can account for many of the phenomena found, the pricing pattern found for WTP is not completely consistent with the theoretical predictions (see p. 109).

Uncertainty / Regret (Inder and O'Brien, 2003.

Inder and O'Brien (2003) see the endowment effect as the result of regret in conjunction with "uncertainty about market opportunity": When submitting their buy prices, subjects do not yet know the seller's minimum sale prices. So by stating too high a price, there could be a situation where a subject would feel regret: If the seller accepts the bid right away, this could mean that she would also have accepted a lower price. The buyer could have made a bigger gain by stating a lower buy price. The corresponding effect exists on the sale side: There could be situations where the buyer's willingness to pay would have permitted the seller to state a higher sale price. Not doing so could lead to situations of regret. The anticipation of the regret leads to an increase in the stated sale price and to a decrease in the stated buy price.

Counter-arguments:

- The BDM mechanism employed in most experiments (see above) prevents such regret situations due to market uncertainty: If the randomly drawn market price is higher than the stated sale price, the market price is paid to the subject, and not her minimum sale price (and analogous on the buy side – only the randomly drawn price has to be paid, not the possibly higher maximum buy price). If the subjects did indeed state higher sale prices than their true WTA, there could only be regret situations of the opposite type: If the randomly drawn market price is lower than the "strategic WTA", but higher than the true WTA, the subject will not sell, although she would have made a profit by selling. The subject would regret not to have stated her true, lower WTA.
- The possible defense against this counter-argument, that subjects do not want to sell too cheaply (buy for too high a price) in an experiment compared to a possible trade *outside* of the experiment is not convincing:
  Most experiments are conducted with private goods of relatively low value such as a mug. The transaction costs of finding a buyer for such an item outside of the experiment are probably much higher than the possible gains compared to a sale in the experiment. It is most probable that subjects who do not sell their mug in the experiment will not sell it afterwards, but instead just keep it for themselves (this was indeed confirmed in our experiment, see chapter 1).

Other Endowment Effect Theories

Evolution and Bargaining (Carmichael and MacLeod, 2003)

Carmichael and MacLeod see the origin of the endowment effect based in evolution: In the process of evolution, humans learned to like their property more than they desire their neighbour's property, because this reduces conflicts. Carried over to bargaining situations between buyer and seller, this means that nobody is willing to accept less than her own endowment. Evolution also brought automatic search for surplus in bargaining situations: More is claimed than the initial endowment. This leads to situa-

tions where the buyer does not want to pay as much as the seller demands, although based on the true values a trade would be possible that is profitable for both sides.

Counter-arguments

- The use of the BDM mechanism, if understood, prevents "strategic answers" by subjects who state higher WTA and lower WTP than would correspond to their true valuation
- Carmichael and MacLeod try to counter this argument as follows: Humans have two "decision devices": The "high road", a process where thinking and consideration is involved, and a "low road" where the decision is made without much consideration. Thus, the "low road" automatism is seen to produce wrong decisions in the endowment effect experiments: Subjects seem to wrongly assume that they can influence the trading price by setting strategic prices, hiding their true valuations for the objects. The problem with this explanation is that it predicts an endowment effect for all experiments – which is inconsistent with all situations where no endowment effect is found.

Subject Misconceptions (Plott and Zeiler, 2005a)

Plott and Zeiler (2005a) see individuals' mistakes as the reason for the endowment effect: "By proper choice of procedures the phenomenon can be turned on and off" (p. 23). They claim that only using *anonymity, incentive-compatible elicitation, practice,* and *training* together eliminates the endowment effect.

Several arguments speak against misconceptions explaining the entire WTA-WTP-gap:

Counter-arguments

- The proposed reason for the endowment effect – subject misconceptions – cannot explain how the endowment effect can be both present and absent when the same experimental methods are used. Therefore, this argument is inconsistent with 10 out of the 25 studies presented in the appendix of this General Introduction, where results change from a significant WTA-WTP-gap to no gap by only changing the good in question and sticking to the method: Kahneman et al.

(1990[11]), Singh (1991), Ortona and Scacciati (1992), Shogren et al. (1994), Franciosi et al. (1996), van Dijk and van Knippenberg (1996), Morrison (1997), List (2003), Van de Ven et al. (2005), Blondel and Lévy-Garboua (2005). Even in their own (unpublished) practice rounds with lotteries, Plott and Zeiler find a WTA-WTP-gap, although they caution that the practice rounds were not designed to test for a gap.

- A possible explanation for Plott and Zeiler's measurement of no endowment effect for a mug that has otherwise always been found could lie in their specific *practice* rounds: *"In addition, the experimenter had an opportunity to observe individual behavior and clear up any misunderstandings (i.e., the playing of dominated strategies) noted from the observations"* (p. 17). If indicating lower WTP than WTA is seen as a sign of misconceptions that can be corrected by the experimenter, this could have deleted a WTP-WTA-gap that might otherwise have existed.

[11] all experiments with induced-value tokens: exp 2, trial 1-3, exp 3, trial 1, exp 4, trial 1-2, exp 8a

Appendix of the Genral Introduction

Allais Paradox (Allais, 1953)

When asked to choose between gamble A: (4,000, .80) and certain payment B (3,000), most people prefer B. When asked to choose between gamble C: (4,000, .20) and gamble D: (3,000, .25), most people prefer C. This violates expected utility theory which postulates that expected utility is linear in probability. As the payoffs in C and D are exactly four times more unlikely than the same payoffs in gambles A and B, respectively, a preference for B in the first choice would imply preference for D in the second choice.

Additional Tables and Figures

Table 1: The Reflection Effect

(Kahneman and Tversky, 1979, p. 22)

Table 2.1. Preferences between Positive and Negative Prospects

Positive Prospects			Negative Prospects		
Problem 3:	(4,000, .80)	< (3,000).	Problem 3′:	(−4,000, .80)	> (−3,000).
$N = 95$	[20]	[80]*	$N = 95$	[92]*	[8]
Problem 4:	(4,000, .20)	> (3,000, .25).	Problem 4′:	(−4,000, .20)	< (−3,000, .25).
$N = 95$	[65]*	[35]	$N = 95$	[42]	[58]
Problem 7:	(3,000, .90)	> (6,000, .45).	Problem 7′:	(−3,000, .90)	< (−6,000, .45).
$N = 66$	[86]*	[14]	$N = 66$	[8]	[92]*
Problem 8:	(3,000, .002)	< (6,000, .001).	Problem 8′:	(−3,000, .002)	> (−6,000, .001).
$N = 66$	[27]	[73]*	$N = 66$	[70]*	[30]

Problem 1 ($N = 152$): Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

If Program A is adopted, 200 people will be saved. (72%)

If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved. (28%)

Which of the two programs would you favor?

Problem 2 ($N = 155$): If Program C is adopted, 400 people will die. (22%)

If Program D is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die. (78%)

List of Endowment Effect Experiments 1983 – 2005

Starting on next page

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Experiments with real transactions:								
Knetsch and Sinden (1984)	Test 1	Does the gap persist in the lab?	lottery tickets worth 50 $ (or 70 $ merchandise voucher)	gap	76	students		anonymity
	Test 2	effect of experience	lottery tickets for 10 $ or 15 $ voucher	gap	"	"		
	Test 3	robustness check: different subjects	lottery $ 50/$70 voucher	gap	79	part-time students		
	Test 4	robustness check: different parameters	lottery $ 50/$70 bookstore voucher	no gap	69	"		participants knew each other. "social pleasure of participating in the lottery with the group outweighted the value of the prize" was a typical answer in follow-up survey.
	Test 5		lottery $ 70/$90 bookstore voucher	gap	128	students		
	Test 6	advice to others	lottery 60/70 bookstore voucher	no gap for advice	90	part-time students		2 extra groups asked to give to a classmate to buy/sell
Knez et al. (1985)	Series I	do WTA/WTP-responses provide good predictors for market prices?	multi-stage lottery	answer to question: yes	9 to 12			1) Deriving an equilibrium price from demand (WTP) and supply (WTA) yields a better predictor of observed trading prices than the expected payoff of the lottery. 2) "Irrational bidding": 14 % of the sell offers are below the own stated WTA and 46 % of the buy offers are above the own WTP.
	Series II	do subjects answers to WTA/WTP-questions change after repeated trading?	simple lottery	no answer to question possible	9			1) seller and buyer surplus smaller than in series I. 2) 34% of lowest offers below WTA, 47 % of highest bid above WTP. 3) "Irrationalities": WTA<WTP - occur mostly in early periods
Coursey et al (1987)	Part 1	other good than lottery ticket - hypothetical question	right to avoid bitter lasting liquid	gap	64	full-time students	3.8	hypothetical question: WTA - how much should you be paid to make you taste the bitter liquid. WTP - how much would you pay to avoid tasting the bitter liquid. (avoiding a bad = acquiring a good)
	Part 2	let subjects try the good - hypothetical question	right to avoid bitter lasting liquid	gap	"	"	4.2	"semi-hypothetical" question: subjects could tasted a few drops, then were asked again for their WTA/WTP (and asked if they would accept a further decreased WTA/increased WTP offer relative to their answer, which changed the bids slightly)
	Part 3	allow for learning - real auction	right to avoid bitter lasting liquid	no gap	"	"	1.8	consecutive rounds of Vickrey auctions were conducted, as long as subjects stated that they wanted to change their bids (max 10). Subjects decreased their WTA from 10 to 4,8, but did not change their WTP when learning other subject's bids.
Brookshire and Coursey (1987)	Part 1 - contingent valuation survey	hypothetical elicitation vs. Marketplace	tree density in a public park	gap	93	households	20.8	classical contingent valuation methodology - all numbers for a change of 25 trees
	Part 2 - "field Smith auction"	hypothetical elicitation vs. Marketplace	tree density in a public park	gap	94	households	2.6	field smith auction process: payment/compensation is made more concrete (=probable)
	Part 3 - laboratory Smith auction with real payments and real outcomes!	hypothetical elicitation vs. Marketplace	tree density in a public park	gap	54	randomly selected individuals	1.4	laboratory smith auctions: auctions for separate groops that resulted in real payments/compensations. Numbers for final bids. Results: WTA decreases dramatically.

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Knetsch (1989)	Test 1	direct test of reversibility of indifference curves	coffee mug vs. 400-gram Swiss chocolate bar	gap	218			
	Test 2	direct test of reversibility of indifference curves	Candy Bar vs. Money	gap	80			
	Test 3a	direct test of reversibility of indifference curves	0.5 % chance of an accident that year	gap	295			
	Test 3b	direct test of reversibility of indifference curves	one week of vacation time	gap	295			
Harless (1989)		hints to subjects to reveal true values; within subject comparison	lottery tickets (good)	no gap	8		med 1,1 to 2	2nd price auctions. Instructions stated that it is "the best strategy go make an offer equal to your minimal value" (and corresp. For WTP). WTA/WTP-ratios are calculated for individual subjects.
			lottery tickets (bad)	no gap	8		med 1,1 to 1,5	Apparent definition of WTA for bad lottery: willingness to accept money and the lottery. WTP: Willingness to pay to rid oneself of the lottery.
Kahneman et al. (1990)	Exp 1, trial 1-3	control for transaction costs	induced-value token	no gap	44	students	1.0	limited monetary incentives in Exp 1&2;
	Exp 1, trial 4-7	trading experiment	coffee mugs	gap	"	"	1.9	sell for $6.00 at the bookstore
	Exp 1, trial 8-11	trading experiment	boxed ballpoint pens	gap	"	"	1.7	visible bookstore price tag of $3.98
	Exp 2,1-3	trading experiment	induced-value token	no gap	38	"	1.0	
	Exp 2,4-7	trading experiment	coffee mugs	gap	"	"	2.2	
	Exp 2, 8-11	trading experiment	folding binoculars	gap	"	"	2.0	available at the bookstore for $4.00
	Exp 3,1	control for transaction costs	induced-value token	no gap	26	"		
	Exp 3,2-5	questioning WTA and WTP directly	Pen	gap	26	"	5.5	no monetary incentives
	Exp 4,1-2	control for transaction costs	induced-value token	no gap	74	"		
	Exp 4,3.7	questioning WTA and WTP directly	Mug	gap	74	"	2.5	no monetary incentives
	Exp 5	testing for "misrepresentation"	mug	gap	59	"	2.6	Becker-DeGroot-Marschak-Mechanism of randomly selected transaction price ensures that individual price decision has no effect on transaction price
	Exp 6	reluctance to buy vs. Reluctance to sell	mug	gap	77		2.5	Equivalent Gain!
	Exp 7	reluctance to buy vs. reluctance to sell - with price tags	mug	gap	117		3.5	Equivalent Gain - price tag (3,98)
	Exp 8 a	bilateral bargaining experiment	induced-value token	no gap	70			subjects were paired. Value of token for seller: 3$, for buyer 5$. 29 out of 35 possible trades is seen as no significant undertrading (compared to a ratio between 0,1 to 0,2 trades over possible trades for the gap-experiments)
	Exp 8 b	facilitate exchanges by earning cash before experiment	chocolate bar	gap	70		2.8	

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Singh (1991)	Test 1a - before trading	do non-student subjects show other behavior?	lottery	gap	42	Malaysian civil servants	median 1,5	
	Test 1b - after trading		lottery	no gap	"		median 1,12	After trading, the answers converge sufficiently such that the 0-hypthesis WTA/WTP<1,1 cannot be rejected at the 1%-level.
	Test 2a - before trading	benchmark with students	lottery	no gap	54	students	median 1,07	with students as subjects, the 0-hypothesis cannot be rejected even before trading.
	Test 2b - after trading		lottery	no gap	"		median 1,03	
	Test 3	does asking for "advice to a client" produce different results?	lottery	no gap	46	unspecified	median 1,01	no gap for "advice" answers as in Kn&S 1984 Test 6 - author's interpretation of this result as "endowment effect" is misleading
Boyce et al. (1992)	no-kill-condition	Do sellers care more about the survival of a good than buyers?	Norfolk Island pine tree	gap	115	univ. staff	1.7	approx. retail value of a tree: $6; BDM mechanism
	kill-condition	Do sellers care more about the survival of a good than buyers?	Norfolk Island pine tree	gap	"		2.4	WTA-distribution bimodal: Some subjects cared about survival and stated high offers, some didn't care. Authors state that effect would be only a supplement to loss aversion. anonymity
Ortona and Scacciati (1992)	Experiment 1	Does the endowment effect exist for time?	one hour of leisure time	gap	40	local government employees	10.2	In three out of the four experiments (all but the gov. Empl.), both WTA and WTP questions were asked to the same persons. "The first answer, therefore, may have influenced the second one, reducing the disparities."
			two hours in a train	gap	25	university students	3.2	
			one hour of leisure time per month	gap	35	high school teachers	6.3	
			one hour of leisure time per month	gap	23	bank employees	4.2	
	Experiment 2	Looking for the effect of time and psychological transaction costs.	$35 book voucher	no gap	34	students		no significant difference between three rounds: immediate WTA, WTA one hour later and EG (taken for WTP). Features: real payoff, necessary good (students needed books), payoff substantial.
	Experiment 3	not necessary goods	book about military uniforms	no gap	33	students		maket value: 70$. Unclear, what procedure was used in round 1 - EG? Table 2 (294) and text are contradicting each other.
Loewenstein and Issacharoff (1994)	Experiment 1	do subjects value objects more when they receive them as a reward for performance?	mug	answer to question: yes; gap: yes	39	students		"good mood" because of good performance is ruled out, because half of the successful subjects were told that they received the mugs because of chance and they valued it lower
	Experiment 2	Does "self-representation" influence the source dependence?	mug	answer to question: no; gap: yes	67	students		"Self-representation": successful subjects want to keep the mug because it indicates them as successful (other subjects did not know that success is connected with getting a mug, so this could not alter their behavior).

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Shogren et al. (1994)		Does the degree of substitution play a role?		authors: yes				
	stage 1		regular size brand-name candy bar instead of small candy	no gap	144		round 1: 1.38, round 3-5: 1	significant gap only in first round. WTA decreases and reaches WTP in round 3. Authors: good has close substitutes, so doesn't produce EE (compare Hanemann 1991). Getting the candy bar (market price: 0,50) was in fact an "upgrade" from a smaller candy (market price: 0,10).
	stage 2		food-borne pathogen risk	gap	142		1st round: 20; 7-10:8; 17-20:23	Authors eliminate outliers for a second table that still shows most of the gaps highly significant. Gaps seem to decline through trading. Information about the probability and severeness of the illnesses seems not to decrease WTA further, but instead to increase it again.
	stage 3		coffe mug "upgrade"	no gap			1:2,75; 4-10: approx 1,2	Trading reduces WTA greatly in 3-4 periods, WTP rises moderately in the first 3 periods. Value of coffee mug: 5,20; plastic mug: 1,60.
Franciosi et al. (1996)	choice test	does not using the words "buyer", "seller" and "price" alter the results?	mugs	gap	120		2.4	Same setup as KKT (1990), except that the words "buying", "selling" and "price" are not used in the instructions. The gap is a little smaller than in the original KKT results, but still significant (factor of more than 2). Having been in the role of buyer or seller in the preceding experiment does not influence valuations. Amount earned in prior experiments does not alter the valuations = no "house money" effect.
	exchange test part 1		induced values (randomly assigned between $0 and $9.99)	no gap	24			Uniform price double auction mechanism (4 or 6 min bidding time).
	exchange test part 2		mug (w. price tag $ 9.95)	gap	24			Uniform price double auction mechanism (4 or 6 min bidding time). Less untertrading than in KKT 1990 experiments - authors: trading mechanism. No significant effect of experiment earnings on WTP or WTA. Bids and offers are significantly below the WTP/WTA answers in the corresponding choice experiment! Choice WTP answers are the best predictor for exchange price levels.
van Dijk and van Knippenberg (1996)	fixed exchange value	EE with "exchange goods" (lotteries)	induced-value token	no gap	66	students	1.1	
	uncertain value conditions		lottery	gap	67	students	1.4	The estimated values of buyer and seller groups were not statistically different. Buyers: mean Dfl 3.34; sellers 3.27) Distribution of lottery (1,75; 5,25) was not made explicit: "any value between" - so could be seen as a uniform distribution with maybe a slightly larger standard deviation (more weight to the extreme values which can only occur with 1/350 in a uniform distribution).
Bateman et al. (1997)		testing equivalent gain and equivalent loss measures and different response modes	can of coke	gap	156	students		Numerical answers to the questions not published. From these answers, for every subjects a preference for one endowment point is calculated. More subjects prefer an endowment point when they are already in this endowment point. When in neither of the two points, preferences are in-between, so that WTA>EG>EL>WTP can be infered from the results.
			luxury chocolate	gap	156	students		slightly stronger preference for own endowment than in coke experiments, although not directly statistically compared

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Morrison (1997)		Does the substitutability play a role?	chocolate bar	no gap	20	3d/4th year students, taking a course in experimental economics	1.1	WTP subjects were "uncompensated": they did not receive a compensation equalling the chocolate bar that the WTA group received.
			coffee mug	gap	20	"	2.2	WTP subjects were "compensated": they received a compensation worth the average WTA answers of the other group, so there cannot be wealth effects. Author: this rules out substitutability as an explanation of the EE.
Arlen et al. (2002)	agency experiment	Does the gap exist in agency relationships?	coffee mug	no gap	145	1st year law students	1.0	WTA subjects were asket whether they would "contribute" their mug to a project of their firm. This would allow the firm to possibly earn more profits, so to offer higher wages. If the offer was accepted, higher wage - base wage = WTA. WTP subjects were asked whether they wanted to "take" the mug from the firm, accepting a lower base wage instead of the wage indicating higher firm profits.
	control experiment	Control experiment to ensure EE shows up.	coffee mug	gap	35	"	1.9	
	exchange-value experiment	"shared-entitlement approach" for agency effect	coffee mug	no gap	76	"	1.3	No mentioning of low or high profit for firm. Firm-contract was offered at same time as mug question posed, not in a sequential manner, as before. Authors: "Shared entitlements" thesis is wrong, "exchange-value hypothesis" is right: subject only considers the "exchange value" instead of its "consumption value".
Bateman et al. (2002)	"money response mode"	"current endowment hyptothesis" vs. "no loss in buying"	luxury chocolate vouchers (for 10 pieces)	gap	200	undergr. Students	geom. Means: 2,13	Authors see this as confirmation of "current endowment hypothesis" (british group) vs. "no loss in buying" (Kahneman).
	"chocolate response mode"		money vs. Chocolates	gap	120	undergr. Students		
	"immediate chocolate"		real chocolate	gap	107	undergr. Students		Packages of 10 real luxury chocolates were used to increase the gap (measured by WTA/EG) - successfully.
List (2003)	market pretest	choice control experiment	sports memorabilia (two different, "unique" goods)		50	visitors of sportscard show		
	Sports memorabilia: nondealer treatments	does market experience play a role?	sports memorabilia (two different, "unique" goods)	gap	74	sportscard show professional dealers		142 of 148 of the subjects stated that the planned to "consume" (keep) the good. One year later, only one subject had sold the good. Experienced nondealers (> 6 trades/month) trade: 46,7 % while inexperienced nondealers: only 6,8 % trade! Logit estimation shows that trading experience has a positive effect on the likelihood to trade (p<0,01)! Quadratic experience term has negative impact: diminishing return to experience.
	Sports memorabilia: dealer treatment		sports memorabilia (two different, "unique" goods)	no gap	74			Logit estimation shows no significant effect of trading experience on likelihood to trade.
	Collector pin market (nondealers only)	robustness test: market experience in different environment	2 different pins of Mickey and Minnie Mouse	gap	80	visitors of collector pin market		78 of 80 subjects stated that they wanted to "consume" (keep) the pin. Inexperienced consumers (<5 trades/month): 18 % trade; experienced consumers: 46,7 % trade! Logit estimation reveals sig. effect of trading experience (quadr. negative, third poser positive).

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
	follow-up experiment to sports memorabilia exp. - inexperienced consumers	treatment effect or selection effect?	autographed photo vs. autographed baseball	gap	21	nondealers (of the above sample)		for both experiments: 52 of 53 subjects planned to keep the good they got ("consume").
	follow-up experiment to sports memorabilia exp. - experienced consumers			no gap	32	nondealers (of the above sample)		experienced: trade 7 or more times/month. Logit/probit estimations: trading experience increases likelihood to trade significantly. Controlling for sample selection (those subjects of the first experiments that participated again), the results are unchanged. Within-person analysis (whole group): increase in trading activity of the year --> significant positive influence on propensity to trade! So the "selection bias" argument, that those subjects that do not have the endowment effect trade more can be rejected vs. the experience argument: more trading experience leads to a lower endowment effect!
	fourth field experiment - nondealers	Effect of using an auction	sheet of basketball trading cards ("unique")	gap	60	sportscard show visotors	5.6	nth-price auction (n-1 subjects get trade at the price given by the nth subject --> dominant strategy: reveal value)
	fourth field experiment - dealers	Effect of using an auction	sheet of basketball trading cards ("unique")	no gap	60	sportscard show professional dealers	1.3	
	laboratory experiment	evidence from non-memorabilia collectors	mug vs. candy bar, ballpoint pen vs magic marker, can of coke vs. pencil, highlighter vs. letter opener	gap, decreasing in 4 weeks	35+33	undergr. students		every group had four weekly sessions. Group 1: order ABCD; Group2 : order DCBA. Result: In later trading rounds, gap decreased. (If probable typo o p.66, 4th and 5th line from below is taken into account: exchange group 1 and group 2. Otherwise inconsistent with statements and numbers given above.) If students interacted, they might have learned the utility the other group got from the goods so could better evaluate them in their own experiments?
Schmidt and Traub (2003)	treatments 1 and 2	role of income effect	60 different lotteries	means: gap, median: no gap	24	students	mean: 1.88, median: 1.06	second-price sealed bid/offer auction. Median of mean WTA/WTP-disparity: 1.88. Yet, the overall median is 1.06. Highly skewed distributions with many outliers and many subjects without gap. Reversed income effect did not delete gap. Gap concentrated in subsample of 60 % of the subjects.
	treatments 4 and 5	role of "background risk"	30 pairs of lotteries	no gap	24	students	median: 1.00	subjects endowed with a lottery and can change to another lottery with additional payments to and from them, eliciting differential WTA and WTP. In 11 of 15 cases, median = 1. No significant gap between DWTA and DWTP
Blondel and Lévy-Garboua (2005)		endowment effect for lotteries and preference reversal	30 different lotteries	gap	62	students		significant gap for all lotteries, varying with payoff and winning probability (see chapter 2)

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Plott and Zeiler (2005b)	baseline procedures	control experiment	pens vs. mugs	gap	129	students		standard procedure of exchange experiment
	transaction costs test	transaction cost test	pens vs. mugs	gap	101	students		endowed good not immediately in front of subject at time of choice; use of forms instead of show of hands
	standard procedures	control experiment	pens vs. mugs	gap	96	students		as baseline, except that raise of hand means trading and not keeping
	full set of procedural controls	influence of various signals	pens vs. mugs	no gap	139	students		as transaction cost test except that 1. endowed good is randomly chosen instead of chosen and given by experimenter and 2. experimenter did not "purposefully and repeatedly emphasize ownership", decision form resembles choice instead of exchange: ownership signal might have been removed altogether.
Plott and Zeiler (2005a)	KKT replication	Does the EE ever exist?	mug	gap	29	undergr. Students	2.7	
	Plott/Zeiler design 1	Is EE due to subject misconceptions?	mug	no gap	31	students	1.1	training, practice, anonymity & binding outcome experience
	Plott/Zeiler design 2	Is EE due to subject misconceptions?	mug	no gap	26	students	0.7	training, practice, anonymity, NO binding outcome experience
	Plott/Zeiler design 3	Is EE due to subject misconceptions?	mug	no gap	17	students	0.7	training, practice, anonymity & binding outcome experience
Van de Ven et al (2005)	Experiment 1	are sellers more curious?	lottery (hypothetical)	answer: yes; gap	41	students	2.9	Hypothetical question. Sellers are more curious (mean 5.2 (scale from 1 to 7)) than buyers (mean 3.3).
	Experiment 2, fixed value	control experiment	fixed value token	no gap	33	students	1.0	control experiment as in v. Dijk and v. Knippenberg (1996)
	Experiment 2, uncertain with information to owner	control experiment	lottery	gap	33	students	1.3	control experiment as in v. Dijk and v. Knippenberg (1996)
	Experiment 2, uncertain with information to all	does curiosity affect the gap?	lottery	answer: yes; gap	33	students	1.2	Value of lottery ticket is revealed to everybody, not only to owners. WTA significantly lower than in control experiment where only owners witnessed the random chance procedure.
Brown (2005)		use of verbal protocol technique: find out subjects' motivations	chocolate	gap	21	students	2.4	subjects were asked to think aloud, taping all comments on audio tape. 3 out of originally 24 subjects removed, because they did not sufficiently understand the instructions or cooperate with the "think aloud" request
			mug	gap	21	students	1.8	seeking a good deal (20 of 24 subjects) mentioned most often as explanation for gap. Ambiguity about price or value mentioned by 3 subjects
			notebook	gap	21	students	2.3	Most subjects indicated they wanted to make a "good deal" and avoid a net loss in the transaction, i.e. not sell for much below market price

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Hypothetical Experiments								
Einhorn and Hogarth (1985)	Exp. 4	How do ambiguous probabilities affect WTP/WTA?	insurance against loss (100000)	gap increasing with ambiguity	112	MBA students		Hypothetical experiments without incentive-device. In ambiguous situations, a statement was added about "considerable uncertainty" concerning the probability estimate of the loss.
			p(loss)=.01				1.0	
			p(loss)=.01 - ambiguous				1.7	
			p(loss)=.35				1.1	
			p(loss)=.35 - ambiguous				1.5	
			p(loss)=.65				1.0	
			p(loss)=.65 - ambiguous				1.6	
			p(loss)=.9				1.1	
			p(loss)=.9 - ambiguous				1.5	
Viscusi et al. (1987)		Valuation of risk connected with consumer goods	injury risk caused by toilet bowl cleaner and insecticide	gap	1519	users of the products	not measur able: very large	3/4 of all consumers refused to accept the product for free (full discount) if the risk of injury would be increased from 15/10,000 to 16/10,000 - contingent valuation approach.
Dubourg et al (1994)		Are imprecise preferences the reason for the EE?	road safety (private good)	Answer to question: no		public sample	mean of individu al:	
	Stage 1		slight permanent injury - entire life of car	gap	37		2.4	same subjects answered WTA and WTP questions. For WTP/WTA-measures, answers with WTA>£75, WTP=0 were excluded (this lowers the ratio). H* and L* assign upper and lower "certainty" bounds to the WTP and WTA answers, elicited in the questionnaires. Elicitation method: rotating disk, 25 to 75 £.
			slight permanent injury - one year	gap	37		2.7	
			recover 1-3 years: entire life o.c.	gap	37		4.1	
			recover 1-3 years: 1 year	gap	37		3.1	
	Stage 2	Under which circumstances do the WTP/WTA-ranges of ucertainty overlap? (control experiment)	as above (4 variants)	gap	101		4.43 to 6.16	Elicitation method: payment cards, 0 to 500/1500 £. Respondents rather insensitive to the magnitude of risk reduction. For most subjects, WTA/WTP-intervals of uncertainty (personal confidence interval) do not or only partly overlap. --> this cannot (entirely) explain the EE.
Bateman et al. (2000)	original	How do equivalent loss (EL) and equivalent gain (EG) perform?	change in local traffic level	gap	903			Compensating loss and gain are used instead of WTP and WTA, creating inconsistent labeling within the paper. Confidence intervals for EG/CL are very large (-10000 to 13000). No statistical difference between CG and EL and between EG and CL. 81 of 447 (18 %) did not agree to any compensation for traffic deterioration: 53 of them (65 %) stated that they "would not accept any reduction in amenity level". Correction for inconsistent labels - table 7 must probably be: CG -> WTP; EL -> EG; EG->EL; CL -> CG.

Name	part	Question under investigation	good	result	n	subjects	ratio WTA/ WTP	comment
Other Empirical Observations								
Salkeld et al. (2000)		Status quo effect in health care.		status quo bias	600	bowel scan patients		Respondents face choices of new bowel scan methods which differ in different characteristics. Aggregation to a regression on the characteristics reveals a significant negative constant: Respondents prefer the current scan over a scan with identical characteristics - status quo bias.
Madrian and Shea (2001)		Does "automatic enrolment"-question increase the participation rate in 401(k) pension plans?		status quo bias	19935	emplyees of one fortune 500 company		"Automatic enrolment" (enrolement as default option with "opt-out" possibility) increased participation rate from 49 % to 86 % (even more taking tenure into account). 65 % of new employees leave contribution rate at default 3 % (vs. 4 % choosing it before). 80 % of new employees invest only in money market (default option) vs. 6 % before.
Chen et al. (2005)		Do monkeys show loss aversion?	food vs. metal chips	loss aversion	5	capuchin-monkeys		First experiments with non-human subjects. Results can be interpreted to speak for monkeys showing loss aversion in riskless and risky choice.

Chapter 1:

Uncertainty and the Experimental Endowment Effect

Elsevier/SABE/IAREP "Best PhD student paper" 2004[12]

Abstract: Recent experiments have shown that the so-called endowment effect or status quo bias disappears under certain circumstances like trading experience. Existing theories fail to explain these patterns. This paper develops a simple theory of uncertainty about the desire to trade leading to a gap between willingness to accept (WTA) and willingness to pay (WTP).

Our endowment effect experiment with additional psychological questions rejects the predictions made by "loss aversion in riskless choice". Plott and Zeiler's (2005a) misconception hypothesis and our uncertainty hypothesis are both confirmed.

When subjects with apparent misconceptions are excluded from the data, the gap vanishes for a metro ticket, but not for a share certificate with unknown quote. The gap for the share collapses when the quote information is released. Overall, as uncertainty influences the range of possible "strategic" answers as well, it can be seen as a main factor in order to predict the measured gap.

Keywords: endowment effect, status quo bias, loss aversion, prospect theory, reference point, WTA-WTP-gap, uncertainty.

JEL classification: D81, **PsycINFO classification:** 2229

[12] A former version of the paper with the title "Caution Theory as an Explanation of the Endowment Effect" was chosen as the "Best PhD student paper" on the 2004 SABE/IAREP conference "Cross Fertilization Between Economics and Psychology" in Philadelphia (SABE: Society for the Advancement of Behavioral Economics, IAREP: International Association for Research in Economic Psychology).

Introduction

The purpose of this paper is to provide a theory that explains not only the endowment effect without exception but cases in which it does not hold as well. We test the predictions of our theory and two other theories in a behavioral experiment.

The main characteristic that determines the variation in the gap between WTP and WTA is uncertainty: The more people are uncertain how much they value an object, the more WTP and WTA differ. If they are certain about their valuation and about whether they should trade or not, there is no such gap.

A formal theory to predict the size of the gap is developed in the following section. Prospect Theory (Kahneman and Tversky, 1979), one of the most accurate theories that predict behavior under uncertainty, can be extended in a way to predict the relation between uncertainty and the WTA-WTP-gap. The only step necessary to do this is to extend the concept of a reference point in wealth to the domain of risk.

I. Uncertainty about Desire to trade

Imagine that an individual is presented with a choice between an object, say a mug, and different amounts of money. Imagine that our individual is certain that she prefers the mug over 1.00 €. Yet if the amount of money is 2.00 €, she is certain to prefer the money over the mug. The traditional microeconomic approach suggests that there must be an exact amount of money where the individual is exactly indifferent between choosing the money and the mug. Imagine that our individual is indeed indifferent between choosing the mug and 1.50 €. Now, traditional economic theory would proceed by stating that our individual would prefer the mug over all amounts of money up to 1.49 € and prefer the money over the mug for all amounts above 1.50 €.

The hypothesis presented in this article contrasts with this view and posits that due to uncertainty, individuals' range of indifference might be far larger than a single price. In the above example, it might well be that even for all prices between 1.00 € and 2.00 €, our individual is not absolutely sure whether she prefers the mug or the money. There could be different sources of this uncertainty:

1. Uncertainty about the market price of an object (i.e. how much one would have to pay in a store).

2. Unfamiliarity with determining an exact value of an object for oneself, especially when asked to sell this good.
3. Unfamiliarity with a good itself.

If there is indeed uncertainty with respect to trading a good at a certain range of prices, the question arises whether this uncertainty leads to different reactions in a buying than in a selling situation?

Our hypothesis is that individuals do indeed react to uncertainty differently in situations where they own something of uncertain value than when they do not own it: A principle of "erring on the side of caution[13]" leads to a "status quo bias" if there is uncertainty. In the above example, our individual might refuse to buy the mug for more than 1.00 € and at the same time refuse to sell the same mug for less than 2.00 €.

Caution corresponds to decreasing the risk of an "erroneous action", while increasing the risk of letting a good opportunity pass. The risk of an "erroneous action" here is to buy too high and to sell too low. The risk of letting a good opportunity pass is not to buy or sell at a price that might later turn out to have been profitable.

In order to treat this question formally, let us represent goods as lotteries that can yield a high or a low value, corresponding to the individual's uncertainty about the value of the good.

[13] In case of understanding problems with respect to this expression, a helpful informal discussion can be found under http://www.speedreading.com/phpBB2/ptopic30.html (especially the 4th posting).

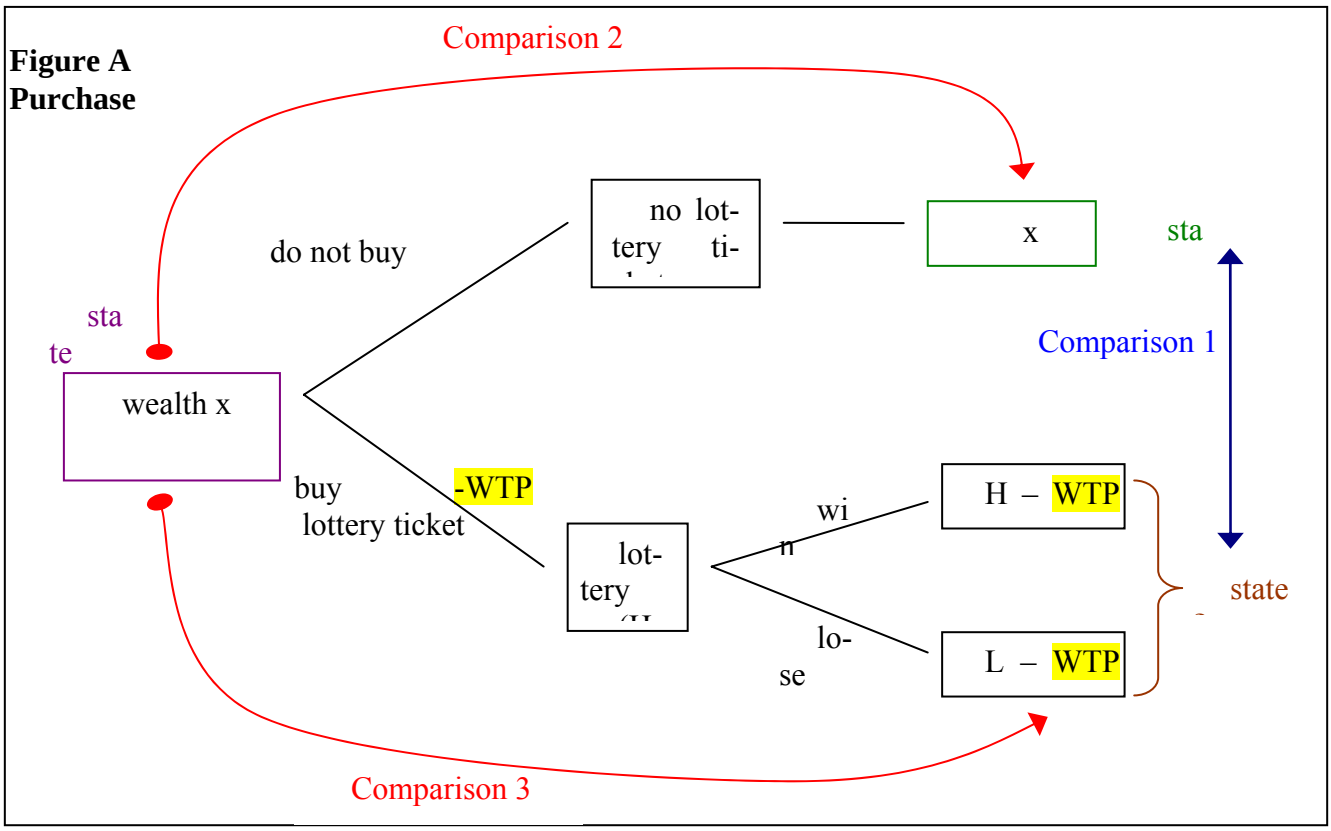
Figure A
Purchase
Comparison 2
do not buy
no lot-
tery ti-
x
sta
sta
te
Comparison 1
wealth x
buy
lottery ticket
-WTP
lot-
tery
wi
n
H – WTP
lo-
se
L – WTP
state
Comparison 3

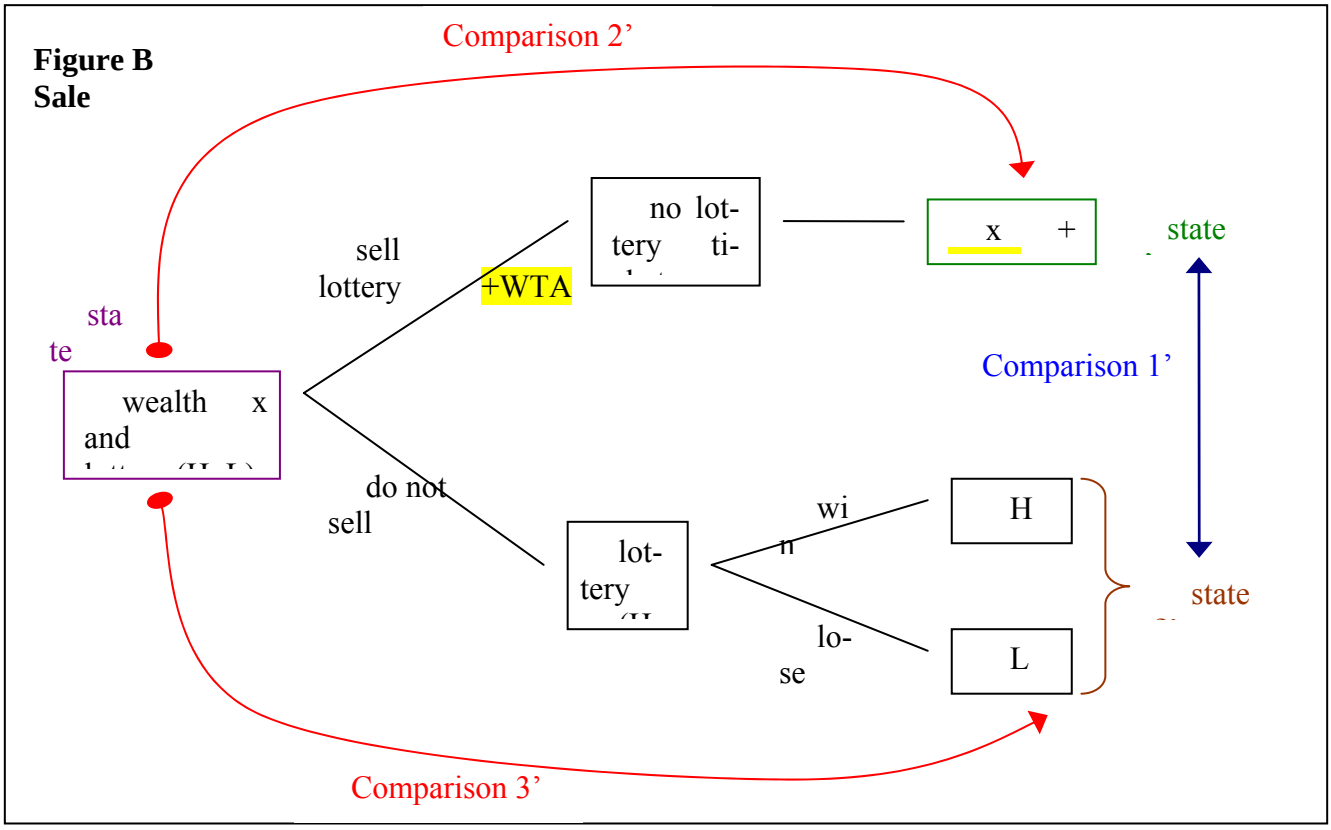
Figure B
Sale
Comparison 2'
sell
lottery
+WTA
no lot-
tery ti-
x +
state
sta
te
Comparison 1'
wealth x
and
do not
sell
lot-
tery
wi
n
H
lo-
se
L
state
Comparison 3'

II. A simple Model of Aversion to Risk Changes

To explain the endowment effect in a risky setting, a model must lead to a distinction of two situations: The decision whether to purchase a lottery ticket (figure A) and the decision whether to sell a lottery ticket (figure B). The lottery pays a high (H) or low (L) payoff with the same probability of 0.5. The other wealth that the individual holds is equal to x. The money value WTP in figure A (purchase) is defined such that the individual is indifferent between the two end-states γ (no lottery ticket) and δ (holding the lottery ticket – but *before* the lottery is resolved, so actually containing two possible sub-states). In the sell situation (figure B), the money value WTA is defined in the same way such that the individual is indifferent between the end-states γ' (no lottery ticket) and δ' (holding the lottery ticket).

Expected Utility Theory would now compare the two end-states in both situations directly. Comparisons 1 and 1' yield the same result[14]: The end-states without lottery ticket are less risky in both cases. So the individual has to be compensated to choose end-state δ and δ': The individual must receive a *risk-premium* that increases the expected payoff to compensate for the larger risk. As this result is the same in both situations, the risk-premium must be the same, leading to WTP=WTA.

Although Prospect Theory (Kahneman and Tversky, 1979) uses relative *changes* in wealth instead of absolute wealth, this does not apply to the domain of risk. Prospect Theory also determines the level of *absolute* risk and compares this uncertainty using comparisons 1 and 1'. The result is the same as under Expected Utility Theory: Both end-states with the lottery ticket, δ and δ', are seen as more risky than the end-states without lottery ticket, γ and γ'. WTP and WTA must be set such that δ and δ' include a risk-premium, so that they are again of the same magnitude.

Regret Theory (Loomes and Sugden, 1982) directly compares the consequences of two actions without an explicit notion of risk aversion. Instead, the wealth resulting from the two actions is compared for every possible state of the world separately. This again means using comparisons 1 and 1', so it cannot yield different results for the purchase and the sell situation. Regret Theory, as Expected Utility and Prospect Theory, cannot explain the endowment effect for lotteries.

[14] Neglecting a possible income effect.

Now consider another method of evaluating the risk of an action. The risk of the end-states γ (γ') and δ (δ') is compared with the original state ρ (ρ'), viewed from ρ (ρ'), so taking this point as a *reference point*. In the purchase situation (2 A), the resulting comparisons 2 and 3 yield the same result as the theories cited above, as the starting point is risk-free: The state with the lottery δ contains more risk than the starting point ρ without a lottery. The individual has to be compensated with a risk premium to choose the action "buy lottery ticket".

The change this approach brings is visible by applying it to figure B, the sell situation: Comparisons 2' and 3' now yield a different result: Comparison 3' shows that the end-state with lottery ticket, δ', contains exactly the same risk as the starting point ρ', where the lottery risk is also included. There is no difference between the two states in any possible state of the world. There is no *change* in the risk. Comparison 2' reveals the opposite for state γ': Seen from the reference point, ρ', the risk has *changed*, because the lottery ticket has been sold. The conventional comparison would state that the risk has been reduced. However, with a *relative* notion of risk, one must state that the risk has nevertheless been changed. The difference γ' – ρ' is in itself a lottery: (WTA-H, WTA-L). In comparison with the original state, either the high payoff H is foregone or the low payoff L. By choosing "sell ticket", the relative result is now "additional risk".

Now comparing these *relative* outcomes of δ' and γ' shows that the individual has to *receive* a risk premium to make her *sell* the lottery, to choose the end-state γ' without the lottery. This is the opposite result of the one achieved in the buy situation, so WTP and WTA differ.

We need to extend the concept of a reference point as used in Prospect Theory from the domain of wealth to the domain of risk. To model this in a corresponding assumption, we will for a moment treat the risk of all current holdings as incorporated and accepted. Formally, the current state is risk-free. By giving up a "positive" risk, this is treated as if acquiring a corresponding "negative" risk.

Assumption: Giving up the lottery (H, L) corresponds to accepting the opposite lottery (-H, -L).

This "trick" allows us to proceed with the standard framework and the conventional notion of risk aversion to display "aversion to risk changes". Later, the conventional absolute risk aversion will be reintroduced.

Compared to the other theories that link uncertainty and the endowment effect (Rankin, 1990, Sugden, 2003, and Blondel and Lévy-Garboua, 2005), our approach stays closest to Prospect Theory by only making the single assumption stated above.

Formulation of the Model

We model one individual with a given preference set in two different situations: As a buyer and as a seller of a lottery that pays out money. The information the individual has about the good is always the same, so there is no problem of asymmetric information[15]. A rational (complete, transitive) preference ordering over lotteries is assumed to exist. "~" displays indifference between two options.

The discrete lottery (H, 0.5; L, 0.5) yields a high payoff H and a low payoff L with even probability of 50 % each. $H \geq L$. (Round brackets will be used for lotteries, square brackets for mathematical operations. As the probabilities are always 50 %, they are omitted in all lottery notations: (H, L). To simplify the notation, the current wealth level that has to be added in all states of the world is defined as zero, so it can be left out. Willingness to pay (WTP) and Willingness to Accept (WTA) are the money values that satisfy the following conditions:

Purchase: (H-WTP, L-WTP) ~ 0; (3.)

Sale: (-H+WTA, -L+WTA) ~ 0 (4.)

The first equation, related to the buy situation, is straightforward: The price one has to pay for the lottery is subtracted from the payoffs in both the high and the low state. WTP is defined as the price at which the individual is indifferent between buying (left hand side) and not buying (right hand side). The second equation is related to the "aversion to risk changes". Selling the lottery (H, L) is treated as acquiring the lottery (-H, -L). The WTA is the price attached to this lottery that makes the individual indifferent towards the transaction.

It is straightforward to see that in both cases the variance of the lottery is not altered by the price attached to it[16]. The difference between the two states is $H-L \equiv k$ in the buy as well as in the sell situation. The corresponding lotteries must be identical for two rea-

[15] In reality, a seller will most probably have more information than a buyer. In the experiments, this is not the case.

[16] The variance is $[(H-L)/2]^2$, the standard deviation is $(H-L)/2$.

sons: First, they have the same variance (and probabilities) and second, the individual is indifferent between both lotteries and doing nothing (staying at current wealth, which is defined as zero). There cannot exist two different lotteries (a, b) and (a', b') such that both fulfill (a, b) ~ 0 ~ (a', b') when their payoff difference is the same a-b=k=a'-b'. They must be the same lotteries, a=a' and b=b'.

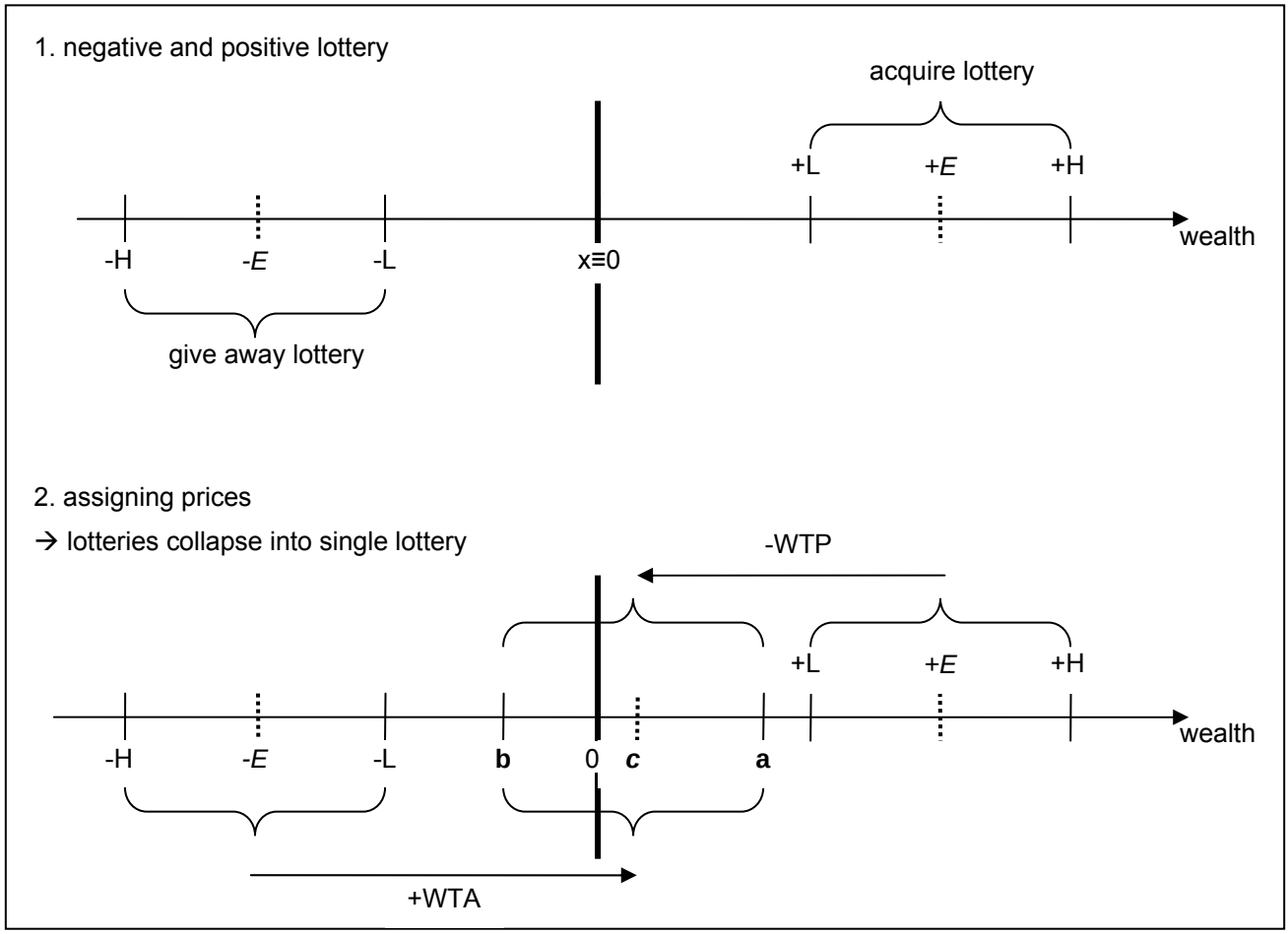

Figure 3: The resulting gap between WTA and WTP.

Consider Figure 3: The lotteries (+H, +L) and (-H, -L) are both shifted towards zero (the reference point of actual wealth) and collapse into the lottery (a, b) that is defined as (a, b) ~ 0.

Being indifferent between these two transformed lotteries and zero means (from 3. and 4.):

(H-WTP, L-WTP) ~ (-H+WTA, -L+WTA) ~ 0 (5.)

This can only be the case if the high and the low outcomes of the buy- and sell-lottery are identical. The high outcome of the "buy lottery" is H-WTP, while the high outcome of the "sell lottery" is –L+WTA:

H-WTP = -L+WTA and L-WTP = -H+WTA (6.)

yielding in both equations:

WTA+WTP = H+L (7.)

Definition: [H+L]/2 ≡ E

E=E(H, L) is the expected value of the lottery. The last equation can be rewritten as:

[WTA+WTP]/2 = E **(8.)**

With "aversion to risk changes" only, the midpoint of willingness to accept and willingness to pay is the expected payoff of the lottery.

a) Benchmark I: Neutrality towards Risk Changes

As a benchmark, let us briefly consider the case of risk neutrality: The individual is indifferent between the lottery and the payment of its expected payoff: (a, b) ~ E(a, b) = [a+b]/2. If (a, b) ~ 0, this means that a= -b. Applying this to the lotteries in (3. and 4.) we get:

H-WTP =-[L-WTP] and –H+WTA=-[-L+WTA] [17] (9.)

WTP=E=WTA **(10.)**

In case of risk neutrality, WTA and WTP fall together and correspond to the expected payoff. There is no gap between WTA and WTP.

b) Benchmark II: No Uncertainty

If there is no uncertainty, we have H=L=E. Insert into (5.):

(E-WTP, E-WTP) ~ (-E+WTA, -E+WTA) ~ 0 (11.)

(E-WTP) ~ (-E+WTA) ~ 0 (12.)

This can only be solved for

WTP=E=WTA **(13.)**

When there is no uncertainty, there is no endowment effect.

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[17] One can also formulate that the expected value has to be zero: 0.5*(L-WTP)+0.5*(H-WTP)=0 and analogously for WTA, yielding the same result.

c) Uncertainty and Aversion to Risk Changes

Now let us consider the case when there is both risk aversion and uncertainty. Risk aversion means that (a, b) $\prec$ E(a, b)=[a+b]/2 – an individual prefers the payment of the expected payoff to the lottery. This means that for accepting a lottery, there has to be a reward: the expected value of the lottery has to be positive. For a mixed lottery (a, b) with a>0, b<0 such that (a, b) ~ 0, this means that 0.5a+0.5b=c>0. It will depend on the individual risk aversion how the payoffs of the lottery have to be increased to make the lottery just acceptable. For a given payoff variation H-L of a lottery, there is exactly one such value c.

Definition: c is the "normalized" risk premium of the lottery (H, L) such that: c=E(a, b)=0.5a+0.5b with (a, b) ~ 0, a>0, b<0 and a-b=H-L=k.

We have seen that the payoff variation in both lotteries (purchase and sale) is of the same size H-L=k, so the expected value of both lotteries has to be the same to make them just acceptable.

$$0.5[H-WTP] + 0.5[L-WTP] = c = 0.5[-H+WTA] + 0.5[-L+WTA] \quad (14.)$$

$$WTP = [H+L-2c]/2 \text{ and } WTA = [H+L+2c]/2 \quad (15.)$$

$$\mathbf{WTP = E - c} \text{ and } \mathbf{WTA = E + c} \quad (16.)$$

$$\mathbf{WTA = WTP + 2c} \quad (17.)$$

In case of uncertainty and aversion to risk changes, a gap arises between the willingness to accept and the willingness to pay, symmetrically around the expected value of the lottery. WTP is equal to the expected value minus the normalized risk premium of the lottery. WTA is equal to the expected value plus the normalized risk premium of the lottery. Therefore, the size of the WTP/WTA-gap depends positively on the (relative) risk aversion and on the variance of the lottery.

d) Reintroduction of absolute Risk Aversion

Allowing for absolute risk-aversion together with aversion to risk changes simply decreases the value of the lottery in both the buy and the sell situation: The individual has to receive a risk premium ***r*** to hold the lottery. Applying this to (16.) yields:

Results:

[WTP + WTA] / 2 = E - r (18.)

WTP = E - c - r and **WTA = E + c - r** (19.)

WTA = WTP + 2c (corresponds to 17.)

Equation (17.) remains unchanged. "Aversion to risk changes" alone cause the endowment effect.

The results (14.) to (16.) are applied to the experimental lottery data of van Dijk and van Knippenberg (1996) in Appendix I. The necessary risk aversion to predict the data is the same as empirically found in Tversky and Kahneman (1992, p. 59).

III. Experiment

Method

An experimental study with 60 subjects was carried out at University of Munich in August and September 2005. The experiment was conducted with one subject at a time and took approximately 60 minutes for each subject (including 4 survey questions in the beginning that are examined in chapter 3 of this dissertation). A detailed description of the experimental procedures and instructions can be found in Appendix III of this chapter.

Subjects were recruited on the location, leading to a broad mix of students of different subjects, retired persons and others. Average age was 27,7 (median 25) and 83 % of the participants reported to live on 1,000 € or less per month (average net income in Munich is around 2,500 € per household[18]). Subjects received an initial fee of 3 € and left with an average cash of 6 € and goods worth 3 €.

After the survey questions were finished, subjects read an introduction to the experiment. Following this, the experimenter explained the Becker-de Groot-Marschak random price mechanism (see above). As an example, subjects were asked to (hypothetically) buy an apple and sell an orange. The mechanism of comparing a randomly drawn transaction price with their WTP and WTA was explained with the help of a table drawn on the blackboard.

[18] Source: survey from 2000: 4,870 DM (2,490 €) for all households (n=3,502).

Afterwards, subjects read detailed instructions on the mechanism following Plott and Zeiler's (2005a) instructions – yet they were told they were free to skip them if they felt they did not need them. Our approach was, therefore, not to exclude misconceptions by declaring our instructions fool-proof. Instead, we included additional valuation questions to check for misconceptions, as explained below.

In the experiment, subjects were asked to state a minimum selling/maximum buying price for the following goods:

- A **mug** (a standard mug bought at Walmart for 1.47 €)
- a **metro ticket** (single ride, 1 zone, valid in Munich's public transport "MVV" with the official price of 2.20 € printed on it[19])
- a **lipstick** (bought at a local drugstore for 1.59 €),
- a **share** (a real share certificate of the company Bremer Vulkan, which was still traded at the Frankfurt Stock Exchange at a quote of 0.11 € on 1st of September 2005).

In both WTA and WTP tasks, the object was put on the subject's table. Subjects were allowed to inspect the object. No questions concerning the object itself were answered (this was also indicated in the instructions).

After subjects had indicated their WTA or WTP for an object, they were asked in the instructions whether they were sure they would not accept a slightly lower price/pay a slightly higher price[20] and to change their WTA/WTP answer if they would. After this, subjects answered a question on the difficulty of determining this WTA/WTP answer and on the importance of their estimation of the official market price[21] of the object in this decision. Additional questions concerning the objects themselves were postponed after all WTA/WTP questions had been answered, in order not to influence them.

After indicating WTA or WTP for an object and going through the three immediate follow-up questions, the transaction was carried out: A random transaction price was

[19] In a subsample, we used the same tickets with a printed price of 2.00 € (the reduction stemming from buying the ticket with an electronic cash card). The answers for this ticket are only analyzed together with the answers for the 2.20 €-tickets when checking for individual WTA-WTP-gaps (as there is no reason why gaps should be different).
[20] This deviates from Plott and Zeiler (2005) who asked this verbally, giving it greater weight.
[21] For the metro ticket, they were asked about the importance of the price printed on it. For the share, subjects were asked about the importance of the quote they estimated.

drawn from a plastic box containing small paper sheets with different prices[22]. If the price indicated that the subject would buy/sell the object, the money and the object were immediately transferred.

The last five transactions were part of a randomization process, with a letter from A to E deciding which transaction would be carried out. This allowed eliciting both WTA and WTP for the same good from the same subject. Before subjects came to this randomization process, they had at least answered and carried out one real selling and buying task.

The current quote of the stock was not revealed in the beginning. After subjects had given all WTA and WTP answers in the five randomized tasks, they were given additional valuation questions, asking them whether they would consider buying or selling an object at different prices a "good deal" and how certain they were about this. We discuss these questions in more detail below.

Before one of the randomized tasks was selected, subjects were told what the current quote of the stock was (0.11 €). They were then allowed to give new answers in the WTA and WTP conditions for the share before the random letter was drawn and one of the five transactions was carried out. When we refer to "share with quote information", we refer to these answers, while "share" alone refers to the answers in the first WTA and WTP task, before this information had been released.

After all transactions, subjects had to answer additional questions about the goods they had seen. The additional questions regarding the share were asked before the quote information was released, as subjects were asked to estimate the value (quote) of the share.

As the experiment was run successively over a time span of two weeks, the experimenter seized the occasion to exclude questions and treatments that did not appear promising after a certain number of subjects, and to include additional questions and treatments to answer questions that had come up. Therefore, as the result tables show, not all treatments and questions have the full possible number of subjects. New questions and treatments were always added at the end of the instructions in order not to influence the answers to the treatments and questions that were continued.

[22] There was a different box with different prices for every object. In order not to influence subjects' answers, they were only told that prices always started at 0, but not what the highest price was for every object.

Results

The most important facts about the data can be seen in Table 2 below.

There are four different ways how to measure the gap between WTA and WTP:

- Difference between mean WTA and mean WTP (aggregate mean gap)
- Difference between median WTA and median WTP (aggregate median gap)
- Mean individual gap between individual WTA and WTP from the same subject (mean individual gap; only possible for the subsample of subjects that have answered both WTA and WTP questions for a given good)
- Median individual gap between individual WTA and WTP from the same subject (median individual gap; only possible for the subsample of subjects that have answered both WTA and WTP questions for a given good)

For all subjects together, all types of measurement of the WTA-WTP-gap show a significant gap for each good (see Table 5, appendix I, for the relevant tests). The largest measured gap is the aggregate mean gap for the share (without quote information): 15.99 €. The smallest measured gap is the median individual gap for the lipstick: 0.10 € (which is still significantly different from zero, as a Wilcoxon rank-sum test shows, see Table 5).

It is not mainly the mere existence of the WTA-WTP-gap that is of interest here. We will also test the hypotheses formulated for three different explaining theories.

Table 2: Main experimental results

		Metro ticket	Mug	Lipstick	Share	Share quote given
WTA	No. of WTA answers	29	43	43	54	31
	mean WTA	1.79 €	1.85 €	1.51 €	21.29 €	4.61 €
	(std error)	*0.15*	*0.29*	*0.29*	*4.67*	*3.21*
	median WTA	2.00 €	1.00 €	0.80 €	10.00 €	0.70 €
	Importance of price	74	48	39	60	
	(std. error)	*5.8*	*6.2*	*6.9*	*6.6*	
	difficulty (mean)*	1.07	1.41	1.14	2.43	
	(std error)	*0.17*	*0.14*	*0.14*	*0.13*	
WTP	No. of WTP answers	28	30	31	54	31
	WTP: mean	1.33 €	1.01 €	0.59 €	5.30 €	0.29 €
	(std error)	*0.15*	*0.22*	*0.14*	*1.10*	*0.10*
	WTP: median	1.50 €	0.50 €	0.20 €	2.25 €	0.10 €
	Importance of price	65	42	21	47	
	(std. error)	*6.4*	*7.9*	*6.9*	*6.8*	
	difficulty (mean)*	0.96	1.14	0.83	2.35	
	(std error)	*0.14*	*0.15*	*0.17*	*0.16*	
Aggregate gap	mean	0.46 €	0.84 €	0.92 €	15.99 €	4.32 €
	median	0.50 €	0.50 €	0.60 €	7.75 €	0.60 €
Individual gaps	individual gap: n	31	13	14	48	31
	individual gap (mean)	0.64 €	1.10 €	0.86 €	12.88 €	4.32 €
	(std error)	*0.15*	*0.43*	*0.43*	*3.08*	*3.22*
	individual gap (median)	0.30 €	0.70 €	0.10 €	4.50 €	0.20 €
Market price	real price	2.20 €**	1.47 €	1.59 €	0.11 €	0.11 €
	No. of answers	41	59	58	55	
	estimated price: from	2.10 €	1.61 €	1.63 €	17.19 €	
	(std error)	*0.04*	*0.15*	*0.14*	*5.27*	
	…. to	2.27 €	4.27 €	5.05 €	49.51 €	
	(std error)	*0.06*	*0.35*	*0.41*	*11.51*	
Uncertainty	No. of answers	29/21***	6	4	31/28***	
	Buying uncertainty at WTP (mean; std. error)	92 (3.5)	77 (10.5)	80 (12.2)	53 (6.6)	
	Buying uncertainty at (WTP+WTA)/2	*92 (3.3)*	*83 (6.7)*	*85 (9.6)*	*45 (6.6)*	
	Selling uncertainty at WTA	*87 (3.0)*	*73 (9.2)*	*88 (7.5)*	*58 (5.9)*	
	Selling uncertainty at (WTA+WTP)/2	*83 (4.5)*	*65 (10.9)*	*78 (8.5)*	*52 (6.6)*	
Intention	keep	64	65	18	46	
	(std error)	*6*	*4.26*	*4.21*	*5.69*	
	gift	21	32	80	12	
	(std error)	*5*	*3.88*	*4.14*	*4.38*	
	sell	13	5	3	42	
	(std error)	*4*	*2.12*	*1.05*	*5.37*	

**reported difficulty of finding the WTA or WTP answer. 0 - very easy to 4 - very hard*

***aggregate results for the ticket with a printed price of 2.20 € are shown, while results for individual gaps stem from the 2.20 €-ticket and a ticket with 2.00 € as the printed price*

**** no. of answers for buying and selling at WTP and WTA/no. of answers for buying and selling at (WTP+WTA)/2*

Testing the Hypothesis of Loss Aversion in iskless Choice

As outlined above, the hypothesis of loss aversion in riskless choice makes only one falsifiable prediction: an endowment effect exists for goods that individuals intend to keep, while no endowment effect exists for goods that individuals intend to sell. A somewhat extended continuous form of this prediction would state that, the more an individual intends to keep a good, the larger the endowment effect would be.

One of the follow-up questions for every object in our experiment was about the subjects' intention with respect to the object:

> "Usage of the object
>
> Please distribute 100 % onto the three possibilities, according to how likely you consider them.
>
> If I own the object after the experiment, I will
>
> Keep it: _____ %
>
> Give it as a gift to someone _____ %
>
> Sell it : _____ %"

The aggregate answers to these questions can be found in Table 2. It is possible to check for a relationship between intention to keep or sell and a gap between WTA and WTP in different ways:

Hypothesis I – relationship between intention to keep/sell and WTA-WTP-gap:

H.I.1 - Between-goods-comparison:

- **H.I.1.a** - keeping**:** A high average intention to keep the good leads to a significant aggregate gap between mean/median WTA and mean/median WTP. (H.I.1.a': continuous relationship: the higher the intention to keep the good, the higher the gap)
- **H.I.1.b** - selling: A high average intention to sell the good after the experiment leads to no (or only a small) gap between mean/median WTA and WTP (H.I.1.b': continuous relationship)

H.I.2 - Between-subjects-comparison:

- **H.I.2.a** - keeping: a high individual intention to keep the good leads to a significant individual gap between WTA and WTP (H.I.2.a': continuous relationship)
- **H.I.2.b** - selling: a high individual intention to sell the good after the experiment leads to no (or only a small) gap between individual WTA and WTP (H.I.2.b': continuous relationship)

Evidence

Aggregate data:

Subjects indicate a significantly higher intention to keep the metro ticket (average answer of 63 % versus 45 % for the share, see Table 6, appendix II). The measured aggregate gap is significantly larger for the share. This contradicts H.I.1.a'.

Subjects indicate a significantly higher intention to sell the share (score of 42 versus 11 for the metro ticket), contradicting H.I.1.b'. The low intention to sell the metro ticket together with a significant gap contradicts H.I.1.b. The measured intention to sell the share, if estimated as being "high", must lead to another contradiction of H.I.1.b.

Individual data

Table 6shows the relevant tests (11 and 12) for testing H.I.2:

Subjects stating almost no intention to keep the metro ticket (score $\leq$ 1/100) nevertheless show a mean individual gap of 0.70 €[23]. This contradicts H.I.2.a.

Subjects stating a high intention to sell the share after the experiment (score $\geq$ 50) nevertheless report a significant mean individual gap of 18.56 €. This contradicts H.I.2.b.

Table 7 shows the results of the relevant regressions for the continuous versions of H.I.2:

For the metro ticket, there is no relationship between the selling or keeping intention and the individual gap. H.I.2.a' and H.I.2.b' are rejected.

[23] That is different from 0 only at p=0.063 (t-test) and even higher (p=0.19) in the sign test. The low number of subjects in this category (6) must be taken into account when making conclusions from this test alone. Additionally, after taking out misconception answers, the remaining gap is indeed close to zero for the remaining (whole) sample, as shown below.

For the share, the relationship found in the data is of the opposite direction than hypothesized: A higher intention to keep the share after the experiment is associated with a *smaller* individual gap. A higher intention to sell the share after the experiment is associated with a *larger* individual gap. Again, H.I.2.a' and H.I.2.b' are rejected[24].

Overall, Hypothesis I stating that an intention to keep an object after the experiment leads to a significant gap and that an intention to sell an object after the experiment leads to no or only a small gap must be seen as strongly rejected by our data.

Testing the Misconception Hypothesis (Plott and Zeiler, 2005a)

Plott and Zeiler (2005a) state that individual misconceptions (strategic answers) are responsible for the WTA-WTP-gap. Subjects that completely understand the BDM-mechanism are expected to show no WTA-WTP-gap.

If behavior of both types is present, this could possibly be detected by answers following two distinct patterns.

Hypothesis II - Misconceptions/incomplete understanding of the BDM mechanism together with strategic answers lead to the WTA-WTP-gap.

- **H.II.1** – Subjects who do not fully understand the mechanism and are subject to "strategic motives" show a gap between individual WTA and WTP.
- **H.II.2** – Subjects who completely understand the mechanism do not show a gap between individual WTA and WTA.
- **H.II.3** – If some subjects are subject to misconceptions and strategic motives, while others fully understand the BDM mechanism, answers should fall into one of two categories: no individual gap (comparably low WTA, large WTP) and large individual gap (high WTA, low WTP).

[24] The reason for this relation could lie in the correlation (0.34, significance: 0.08) between a high estimation of the minimum market price (quote) for the share and the selling intention: Subjects that think the share is not worth a lot, rather intend to keep it as a souvenir (as the costs associated with selling the stock on the stock exchange might be larger than the value of the stock). Subjects, who think the share is worth a lot, consider selling it later more likely. More on the relationship between estimation of the market price and the gap below.

Evidence – individual data

A question on subjects' understanding of the instructions shows that 57 of 60 subjects at least believed they had understood them. Table 13 (Appendix I) shows the individual gaps of the three subjects that did not answer the understanding questions with "yes" (subjects no. 46, 48 and 54). Subject 48's behavior does clearly not fall into the category of strategic answers, while the answers of no. 46 and 54 are consistent with this pattern. Case numbers are too small for statistical tests, nevertheless one can see that a failure to understand can lead to high gaps.

It is questionable whether the understanding question can be fully trusted. Subjects might very well pretend to fully understand the instructions, while in fact they do not understand them or understand them wrongly (many indeed commented something like: "I think I have understood, well, we will see…").

As an additional check on subjects' understanding, we run additional valuation questions on the goods on which subjects had stated both WTA and WTP, investigating the nature of a gap between these answers. The additional questionnaire consisted of two buying questions and two selling questions per good. In the buying questions, subjects were asked whether they would consider buying the good at two different prices (inserted by the experimenter) as a "good deal" (or a "bad deal" or neither of the two) and how certain they were about their answers. In the selling questions, they were asked

whether they would consider selling the good (given they owned it[25]) at two different prices as a "good deal". The four prices were inserted by the experimenter according to the subjects' earlier WTP and WTA answers: The buying prices were WTP and (WTP+WTA)/2, the selling prices were WTA and (WTP+WTA)/2.[26] Directly after each "good deal" question, subjects were asked how certain they were about their answers (on a scale from 0 to 100 %).

If a subject indicates that buying (selling) at (WTP+WTA)/2 would be a "good deal", giving a higher WTP answer (a lower WTA answer) would have been optimal with the employed mechanism. 41 % (12 of 29) of the subjects answering these questions for the metro tickets showed this kind of mistake (indicating either a good buy or a good sale at (WTP+WTA)/100 while being 100 % certain of it), compared to 10 % (3 of 31) for the share. Yet such a behavior need not be a sign of complete misunderstanding: if the WTP and WTA answers were quite close together, it only means that one would be willing to pay a little more (accept a little less) than said before. We can check for "larger" mistakes if we look for the same pattern of answers when the WTA-WTP-gap reported for the object was at least 1 € (i.e. one would have been willing to pay 0.50 € more or accept 0.50 € less). This kind of economically more significant mistakes was revealed by 14 % for the metro ticket and 10 % for the share[27].

Although the number of subjects stating either WTA too high or WTP too low is not large, their answers have a large effect on measures of the gap in terms of means. Some very high WTA answers influence these measures greatly, such as subject 47 stating a WTA for the mug of 10 € and subject 38 stating a WTA of 9 € for the lipstick and WTA of 100 € for the share with quote information (see Table 13; subject 38 alone accounts for 75 % of the mean gap (individual and aggregate) for the share with quote information).[28] These case studies, also reported in Table 13, support H.II.1.

---

[25] In order to diminish a felling of a sale of something one has just received always being a „good deal", subjects were told they should imagine they had found the object or received it as a gift from their bank (share) and were now considering whether keeping or selling it.

[26] If the subject had indicated WTP=WTA, the second buying and selling question was deleted. If the subject had indicated WTA<WTP, the first buying price was set to WTA and the first selling price to WTP. If the subject had indicated WTP=0, the first buying price was set to 0.10 €.

[27] Case numbers for the mug and lipstick are small and biased, because additional valuation questions were only asked if WTA and WTP differed. Significant mistakes – mug: 1 out of 6 (17 %), lipstick 1 out of 4 (25 %)

[28] Subject 54 provides a typical revealing insight: For the metro ticket, she stated WTA=4 €, WTP=2 € (and an even larger gap for the lipstick). She later indicated that selling the ticket at 4 € would be a "bad

Examining the data for outliers can be helpful in judging H.II.3, whether both types of behavior are present. The distributions (Figure 4 to Figure 8 below) show that outliers seem to appear for all goods. They are particularly extreme for the mug, the lipstick, and the share with quote information. The largest mass of answers without outliers above zero is found for the share. This evidence supports a conjecture according to H.II.3 that some subjects were subject to misconceptions and answered strategically, while others understood the mechanism.

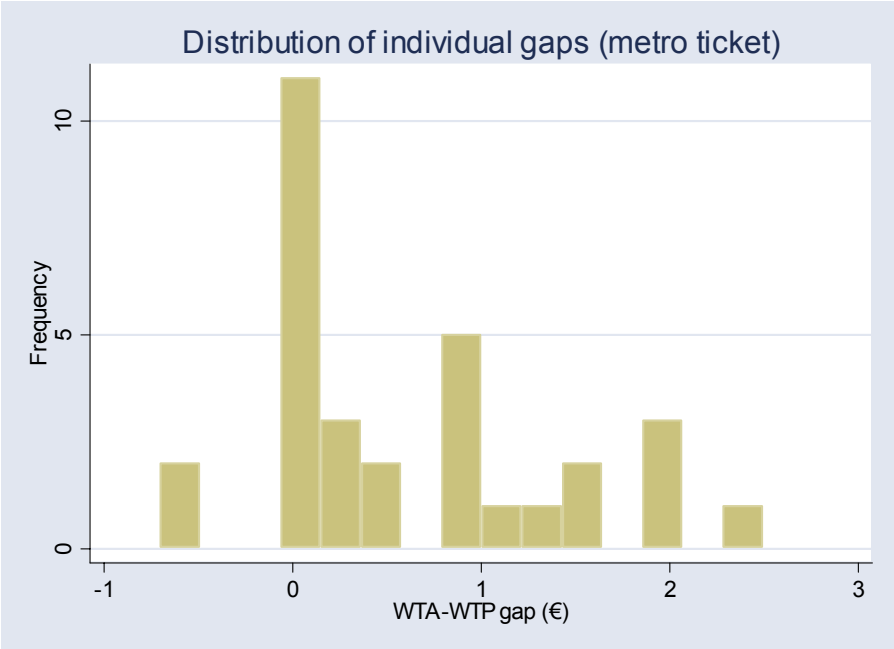

Figure 4: Distribution of individual gaps – metro ticket

deal" for her, because she would have a bad conscience (as the official price, printed onto the ticket, was 2 €).

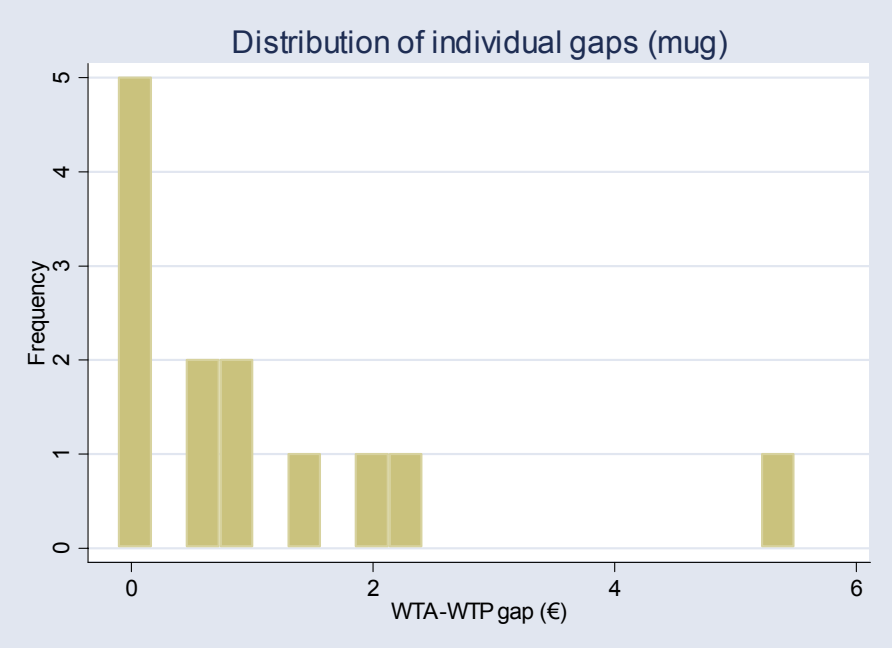

Figure 5: Distribution of individual gaps – mug.

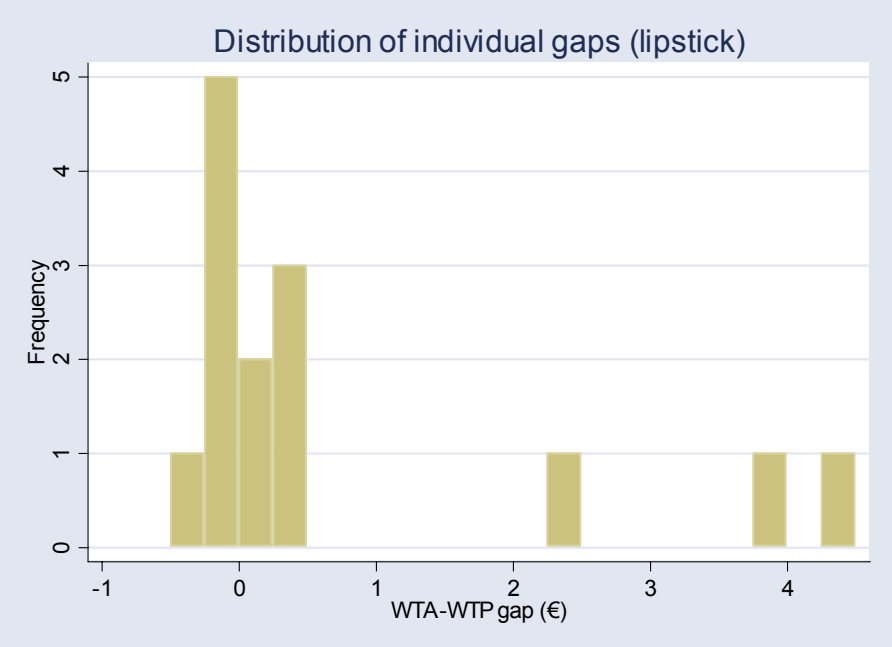

Figure 6: Distribution of individual gaps - lipstick

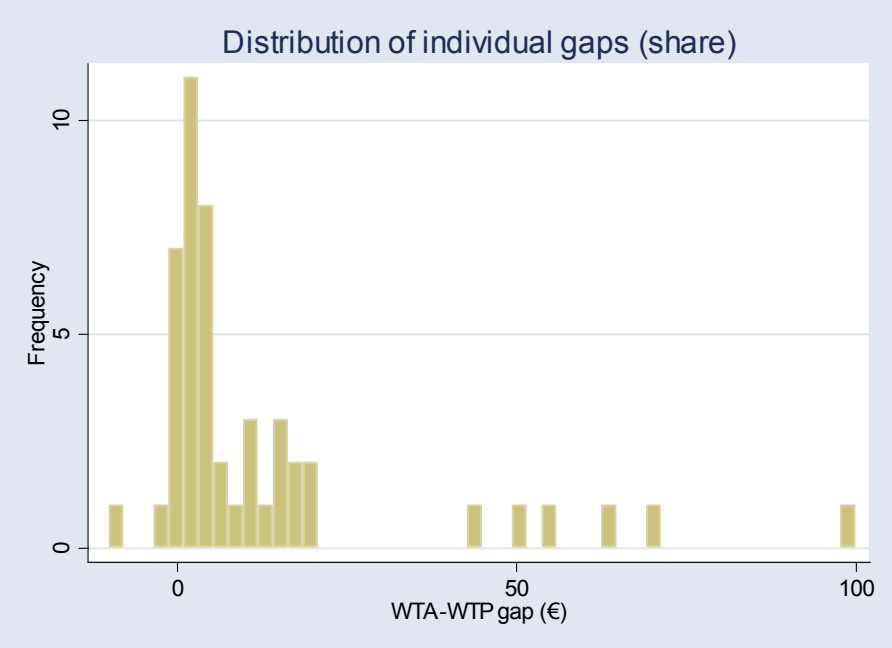

Figure 7: Distribution of individual gaps - share

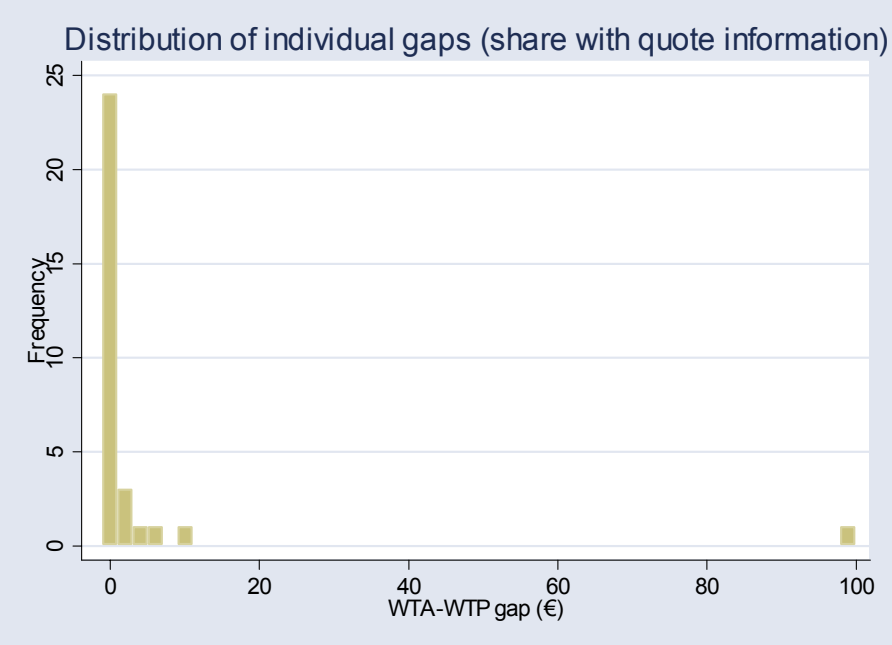

Figure 8: Distribution of individual gaps – share with quote information

This explains the large difference between the mean and median measurements of the gap. The mean measures are influenced by the outliers due to these misconceptions, while the medians are only marginally influenced[29].

To test whether subjects, who understood the mechanism, report no gap for all goods, we categorized subjects into 3 different categories, according to their answers in the extra valuation questions:

Category 0 – no detectable misconception: Subjects who did not say they would see it as a good deal to sell at their WTA or buy at their WTP with 100 % certainty.

Category 1 – misunderstanding cannot be excluded: Subjects stating that selling at their WTA or buying at their WTP would be a good deal with 100 % certainty, but did not say the same about buying or selling at (WTP+WTA)/2.

Category 2 – clear misunderstanding, real gap at most half as large as reported gap: Subjects stating that buying or selling at (WTP+WTA)/2 would be a good deal with 100 % certainty.

The existence and scope of a misconception for subjects falling into category 1 cannot be determined with the data: Stating that buying at one's WTP would be a good deal with certainty could still mean that buying at "WTP+0.01 €" (or, more economically relevant +0.10 €) would not be perceived as a good deal. Stating as WTP the highest price, at which buying is still perceived as a good deal, is in fact a strategy as good as naming the lowest price at which the individual is indifferent between buying and not buying (and the same for selling).

Table 3 shows the result of this categorization for the metro ticket and the share. The subjects without detectable misconception show quite a low gap for the metro ticket: the average individual gap is 0.28 €, the median gap is even 0.00 €. Even if these measures can still be shown to be somewhat significantly larger than zero (a one-sided t-test indicating $p=0.049$ for mean>0; a sign-test indicating that median>0 with $p=0.11$), the size of the gap cannot be distinguished from mere transaction costs. The data for the metro ticket supports H.II.2, according to which the full understanding of the mechanism leads to no (or only a very small) gap.

[29] As the outliers are all on the same side of the distribution (high for WTA, low for WTP), the median is also biased, yet only indirectly by being shifted half a rank per outlier and not directly influenced by the amount stated.

Table 3: Categorization of subjects according to possibility of misconception

	N	Average ind. Gap (std. error)	Median ind. Gap	95 % Conf. interv
Metro ticket				
Category 0: no misconception	12	0.28 € (0.15)	0.00 €	-0.06; 0.61
Cat. 1: possible misconception	5	1.12 € (0.46)	1.60 €	-0.17; 2.41
Cat. 2: sure misconception	12	0.91 € (0.25)	0.95 €	0.36; 1.46
Share				
Category 0: no misconception	24	7.15 € (2.05)	3.85 €	2.91; 11.37
Cat. 1: possible misconception	4	3.30 € (1.37)	2.95 €	-1.06; 7.66
Cat 2.: detectable misconception	3	72.57 € (13.90)	62.70 €	12.78; 132.35

This cannot be said for the answers concerning the share: Subjects showing no sign of misconception report a significant median individual gap of 3.85 € (mean individual gap of 7.15 €)[30]. The subsample of 10 subjects showing no sing of misconception in any of the treatments also shows a significant gap for the share (mean 9.10 €, median 4.75 €) that is significantly larger than zero (p-values 0.03 (t-test for mean>0) and 0.00 in sign-test for median>0). Therefore, the answers from the share treatment (without quote information) contradict hypothesis H.II.2 – at least detectable misconceptions cannot account for the entire gap found for the share.

Therefore, although the misconception hypothesis can be seen as broadly confirmed, it can certainly not account for the entire gap.

Testing the Uncertainty Hypothesis

Following the model outlined above, we test the following hypotheses concerning the relationship between specific kinds of uncertainty and the WTA-WTP-gap:

Hypothesis III – Relationship between uncertainty and WTA-WTP-gap

H.III.1 – between goods/situations

[30] T-test (mean>0) and sign test (median>0) show p=0.001 and p=0.000, respectively.

- **H.III.1.a** – Uncertainty about the market price increases the aggregate WTA-WTP gap.
- **H.III.1.b** – Unfamiliarity with exact valuation of goods in the selling task increases the aggregate WTA-WTP-gap.

H.III.2 – **between subjects**:

- **H.III.2.a** - Uncertainty about the market price increases the individual WTA-WTP-gap.
- **H.III.2.b** – Unfamiliarity with exact valuation of goods in the selling task increases the individual WTA-WTP-gap.

Evidence

Aggregated data

The rationale behind the choice of a share and a metro ticket in our experiment relies on our presumption that subjects would be quite uncertain about the value of the share while they would be quite certain about the value of the metro ticket. This is indeed what subjects report in our experiment. The certainty reported in the additional valuation questions is much higher for the metro ticket than for the share (see Table 2 and Table 6, test 10, Appendix I). At the same time, the gap for the share is much larger than the gap for the metro ticket (see test 1,

Table 6 in Appendix I). The fact that determining WTP and WTA for the share is more difficult than for the metro ticket (tests 2 and 3) also speaks in favour of subjects being more uncertain about the value of the share. These results support H.III.1 in general.

The average range of possible market prices that every subject had to indicate was also much larger for the share than for the metro ticket (test 5). This supports hypothesis H.III.1.a.

After the stock quote had been revealed, the gap for the share decreased dramatically to 0.20 € (median individual gap) and 4.30 € (mean aggregate gap). This is also consistent with H.III.1.a.

Before we test whether selling might be more unfamiliar than buying, we introduce and test a hypothesis about how subjects decide whether to trade an object or not:

The "good deal" heuristic

From his endowment effect experiment following a "verbal protocol technique" (where subjects are asked to think aloud), Brown (2005) reports:

"Overall, most subjects seemed primarily concerned with getting a good deal (or, conversely, avoiding a bad deal) in the transaction." (p. 375)

From this finding, we hypothesize that a heuristic of "getting a good deal" might exist that people use when buying and selling, without recurring to the exact value that a good would represent to them, by simply asking themselves more intuitively: "Would the proposed transaction at this price be a *good deal* for me?". The answers to the following questions (that were asked at the end of the experiment) confirm that this heuristic exists and has some importance for buying.

Question:

"When you go shopping and see an object that you did not originally intend to buy, how do you decide whether to buy nevertheless?

Please distribute 100 points onto the answers, according to how correctly they represent your attitude."

Answers (n=26)	Score: Mean (std error)	Score: Median
I consider whether it is a good deal or even a bargain to buy the object at this price	34 (4.9)	30
I consider how much the object would be worth for me and compare this value with the price	47 (4.8)	50
Other consideration	18 (4.3)	10

Have you applied the concept of making a good deal/bargain in our **buying** tasks? Please answer with a number from 0 to 100, meaning:

0 – I did not use the concept

100 – the concept has always played an important role

Result (n=30): Average score: 52 (std error 5.6); median score: 55.

We further hypothesized that, because situations where people are deciding whether to sell something are much rarer, they might have more difficulty to apply the "good-deal-heuristic" in selling situations. The answers to the following questions confirm that this was indeed the case at least for some subjects in our experiment.

Question:

"In the **selling** tasks, have you used a similar concept: the thought whether it is a good deal to sell at a certain price? Please distribute 100 points onto the answers, according to how correctly they represent your attitude."

Answers (n=25)	Score: Mean (std. error)	Score: Median
Yes, I can use this concept for selling as easily as for buying	37 (7.6)	30
Yes, but as I am less used to selling, it is more difficult for me to apply the concept.	37 (7.3)	30
No, I proceed in a completely different way when selling	27 (6.8)	10

Since some subjects have more difficulty applying the "good-deal-heuristic" in selling than in buying situations, the question is whether this necessarily leads to a gap between WTA and WTP? We hypothesized that subjects, as an answer to uncertainty in

the selling situation, might attach greater weight to what they estimate as the market price for the object (even if they do not intend to sell the object afterwards). Brown (2005, p. 375) reports from his experiment: "*Although a few subjects were obviously cognizant of the opportunity cost of failing to sell the item, most indicated they were primarily concerned with not giving up the item for less than some meaningful portion of what it was worth in a sale situation.*"

In the buying situation, subjects might more easily incorporate the fact whether they really want to own the object, i.e. how much utility they derive from owning it. In cases where subjects rather do not want to own an object, the bias in the selling situation to rely on an estimated market price could lead to a WTA-WTP gap. Therefore, we formally test whether the estimated market price is more important in the selling than in the buying task, and whether selling is considered more difficult than buying:

Evidence:

- The measured mean importance that subjects attach to the estimated market price is indeed larger in the WTA than in the WTP task for all goods. Tests show a significant difference only for the lipstick and the share (see Table 5 in Appendix I).
- For the mug and the lipstick, selling was considered more difficult than buying (Table 5). No such difference exists for the metro ticket (possibly because of the printed price helping in the selling task) and the share (possibly because the quote is the only influencing factor that is equally unknown in both treatments).

This evidence supports H.III.1.b, according to which unfamiliarity with exact valuation of goods in the selling task increases the aggregate WTA-WTP-gap.

Individual data

In order to test H.III.2 – whether individual gaps are influenced by uncertainty -, we regress the individual gaps on several indicators of uncertainty (see Table 8 to Table 11 in appendix I). It turns out that the factors significantly influencing the gap are:

- Range of price estimations - H.III.2.a

The most influential variable in the lipstick and mug regression is the range of price estimations ("I estimate the price in the store to be between *x* and *y*", taking *x*-*y* as the range). Yet this range of the estimated prices is only important if the official price of the good is important for the subject. Especially for the lipstick, many people show that they have no interest whatsoever to buy or keep the lipstick: they answer WTP and WTA as being 0.00 or 0.10 € and indicate with a low price importance that they do not care about the official price of the lipstick. The variable used for the regression is therefore the range of market price estimations multiplied with the reported price importance (sum of the scores for WTP and WTA task). If a subject showed no interest in the market price (score=0), her range of possible market price will not influence the gap (0*x=0).

For the share, the importance of the estimated quote does not mediate the influence of the quote estimation in this way. Instead, the range of the quote estimations positively influences the gap directly. It is possible that subjects did not indicate how important the *thought* about the estimated quote was, but how important this quote itself was for them, expressing trust in their own estimation[31]. So, in this case, the score of price importance could also be understood as a willingness to take a risk (many subjects actually commented that they would be willing to "wager" a certain amount by stating it as their WTP).

For the metro ticket, the range of price estimations does not explain any variation in the gap. The most probable reason is the fact that the range of estimated prices is close to zero (median 0.00 €, mean 0.12 €), as the official price was printed on the ticket.

These results suggest that H.III.2.a is confirmed.

- Selling being more difficult – H.III.2.b

The difference in difficulty between the WTA and the WTP task is a significant factor influencing the gap for the lipstick positively.

The difference in importance of the printed price is a significant factor influencing the gap for the metro ticket and for the share positively.

[31] A comment by a subject: „Of course the thought about the quote is important, it is the only thought."

- Familiarity with the good in general

For the lipstick, the variables "Never uses lipstick" (dummy), sex (dummy: male), and "intention to give lipstick away as a gift to someone else" all increase the individual gap if used separately, as they are correlated. (A male subject is of course much more likely never to use lipstick and therefore to intend to give it away.) At least the variables "never uses lipstick" and sex (male) could be seen as standing for less familiarity with lipsticks and therefore supporting H.III.2 in general.

Table 4 shows which types of uncertainty influence the gap for which good:

Table 4: Types of uncertainty influencing the individual gaps for the different goods

(variable used in regression in brackets)

Type of uncertainty	Metro ticket	Mug	Lipstick	Share
Market price uncertainty	- (no uncertainty)	√ (mediated by sum of price importance)	√ (mediated by sum of price importance)	√
Selling uncertainty	√ (difference in price importance)	-	√ (difference in difficulty)	√ (difference in price importance)

As the price importance has been used to mediate the market price uncertainty for the mug and the lipstick, it cannot be used to represent the uncertainty caused by selling being more difficult in general than buying. Instead, for the lipstick, the difference in reported difficulty between WTA and WTP task is a significant factor.

Additional observations:

- When subjects were asked to reveal their WTP for the share (without quote information), some counted the money they had earned so far in the experiment.[32] Their comments were as follows: aware of the risk of buying a share that might turn out to be worthless, they would try not to leave the room with

[32] For 4 subjects, their WTP answer for the share corresponds exactly to this amount of money.

a loss. In the WTP condition, they were willing to "wager" the amount of money they had on the table in front of them. In the WTA condition, this did not play a visible role. This is consistent with the current endowment *before* entering the experiment was an important reference point for many subjects.[33] This observation is consistent with our notion of uncertainty being evaluated differently in the WTP and WTA conditions according to the principle of "erring on the side of caution" (aversion to risk changes). In the WTP condition, subjects did not want to lose a lot of their cash. In the WTA condition, they were more ready to forego higher prices for the share. The risk of keeping a share that might turn out worthless was apparently seen as less severe than paying the same amount of money for a possibly worthless share.

- A question about the subjects' knowledge about the company Bremer Vulkan (of which the share was provided) showed that only 2 subjects considered themselves to be "well informed" about the company and one subject to be somewhat well informed. Table 12 (Appendix I) shows the answers of these subjects. These case studies speak for the hypothesis that the greater knowledge about the company decreased the individual gaps for the share.

Summarizing, the uncertainty hypothesis in its various forms is confirmed by our data.

Uncertainty vs. Misconceptions

As shown above, misconceptions can indeed account for a part of the gap and controls for misconceptions can even decrease the gap to almost zero for the metro ticket, although not for the share. Uncertainty about the market price and selling in general has been identified as a significant factor influencing individual gaps positively. Nevertheless, the question remains which factor is more important in general, i.e. can account for most of the gaps that have been measured in the experiments so far.

It is important to note here that the above controls for misconceptions are very likely to sort out individuals who were uncertain about selling in general. These individuals

[33] One subject that was apparently in desperate need of money (no. 38) even claimed that he would not spend a cent of the 3 € participation fee after he received the money (right at the beginning of the experiment). Consequently, all WTP answers were zero (except WTP for the metro ticket), indicating that the 3 € were seen as being part of the current endowment/reference point.

orient their WTA answer close to an estimated market price. When asked later whether they would consider selling at a lower price a "good deal", they might only then realize that the most relevant influence for them should have been their own estimation for the object and not the market price. The larger importance of the market price in the selling situation can also be seen as a kind of misconception. Indeed, some subjects that had bought or kept an object in the experiment, realized after the experiments that they did not really want to have it.[34]

Predicting the Gap

In order to predict the occurrence and size of a WTA-WTP-gap, uncertainty seems to play a role in a direct, and even in an indirect way: Also for the "strategic answers" due to misconceptions, uncertainty plays a role. Even a very high "strategic" WTA must be in a range that one can expect to obtain as a price. Consider the maximum WTA answers given in this experiment: metro ticket – 4 €, lipstick – 9 €, mug – 10 €, share (with quote information) – 100 €, share (without quote information) – 200 €. Nobody would expect to receive 100 € for a metro ticket, while this cannot be seen as impossible for a share. So in terms of *predicting the variation of the gap* in different settings where misconceptions cannot be excluded ex ante, uncertainty plays a role directly as well as indirectly via influencing the strategic answers/misconceptions.

IV. Discussion

Relation to other empirical Evidence

Our result that uncertainty is responsible for a considerable part of the endowment effect is consistent with the body of experimental evidence.

List (2003) finds no gap for experienced traders of sports memorabilia. These traders know quite well, how valuable the "unique" good in question is – whether it is more valuable than the good offered in exchange or not. The amateur traders are more uncertain about the value of the good. List even finds a direct continuous relationship be-

[34] 3 goods that were kept (instead of sold) and 2 goods that were bought were given back/sold back. This shows that this mistake is also possible in the buying task. As our price importance answers show, the mistake seems to be more likely in the selling task.

tween years of trading experience and the size of the endowment effect[35] (57, 61). The longer the individual experience as a trader, the smaller the influence of the endowment effect.

Ortona and Sccacciati (1992) find no significant gap for a book voucher. The subjects (students) are mostly in need of books[36], so it is not hard for them to estimate the value of the voucher.

Shogren et al. (1994, stage 3) find no gap when a coffee mug is offered in exchange for a plastic mug. This is in line with the argument forwarded here: The plastic mug provides almost the same function as the coffee mug – they both are only useful if one needs a mug at all. The difference in functionality and design of the two mugs can probably be judged with relative certainty, so there is little uncertainty about whether to trade or not.

"Fixed-value tokens" are often used in control experiments (e.g. Kahneman et al., 1990, 1332 & 1340) and never induce a gap. The value of the tokens is fixed in money terms. Subjects know exactly what they will get out of a token.

Our observation that uncertainty about the market price of an object influences the decisions in the buying and selling tasks differently, i.e. that the original form of loss aversion in *risky* choice (concerning the net result of a transaction cf. p. 17) plays a role, is supported by Brown's (2005) observation: "*Subjects were, to put it simply, averse to incurring the net loss that results from paying too much or selling too cheaply. If loss aversion is separated from the good per se and instead refers to the net result of the transaction, loss aversion may certainly play a role in the disparity."* (Brown, 2005, p. 376).

Simonson and Drolet (2004), researching on "anchoring effects", find that "needs and values" of the respondents are more important in determining WTP (37,5 % of respondents refer to them) than in WTA (15 %). For WTA judgements, 58 % of respondents explain their minimum selling prices with market prices and others' WTP compared to 43 % of respondents in the WTP setting. From a different experiment, the authors conclude: "The results […] suggest that anchoring effects on WTP-WTA judgements and the endowment effect are related phenomena and might be moderated by a

[35] Measured as "propensity to trade".
[36] This leads the authors to label the book vouchers "necessary goods".

similar underlying factor, namely, the level of uncertainty about the desire to trade." (p. 689)

Our finding that misunderstandings are present and influential are consistent with Plott and Zeiler's (2005a) results and Brown's observations: *"Many subjects' statements about what the good was worth to others or about making a profit suggest that they did not embrace, or perhaps even understand, the random price auction."* (Brown, 2005, p. 376)

Our rejection of the hypothesis of loss aversion in riskless choice is also consistent with Brown's results *"The most surprising finding of this study is that there was not more evidence of the endowment effect."* (Brown, 2005, p. 376 – his notion of the endowment effect corresponds to what we call the hypothesis of loss aversion in riskless choice).

In a recent study, Plott and Zeiler (2005b) investigate on the status quo bias in exchange experiments (where goods are exchanged for other goods instead of money, such as in Knetsch, 1989 and List, 2003). They show that when they incorporate several controls into an experiment where some subjects can exchange a mug for a pen and others a pen for a mug, the unwillingness to exchange the good vanishes.

The controls that Plott and Zeiler used were intended to avoid "other-regarding preferences" and various signals to interfere with the exchange decision. Ownership over the good was randomly assigned and the experimenter did not "purposefully and repeatedly emphasize ownership". In experiments without these controls, the standard status quo bias was found that more subjects in both groups kept their endowed good. One could, however, argue that Plott and Zeiler even removed ownership altogether.[37]

Ownership/endowment itself must be considered rather a signal than a physical characteristic. The question is why and when this signal leads to a status quo bias in trading behavior.

[37] In the setting where no such status quo bias was observed, subjects had to indicate their intention to exchange their good by answering the following question: "please circle the item you wish to take home with you: mug; pen; don't care." The question remains whether subjects still perceived this as exchanging their endowment for something else or whether they might have perceived it as a choice between receiving different objects? The meaning of the concept of ownership in this concept is "if you do nothing, you take the object home with you". By making the question rather a choice question between two objects, this characteristic of ownership is removed. There can be no status quo bias in choice if none of the options is recognized as "status quo".

With the results from our experiment, we think we can give an answer to this question. When subjects are *uncertain* about trading the object in question, subjects are more likely to be influenced by any signal: by the signal of ownership, inducing the status quo bias and by signals such as those as singled out by Plott and Zeiler (2005b) in one or the other way. On the other hand, when individuals are certain about the evaluation of their options, any signal will hardly influence their behavior. If the two options are, for example, a pen and a new car, subjects would always leave the experiment with the car, regardless of their initial endowment.

In our experiment, subjects indicated that they would always prefer 10 € over the metro ticket, regardless of whether they owned the ticket or not. Yet for the share, most subjects were more uncertain about preferring 10 € or the share, so the signal of ownership led to the status quo bias/endowment effect. The answer to this question was different in the buying and selling question (11 % of the WTP answers were larger than 10 € and 44 % of the WTA answers). So the signal of ownership did not induce a status quo bias in the decision between 10 € and the metro ticket, but it did induce a bias in the decision between 10 € and the share.

Relevance for Policy Issues

If one accepts that individual uncertainty with respect to a decision can induce status quo bias, this has importance for at least two different fields of policy.

Employee Saving Plans

One of the most important applications of the status quo bias debate concerns voluntary saving. Many employees save less than economists think they should. Economists have tried a strategy called "automatic enrolment". It consists of simply changing the question that firms ask their employees in a questionnaire from "Do you want to participate in the savings plan?" to "You are automatically enrolled in our savings plan, unless you indicate that you do not want to." Doing this raises the participation rate dramatically to over 85 % (Choi et al, 2001 and Madrian and Shea, 2001) from usually quite low levels below 50 %. About 80 % of participants accept both the default savings rate and the default conservative investment fund (Choi et al, 2001).

As a response and further extension to these findings, Richard Thaler and Shlomo Benartzi have designed a "Save more tomorrow" program: Employees are given the possibility to join a savings plan in which their contribution rate is automatically increased every year. After the program has been in place for four annual raises, Thaler and Benartzi (2004) conclude that:

"(1) a high proportion (78 percent) of those offered the plan joined, (2) the vast majority of those enrolled in the SMarT ["Save more tomorrow"] plan (80 percent) remained in it through the fourth pay raise, and (3) the average saving rates for SMarT program participants increased from 3.5 percent to 13.6 percent over the course of 40 months. The results suggest that behavioral economics can be used to design effective prescriptive programs for important economic decisions." (p. 165)

With the results from our experiment, the great importance of the following statement from the same paper might become clear:

"These households [that appear to be saving too little] are not sure how much they should be saving, though they realize that it is probably more than they are doing now; but they procrastinate about saving more now, thinking that they will get to it later." (Thaler and Benartzi, 2004, p. 170)

How much to save and how to save is a difficult decision for many people, especially for non-economists. Our experiment has demonstrated that at least for buying and selling, "status quo bias" reacts strongly to uncertainty. A transfer to the saving decision would state: If the employees were less uncertain about their saving decision, the problem of status quo bias would diminish. An alternative to automatic enrolment and automatic rise of contribution rates that Thaler and Benartzi themselves call "libertarian paternalism" could therefore be to increase people's knowledge about the saving decision. Including a single question on whether or not employees want to join a saving plan is certainly the minimum of information that can be given. Increasing people's knowledge about how much and how to save might be no easy task, but it avoids the shortfalls of all prescribed programs that have to make a decision for the individuals (e.g. allocation of the savings to a certain fund) while it is unclear whether this is indeed the optimal decision for them.

The Kyoto Protocol

A second important application of the endowment effect/status quo debate concerns the validity of Coase's Invariance Theorem that states that an efficient allocation of ownership rights will be reached regardless of the initial allocation of ownership rights. This theorem lies at the heart of the CO_2-certificate trading resulting from the Kyoto protocol. The question to be answered is: Do companies experience the same status quo bias in trading as individuals in experiments? If this was the case, the initial allocation of the certificates would indeed matter and lead to different results than, say, all companies buying the certificates from the government (coming close to a tax solution).

Given our results about uncertainty and status quo bias, we can partly answer this question by referring to the hope that companies should have quite a good knowledge about the value of their certificates and therefore not be susceptible to a strong status quo bias in selling. It is, on the other hand, not impossible that at least some companies do not invest much into research about future market values of the certificates, or that this research leads to a wide range of possible values. In this case, only a willingness to take a risk in a transaction (i.e. small or no "aversion to risk changes") could save the Coase Theorem and the seamless functioning of the market for certificates. Economists usually assume companies to be risk neutral (in the conventional sense). Decision makers, however, are humans and might therefore nevertheless be susceptible to phenomena like loss aversion in risky choice, i.e. show status quo bias under uncertainty. We therefore conclude that research in this area might be much needed.

Conclusion

The endowment effect is an influential and well-established phenomenon at the heart of economic decision theory. This paper provides a theory that explains the size of the WTP/WTA-gap as a function of uncertainty about the desire to trade.

This risk is seen to cause the endowment effect, because here people are assumed to be averse to "risk changes". They demand a premium for selling a risky asset, because they are averse towards a net loss in comparison to their reference point in which they incorporate the risky asset.

Our experiment rejects the predictions of the prominent hypothesis of "loss aversion in riskless choice", that states that a WTA-WTP-gap exists for goods which people intend to keep, while no gap exists for goods that people intend to sell. This prediction is also inconsistent with a large body of experimental evidence.

The predictions of Plott and Zeiler's (2005a) "misconception hypothesis" were supported by our experimental result, although not in their entirety. The WTA-WTP-gap found for a metro ticket falls almost to zero when controlling for possible misconceptions. Nevertheless, by deleting possible misconceptions, the gap measured for a share cannot be eliminated.

Various measures of uncertainty about market prices and selling in general are found to influence the measured gaps positively. This confirms our uncertainty hypothesis.

In a broader sense, status quo bias might be influenced by a decision maker's uncertainty with respect to a decision. Applied to the question how to increase voluntary saving for retirement, an alternative to "paternalistic" strategies like automatic enrolment and automatic increases of contribution rates would be efforts to decrease employees' uncertainty with respect to the saving decision.

Appendix

I. Application of the Results to Experimental Data

Data from Van Dyk and van Knippenberg (1996): Lottery that pays between L=$0.96 and H=$2.89 (original values were in Dutch Guilder). Expected payoff E=$1.93. Subjects were told that any value between the minimum and maximum could be drawn; for resolving the lottery, the authors used a uniform distribution.

Experimental results (67 student subjects): mean WTP=$1.58; mean WTA=$2.18.

Calculations: "Absolute risk premium" r=E-[WTP+WTA]/2=$0.044 "Risk change premium" c=WTA-E+r=E-r-WTP=$0.303.

Resulting "neutral" lottery: (H-WTP, L-WTP)=(-L+WTA+2r, -H+WTA+2r)=**($1.31, –$0.62)** distribution as in the experiment (unspecified/uniform). This seems indeed like a good candidate for a lottery towards which subjects are indifferent without compensation. The necessary risk aversion of roughly 2:1 for wins : losses corresponds to empirical findings in Tversky and Kahneman (1992, p. 59): their subjects (25 students) are indifferent to the following "50-50" discrete lotteries:

(-$25, +$61), (-$50, $101), (-$100, +$202), (-$150, +$280).

II. Additional Tables & Figures

Table 5: Tests

(H1: first row>second row vs. H0: equality; for single rows, tests are in comparison to zero)

	answer	mean	t-test: p-value (one-sided)	median	Wilcoxon rank-sum test (p-value)
Metro ticket	WTA	1.79 €		2.00 €	
	WTP	1.33 €	0.017	1.50 €	0.048
	Individual gap	0.64 €	0.000	0.30 €	Sign test: 0.000
Mug	WTA	1.85 €		1.00 €	
	WTP	1.00 €	0.011	0.50 €	0.009
	Difficulty WTA	1.41		1	
	Difficulty WTP	1.14	0.091	1	
	Individual gap	1.10 €	0.012	0.70 €	sign test: 0.020
Lipstick	WTA	1.51 €			
	WTP	0.59 €	0.003		0.008
	Difficulty WTA	1.14			
	Difficulty WTP	0.83	0.087		
	Price importance - WTA	39			
	Price imp. WTP	21	0.034		
	Indiv. gap	0.86 €	0.031	0.10 €	0.020
Share	WTA	21.29 €			
	WTP	5.30 €	0.001		0.000
	Price Imp WTA	60			
	Price Imp. WTP	47	0.100		
	Indiv. Gap	12.88 €	0.000	4.50 €	Sign test: 0.000
Share with quote	WTA	4.61 €		0.70 €	
	WTP	0.29 €	0.094	0.10 €	0.001
	Ind. Gap	4.32 €	0.095	0.20 €	Sign test: 0.000

Table 6: Metro ticket vs. share

(one-sided tests: H1: first row > second row vs. H0: equality)

Test no.	Variable	Mean	t-test (one-sided): p-value	Sign-test: p-value (one-sided)
	Ind. gap (metro t.)	0.64 €		
1	Ind. gap (share)	12,98 €	0.003	0.000
	Selling Difficulty (share)	2.29		
2	Selling Difficulty (metro t.)	1.37	0.000	0.001
	Buying difficulty (share)	2.37		
3	Buying difficulty (metro t.)	0.93	0.000	0.000
	Price Imp. Selling (metro t.)	74		
4	Price Imp. Selling (share)	60	0.029	
	Price imp. Buying (metro t.)	65		
5	Price imp. Buying (share)	47	0.036	
	Range of price estimate (share	30.13 €		
6	Range of price estimate (metro t.)	0.12 €	0.000	
	Keeping (metro t.)	63		
7	Keeping (share)	45	0.042	
	Selling (share)	42		
8	Selling (metro t.)	11	0.000	
	Individual gap (share)	12.98 €		
9	Individual gap (share with quote information)	4.31 €	0.002	0.0002
10	Certainty of buying at WTP (metro ticket)	92		
	Certainty of buying at WTP (share)	55	0.000	0.000
11	Ind. Gap (share, selling intention ≥ 50) – larger than 0?	18.56 €	0.0429	0.0078
12	Ind. Gap (metro t., keeping intention ≤ 1) – larger than 0?	0.70 €	0.0629	0.1875

Table 7: Relation between individual gaps and keeping/selling intention.

Numbers in brackets indicate p-values for normal standard errors (first number) and robust standard errors (second number).

Dependent Variable	Individual gap **share**	Individual gap **share**	Individual gap **metro ticket**	Individual gap **metro ticket**
Explanatory Variable	Intention to **keep** after experiment (score from 0 to 100)	Intention to **sell** after experiment (score from 0 to 100)	Intention to **keep** after experiment (score from 0 to 100)	Intention to **sell** after experiment (score from 0 to 100)
Constant (p-value)	36.8 (0.000; 0.004)	-4.77 (0.453; 0.403)	0.61 (0.064; 0.071)	0.64 (0.001; 0.002)
Coefficient (p-value)	-0.449 (0.002; 0.021)	0.441 (0.002; 0.014)	0.001 (0.769; 0.779)	-0.003 (0.679; 0.435)
Heteroscedasticity test: p-value*	0.066	0.033	0.965	0.346
Adjusted R^2	0.455	0.461	-0.035	-0.034
R^2	0.491	0.497	0.003	0.007
n	16	16	28	26

*Breusch-Pagan / Cook-Weisberg test for heteorscedasticity. H0: Constant variance. A low p-value indicates that the hypothesis of homoscedasticity should be rejected (in which case p-values for robust standard errors should be looked at).

Table 8: Individual gap (lipstick) – regressions of influencing factors

Dependent variable	Lipstick individual gap			Lipstick individual gap			Lipstick ind. gap		
	Coef-ficient	p-value*	β	Coeff.	p-v*	β	Coeff.	p-value*	β
Constant	0.21	0.205 (0.126)		-0.394	0.133 (0.008)		-.26	0.135 (0.075)	
Range of estimated price * price impor-tance (sum)	.0038	0.000 (0.000)	0.71	0.0038	0.000 (0.000)	0.7	.0037	0.000 (0.000)	0.67
Difficulty (differ-ence between selling and buying)	0.540	0.000 (0.000)	0.53	0.511	0.000 (0.000)	0.5	.539	0.000 (0.000)	0.54
Never uses lipstick (dummy; compared to "often" or "rarely")							.438	0.075 (0.031)	0.13
Sex: female (dummy)	-0.364	0.057 (0.020)	-0.12						
Gift (score)				0.0052	0.122 (0.047)	0.105			
Adj. R^2	0.965			0.9597			0.9631		
Heteroscedasticity test: p-value**	0.281			0.349			0.1894		
n	14			13			13		

*normal p-values; p-values for robust std. errors in brackets
**Breusch-Pagan / Cook-Weisberg test for heteorscedasticity. H0: Constant variance. A low p-value indicates that the hypothesis of homoscedasticity should be rejected.

Table 9: Individual gap metro ticket – regression of influencing factors

Dep. Variable	Metro ticket individual gap		
	Coeff	p-v: n (rob)	Beta
Const	-0.179	0.569 (0.396)	
Has no monthly ticket (dummy)	1.022	0.024 (0.001)	0.639
Gift (score)	0.014	0.025 (0.019)	0.554
Uses metro rarely or never (dummy)	-0.602	0.167 (0.063)	-0.279
Price importance (diff. betw. sell and buy; score)	0.008	0.021 (0.007)	0.422
Adj. R^2	0.345		
Heteroscedasticity test: p-value*	0.857		
n	26		

*Breusch-Pagan / Cook-Weisberg test for heteorscedasticity. H0: Constant variance. A low p-value indicates that the hypothesis of homoscedasticity should be rejected.

Table 10: Individual gap mug – regression of influencing factors

	Mug: individual gap		
	coefficient	p-v (rob)	Beta
Const	0.403	0.214 (0.052)	
Range of market price estimation * price importance (sum)	0.0065	0.000 (0.000)	0.964
Gift (score)	-0.019	0.014 (0.001)	-0.356
Adj. R^2	0.8575		
Heteroscedasticity test: p-value*	0.894		
n	12		

*Breusch-Pagan / Cook-Weisberg test for heteorscedasticity. H0: Constant variance. A low p-value indicates that the hypothesis of homoscedasticity should be rejected.

Table 11: Individual gap share – regressions of influencing factors

Dep. variable	Share: ind gap			Share: ind. Gap (gap & range logged)			Only logged gap & range
	Coeff	p-v (rob)	beta	Coeff	p-v (rob)	beta	
Const							
Price importance (diff. betw. sell and buy)	0.253	0.007 (0.003)	0.438	0.015	0.012 (0.008)	0.491	
Range of market price est.	0.471	0.032 (0.118)	0.337	0.281	0.084 (0.142)	0.334	0.26; p: 0.047 (0.058);
Certainty of buy-ing at (WTP+WTA)/2	0.263	0.015 (0.045)	0.384	0.009	0.182 (0.247)	0.236	
Adj. R^2	0.4498			0.4053			0.079
Heteroscedasticity test: p-value*	0.000			0.6824			0.1773
n	27			23			39

*Breusch-Pagan / Cook-Weisberg test for heteorscedasticity. H0: Constant variance. A low p-value indicates that the hypothesis of homoscedasticity should be rejected.

Table 12: Share: Subjects stating they are "well informed about the company"

Subject no.	Comment	WTA (share)	WTP (share)
8	Only WTA elicited	0.10 €	
31		1.00 €	1.00 €
39	Checked both "well informed" and "have heard the name, but are not well informed"	5.00 €	2.00 €

Table 13: Subjects with reported understanding problems or persistently large gaps

Subject no.	comment	Ind. gap mug	Metro ticket	Lipstick	Share	Share with quote in-formation
46	Understanding: (blank)	5.50 €	2.00 €		4.50 €	0
48	Understanding: no	1.50 €	0.10 €		0	0
54	Understanding: no		2.00 €	4.50 €	55 €	0.90 €
47			2.00 €	4.00 €	6.80 €	6.90 €
38	Did not finish; reported to desperately need money	1.00 €	0.20 €	WTA: 9.00 €	100 €	100 €
Individual median gaps		0.70 €	0.30 €	0.10 €	4.50 €	0.20 €

III. Own Experiment – Setup and Instructions

1. Setup

Overview

(S = subject; E = experimenter):

1 – Survey

2 – Begin of experiment: money handed out (3.00 €) – S reads 1st page of instructions

3 – Experimenter explains example with apple & orange at the blackboard

4 – S continues with instructions, fills out questions about understanding and personal questions

5 – E starts experiment by putting first object on S's table. The tasks were run in the following order:

E1: mug – either WTA or WTP

E3: lipstick – either WTA or WTP (the opposite of the previous task; sheets are put on the side, as their backs are needed later. E records the WTP answer.)

6 - Random task selection: after answers were recorded, a letter from A to E was drawn to decide which task was executed:

A – share – either WTA or WTP

B – metro ticket – WTP

C – mug or lipstick – WTA (if E1 was WTP: mug, otherwise, E2 was WTP and this task was about the lipstick, such that the subject had previously answered the WTP question. If S did not buy the object, they were told: "If we draw "C", you will own the object and you can keep or sell it." If S had previously bought it, they were told: "If we draw "C", you can sell this object that you already own. We will draw a price whether you sell it back to me or keep it."

D – metro ticket – WTA

E – share – WTP or WTA (opposite of A) – the reason for switching the order of WTA and WTP task was to check for order effects in the answers

The letter was not drawn yet, but first the following steps were done:

7 – S answers additional share questions (back of sheet E) while E fills out additional valuation questions with S's previous answers

8 – S receives sheets with additional valuation questions for the share, the metro ticket and the mug/lipstick (only if WTA and WTP differed for the latter)

9 – S is told the quote (value) of the stock (0.11 €) and given the chance to change answers for task A and E. Afterwards, a letter is drawn and the resulting task is resolved.

10 – S answers the additional questions for the mug, the lipstick and the metro ticket (back of E1, E3 and B). The reason for postponing the additional questions after the WTP/WTA answers was to prevent influence on the answers. S answers general questions and fills out a receipt for the goods and the money.

2. Instructions viewed by Subjects

** Comments between asterisks **

Experiment – Introduction

** The instructions follow those used by Plott and Zeiler (2005) as closely as possible. **

This is an experiment in individual decision-making. Out purpose is to study factors that influence buying and selling decisions. The experiment is financed by the German Research Foundation (graduate program „Markets, Institutions and the Scope of Government"). The results will be used in my dissertation in economics.

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. There are no right or wrong decisions. Simply decide as you think it is right. You can ask questions concerning the procedure at any time. Questions concerning the objects themselves will not be answered, in order to let your own thoughts guide you in the valuation of the objects. You should not understand any instruction, example or comment as a hint on the value of an object.

You will perform different buying and selling tasks. The procedure is always the same:

You are shown an **object**. In the selling task, the object is yours, i.e. it is a gift for you that you can sell. In the buying task the object is not yours yet, but you can buy it.

You name a **price range.** In the selling task a minimum sale price, in the buying task a maximum buy price.

A **transaction price** is determined, that is compared to your price range.

The **purchase/sale** is arranged with real money, if your price range permits this. In case you want to spend more than you have in cash with you or in case you do not want to take an object with you immediately, you can take the object and pay for it on a later day.

Please tell the experimenter to explain the procedure with the help of an example.

The experimenter went through the following example:

Example given by the experimenter

„In case you are confused by the instructions, don't worry, we will go through an example together and you will see how it works. When you can *buy* something, it works as follows: I show you something (* places an apple on the subject's table *) and you have the possibility to buy it with your own money, of course including the 3 Euro you got. (* goes to the blackboard where the following table is shown – see Table 14 :*)

Table 14: Table presented to the subjects (on the blackboard)

	Randomly drawn transaction price (other prices possible)			
Maximum buying price:	0.10	0.50	1.00	2.00
(I - 0.30)*	(0.10)	(-)	(-)	(-)
1.00	0.10	0.50	1.00	-
Minimum selling price				
(II - 0.40)*	(-)	(0.50)	(1.00)	(2.00)
0.10	0.10	0.50	1.00	2.00
2.00	-	-	-	2.00

*Price named by subject. Row then filled out by experimenter (example given in parentheses).

For buying, I ask you: "what is the maximum you would be willing to pay for this apple?" If you are bargaining on a bazaar, it is usually unwise to reveal the maximum you are willing to pay right at the beginning, because this might increase the price you pay. Nevertheless, I ask you here to directly name the maximum you would pay. This is only an example. (* Subject says an amount, typically around 0.30 €, which the experimenter enters in row I under "Maximum buying price". *)

After you have named your maximum buying price, we draw a random transaction price. Look, we have here these little plastic boxes with paper sheets, indicating many different prices. There is a different box for every object, containing different prices, starting at 0. (* If subjects asked for the price ranges, they were told that they went up to different prices for every object, but these thresholds were not revealed in order not to influence the subjects' decisions. *) We would now draw such a price and compare it

with the maximum buying price that you have named. I have named four possible prices on the blackboard as an example, although many other prices are also possible.

If we draw 10 cents as a transaction price, you buy, because you have said you would pay up to (0.30). The important thing is that you pay the price that we have drawn, in this case the 10 cents (* writes 0.10 in the first column of the first row *). If we draw a price of 50 cents, you do not buy, because you have said you would not pay more than (0.30) (* marks the second cell with a "-" *). If we draw 1.00, you do not buy, if we draw for example 2.00, you do of course also not buy. (* marks next two cells with "-" *)

So the important thing is that, if you buy, you pay the price that we have drawn. The reason for this procedure is that by naming a high maximum buying price,, you do not automatically increase the transaction price, as would be the case on a bazaar. Imagine, for example, that I offer you something an you think "ok, I would be willing to pay up to 1.00 € for it". Now your best answer would be indeed to name 1.00 € as your maximum buying price (* points at second row *). Because, if we draw a price lower than 1.00 €, you pay this lower price. You only pay 1.00 € if we draw this as a transaction price.

As it is your own money that is at stake, there is no right or wrong. You do not have to buy anything. If you don't want to buy something at all, you can simply name 0.00 as your maximum buying price. It's your decision.

So let's come to the selling task. (* replaces apple by an orange *). In the selling task, you receive an object from me, for example this orange. It then belongs to you, you can take it home with you or sell it to me. Before, I have asked you to name a *maximum buying price*. Now I am asking you to name a *minimum selling price* (* subjects were usually nodding at this point as a sign that they anticipated that selling worked similar to buying *). Ok, what is the minimum that you want to have for this orange? It is again only an example. (* subject names a price, usually something like 0.40 € that the experimenter enters in row II under "minimum selling price" *) Again we will draw a price from one of these boxes and compare it to what you have said. For example, if we draw 10 cents, the result is that you do not sell, as you have said that you want to sell for at least 40 cents. So you keep the object and I keep my money. (* marks the first cell in row II with a "-" *) If we draw 50 cents as a price, this is enough, so you

sell the object to me. The important thing is that you sell for the price that we have drawn, so in this case for 50 cents (* writes "0.50" in the second cell *). If we draw 1.00, you also sell and you receive 1.00. I we draw for example 2.00, you sell and receive 2.00 (*writes the numbers in the last two cells. Subjects usually made nodding gestures, indicating that they understood. Little smiles sometimes seemed to indicate that they were positively surprised that they could indeed earn some money. *)

Again, the purpose of the procedure is that you can name the absolute minimum that you would accept as a selling price without automatically reducing the amount of money you receive. If I give you something that you do not want to keep at all, just say a very low price, for example 0.10 € or 0. (* pointing to the second row under "Minimum selling price" *). You will always sell in these cases. Yet, if we draw a higher price, say 1.00 or 2.00 €, you do receive this high price, although you have named only 0.10 € as your minimum selling price.

However, if you think that you like the object that I give you and want to keep it, you can name a higher price, for example 2.00 €. You do not increase the selling prices, but you will increase the chance that you keep the object. You keep it if we draw a lower price, for example here (* points to cells with prices of 0.10, 0.50 and 1.00 *)

So just decide whether or not you want to have what I offer or give you and say what you think is right. As we are talking about your own money, it is completely up to you what you do.

Everything clear so far? (* subjects usually say "yes" with varying degrees of confidence *) On the next two pages there is a detailed written description of what I have just told you. You can go through it. If you think that you have understood the mechanism, you are also free to skip this part.

Instructions continued: *

Buying Task:

The buying task works as follows. The experimenter will offer an item for sale. Your task is to write down your maximum buying price.

The purchase will be arranged according to the following rules. In case of a purchase, you pay with your own money (of course including the 3 Euro participation fee that you have received) and take the object home with you.

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 p will be compared to a randomly drawn transaction price. The random transaction price will be drawn from a box with lottery tickets which contains a pre-determined range of prices. The random transaction price will be completely unrelated to your maximum buy price.

After the random transaction price is drawn, it is compared with your maximum buy price.

If your offer is more than or the same as the randomly drawn transaction price 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 randomly drawn transaction price, an amount equal to or less than your offer.

> Example: if you offer 2.00 € and the randomly drawn transaction price is 1.00 €, you have the high offer. You buy the item but pay only 1.00 €.

If your offer is less than the random transaction price, then you do not buy the item.

> Example: if you offer 2.00 € and the random transaction price is 2.20 € you do not have the high offer. 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

The **selling task** works as follows. The experimenter wishes to buy an item that you own. Your task is to write down your minimum selling price.

The sale will also be arranged with real money. If you do not sell, you keep the object and can take it home with you.

As you will see, your best strategy is to determine the **minimum** you would be willing to accept for the item. 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 minimum selling price.

Your minimum selling price will be compared to a random transaction price that is drawn the same way as described above. The random transaction price will be completely unrelated to your offer.

If your minimum selling price is less than or the same as the random transaction price, 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 minimum selling price**. Instead, you receive the random transaction price, a price higher than your offer.

> Example: if you write 2.00 € as your minimum selling price and the random transaction price is 2.50 €, you have the low offer. You sell the item and you receive the random transaction price of 2.50 €.

If your offer is more than the random transaction price then you do not sell your item. You keep the item and can take it home with you.

> Example: if you offer 2.00 € and the random transaction price is 1.00 €, 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 you saw 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 minimum selling price. There is not necessarily a "correct" value. Personal values can differ from individual to individual.

Have you understood the instructions completely?

Answer: ☐ yes ☐ no

In the following rounds, you will act as a buyer and a seller. For which object you have which role has been randomly determined in advance.

Personal questions:
Sex: ☐ male ☐ female
Age: _____
Do you live in Munich? ☐ yes ☐ no
Income or received payments per month (after taxes, in Euro):
☐ until 1,000 ☐ 1,001 to 2,000 ☐ 2,001 to 3,000 ☐ more than 3,000

Comments were to support the buying/selling task: *

"So now we start with a buying task. You can buy this *object* (* the object was put on the subject's table in both WTP and WTA tasks *). Please indicate the maximum you would be willing to pay on your sheet. Now please answer the next to questions. Ok, let us draw a random transaction price. (* holds plastic box close to subject that draws a small folded sheet of paper and opens it, reading and showing the price *). Ok, so you do/do not sell. Please write the price under "drawn transaction price" and mark purchase/no purchase. (* making the transaction if there was one, immediately exchanging the good against money that was put onto the subject's table *)"

Comments in the selling task were the same, except that the experimenter said: * "this *object* is now yours, you can keep it or sell it to me. Please write down your minimum selling price."

*either *

Sale

My minimum selling price is: _____ €

Are you sure that you would not also accept a slightly lower price? If you are not sure, please change your price accordingly.

*or *

Purchase

My maximum buy price is: _____ €

Are you sure that you would not also pay a slightly higher price? If you are not sure, please change your price accordingly.

*for both treatments: *

For me, finding this minimum selling price was

□ very easy □ easy □ neither easy nor difficult □ difficult □ very difficult

Before finding your minimum selling price, you might have reasoned how much this object costs in a store *.

For finding your minimum selling price, how important was this (estimated) store price (mug, lipstick) / printed price (metro ticket) / (estimated) stock quote (stock)? Please give your answer as a number between 0 and 100, following these meanings:

0 – the (estimated) price did not play a role

50 – the (estimated) price played as much a role as other considerations

100 – the (estimated) price played the decisive role, was the only consideration

Importance of the (estimated) price: _____ (number between 0 and 100)

Drawn transaction price: _____ €

Sale: □ yes □ no

The following five tasks will not all be executed. After you have given your answers to all five tasks, the draw of a lottery ticket will determine, which task will be indeed executed. Simply answer as if every task would indeed be executed.

Task A - Share: Bremer Vulkan

The share is valid, is traded on the Frankfurt Stock Exchange and can be delivered into a portfolio at most banks (e.g. HypoVereinsbank, but not Direct-Banks) and sold at the stock exchange.

We do not give you any information about the stock quote (value of the stock at the stock exchange). You have to rely on your own estimations.

Notes:

Coupons are used in case of dividend payouts. (* A sheet with the coupons was accompanying the share *)

For all shares that were printed before 1999, the **face value** (denomination; par) is given in DM (* currency valid in Germany until 1999/2001 *), although it has been converted into Euro. The shares are nevertheless valid in their original form.

The **face value** only indicates what **share** a stock owner owns in a company. No direct conclusions can be drawn from the face value in determining the **quote** of a stock.

When the subject reached the task for buying or selling the share, several points were always repeated verbally, to stress them: *

"So if we might indeed do this task. If we later draw the letter "A", we will do this task according to what you have written. You can buy the share with your own money/the share then belongs to you and you can sell it. We will draw a price and see what happens, as we have done before.

The share is real and valid, but we do not tell you what it is worth at the stock exchange."

*After the subject had answered the pricing (and two directly following) questions for tasks A to E these sheets were put on the side. The subject was then asked to fill out

the back of sheet E, asking the additional questions about the share, while the experimenter read the WTA and WTP answers from the sheets that the subject had already answered in order to fill out the additional valuation questions. After the subject had answered the back of E (the question about the estimated market price of the share had to be answered before the quote of the share was revealed), the additional valuation questions were given to the subject, asking whether she would consider it a good deal to buy/sell the objects at different prices inserted by the experimenter (see below). After the subject had answered these questions, the experimenter said: *

"Ok, I did not tell you what the share is worth, this was a little unfair. So now I tell you the current quote (value) of the share at the Frankfurt stock exchange: It is 11 cents. As I do not want to betray you, you can now change your answers in the two tasks concerning the share before we execute the task. (* handing back the sheets for situation A and E where WTP and WTA for the share were indicated *) Here you said what you would be willing to pay for the share if you can buy it and here you said what you would accept as a minimum if you sell the share. Please do not erase your original answers, but write your new answers on the dotted line here. We will proceed with your new answers. (*Almost all subjects changed both answers. Afterwards, a letter was drawn and the resulting task was resolved. Afterwards, subjects were asked to answer the additional questions concerning the mug, lipstick and metro ticket and the general questions. *

Additional questions

Mug

I am at the moment in need of a mug: □ yes □ maybe □ no

Metro ticket

I use the public transport in Munich: □ often □ rarely □ never

I own a monthly ticket: □ yes □ no

Lipstick

I use lipstick: ☐ often ☐ rarely ☐ never

All goods:

Market price

I estimate the price that one usually pays for this object in a store to lie between _____ € and _____ €.

(If you are absolutely sure, you can write two times the same price.)

Usage of the object

Please distribute 100 % onto the three possibilities, according to how likely you consider them.

If I own the object after the experiment, I will

Keep it: _____ %

Give it as a gift to someone _____ %

Sell it : _____ %

Value for me and others

Even if you answered the selling question above, you are now asked at what prices you would **buy** the object.

In the category „for others" please ask yourself, whether others would buy at this price. Please imagine "others" being the residents of Munich aged 18 and over.

I:

I would buy the object **here and now** at a price of **up to** _____ €.

I would certainly **never buy** the object at a price of **more than** _____ €.

Others:

I think that **almost everybody** would buy the object at a price of **up to** _____ €.

I think that **almost nobody** would buy the object at a price of **more than** _____ €.

Additional Valuation Questions

these questions concerned the metro ticket and the share and the mug or the lipstick if there was a large difference between individual WTA and WTP *
(These questions are hypothetical and have no influence on the real transaction.)

Buying

If I can buy the object at a price of __*_____ , this is for me a

□ good deal □ neither a good nor a bad deal □ a bad deal

The experimenter entered the amount that the subject had previously given as the WTP answer into the first buying question, (WTP+WTA)/2 into the second buying question (if WTA and WTP differed)

Please indicate how **certain** you are about your answer above. Please answer with a number from 0 to 100, meaning:

0 – completely uncertain

100 – completely certain

Answer: _____

Selling - Suppose you own the object (you have found it/it was a gift from your bank - *share*) and you are considering whether selling or keeping it.

If I can sell this object at a price of ___*____, this is for me a

□ good deal □ neither a good nor a bad deal □ a bad deal

The experimenter entered the amount that the subject had given as the WTA answer for this object into the first selling question and (WTP+WTA)/2 (if WTP and WTA differed) into the second selling question. In the rare cases that WTP>WTA, WTA was used in the first buying question and WTP in the first selling question. For WTP=WTA, the second buying and selling question was left out

General Questions

When you go shopping and see an object that you did not originally intend to buy, how do you decide whether to buy nevertheless?

Please distribute 100 points onto the answers, according to how correctly they represent your attitude.

___ I think whether it is a good deal or even a bargain to buy the object at this price

___ I consider how much the object would be worth for me and compare this value with the price

___ Other consideration.

Have you applied the concept of making a good deal/bargain in our **buying** tasks? Please answer with a number from 0 to 100, meaning:

0 – I did not use the concept

100 – the concept has always played an important role

Answer: _____ (number from 0 to 100)

In the **selling** tasks, have you used a similar concept: the thought whether it is a good deal to sell at a certain price? Please distribute 100 points onto the answers, according to how correctly they represent your attitude.

___ yes, I can use this concept for selling as easily as for buying

___ yes, but as I am less used to selling, it is more difficult for me to apply the concept

___ No, I proceed in a completely different way when selling

Original version in German

Experiment – Einleitung

Dies ist ein Experiment zum Entscheidungsverhalten. Der Zweck des Experimentes ist es, Einflussfaktoren von Kauf- und Verkaufsentscheidungen zu erforschen. Das Experiment wird von der Deutschen Forschungsgesellschaft im Rahmen des Graduiertenkolleg „Markets, Institutions and the Scope of Government“ finanziert und wird für meine Dissertation in Volkswirtschaftslehre verwendet.

Die Anweisungen sind einfach. Wenn Sie ihnen sorgsam folgen, können Sie Geld oder verschiedene Objekte bekommen. Was Sie bekommen, hängt von Ihren Entscheidungen

ab. Es gibt keine richtigen oder falschen Entscheidungen. Entscheiden Sie sich einfach so, wie Sie es für richtig halten. Sie können jederzeit Fragen zum Ablauf des Experiments stellen. Fragen zu den Objekten selbst werden Ihnen allerdings nicht beantwortet werden, damit Sie sich bei der Bewertung der Objekte ausschließlich auf sich selbst stützen. Sie sollten keine Anweisung, kein Beispiel und keine Bemerkung als Hinweis auf den Wert eines Objekts verstehen.

Sie werden mit unterschiedlichen Kauf- und Verkaufssituationen konfrontiert. Der Ablauf ist dabei immer gleich:
Sie bekommen einen **Gegenstand** gezeigt. In der *Verkaufs-Situation* gehört der Gegenstand Ihnen, d.h. er ist ein Geschenk an Sie, das Sie verkaufen können. In der *Kauf-Situation* gehört der Gegenstand Ihnen noch nicht, aber sie können ihn kaufen.
Sie **nennen** eine **Preisvorstellung**. In der Verkaufs-Situation einen minimalen Verkaufspreis, in der Kauf-Situation einen maximalen Kaufpreis.
Ein **Transaktionspreis** wird bestimmt, der mit Ihrem Preis verglichen wird.
Der **Verkauf/Kauf** wird mit echtem Geld **durchgeführt**, falls Ihre Preisvorstellung dies zulässt. Sollten Sie mehr ausgeben wollen, als Sie in bar bei sich führen, oder einen Artikel nicht sofort mitnehmen wollen, können Sie den/die Artikel auch an einem späteren Tag bei uns abholen und bezahlen.

Bitte geben Sie dem Versuchsleiter jetzt Bescheid, damit er Ihnen den Ablauf an einem Beispiel erklärt.

Explanation of Example
<u>Kauf-Situation:</u>
Die Kauf-Situation funktioniert wie folgt: Der Versuchsleiter bietet ein Objekt zum Verkauf. Ihre Aufgabe ist es, Ihren maximalen Kaufpreis aufzuschreiben.
Der Kauf wird den nun folgenden Regeln tatsächlich abgewickelt. Sie bezahlen im Falle eines Kaufes mit Ihrem eigenen Geld (natürlich einschließlich der 3,- Euro Teilnahme-Honorar, die Sie bekommen haben) und nehmen das gekaufte Objekt mit nach Hause.
Wie Sie sehen werden, ist es Ihre beste Strategie, das **Maximum** zu bestimmen, das Sie für das Objekt bezahlen würden, und dieses Maximum zu bieten. Es ist weder vorteil-

haft für Sie, mehr zu bieten als dieses Maximum, noch weniger zu bieten. Bestimmen Sie einfach dieses Maximum, das Sie bezahlen würden und machen Sie dies zu Ihrem maximalen Kaufpreis.
Ihr Gebot wird dann mit einem **zufällig gezogenen Transaktionspreis** verglichen. Dieser Preis wird aus einem Lostopf gezogen, in dem verschiedene Preise in einer vorher festgelegten Spanne sind. Der Mechanismus ist von Ihrem angegebenen maximalen Kaufpreis unabhängig.

Nach der Ziehung des zufälligen Transaktionspreises wird dieser mit dem von Ihnen angegebenen maximalen Kaufpreis verglichen. Wenn Ihr maximaler Kaufpreis höher ist, kaufen Sie das Objekt **zum zufällig gezogenen Transaktionspreis**. Sie bezahlen nicht Ihren maximalen Kaufpreis. Sie bezahlen nur den tatsächlich gezogenen Transaktionspreis.
Beispiel: Wenn Sie 2,00 € bieten und der zufällig gezogene Transaktionspreis 1,00 € ist, kaufen Sie, und zwar zum Preis von 1,00 €.
Wenn der zufällig gezogene Transaktionspreis höher ist als Ihr maximaler Kaufpreis, passiert nichts, Sie kaufen das Objekt also nicht.
Beispiel: Wenn Sie 2,00 € bieten und der zufällig gezogene Transaktionspreis 2,20 € ist, kaufen Sie das Objekt nicht.

Als Käufer sollten Sie genau das **Maximum bieten, das Sie bereit sind für das Objekt zu bezahlen.**
Es hat für Sie keine Vorteile, sich „strategisch“ zu verhalten und einen niedrigeren maximalen Kaufpreis anzugeben. Ihre beste Strategie ist es, den Wert zu bestimmen, den das Objekt für Sie persönlich darstellt und diesen Wert als Ihren maximalen Kaufpreis anzugeben. Es gibt nicht notwendigerweise einen „richtigen“ Wert. Der persönliche Wert kann von Individuum zu Individuum verschieden sein.

Verkaufs-Situation

Die Verkaufs-Situation funktioniert wie folgt: Der Versuchsleiter möchte ein Objekt kaufen, das wir Ihnen gegeben haben und das damit Ihnen gehört. Ihre Aufgabe ist es, einen Mindest-Verkaufspreis aufzuschreiben.

Der Verkauf wird ebenfalls mit echtem Geld abgewickelt. Sollten Sie nicht verkaufen, behalten Sie das Objekt und können es mit nach Hause nehmen.

Wie Sie sehen werden, ist es Ihre beste Strategie, das **Minimum** zu bestimmen, das Sie für den Verkauf des Objekts akzeptieren würden. Es ist nicht vorteilhaft für Sie, mehr als dieses Minimum zu verlangen, und es ist nicht vorteilhaft, weniger zu verlangen. Bestimmen Sie einfach das Minimum, das Sie als Verkaufspreis akzeptieren würden und geben Sie diesen Betrag als Mindest-Verkaufspreis an.

Ihr Mindest-Verkaufspreis wird mit einem **zufällig gezogenen Transaktionspreis** verglichen, der nach dem gleichen Verfahren wie oben generiert wird und wieder unabhängig von Ihrem oder anderen Mindest-Verkaufspreisen ist.

Wenn Ihr Mindest-Verkaufspreis kleiner oder gleich dem zufällig gezogenen Transaktionspreis ist, verkaufen Sie das Objekt **zum zufällig gezogenen Transaktionspreis**. Sie verkaufen also nicht zu Ihrem Mindest-Verkaufspreis, sondern stattdessen zum Transaktionspreis, der höher liegt als ihr Mindest-Verkaufspreis.

Beispiel: Wenn Sie 2,00 € als Mindest-Verkaufspreis angeben und der zufällig gezogene Transaktionspreis 2,50 € ist, verkaufen Sie zum Preis von 2,50 €.

Wenn Ihr Mindest-Verkaufspreis höher ist als der zufällig gezogene Transaktionspreis, verkaufen Sie das Objekt nicht, sondern können es mit nach Hause nehmen.

Beispiel: Wenn Sie 2,00 € bieten und der gezogene Transaktionspreis ist 1,00 €, verkaufen Sie nicht.

Als Verkäufer sollten Sie das **Minimum angeben, das Sie als Verkaufspreis akzeptieren würden**.

Genau wie in der Kauf-Situation gibt es keine Vorteile davon, sich „strategisch“ zu verhalten und einen höheren Mindest-Verkaufspreis anzugeben. Ihre beste Strategie ist es, den Wert zu bestimmen, den das Objekt für Sie persönlich hat, und diesen Wert als Ih-

ren Mindest-Verkaufspreis anzugeben. Es gibt nicht notwendigerweise einen „korrekten“ Wert, dieser kann von Individuum zu Individuum unterschiedlich sein.

Haben Sie die Instruktionen vollständig verstanden?

Antwort: ☐ ja ☐ nein

In den nun folgenden Runden werden Sie sowohl als Käufer, als auch als Verkäufer agieren. Für welches Objekt Sie welche Rolle haben, wurde im Voraus zufällig bestimmt.

Persönliche Angaben:

Geschlecht: ☐ männlich ☐ weiblich

Alter: _____

Wohnen Sie in München? ☐ Ja ☐ Nein

Einkommen / empfangene Leistungen pro Monat (nach Steuern, in Euro):

☐ Bis 1.000 ☐ 1.001 bis 2.000 ☐ 2.001 bis 3.000 ☐ über 3.000

Verkauf

Mein **minimaler Verkaufspreis** beträgt: _____ €

Sind Sie sicher, dass Sie nicht auch einen etwas niedrigeren Preis akzeptieren würden? Wenn Sie sich dessen nicht sicher sind, ändern Sie den Preis bitte entsprechend.

oder:

Kauf

Mein **maximaler Kaufpreis** beträgt: _____ €

Sind Sie sicher, dass Sie nicht auch einen etwas höheren Preis bezahlen würden? Wenn Sie sich dessen nicht sicher sind, ändern Sie den Preis bitte entsprechend.

**beide Treatments: **

Die Bestimmung dieses minimalen Verkaufspreises war für mich

☐ sehr leicht ☐ leicht ☐ weder leicht noch schwer ☐ schwer ☐ sehr schwer

Möglicherweise haben Sie, bevor Sie Ihren minimalen Verkaufspreis bestimmt haben, überlegt, wie viel das Objekt in einem Geschäft kostet.
Wie wichtig war Ihnen bei der Bestimmung des minimalen Verkaufspreises dieser **(geschätzte) Ladenpreis** (Tasse, Lippenstift)**/ aufgedruckte Preis** (U-Bahn-Ticket) / **(geschätzte) Börsenkurs** (Aktie)? Bitte geben Sie Ihre Antwort als Zahl zwischen 0 und 100. Dabei bedeuten
0 – der (geschätzte) Preis hat gar keine Rolle gespielt
50 – der (geschätzte) Preis hat eine genauso große Rolle gespielt wie andere Überlegungen
100 – der (geschätzte) Preis hat die entscheidende Rolle gespielt, war die einzige Überlegung
Wichtigkeit des (geschätzten) Preises: _____ (Zahl zwischen 0 und 100)
Gezogener Transaktionspreis: _____ €
Verkauf: □ Ja □ Nein

Die folgenden fünf Situationen werden nicht alle durchgeführt. Nachdem Sie für alle fünf Situationen Ihre Entscheidung angegeben haben, wird stattdessen **ausgelost**, welche Situation tatsächlich durchgeführt wird. Antworten Sie einfach so, als würde jede Situation tatsächlich durchgeführt.

Situation A - Aktie: Bremer Vulkan

Die Aktie ist gültig, wird an der Börse Frankfurt gehandelt und kann bei den meisten Banken (außer Direktbanken) in ein Depot eingeliefert (z.B. bei der HypoVereinsbank) und dann an der Börse verkauft werden.
Über den Börsenkurs (Wert der Aktie an der Börse) geben wir Ihnen keine Informationen. Sie müssen sich auf Ihre eigene Schätzung verlassen.
Hinweise:
Ein **Kupon-Bogen** dient zum Einlösen bei eventuellen Dividenden-Zahlungen.
Bei allen Aktien, die vor dem Jahr 1999 gedruckt wurden, ist der **Nennwert** („ist mit 50 DM beteiligt“) noch in **DM** angegeben, obwohl er in Euro umgewandelt wurde. Die Aktien sind dennoch unverändert gültig.

Der **Nennwert** gibt lediglich an, welchen **Anteil** eines Unternehmens ein Anleger besitzt. Es lassen sich aus dem Nennwert keine direkten Schlüsse auf den **Börsenkurs** einer Aktie ziehen.

Zusatzfragen

Tasse

Ich kann zurzeit eine Tasse gut gebrauchen: □ ja □ vielleicht □ nein

U-Bahn-Ticket

Ich benutze den MVV: □ häufig □ selten □ nie

Ich besitze eine Monatskarte: □ ja □ nein

Lippenstift

Ich benutze Lippenstift: □ häufig □ selten □ nie

Aktie

Wie gut sind Sie über die Gesellschaft Bremer Vulkan informiert?

□ gut informiert

□ habe den Namen schon gehört, bin aber nicht gut informiert

□ nie gehört

Marktpreis

Ich schätze, dass man üblicherweise in einem Geschäft (*Fahrkartenautomaten; Börse – Kurs *) für dieses Objekt

einen Preis zwischen _____ € und _____ € bezahlt

(Wenn Sie sich ganz sicher sind, können Sie auch zweimal den gleichen Preis angeben.)

Verwendung des Objekts

Bitte verteilen Sie 100 % auf die drei Möglichkeiten, je nachdem für wie wahrscheinlich sie sie halten.

Wenn ich das Objekt nach dem Experiment besitze, werde ich es

behalten: _____ %

verschenken: _____ %

verkaufen: _____ %

Wert für mich und andere

Auch wenn Sie oben die Verkauf-Frage beantwortet haben, geht es hier nur darum, zu welchen Preisen Sie und andere Menschen das Objekt **kaufen** würden.

In der Kategorie „für andere" fragen Sie sich bitte, ob andere zu diesem Preis kaufen würden. Unter „andere" stellen Sie sich bitte die Bewohner Münchens über 18 Jahre vor.

Ich:

Ich würde das Objekt **hier und jetzt kaufen** bei einem Preis **bis zu** _____ €.

Ich würde das Objekt sicher **niemals kaufen** bei einem Preis **über** _____ €.

Andere:

Ich denke, dass **so gut wie jeder** das Objekt kaufen würde

bei einem Preis **bis zu** _____ €.

Ich denke, dass **so gut wie niemand** das Objekt kaufen würde

bei einem Preis **über** _____ €.

Zusatzfragen * *misconception checks* * MVV-Ticket, Aktie, Lippenstift, Tasse

(Diese Fragen sind hypothetisch und haben keinen Einfluss auf die tatsächliche Transaktion.)

Kaufen

Wenn ich dieses *Objekt* zum Preis von _____ kaufen kann, ist das für mich ein

□ gutes Geschäft □ weder gutes, noch schlechtes Geschäft □ schlechtes Geschäft

Bitte geben Sie an, wie **sicher** Sie sich Ihrer obigen Antwort sind. Bitte antworten Sie mit einer Zahl von 0 bis 100. Dabei bedeutet

0 – völlig unsicher

100 – völlig sicher

Antwort: _____

Wenn ich dieses *Objekt* zum Preis von _____ kaufen kann, ist das für mich ein

□ gutes Geschäft □ weder gutes, noch schlechtes Geschäft □ schlechtes Geschäft

Bitte geben Sie an, wie sicher Sie sich Ihrer obigen Antwort sind. Bitte antworten Sie mit einer Zahl von 0 bis 100. Dabei bedeutet

0 – völlig unsicher

100 – völlig sicher

Antwort: _____

Verkaufen - Nehmen Sie an, Ihnen gehört das *Objekt* (Sie haben es gefunden) *Aktie: Sie haben es von Ihrer Bank geschenkt bekommen* und Sie überlegen sich, ob Sie es verkaufen oder behalten wollen.

Wenn ich dieses *Objekt* zum Preis von _____ verkaufen kann, ist das für mich ein

□ gutes Geschäft □ weder gutes, noch schlechtes Geschäft □ schlechtes Geschäft

Bitte geben Sie an, wie sicher Sie sich Ihrer obigen Antwort sind. Bitte antworten Sie mit einer Zahl von 0 bis 100. Dabei bedeutet

0 – völlig unsicher

100 – völlig sicher

Antwort: _____

Wenn ich dieses *Objekt* zum Preis von _____ verkaufen kann, ist das für mich ein

□ gutes Geschäft □ weder gutes, noch schlechtes Geschäft □ schlechtes Geschäft

Bitte geben Sie an, wie sicher Sie sich Ihrer obigen Antwort sind. Bitte antworten Sie mit einer Zahl von 0 bis 100. Dabei bedeutet 0 – völlig unsicher

100 – völlig sicher

Antwort: _____

Allgemeine Fragen

Wenn Sie einkaufen und einen Artikel sehen, den Sie ursprünglich nicht kaufen wollten, wie entscheiden Sie, ob sie es doch tun?

Bitte verteilen Sie insgesamt 100 Punkte auf die Antworten, je nachdem wie zutreffend sie für Sie sind.

___ Ich überlege, ob es ein gutes Geschäft oder sogar ein „Schnäppchen“ ist, den Artikel zu diesem Preis zu kaufen

___ Ich überlege, was der Artikel für mich wert wäre und vergleiche diesen Wert mit dem Preis

___ Andere Überlegung

Haben Sie das Konzept, ein gutes Geschäft/"Schnäppchen" zu machen, auch bei unseren **Kauf**-Experimenten angewendet? Bitte geben Sie Ihre Antwort als Zahl von 0 bis 100, dabei bedeuten:

0 – habe das Konzept nicht angewendet

100 – das Konzept hat immer eine große Rolle gespielt

Antwort: _____ (Zahl von 0 bis 100)

Haben Sie bei den **Verkaufs**-Experimenten auf ein ähnliches Konzept zurückgegriffen, also die Überlegung angestellt, ob es ein gutes Geschäft ist, zu einem bestimmten Preis zu verkaufen?

Bitte verteilen Sie insgesamt 100 Punkte auf die Antworten, je nachdem wie zutreffend sie für Sie sind.

___ ja, ich kann dieses Konzept beim Verkaufen genauso leicht anwenden wie beim Kaufen

___ ja, da ich das Verkaufen weniger gewöhnt bin, fiel es mir jedoch schwerer, dieses Konzept anzuwenden

___ nein, beim Verkaufen gehe ich ganz anders vor

Chapter 2:

Can we predict Preference Reversal?

Abstract: Experiments show that people reverse their preferences over lotteries when they are asked to price the lotteries, instead of making direct choices between them. Psychologists and economists have studied this phenomenon, termed "preference reversal", for more than 30 years. Recent evidence contradicts existing explanations. This article argues that a prediction of the phenomenon is possible without giving up transitivity of preferences. A model of "aversion to risk changes", corresponding to a reference point in risk, together with over-weighting of low probabilities, is consistent with the body of empirical evidence and correctly predicts the pattern of experimental outcomes of an experiment by Blondel and Lévy-Garboua (2005).

Keywords: preference reversal, endowment effect, transitivity, lotteries
JEL classification: D81
PsycINFO classification: 2229

Introduction

„Phenomena that appear anomalous from the perspective of standard preference models are in fact ***predictable*** *– indeed, inevitable – consequences of well-established rules of judgement and valuation, which apply in domains that are beyond the reach of choice theory."* (Kahneman et al., 1999, p. 230, emphasis added)

Is microeconomic choice theory with its stringent assumptions doomed to fail in the light of the growing experimental evidence from behavioral economics and economic psychology?

This article argues that, at least for a certain class of anomalies concerning gambles, this need not be the case. Keeping the rationality assumptions intact, but modifying other parts of the theory can be a way to predict anomalies such as *preference reversal* and the *endowment effect*.

The anomaly in the focus of this article, the "preference reversal" phenomenon, has its name from a perceived inconsistency of subjects' choices with the stability of their preferences. Psychologists Lichtenstein and Slovic (1971, 1973) were the first to observe it in experiments with gambles. Subjects are asked to make a choice between two gambles with similar expected value, one relatively risky bet and one relatively safe bet. From this choice, one gets a direct measure of preferences. Subjects are then asked to evaluate the same bets in a pricing treatment, i.e. to state minimum selling prices for each bet. From these minimum selling prices, one can infer an "indirect" measure of preferences, by comparing the answers for the different lotteries. When comparing these direct and indirect measures of preferences, it turns out that, very often, they contradict each other: A majority of those subjects, who prefer the relatively safe bet in choice, attach a higher price to the risky gamble.

Although economists were at first very reluctant to accept these experimental results, a great number of subsequent experiments conducted by economists themselves (starting with Grether and Plott, 1979) have confirmed the robustness of the phenomenon. For an overview, see Seidl (2002).

The most prominent explanations of preference reversal have proposed that, when choosing between gambles, people regard a high probability of winning as more impor-

tant than a high stake. When it comes to pricing, it is argued that the stake plays a larger role than the probability of winning.

Over the last years, evidence has been found, which contradicts these prominent explanations. This article tests an alternative hypothesis proposed in chapter 1 of this dissertation.

We proceed as follows: Part I briefly summarizes the predictions that Expected Utility makes. Part II shows the most important experimental evidence and the proposed explanations. In part III we slightly expand and test the model (introduced in Chapter 1) to the data from Blondel and Lévy-Garboua (2005).

I. Expected Utility: Choice vs. Pricing

Let there be a lottery where a high payoff (H) and a low payoff (L) can be won with equal chances of 50 %: (H, 0.5; L, 0.5). The expected value of this lottery is $E=(H+L)/2$. Expected Utility Theory posits that there is a *certainty equivalent* (CE) such that an individual is indifferent between receiving the lottery and the certain amount of money:

$$CE = E - r, \qquad (20.)$$

with r denoting the *risk premium*.

Choosing

Imagine there are now two lotteries: One more risky lottery (H_R, 0.5; L_R, 0.5), and another, relatively safe lottery (H_S, 0.5; L_S, 0.5), with the risky lottery having a larger payoff variation: H_R-L_R>H_S-L_S (see Figure 9). Let EU(.) indicate expected utility.

If an individual is indifferent between the two lotteries, this corresponds to:

$$EU(risky) = EU(safe) \text{ and } CE(risky) = CE(safe) \qquad (21.)$$

If one of the lotteries, say the risky lottery, is preferred, it must be that

$$EU(risky) > EU(safe) \text{ and } CE(risky) > CE(safe) \qquad (22.)$$

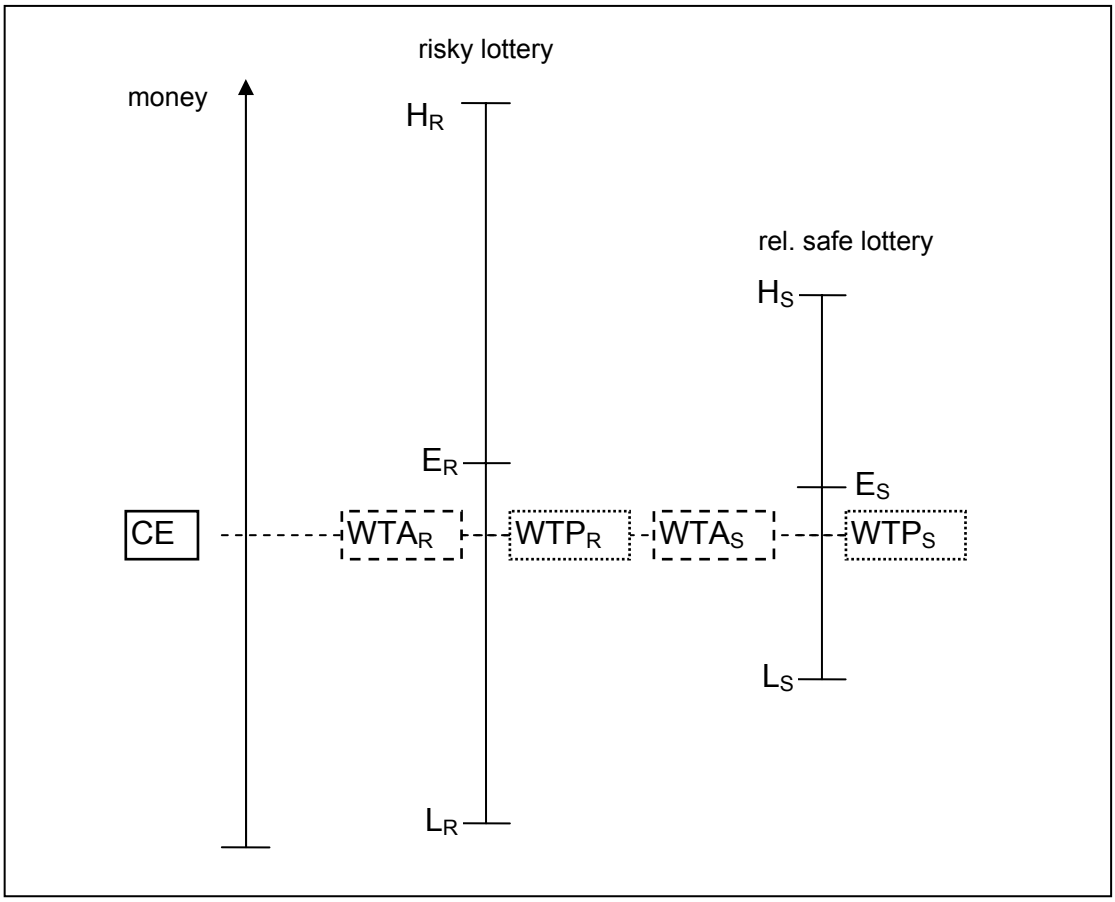

Figure 9: Pricing of lotteries in Expected Utility Theory

(here for indifference between both lotteries)

Pricing

When deciding whether or not to sell or to buy a lottery, the individual compares the lottery with receiving/paying a certain amount of money. The price at which the individual is indifferent between keeping and selling (between not buying and buying) is again the certainty equivalent:

Minimum selling price (willingness to accept): $WTA = CE$

Maximum buy price (willingness to pay): $WTP = CE$

When comparing the different measures, one has to take into account different wealth positions. Let x be current wealth:

- Choice: The individual starts with $\{x\}$ and ends with $\{x + lottery\}$
- Selling: The individual starts with $\{x + lottery\}$ and ends either with $\{x + lottery\}$ or $\{x + selling\ price\}$

- Buying: The individual starts with $\{x\}$ and ends with either $\{x\}$ or $\{x$ - *buying price* + *lottery*$\}$.

In Expected Utility Theory, individuals compare end-states, regardless where they start. Therefore, the choice and selling decision are equivalent, while in the buying decision the end-state is lower. It is therefore possible that when comparing CE or WTA to WTP, they are different due to an *income effect*: As the individual is slightly richer in the choice and selling condition, this might induce a higher valuation of the lottery.

With income effect: CE = WTA ≥ WTP.

Empirically, it is easy to test for this income effect by giving some subjects an additional amount of money and look for significant changes in their answers. For the amounts of money at stake in lottery experiments (typically <100 €), no income effect is detected (Schmidt and Traub, 2003). Therefore it must hold:

Neglecting the income effect: CE = WTA = WTP.

It follows that if a lottery, say the relatively safe lottery, is preferred in choice, it must also be priced more highly:

CE(safe) > CE(risky) → *WTA(safe)> WTA(risky)* and *WTP(safe) > WTP(risky).*

Expected Utility predicts that preferences are identical, whether measured directly in a choice experiment or indirectly in a pricing treatment.

II. Empirical Evidence

Experiments have cast doubt on the propositions of Expected Utility Theory. Hence, we will now review the empirical evidence.

Preference Reversal in the Selling Treatment

Lichtenstein and Slovic (1971, 1973) presented their subjects 6 sets consisting each of two different gambles (lotteries), a relatively safe and a risky bet. A typical pair was:

- Relatively safe bet (called "P-Bet" for "high probability"): "win $4 with probability 0.8 or lose[38] $0.5 with probability 0.2" – short notation: ($4, 0.8; -$0.5, 0.2)

[38] In latter experiments, the possibility of losing a small amount of money was discarded in favour of just receiving nothing, as this did not seem to be essential for the results.

- Risky bet ("$-Bet" for "high stake"): "win $40 with probability 0.1 or lose $1 with probability 0.9" – short notation: ($40, 0.1; -$1, 0.9)

Both gambles of such a pair are constructed such that they yield a similar expected value (here it is $3.10 for both lotteries).

Lichtenstein and Slovic first presented such a pair of lotteries to the subjects and asked them to choose one of them. Later, the same gambles were presented to the subjects one at a time. Subjects were now asked to state the minimum selling price (willingness to accept – WTA), at which they would just be indifferent between selling and keeping the lottery. Treatments with real gambling and real payments were used: After subjects indicated their price, a random transaction price was drawn. Subjects sold at the transaction price if it was larger than their stated WTA. With this method, also known as Becker-de-Groot-Marschak mechanism (BDM), true revelation of minimum selling and maximum buying prices is optimal.

Lichtenstein and Slovic observed that a significant share[39] of the subjects showed the same pattern of behavior towards all 6 lottery pairs: They preferred the relatively safer (P-) bet in the pairwise choice, but priced the risky ($-) bet higher. For the purpose of further analysis, let us call this pattern "type 1 reversal". The opposite pattern of behavior ("type 2 reversal"), in contrast, was very rare, contradicting a possible hypothesis that subjects were indifferent between the gambles and made random choices with errors.[40] Only a small proportion of subjects showed the behavior predicted by Expected Utility Theory[41].

Table 15 summarizes the two types of possible preference reversals.

[39] 73 % of subjects in experiment I (without real monetary payoff, 173 subjects) and 42 % in experiment III (with real payoffs, 14 subjects).
[40] 83 % of subjects (experiment I) and slightly less in experiment III (no exact number given) never showed this pattern.
[41] 27 % of subjects (experiment I) show stable preferences towards at least 1 of 6 lottery pairs. In experiment III, 36 % of the subjects show stable preferences sometimes and 21 % always.

Table 15: Types of preference reversal

	Preferred lottery in:	
	Choice (direct preference)	**Pricing** (indirect preference)
Type 1 Preference Reversal (also termed "Predicted Preference Reversal" in the literature)	Relatively safe bet	Risky bet
Type 2 Preference Reversal (also termed "Unpredicted" or "Reversed Preference Reversal")	Risky bet	Relatively safe bet

The puzzle consists of explaining why people show the opposite preference when measured in an indirect way (pricing) than when measured in a direct way (choice). This behavior can be seen to contradict the most basic microeconomic definitions and assumptions about preferences.

Preferences: Definitions and Assumptions

The definition of preference relations states:

1. *Indifference relation* „~": $A \sim B \Leftrightarrow A \succsim B$ and $B \succsim A$

2. *Strict preference relation* „$\succ$" : $A \succ B \Leftrightarrow A \succsim B$ but not $B \succsim A$

If one observes that A is chosen over B, this would in any case satisfy weak preference: $A \succsim B$. Whether strict preference is satisfied must be inferred from whether indifference and/or the opposite choice can be observed.

The two most basic assumptions about preferences that together constitute the *rationality* of a set of preferences are the transitivity and the completeness assumption (from which then follow other properties like reflexivity and the existence of a representation in form of a utility function). Only the transitivity assumption is of interest here:

Transitivity Assumption: If $A \succ B$ and $B \succ C \Rightarrow A \succ C$

The behavior forming the preference reversal pattern described above (type 1 reversal) would lead to the following conclusions:

For $ (risky lottery) and P (relatively safe lottery), we get as a result of the choice treatment: $P \succsim \$$. The result of the pricing treatment must be interpreted as $\$ \succ P$.[42]

Therefore, either the transitivity assumption must be violated or preferences must be seen as "unstable", i.e. changing from one moment to the other (contradicting the existence of strong preference as described in definition 2).

Yet, giving up the transitivity or stability assumption would clearly lead to a great loss in predictive power. In order to yield falsifiable predictions, a theory needs strict preference and the transitivity assumption.

Instead of giving up the strict definition of preferences or the transitivity assumption, **extending** the theory of choice can bring results back in line with a theory of rational behavior.

Prominent Explanations of Preference Reversal

Lichtenstein and Slovic were the first to assure that: *"One need not call this behavior irrational, but it casts doubt on the descriptive validity of expected utility models of risky decision making."* (Lichtenstein and Slovic, 1971, p. 46). They already propose adaptations to the theory other than giving up the transitivity assumption.

There are at present three explanations that can probably be seen as the most widely accepted explanation of the *preference reversal* phenomenon. In terms of predictions, these explanations are quite similar and differ mainly in terms of unobservable characteristics.

- "Anchoring-Adjustment": Lichtenstein and Slovic (1971) propose that subjects follow different anchoring-adjustment-procedures in choice and pricing tasks. When making a choice between lotteries, they pay most attention to the probability of winning the prize. When asked to price the lotteries, they start with the possible prize as an "anchor" and adjust this prize downward, so attaching more weight to the prize in the pricing condition[43].

---

[42] For $WTA(\$)=x_1$, $WTA(P)=x_2$ $x_1>x_2$, we have: $\$ \sim x_1$, $P \sim x_2$. So $\$ \succ (x_1+x_2)/2 \succ P$ and therefore $\$ \succ P$ must be true.

[43] Lichtenstein and Slovic already showed direct evidence in form of correlations: The higher the amount to win of the risky lottery compared to the amount to win in the safe lottery, the more subjects priced the

- "Scale Compatibility": Tversky et al. (1990) state that subjects attach greater weight to payoffs in pricing: The "output" in the pricing task is expressed in dollar terms. The "input", the lottery, has two components, probability and payoff. As the component payoff is also expressed in dollar terms, it is *compatible* with the output and therefore given more weight by the decision maker.
- "Prominence Hypothesis" (Slovic, 1975, cited by Seidl, 2002, p. 639): A certain aspect of an object is seen as more *prominent* as other aspects if the decision maker demands a minimum level of this aspect: When subject choose between gambles, the "minimum feature" they want to have in this case is a large probability of winning. Therefore, when choosing between lotteries, probability is seen as the more prominent (i.e. important) dimension. Slovic et al. (1990, cited by Seidl, 2002, p. 640) conclude that both scale compatibility and prominence determine preference reversal.

All three hypotheses are almost identical in their predictions: Subjects prefer a higher probability of winning when choosing between gambles. When asked to name a price, they price risky gambles higher, because in this gamble the stake to be won is higher.

However, although the experimental results were robust to a number of variations, using buy-prices instead of sell-prices brought different evidence that contradicted the above explanations:

Preference Reversal in the Buying Treatment

In the experiments described so far, the mechanism used in the pricing treatment was that of asking a selling question (and therefore getting willingness to accept – WTA – as an answer). There is, however, a second way to elicit valuations in a pricing treatment: If one constructs a possible buying situation, one can elicit willingness to pay (WTP) instead of willingness to accept.

Already Lichtenstein and Slovic (1971) noted a difference between using a buying and a selling treatment. By using the buying treatment instead of the selling treatment to

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risky lottery higher (correlation .55). For the choice task, no such dependence existed (correlation -0.03). (Lichtenstein and Slovic 1971, p. 50). In the light of the evidence of this paper, one might argue that these results could also have been due to over-weighting of low probabilities in pricing, as lower probabilities go hand in hand with higher stakes, if the expected value is kept constant.

measure "indirect preferences", the proportion of subjects that *always* show a "type 1 reversal" fell from 73% to around 10%, the proportion of subjects *never* committing a "type 2 reversal" fell from 83% below 20%[44]. The decrease in type 1 reversals and the increase in type 2 reversals were both significant at the 1%-level.

Only 20 years later, more empirical evidence about using the buy treatment emerged. It highlights that overlooking the impact of using WTP means to neglect quite a different pattern of responses:

- Casey (1991): When stakes are high and buy prices are used, type 2 reversals are significantly more often than type 1 reversals: When the risky bet was chosen, the relatively safe bet received a higher bid in 71 % of the cases. When the relatively safe bet was chosen, the risky bet received a higher bid in only 21 % of the cases. In control experiments, Casey finds out that using the buy instead of the sell treatment together with relatively high stakes (expected value of around $100 - but only hypothetical payoffs) are responsible for this "reversal of the preference reversal phenomenon". When using rather small payoffs and the buy treatment, type 1 reversals dominate.

- Schmidt and Hey (2004) conduct experiments using both buy and sell treatments in addition to choices between lotteries. They find that in buy treatments, the rate of "type 1 reversals" decreases and the rate of "type 2 reversals" increases. *"While for asks [sell treatment], the frequency of [type 1 reversals] is roughly two times higher than the frequency of [type 2 reversals], both frequencies are nearly identical for bids [buy treatment]."* (p. 215).

- Blondel and Lévy-Garboua (2005) conduct buy and sell treatments and choice treatments with a large set of different lotteries. They find type 1 reversal dominating, though the type 2 pattern dominates under some circumstances, creating an ambiguous pattern.

- Hamm (1979) uses buy treatments throughout his extensive study and finds the traditional pattern of type 1 reversal only.

[44] reading from their Fig. 1, p. 49

The findings of "Type 2 reversal" contradict the prediction of the prominent explanations cited above, that probability is more important in choice and the size of the stake more important in pricing. For type 2 reversal in buy treatments, the opposite seems to be true: Probability would have to be even more important than in choice, as the relatively safe (P-) bet was preferred by more subjects in the buy condition than in the pairwise choice.

Schmidt and Hey (2004) claim that errors are responsible for preference reversals. They do not, however, answer the critical question why one kind of error, namely type 1 reversal for selling, occurs much more often than type 2 reversal for selling. Lichtenstein and Slovic (1971, 53) already tested for the possibility of errors being responsible for the outcome and concluded that the pattern of results deviated systematically from the necessary pattern.

Several of the endowment effect theories claim a relationship between the endowment effect and uncertainty. This hypothesis can also account for some of the preference reversal evidence:

Endowment Effect Theories and Preference Reversal

Three theories can predict the endowment effect for lotteries:

- A mixture of Adaptive Utility and Regret Theory (Rankin, 1990, see General Introduction, p. 19): People are uncertain about their preferences. The resulting uncertainty has different effects in the buy and sell situation, as people evaluate the possible results in comparison to their current wealth (the reference point).
- "Reference-dependent subjective expected utility" (Sugden, 2003, see p. 20): Also uses the reference point concept known from Regret Theory (Loomes and Sugden, 1982), yet not with the alternative results as reference points, but current wealth.
- "Cognitive Consistency Theory" (Blondel and Lévy-Garboua, 2005, Lévy-Garboua and Montmarquette, 1996, see p. 21): When deciding, people try to find a compromise between their normative preferences and the action that would be optimal in rational choice.

Though giving different intuitions, all theories have in common that they predict that the WTA-WTP-gap depends positively on uncertainty. Rankin's model was unsuccessfully tested with inappropriate data from a hypothetical survey (see chapter 3 for further details on the different nature of the WTA-WTP-gap in contingent valuation surveys). "Cognitive Consistency" was successfully tested with lottery pricing data, yet is (as "Reference-dependent subjective expected utility") not consistent with all of the lottery choice evidence, as will be shown below.

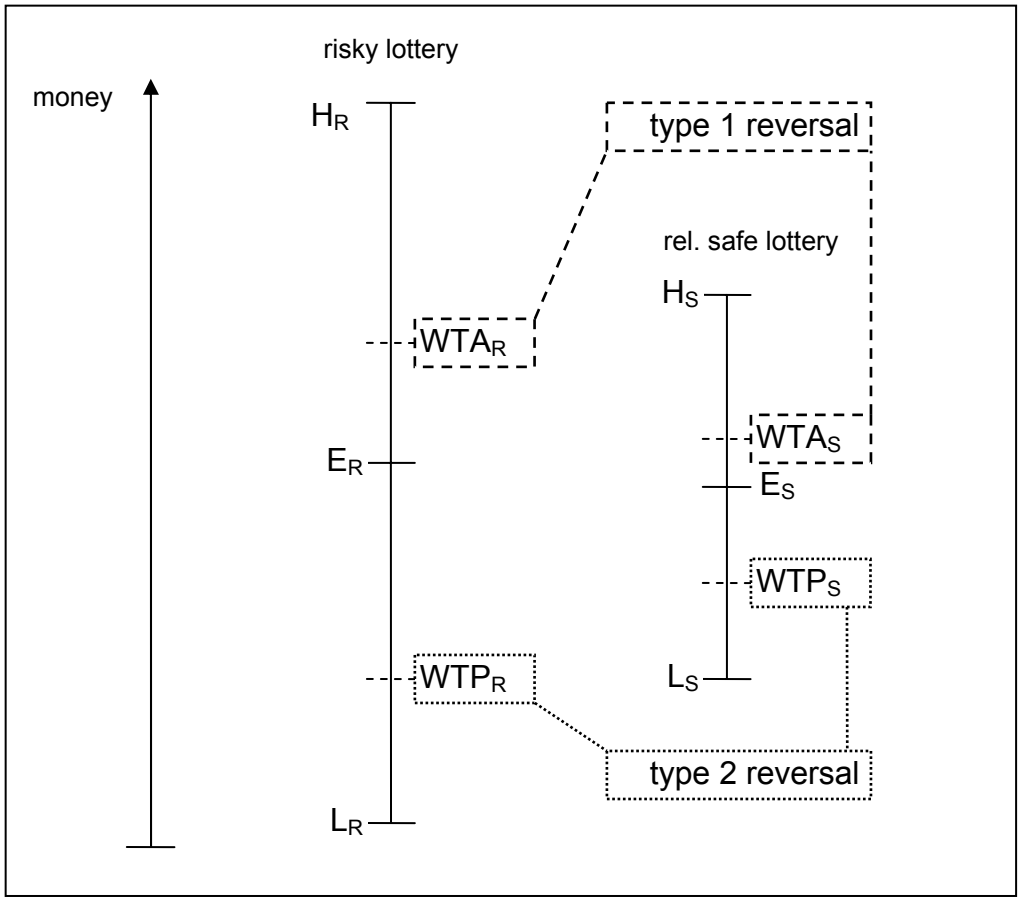

Figure 10: The endowment effect and preference reversal

Consider Figure 10: The scale is one-dimensional, with money in the vertical axis. Two lotteries are described. The left-hand lottery is the more risky lottery with a larger variation between the highest possible prize H_R and the lowest possible prize L_R. The expected value is E_R. The lottery at the right-hand side is less risky and therefore termed "relatively safe" lottery, with the payoff variation between highest prize (H_S) and lowest

prize (L_S) smaller. The lottery is chosen such that it offers a slightly lower expected value E_S, such as to make individuals on average indifferent when choosing between the two lotteries (i.e. they are willing to accept a lower expected value for an increase in safety – the certainty equivalents of the two lotteries are considered to be identical). In most preference reversal experiments, the risky and the relatively safe lotteries are indeed created such that roughly half of the subjects in the choice condition choose the risky, and the other half the relatively safe lottery.

Now consider the predictions of the endowment effect theories mentioned above: An increase in risk drives WTA and WTP further apart. It is straightforward to see that this leads to two different outcomes in the two pricing conditions:

1. WTA: $WTA_R > WTA_S$: In the selling treatment, the risky lottery is priced higher than the relatively safe lottery.
2. WTP: $WTP_R < WTP_S$: In the buying treatment, the relatively safe lottery is priced higher than the risky lottery.

The first result corresponds to the "type 1 reversal", where those who prefer the relatively safe lottery in choice price the risky lottery higher, and is consistent with the fact that for WTA, this pattern is indeed observed, while "type 2 reversal" almost never occurs for WTA.

The second result corresponds to the reversed pattern of "type 2 reversal", where those who prefer the risky lottery in choice price the relatively safe lottery higher. Yet, as outlined above, the empirical evidence indicates that this is pattern is *not always* dominating for WTP. The evidence of "type 1 reversal" dominating under some circumstances for WTP is contradicting the second statement.

The endowment effect theories can explain the traditional pattern of type 1 reversal for selling (WTA), as did the older theories. They add an explanation of the new pattern of type 2 reversals for buying (WTP). They cannot account for type 1 reversal in buying. Our theory will fill this gap by predicting both types of reversal correctly.

[45] "Entia non sunt multiplicanda praeter necessitatem" (entities are not to be multiplied beyond necessity). Attributed to the Oxford Franciscan scholasticist William of Ockham (1285-1349).

III. Test & Calibration of own Model

The purpose of this section is to show that our model can account for all instances of type 1 and 2 reversals encountered so far.

A detailed description of the model that we will test here can be found in Chapter 1. Here, only the model formulation and the predictions are given.

Model Formulation

The model builds on the central principles of Prospect Theory (Kahneman and Tversky, 1979) that are extended in the following way:

1. The current wealth level functions as a *reference point*, i.e. all outcomes are evaluated as changes in comparison to this point.
   Extension: The current risk of the assets in possession is also taken into this reference point, creating a second form of risk aversion: *aversion to risk changes* (representing the principle of "erring on the side of caution").

2. *Probability-weighting* is used instead of utility being linear in probabilities.
   Extensions: "Constant joy of gambling" (see below), leading to
   a) Over-weighting of low probabilities decreases when payoffs become larger.
   b) Probability-weighting stronger in pricing than in choice (see below).

In order to test the model, we have to specify a parametric and well-defined utility/value function out of the class of possible functions. We choose the function yielding the *certainty equivalent* to be the utility function at the same time.

There are four different forms of certainty equivalent, of which we specify three:

1. Equivalent gain (EG) – direct choice between lotteries. Definition: An individual is indifferent between receiving the sure amount EG and the lottery (specification follows below).

2. Equivalent loss (EL) – direct choice between lotteries. Definition: An individual is indifferent between giving up the sure amount EL or the lottery: here unspecified (as empirical results are lacking).

3. Willingness-to-pay (WTP). Definition: The individual is indifferent between buying the lottery for WTP and doing nothing. Specification: $WTP = E - r - c$

4. Willingness-to-accept (WTA). Definition: The individual is indifferent between selling the lottery for WTA and doing nothing. Specification: $WTA = E - r + c$

From which follows: $WTA - WTP = 2c$, $c = (WTA - WTP)/2$; $r = E - (WTA+WTP)/2$

E: expected value of lottery

c: gap parameter of "aversion to risk changes", positively dependent on the risk of the lottery (specification below).

r: conventional risk aversion, depends differently on the risk of the lottery, including payoff-dependent over-weighting of low probabilities (specification below).

Hypotheses:

1. The gap between WTA and WTP increases with the risk (payoff variation) of a lottery.
2. If the probability of winning and stake to be won are small, people show risk-seeking behavior.
3. The variation of WTA and WTP responses predicted by our model are sufficient to explain different types of preference reversal.

Data

The experimental data to be explained comes from experiments run by Blondel and Lévy-Garboua (2005), investigating at the same time the endowment effect for lotteries and preference reversal. Summary statistics of their experimental results are given in Table 16.

Table 16: Endowment effect for lotteries / preference reversal.

(Data in columns 1-4 and 7-8 from Blondel and Lévy-Garboua, 2005)

Column:	1	2	3	4	5	6	7	8
No.	stake (€); win probability	Expected Value	Mean WTA (n=32)	Mean WTP (n=30)	*r*	*c*	Selling: type 1 rev.	Buying: type 1 rev.
$1	10; .8	8.0 €	7.1 €	4.1 €	2.4 €	1.5 €	49	-2
P1	8; .95	7.6 €	6.6 €	4.5 €	2.1 €	1.1 €		
$2	10; .7	7.0 €	6.6 €	3.2 €	2.1 €	1.7 €	69	-13
P2	7; .95	6.7 €	5.9 €	3.9 €	1.8 €	1.0 €		
$3	10; .6	6.0 €	6.0 €	2.9 €	1.6 €	1.6 €	50	-9
P3	6; .95	5.7 €	5.1 €	3.4 €	1.5 €	0.9 €		
$4	10; .5	5.0 €	5.5 €	3.0 €	0.8 €	1.3 €	74	13
P4	5; .95	4.8 €	4.4 €	2.7 €	1.2 €	0.9 €		
$5	10; .4	4.0 €	4.6 €	2.6 €	0.4 €	1.0 €	62	28
P5	4; .95	3.8 €	3.5 €	2.1 €	1.0 €	0.7 €		
$6	10; .3	3.0 €	4.0 €	2.2 €	-0.1 €	0.9 €	77	60
P6	3; .95	2.9 €	2.7 €	1.4 €	0.3 €	1.2 €		
$7	10; .2	2.0 €	3.5 €	1.5 €	-0.5 €	1.0 €	69	89
P7	2; .95	1.9 €	2.0 €	0.9 €	0.5 €	0.6 €		
$8	20; .4	8.0 €	8.3 €	3.5 €	2.1 €	2.4 €	42	-20
P8	8, .9	7.2 €	6.4 €	4.1 €	2.0 €	1.2 €		
$9	20; .3	6.0 €	6.8 €	2.9 €	1.2 €	2.0 €	82	-11
P9	6, .9	5.4 €	4.7 €	3.4 €	1.4 €	0.7 €		
$10	20; .2	4.0 €	6.0 €	2.6 €	-0.3 €	1.7 €	81	23
P10	4, .9	3.6 €	3.2 €	1.9 €	1.1 €	0.7 €		
$11	20; .1	2.0 €	4.7 €	1.6 €	-1.2 €	1.6 €	78	58
P11	2, .9	2.7 €	1.9 €	0.7 €	1.4 €	0.6 €		
$12	30; .2	6.0 €	8.2 €	3.1 €	0.4 €	2.6 €	52	7
P12	7; .8	5.6 €	5.4 €	2.9 €	1.5 €	1.3 €		
$13	30; .1	3.0 €	7.3 €	2.1 €	-1.7 €	2.6 €	80	61
P13	3; .8	2.4 €	2.7 €	1.3 €	0.4 €	0.7 €		
$14	40; .2	8.0 €	11.2 €	3.6 €	0.6 €	3.8 €	71	8
P14	9; .8	7.2 €	6.4 €	3.8 €	2.1 €	1.3 €		
$15	40; .1	4.0 €	9.6 €	2.5 €	-2.1 €	3.6 €	81	34
P15	4,5; .8	3.6 €	3.6 €	1.6 €	1.0 €	1.0 €		
Mean, $-lotteries		5.1 €	6.6 €	2.8 €	0.37 €	1.93 €		
Mean, P-lotteries		4.7 €	4.4 €	2.6 €	1.26 €	0.90 €		
Overall Mean		4.9 €	5.6 €	2.7 €	0.8 €	1.4 €	68	22

Blondel and Lévy-Garboua used 30 different lotteries. The properties of the lotteries – probability of winning and amount to be won - are given in column 1 (with the remaining probability, nothing was won). The lotteries were created to form 15 pairs, each

pair consisting of one relatively risky ($) and one relatively safe (P) lottery. The 15 lotteries with low/medium winning probabilities (0.1 to 0.8) are classified as risky/$-lotteries, while the 15 lotteries with high winning probability (0.8 to 0.95) are classified as relatively safe/P-lotteries.[46] Column 2 shows the expected value of the lotteries. The lottery pairs were constructed such that in the latter choice condition, roughly half of the subjects would choose the relatively safe/P lottery and half would choose the risky/$ lottery. This leads to slightly lower expected value of the relatively safe/P-lotteries due to conventional risk aversion.

Columns 3 and 4 show the mean answers of two different groups of subjects. One group (n=32) answered in the selling condition, while the other group (n=30) answered in the buying condition (both with the incentive compatible BDM-mechanism, see above). It is straightforward to see that the endowment effect is confirmed with mean WTA-answers being much larger than mean WTP-answers. For every lottery, WTA is significantly higher ($p<0.05$) than WTP.

Column 5 and 6 give the two parameters of our model, calculated directly from the aggregated data: The risk aversion parameter [r=E-(WTP+WTA)/2] and the gap parameter [c=(WTA-WTP)/2, giving half of the gap]. Both parameters are significantly different in the two groups[47]:

- For the risky lotteries, the gap is more than twice as large as for the relatively safe lotteries ($p<0.01$).
- Absolute (conventional) risk aversion is more than three times larger for the relatively safe than for the risky lotteries! ($p<0.05$[48])

While the first statement is consistent with the endowment effect theories mentioned above, the second statement might be surprising at first sight. Closer inspection shows that it stems mainly from some risk premia being *negative*, indicating risk-seeking behavior. This is consistent with over-weighting of low probabilities.

The results of the preference-reversal experiments are given in Table 16, columns 7 and 8. In addition to pricing the different lotteries, subjects had to make choices be-

[46] One lottery ($1) with p=0.8 is classified as risky/$, while the other lotteries with p=0.8 (P12-P15) are classified as safe/P due to the pairwise setting of the authors. This categorization is kept here and should make comparing the means of the two groups more difficult (i.e. less significant differences).
[47] Two-tailed t-tests for different variances.
[48] For difference of means.

tween the $ and P lottery of every pair. The resulting choice preference was then compared to the preference that followed from comparing the stated prices. As there were two different pricing conditions (selling treatment: giving WTA and buying treatment: giving WTP), there are also two different rates of preference reversal for every pair of lotteries.

As described above, there are two possible directions for such a preference reversal: "type 1 reversal": This counts the percentage of those who choose the relatively safe/P bet, but priced the risky/$ bet higher. "Type 2 reversal" counts those who choose the risky/$ bet, but price the relatively safe/P bet higher. Both percentages can be combined as "Rate of type 1 minus rate of type 2 reversals" to give an indication which pattern, if any, dominated in one setting. This is the number given in column 7 for the selling treatment/WTA and in column 8 for the buying treatment/WTP (Table 16). A high positive number means that type 1 strongly dominated, while a negative number means that the rate of type 2 reversal was actually higher than the rate of type 1 reversal.

Over all settings, type 1 reversal dominates in the WTA condition (mean of 68 percentage points more type 1 than type 2), while this dominance is much weaker for WTP (mean of 22 percentage points more type 1 than type 2). The difference between WTA and WTP setting is significant ($p<0.01$). The fact that the variance in the WTP setting is much larger corresponds to the observation that there are both kinds of results for WTP: type 1 reversal dominating strongly (e.g. in set 7) and type 2 reversal dominating weakly (e.g. in set 8).

A first fruitful way to predict this variation is by looking at the probability of winning in the risky $-bet: The smaller the probability, the more "over-weighting of small probabilities" becomes important. Its influence seems to strike in pricing much more than in direct choice between the lotteries. In addition, it seems to be stronger for smaller stakes (10 €) than for larger stakes (20, 30 and 40 €). Figure 17 to Figure 19 in the appendix provide an overview of how this helps in predicting preference reversal. The relation between this effect and the dominance of type 1 reversal is particularly strong for the two WTP settings: Over-weighting of low probabilities will be used in determining our risk-aversion parameter *r*.

Model Testing / Estimation of Parameters

A first overview over the relation between the WTA-WTP-gap and the characteristics of the lotteries can be gathered from Figure 11 and Figure 12. The gap increases with the payoff variation (Figure 11) and decreases with probability (Figure 12).

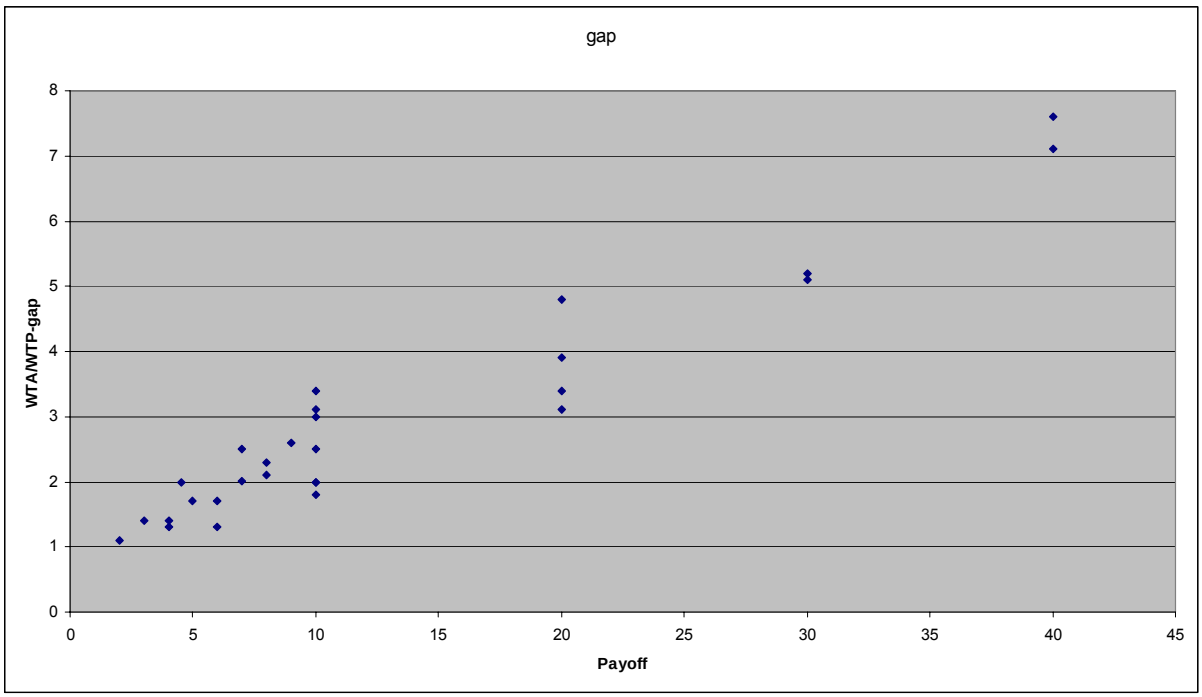

Figure 11: Relation between payoff and WTA-WTP-gap

[49] At least 90 % of the endowment effect experiments listed in chapter 1 follow this design. Exceptions are Harless (1989) and Brown (2005) who elicit both WTA and WTP from every subject.

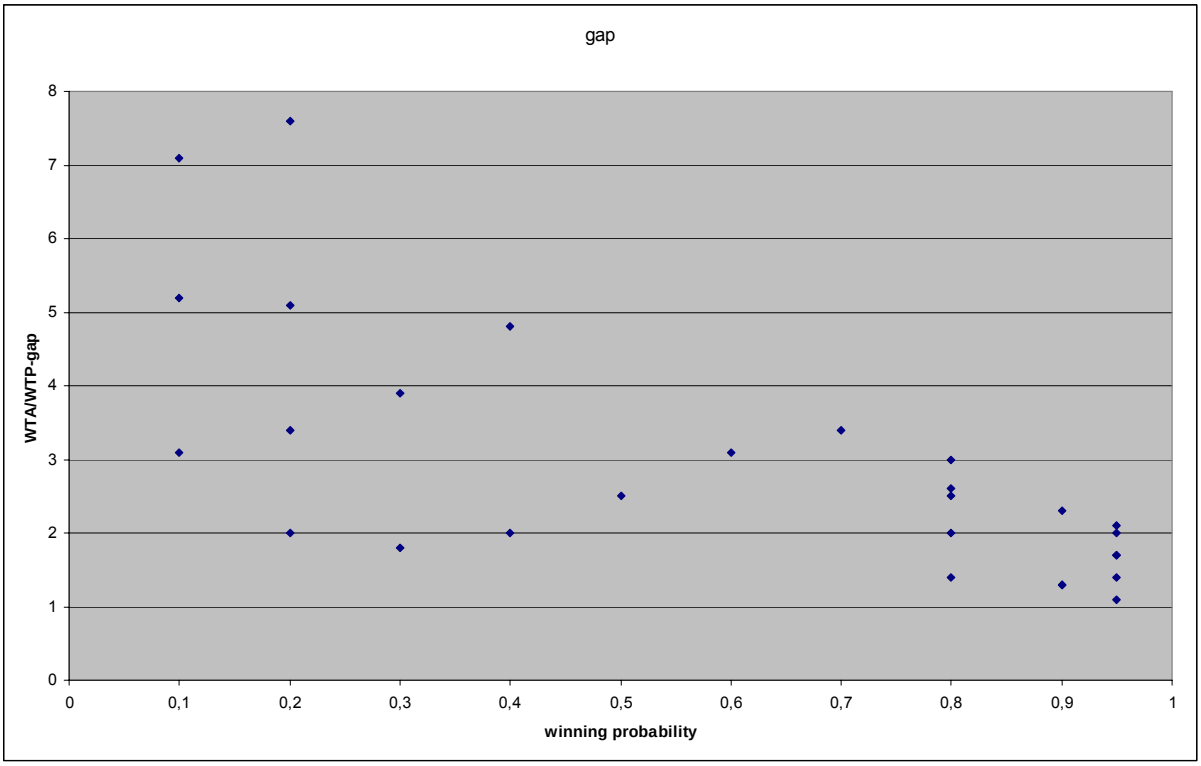

Figure 12: Relation between winning probability and WTA-WTP-gap

Gap parameter ***c***

Notation: Lottery: *(H, p; L, p-1) H* – high payoff, *L* – low payoff (here always = 0).

The prediction of our model is that *c* varies with the uncertainty of the lottery, i.e. mainly the payoff variation *H-L* (here =*H*). A simple linear form would be:

$$\text{Specification 1: } c_{ij} = \beta_{1i} + \beta_{2i}H + \varepsilon_{ij} \qquad (23.)$$

with $i=1\ldots n$ denoting individuals (buying group: n=30, selling group: n=32) and $j=1\ldots 30$ denoting lotteries.

In contrast to the formulation of the model in chapter 1, lotteries are not exclusively in the form of 50-50 gambles here. This allows checking for dependence of c on the winning probability *p*.

To refine the prediction of *c*, we include the winning probability *p* and its quadratic term p^2:

$$\text{Specification 2: } c_{ij} = \beta_{1i} + \beta_{2i}H_j + \beta_{3i}p + \beta_{4i}p^2 + \varepsilon_{ij} \qquad (24.)$$

*Conventional Risk Aversion **r** & Probability Overweighting*

The parameter *r* of absolute risk aversion is defined as:

$r = E - CE,$

with CE: certainty equivalent of a lottery, either equivalent gain, equivalent loss, WTA or WTP.

As the difference between the measured certainty equivalent in buying and selling is already measured by the gap parameter *c*, we can assume that the remaining risk aversion is equal in both occasions, while the risk aversion in the choice occasion (equivalent gain) is seen to follow another process (making no statement about equivalent loss here).

A central element in determining the risk aversion in pricing is *over-weighting of low probabilities:*

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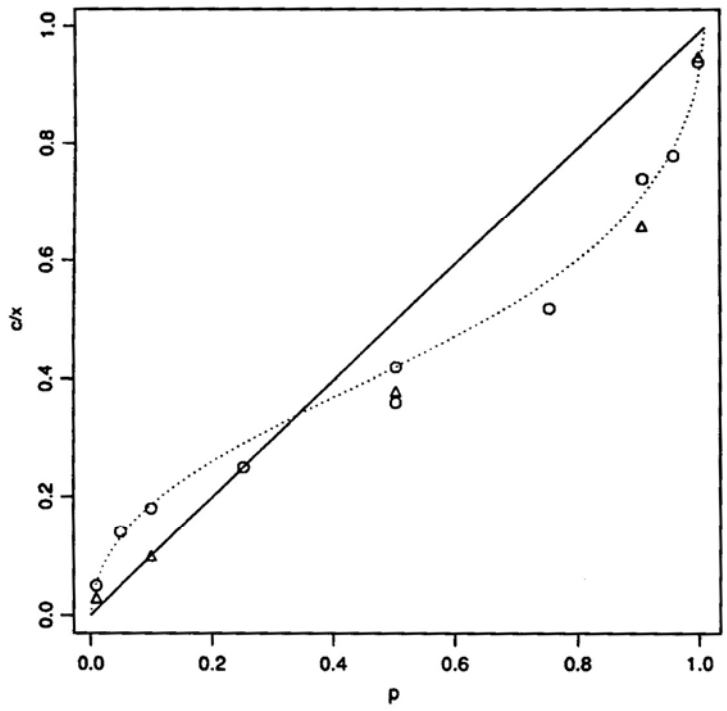

Figure 3.1. Median c/x for all positive prospects of the form $(x, p; 0, 1-p)$. Triangles and circles, respectively, correspond to values of x that lie above or below 200.

Figure 13: Overweighting of low probabilities
(Tversky and Kahneman, 1992, p. 57)

Prospect Theory (Kahneman and Tversky, 1979) states that individuals show risk-seeking behavior towards lotteries with low winning probabilities (0.25 or below): People indicate certainty equivalents for these lotteries that are *higher* than the expected values of the lotteries.

The evidence (e.g. in Tversky and Kahneman, 1992) stems from experiments where subjects had to indicate preferences over lotteries and fixed amounts on a computer screen, narrowing down to a single amount at which the subjects were indifferent between receiving the fixed amount or the lottery. The over-weighting of small probabilities decreases if payoffs are increased, reaching risk-neutrality for payoffs of $200 and above.

For near-certain events (probability around 0.9), individual valuation is most depressed in comparison to the expected value. When rising from impossibility to possibility (from 0 to >0) and from near-certainty to certainty (from <1 to 1), valuations increase more than when intermediate probabilities are increased. This leads to the S-shaped probability-weighting function of Prospect Theory (see Figure 13).

The evidence of the preference reversal in Table 16 strongly indicates that for pricing, overweighting of low probabilities is much more pronounced than for choice.

We make here two adaptations to the concept of probability-overweighting:

1. Probability-overweighting is more important in pricing than in choice.
2. Probability-overweighting is more important for small than for large payoffs.

The first property is consistent with a view that probability-overweighting is connected with the avoidance of losses, that are only possible in buying and selling. A concept of "constant joy of gambling" would say:

- general principle: People are especially unwilling to carry a risk if this involves a possible loss in comparison to the status quo.
- exception: if the winning probability is low, people are more willing to carry the risk of losing a small amount of money and the chance to win a comparably large amount of money – risk-taking might be seen here as something good (bringing a certain "constant joy of gambling", that loses its relative importance as payoffs grow larger).

For testing the model, we will make the following simplifying assumptions:

1. No probability-overweighting in choice (equivalent gain).

2. No concavity in the utility/value function in buying and selling.

The second assumption is due to the size-dependence of probability-overweighting. Having concavity (decreasing sensitivity to gains) at the same time as probability-overweighting already poses problems for estimating the parameters (cf. Tversky and Kahneman, 1992, p. 59). If one introduces size-dependence of probability-overweighting, this problem increases. Therefore, concavity is abandoned here.

Notation: Following Prospect Theory, utility U is calculated as follows:

$$U(H, p; L, 1\text{-}p) = w(p)v(H) + w(1\text{-}p)v(L), \qquad (25.)$$

with v(.) being the wealth-utility function and w(.) being the probability-weighting function.

Choice:

In direct choice between two lotteries, let w(p)=p (so there is no probability-weighting) and $v(x)=x^{\alpha}$. The utility in the choice setting is then given by the *equivalent gain*:

$$EG = [pH^{\alpha} + (1-p)L^{\alpha}]^{1/\alpha} \qquad (26.)$$

Fitting to the data: The results of the direct choice treatment are not shown here, as the pairs have been constructed such that roughly half of the subjects choose the P and half choose the $ lottery. Over all treatments, on average 47 % of the subjects choose the P lottery. No systematic changes in preference can be observed even for lower winning probabilities in the $-lottery, indicating that probability-overweighting is weak (see also Figure 20 in the appendix).

A value of α that leads to utility/equivalent gain for $ slightly higher in all pairs than for P is 0.95 (slightly higher than 0.88 proposed by Tversky and Kahneman, 1992, p.59).

Pricing

For buying and selling decisions, we assume v(x)=x (linear value function).

So in pricing we have

$$EG=w(p, H)H + w(1-p, L)L \qquad (27.)$$

As in this experiment, we have L=0 (low payoff = zero), the last part vanishes.

This simplification of a linear value function allows more detailed estimation of w(p, H). Indeed, probability-weighting can be used to model small- and medium-scale risk aversion.

For *r*, we get:

$$r = E - CE = pH - w(p,H)H \Leftrightarrow r/H = p - w(p, H) \qquad (28.)$$

Prospect Theory assumes a formulation of probability-overweighting that is not well-suited for size-dependence, so we recur to a linear-quadratic form:

$$r_{ij}/H_j = \delta_{1i} + \delta_{2i}\, p_j + \delta_{3i}\, p_j^2 + \delta_{4i}\, H_j + \delta_5\, H_j^2 + \varepsilon'_{ij} \qquad (29.)$$

We will now try to test our model and to estimate the parameters *c* and *r*.

We use the following regressions in order to estimate the parameters:

Individual regressions

For the buying group (n=30) and the selling group (n=32), we run one regression for every individual.

As for every individual, only WTA or WTP is known for a lottery, the *individual* regressions have to recur to the average price answer of the other group:

Buying group: $c_{ij}=(WTA_j-WTP_{ij})/2$. and $r_{ij}=E_j-(WTA_j+WTP_{ij})/2$

With $WTA_j=\frac{1}{n}\sum_{i=1}^{n}WTA_{ij}$ the mean of the other (selling) group, E_j: expected value of lottery *j*. Correspondingly for the selling group:

$c_{ij}=(WTA_{ij}-WTP_j)/2$ and $r_{ij}=E_j-(WTA_{ij}+WTP_j)/2$

In order to find single parameters, we aggregate the results from the individual regressions. Table 17, Table 18 and Table 19 present the results. In each group, we aggregate the coefficients and p-values (for robust standard errors) of these regressions to the medians and means for the buying group (column 7 and 8, standard errors of this aggregation to mean: column 9) and the selling group (columns 12-14). Additionally, we weight the coefficients of the individual regressions with (1-"p-value"). The weighted mean coefficients of the individual regressions for the buying and selling group can be found in column 10 and 16. As an indication of significance of the coefficients in the individual regressions, columns 11 and 16 display in how many of the individual regressions the coefficient significant at the 5 %-level. For every parameter, we get 6 different estimates, resulting from 62 individual regressions (so 186 regressions altogether).

Regressions with aggregated data:

Columns 1-6 show the results of different regressions with take the data for the dependent variables *c* and *r* from the following sources:

- 1: Buying group – average parameters (c_j , r_j) for each lottery calculated from individual *c*s: $c_j=\frac{1}{n}\sum_{i=1}^{n}c_{ij}$ and the same for *r*.

- 2: Buying group – median 2: median individual c_j and r_j for every lottery j.
- 3: Selling group – average parameters c_j and r_j as above.
- 4: Selling group – median individual c_j and r_j for every lottery j.

For the aggregate specifications 5 and 6, c_j and r_j are calculated directly from aggregated WTA and WTP answers:

- 5: $c_j=(WTA_j-WTP_j)/2$, $r_j= E_j-(WTA_j+WTP_j)/2$ with mean WTA and WTP answers.
- 6: as in 5, but with median WTA and WTP answers.

Altogether, we therefore have 12 estimates for every parameter (6 aggregated from the individual regressions and 6 from regressions with aggregated data). As we run two different specifications for c and one specification for r, this leads to 36 estimates altogether (resulting from 204 regressions).

Results

Table 17, Table 18 and Table 19 show the resulting parameter estimates (p-values are for robust standard errors). In order to include all specifications into the final judgements of parameter estimates, we have calculated confidence intervals for every parameter, given the 12 different parameter estimations. Mean and median parameters are shown in columns 17 and 18. Columns 19 and 20 show upper and lower bounds of the 5 %-confidence interval, given this sample of 12 parameters.

The simple specification of c (Table 17) shows a significant influence of the payoff H with the parameter lying between 0.061 and 0.078. The mean coefficient of 0.069 shows that, when the payoff variation[50] is increased by 1 €, the WTA-WTP-gap (=2c) increases by approximately 0.14 € (1 · 0.069 · 2 = 0.138 €).

This second specification of c shows that, although p and p^2 are significant at 5 % in less than half of the individual regressions, the adjusted R^2 increases in the aggregate and individual regressions (from means of 80 % - aggregate – and 56 % - individual – to

[50] Here corresponding simply to the payoff H, as the low payoff L=0.

89 % and 71 %). In the sample of 12 parameter estimates, all mean parameters are significantly different from zero.

Result 1: The risk of a lottery, expressed as a low winning probability and a high payoff variation, has a strong positive influence on the WTA-WTP-gap.

Result 1 confirms our hypothesis 1 stated above.

Table 17: Estimation of gap parameter *c* (specification 1)

Column no:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Aggregated data						Ind. Reg., Buying group, n=30					Ind. Reg., Selling group, n=32					Aggregation over estimates			
	Buy mean	Buy med	Sell mean	Sell med	mean	med	med	mean	*std err*	swted	*sig05*	med	mean	*std err*	swted	*sig05*	mean	median	cf(up)	co(low)
H	0.076	0.08	0.076	0.043	0.076	0.047	0.077	0.076	*0.005*	0.077	*27*	0.047	0.076	*0.017*	0.083	*20*	0.069	0.076	0.078	0.061
p-values	*0*	*0*	*0*	*0*	*0*	*0*	*0.000*	*0.015*	*0.009*			*0.003*	*0.095*	*0.036*			*0.011*	*0.000*	*0.030*	*-0.007*
Constant	0.462	0.508	0.462	0.739	0.462	0.785	0.458	0.462	*0.084*	0.511	*25*	0.602	0.464	*0.152*	0.516	*23*	0.536	0.486	0.600	0.471
p-values	*0*	*0*	*0*	*0*	*0*	*0*	*0.000*	*0.107*	*0.047*			*0.001*	*0.110*	*0.040*			*0.022*	*0.000*	*0.050*	*-0.007*
Observ.	30	30	30	30	30	30	30	30				30	30				30	30.000		
R^2 (agg.)	0.9	0.927	0.9	0.557	0.9	0.617											0.800	0.900	0.933	0.667
R^2 (ind.)							0.784	0.716	*0.043*			0.344	0.387	*0.049*			0.558	0.551	0.778	0.338

Table 18: Estimation of gap parameter *c* (specification 2)

Column no:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Aggregated data						Ind. Reg., Buying group, n=30					Ind. Reg., Selling group, n=32					Aggregation over estimates			
	Buy mean	Buy med	Sell mean	Sell med	mean	med	med	mean	*Std err*	swted	sig05	med	mean	*std err*	swed	sig05	mean	mdn	cf(up)	cf(low)
H	0.099	0.099	0.099	0.078	0.099	0.078	0.101	0.099	*0.005*	0.100	28	0.076	0.099	*0.017*	0.107	26	0.094	0.099	0.100	0.089
p-values	*0*	*0*	*0*	*0*	*0*	*0*	*0.000*	*0.007*	*0.005*			*0.005*	*0.086*	*0.036*			*0.010*	*0.000*	*0.027*	*-0.007*
p	3.723	3.12	3.702	5.764	3.702	5.162	4.405	3.723	*0.668*	4.367	17	3.309	3.721	*0.658*	4.758	14	4.121	3.723	4.567	3.676
p-values	*0*	*0.001*	*0*	*0*	*0*	*0.001*	*0.028*	*0.163*	*0.047*			*0.122*	*0.306*	*0.054*			*0.062*	*0.001*	*0.127*	*-0.002*
p^2	-2.661	-2.256	-2.643	-4.138	-2.643	-3.735	-2.758	-2.661	*0.547*	-3.036	16	-2.576	-2.657	*0.699*	-3.490	13	-2.938	-2.661	-2.622	-3.253
p-values	*0*	*0.002*	*0*	*0*	*0*	*0.003*	*0.014*	*0.136*	*0.040*			*0.187*	*0.319*	*0.060*			*0.066*	*0.003*	*0.135*	*-0.003*
Constant	-0.835	-0.558	-0.83	-1.254	-0.83	-0.976	-0.882	-0.835	*0.150*	-1.084	16	-0.778	-0.834	*0.317*	-0.998	9	-0.891	-0.835	-0.793	-0.989
p-values	*0.002*	*0.023*	*0.002*	*0.004*	*0.002*	*0.031*	*0.028*	*0.250*	*0.057*			*0.259*	*0.369*	*0.061*			*0.097*	*0.025*	*0.183*	*0.011*
Observ.	30	30	30	30	30	30	30	30				30	30				30	30		
R^2 (agg.)	0.945	0.956	0.945	0.766	0.945	0.769											0.888	0.945	0.962	0.813
R^2 (ind.)							0.856	0.807	*0.034*			0.613	0.551	*0.038*			0.707	0.710	0.851	0.562

Table 19: Estimation of absolute risk aversion *r*

Column no:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Aggregated data						Ind. Reg., Buying group, n=30					Ind. Reg., Selling group, n=32					Aggregation over estimates			
	Buy mean	Buy med	Sell mean	Sell med	mean	med	med	mean	*std err*	swted	sig05	med	mean	*std err*	swed	sig05	mean	mdn	cf(up)	co(low)
H	0.009	0.008	0.009	0	0.009	0	0.008	0.009	*0.002*	0.011	14	0.001	0.009	*0.004*	0.015	8	0.007	0.009	0.010	0.005
p-values	*0.001*	*0.016*	*0.001*	*0.937*	*0.001*	*0.953*	*0.0785*	*0.236*	*0.057*			*0.392*	*0.400*	*0.057*			*0.302*	*0.157*	*0.533*	*0.070*
H^{2}*	0	0	0	0	0	0. 0	0.00	0.000	*0.00*	0.000	12	0.000	0.000	*0.000*	-0.00024	8	-0.00003	0.000	0.000	0.000
p-values	*0.009*	*0.043*	*0.009*	*0.458*	*0.009*	*0.608*	*0.084*	*0.246*	*0.055*			*0.281*	*0.358*	*0.056*			*0.210*	*0.165*	*0.343*	*0.078*
p	0.645	0.626	0.666	0.535	0.645	0.507	0.668	0.645	*0.053*	0.670	24	0.545	0.646	*0.083*	0.708	19	0.626	0.645	0.661	0.590
p-values	*0*	*0*	*0*	*0*	*0*	*0.001*	*0.001*	*0.061*	*0.023*			*0.021*	*0.121*	*0.035*			*0.020*	*0.000*	*0.046*	*-0.005*
p^{2}	-0.163	-0.152	-0.176	-0.167	-0.163	-0.145	-0.146	-0.163	*0.051*	-0.227	11	-0.157	-0.163	*0.068*	-0.224	5	-0.170	-0.163	-0.155	-0.186
p-values	*0.049*	*0.1*	*0.034*	*0.109*	*0.049*	*0.156*	*0.127*	*0.286*	*0.059*			*0.213*	*0.318*	*0.051*			*0.144*	*0.118*	*0.206*	*0.082*
Constant	-0.255	-0.235	-0.263	-0.116	-0.255	-0.099	-0.234	-0.255	*0.022*	-0.265	25	-0.139	-0.255	*0.060*	-0.328	12	-0.225	-0.255	-0.186	-0.264
p-values	*0*	*0*	*0*	*0.038*	*0*	*0.121*	*0.002*	*0.056*	*0.030*			*0.217*	*0.255*	*0.048*			*0.069*	*0.020*	*0.129*	*0.009*
Obs.	30	30	30	30	30	30	30	30				30	30				30	30		
R^{2}(agg.)	0.954	0.937	0.956	0.89	0.954	0.88											0.929	0.946	0.956	0.901
R^{2} (ind.)							0.868	0.828	*0.024*			0.773	0.766	*0.022*			0.809	0.800	0.856	0.761

**coefficient estimates for prize^{2} are so small that they were rounded to zero, although they are significant in most regressions.*

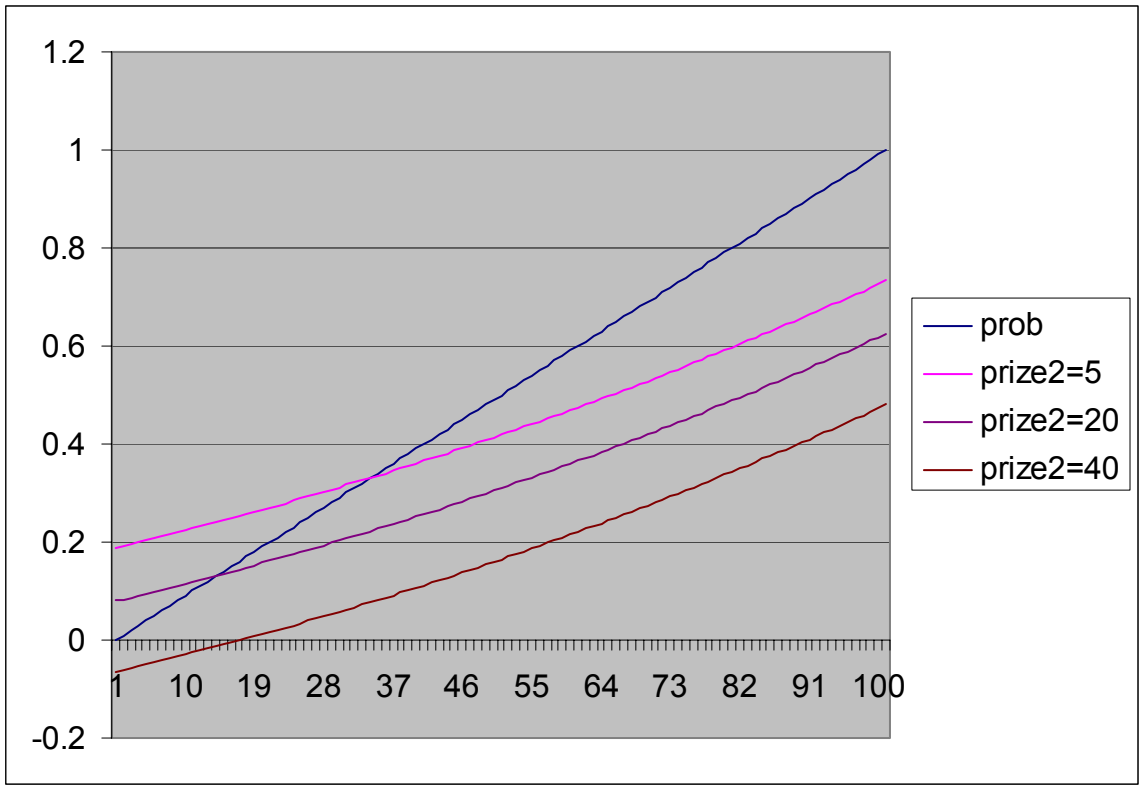

Figure 14: Probability-weighting in the estimation

[probability (horizontal) vs. probability-weight (vertical)]

Table 19 shows that the explanatory power of the regressions to calibrate *r* is both large (mean adjusted R^2 from aggregate regressions of 93 % and from individual regressions of 81 %) and all coefficients are highly significant. The resulting probability-weighting function can be seen in Figure 14 (plotted for different stakes from 5 € to 40 €). The function must be seen as discontinuous at p=0 and p=1 (where the corresponding weights are 0 and 1).

Result 2: The conventional risk aversion in buying and selling is strongly influenced by probability-overweighting that is weakening when payoffs grow larger.

Result 2 confirms our hypothesis 2 outlined above.

Predicting preference reversal

To predict the frequency of type 1 and type 2 reversal (expressed in "frequency of type 1 reversal minus frequency of type 2 reversal", as above), we first have to establish a relationship between the original pricing data and the preference reversal frequency. For the two reversals to happen, the following must be true:

Type 1 reversal: Choice: U(P)>U($) ⇔ Pricing: CE(P)<CE($)

Type 2 reversal: Choice: U(P)<U($) ⇔ Pricing: CE(P)>CE($)

The first part of both conditions is always true for roughly half of the participants, as the lotteries are designed such that the "average subject" is indifferent between the two lotteries of a pair, i.e. half of the subjects choose either of the two. Therefore, we can focus on the second part of both conditions. Keeping in mind that we are processing aggregate data (means), we can nevertheless predict the following tendencies:

1. No strong reversal if certainty equivalents (WTA and WTP) are equal for both lotteries of a pair (difference = 0).
2. If CE(P)<CE($) [CE(P)>CE($)], type 1 reversal [type 2 reversal] dominates. The larger the difference CE($)-CE(P) [CE(P)-CE($)], the more type 1 reversal [type 2 reversal] dominates.

The first statement can be verified for lottery pair 3 and 4, which have quite similar mean WTP answers and show neither strong dominance of type 1 nor type 2 reversal in the buying treatment.

To quantitatively test the second statement, it might be necessary to relate the difference in certainty equivalents to the expected value of the lotteries:

$$\textit{Relative valuation difference: } \frac{CE(\$) - CE(P)}{\frac{E(\$)+E(P)}{2}} \qquad (30.)$$

Figure 15 shows that this relative valuation difference bears a relatively strong relation with the type of preference reversal in the buying treatment: For a high relative valuation difference (i.e. the price for the risky lottery being much larger than the price for the relatively safe lottery), type 1 reversal strongly dominates. For the points to the right of the vertical axis, i.e. the price of the relatively safe lottery being higher, type 2 reversal dominates.

Figure 16 shows that the same relation exists for the selling treatment, yet appears to be weaker. Keep in mind, however, that the maximum score for "type of preference reversal" is 100, so the relationship has to be non-linear at some point.

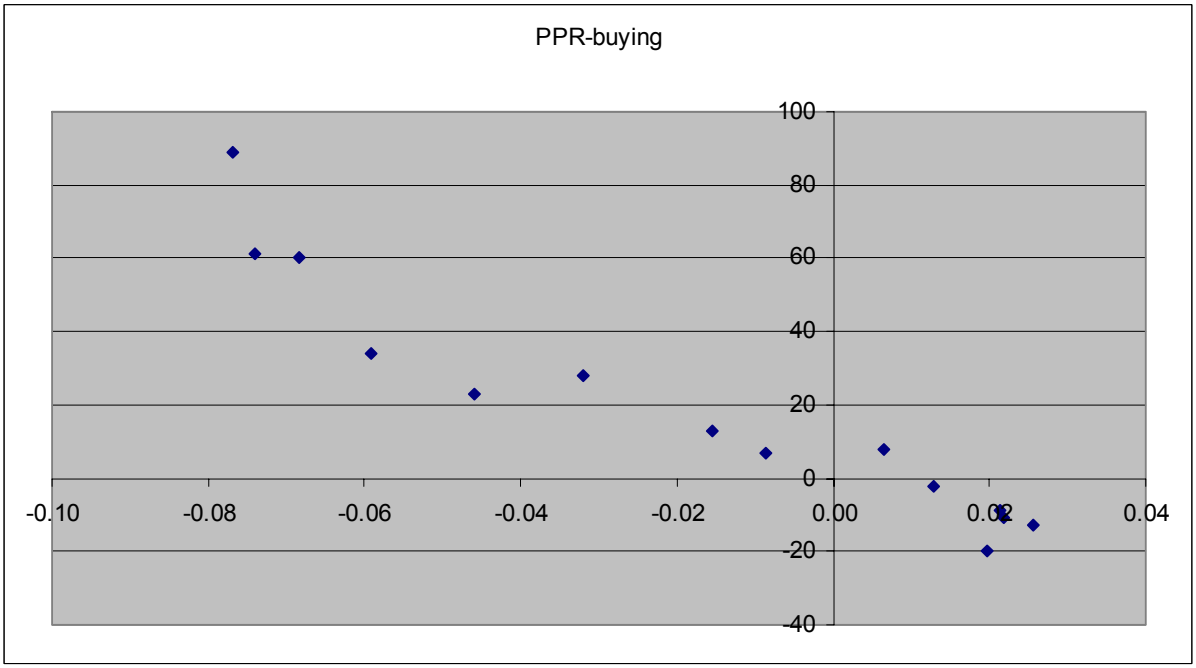

Figure 15: Preference Reversal in the buying treatment and the relative valuation difference

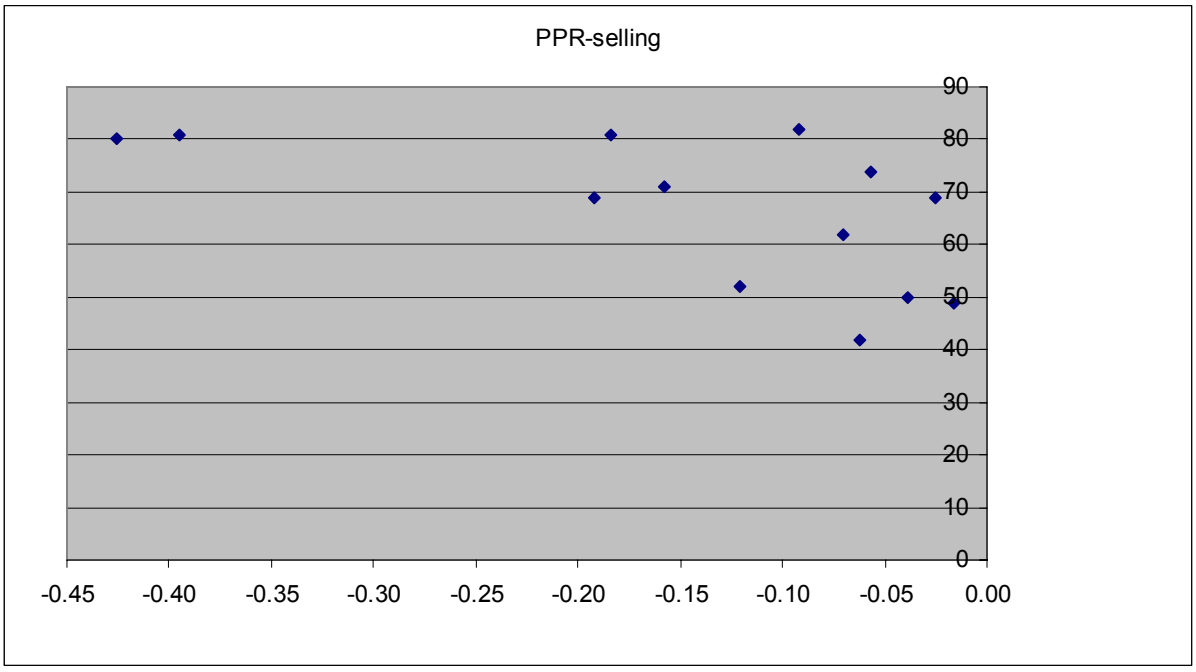

Figure 16: Preference Reversal in the selling treatment and the relative valuation difference

The pattern of type of preference reversal is the following:

- Selling treatment: Subjects on average indicate a much higher WTA for the $-lottery, type 1 reversal dominates in all lottery pairs.
- Buying treatment: For small payoffs and medium to small probability of winning in the $-lottery, subjects indicate larger WTP for the $- than for the P-lottery, leading to a domination of type 1 reversal.
- Buying treatment: The larger the payoffs and the higher the winning probability in the $-lottery, the more WTP($) is depressed in comparison to WTP(P). This leads to a decreasing frequency of type 1 reversal and a larger frequency of type 2 reversals.

Result 3: The differences in aggregate valuation can explain which type of preference reversal dominates.

Result 3 confirms our hypothesis 3 outlined above that the variation in WTA/WTP-answers is sufficient to generate a pattern that follows the path similar to the observed data of type of preference reversal.

Predictions for other settings:

The observation that was so far unexplained, that the use of the buying treatment and relatively large payoffs (such as used by Casey, 1991 and Schmidt and Hey, 2004) leads to "type 2" reversals, is consistent with the model: For small payoffs, probability-overweighting leads to WTP($)>WTP(P) (and therefore "type 1" reversals) despite the WTA-WTP-gap being larger for $. When payoffs grow larger, the importance of probability-overweighting decreases, leading to WTP($)<WTP(P) and type 2 ("unpredicted" or "reversed") preference reversal.

Hamm's (1979) payoffs seem to have been rather small[51], leading the model to correctly predict type 1 reversal strongly dominating, as well as in Casey's (1991) control setting with small payoffs.

[51] He mentions as a typical lottery: (8,50 US$, 0.3; -1.50 US$, 0.7; p. 85).

Conclusion

The preference reversal phenomenon has been observed in many experiments and consists of contradicting preferences measured directly, via a choice between two lotteries, and indirectly, via pricing of the same lotteries.

Anomalies like preference reversal or the endowment effect seem to challenge the economic assumptions of rational preferences. For these two anomalies, it seems nevertheless possible to stick to the transitivity assumption and therefore to rational preferences. An extension of the economic model that restores transitivity must account for different forms of evaluation in choice, buying and selling.

The preference reversal phenomenon could so far not be explained in its entirety. In particular, an explanation of different types of preference reversal observed when a buying treatment is used, has so far not been achieved. This paper links the preference reversal and endowment effect phenomena, showing that the insights won from the latter can help predicting the former.

The hypothesis of "aversion to risk changes" links the gap between maximum buy prices and minimum sell prices to the risk of the lotteries and takes size-dependent overweighting of small probabilities into account. The model successfully predicts the occurrence of both types of preference reversal and can therefore fill the explanatory gap left open by other endowment effect theories.

Appendix

Additional Figures and Tables

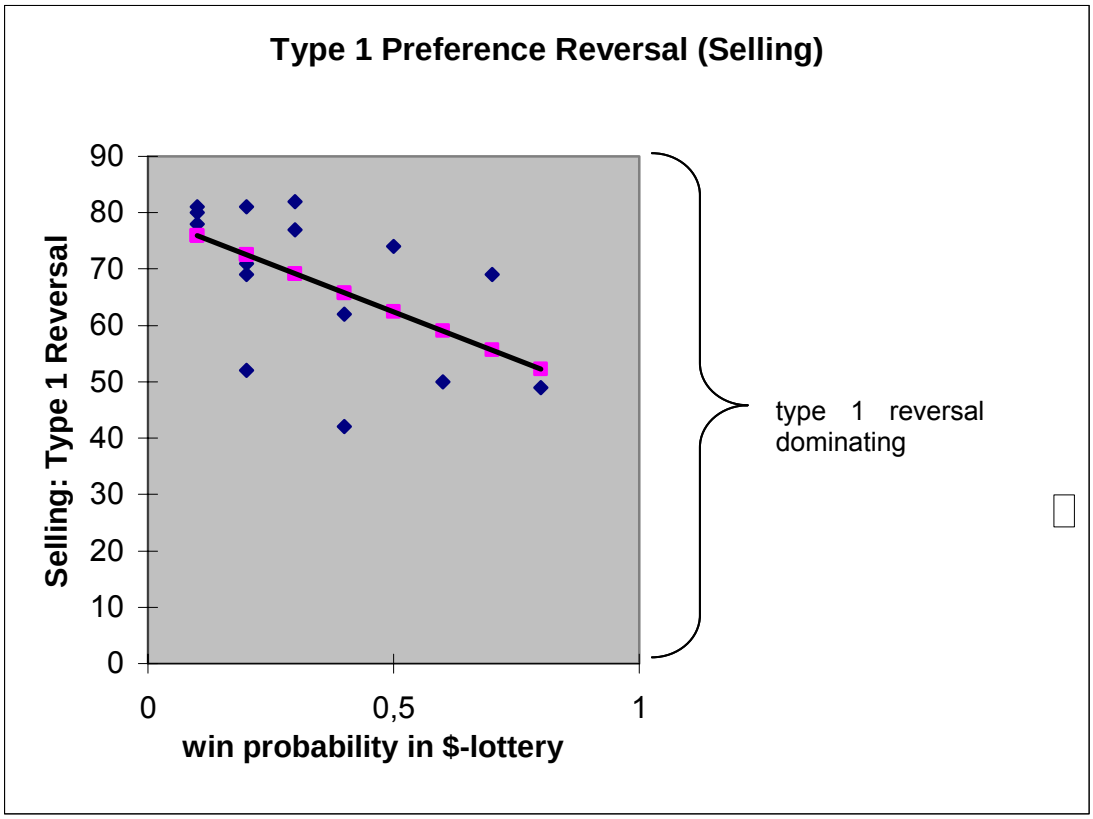

Figure 17: type 1 reversal for WTA and overweighting of low probabilities

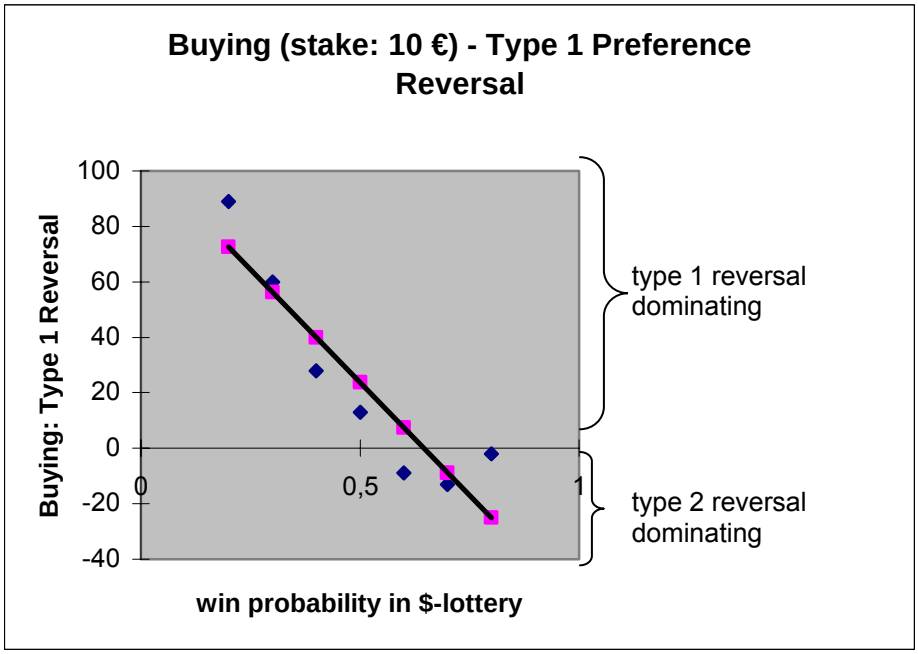

Figure 18: The move from „type 1 reversal" to "Type 2 reversal" for WTP (10 € stake)

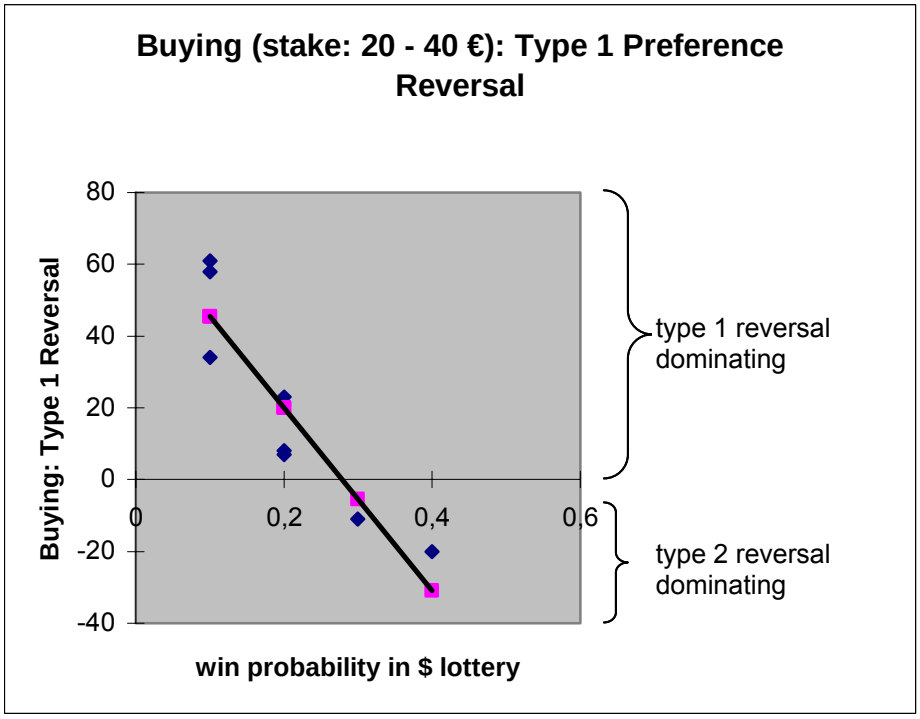

Figure 19: The move from "type 1 reversal" to "type 2 reversal" for WTP (20 - 40 € stake).

For a given probability, type 2 reversal is 35 percentage points more likely than for smaller stakes.

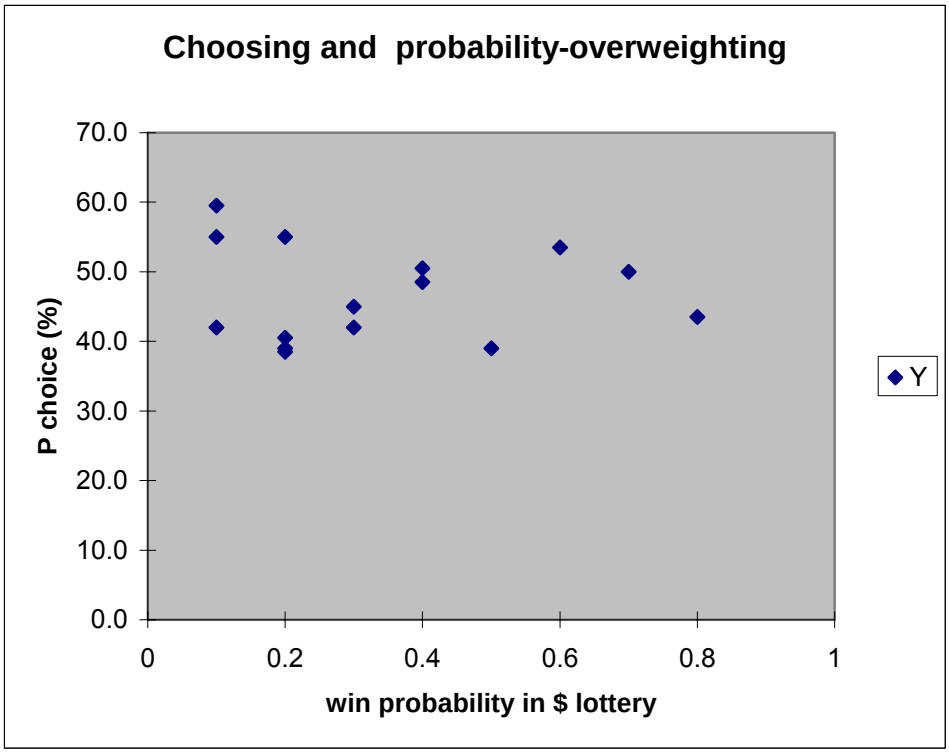

Figure 20: No significant correlation between the winning probability in $ and the choice preferences

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Joke: Intransitivity?

Say, what do you think is better, Spike, a cheese sandwich or complete happiness?"
"I'd say complete happiness, of course."
"Then you'd be wrong, my friend. You see, nothing is better than complete happiness, but a cheese sandwich is better than nothing. Logically, that means a cheese sandwich is better than complete happiness."
"Eh, that's logic?"
"So it is, Spike, so it is."
(From an old comedy sketch)

Chapter 3:

The WTA-WTP-gap in Contingent Valuation Studies

Abstract: A large body of evidence confirms that the difference between willingness to accept (WTA) and willingness to pay (WTP) measured in surveys with the contingent valuation method is much larger than in experiments with real transactions. A survey with 60 respondents about improving water quality in the Isar River sheds light on the reasons for the discrepancy that has so far not been well understood.

The survey confirms our hypothesis that, in the WTA-style question, respondents do not take the proposed money transaction from the government to them as a real possibility. Therefore, instead of reporting their "true economic preferences", they answer as in an opinion poll, with the answers on a monetary scale. As most people can be assumed to be in favour of ameliorating public goods, these answers are quite large and can even be infinite, if respondents want to express their general support for the cause.

In the WTP-style question, in contrast, respondents do not completely disregard the possibility of having to make a future payment connected to the cause. Therefore, their answers are closer to their "true economic preferences". Reasonable doubt remains that even the WTP answers are useful input for policy decisions or damage litigation. Expert advice and rule-based damage assessment seem more reliable alternatives.

Keywords: Contingent Valuation Surveys, WTA-WTP-gap, Endowment Effect

JEL classification: C93

Introduction

"Contingent valuation" is a method used in surveys to value public goods. It consists of putting the respondent into a hypothetical situation where she shall decide whether to "buy" or "sell" a public good. *Contingent* on such a market-like setting, the respondent is supposed to truthfully reveal the value she assigns to the public good. The method has been mainly used to assess the value of environmental goods in policy debates and damage assessments in pollution litigations.

There are two main versions of the valuing question: "What is the maximum you would *pay* for the good (being bought/saved)?"; this elicits the (hypothetical) w*illingness to pay* (WTP) or maximum buy-price. The opposite of this question is: "What is the minimum payment you would *accept* for the good (being sold/destroyed)?", eliciting the (hypothetical) w*illingness to accept* (WTA) or minimum sell-price.

Contingent valuation surveys demonstrate that these answers to the two types of questions differ dramatically: Reported willingness to accept (WTA) is much larger than reported willingness to pay (WTP). By comparing the results of contingent valuation studies with an experimental setting where real goods and money changed hands, it turned out that the gap is much larger in the hypothetical setting of the surveys (see Table 20 below).

The notion of *real* WTP or WTA is used in an experimental setting where goods are traded for real money. The notion of *hypothetical* WTP or WTA is used in the context of contingent valuation (CV) studies, where respondents are asked to imagine a market for the good, but real payments are not made, at least not during the course of the survey.

The question that this article tries to answer is the following: Given that a significant gap between WTA and WTP exists in real experimental settings, what widens the gap so dramatically in the hypothetical setting of a CV survey?

We postulate here that the WTA-WTP-gap in the experimental setting (treated in chapter 1) is of a different nature than the *additional* gap in the hypothetical CV setting. The gap should be seen as consisting of two layers: one existing in the real setting and an additional effect in the hypothetical CV setting. This article tries to explain the latter effect.

I. History of Contingent Valuation Surveys

An unexpected event in 1989 suddenly brought a lot of attention and controversy to the contingent valuation method: The oil spill of the supertanker Exxon Valdez. The damage to the Prince William Sound in Alaska, a natural reserve, led to the question how much Exxon would have to pay as compensation. What was the value of the environment that the 11 million gallons of crude oil polluted?

Originally, CV studies were used to value environmental goods in policy decisions. Portney (1994, p. 4) provides an overview on the history of CV studies. When the Exxon Valdez oil disaster occurred, the CV method was already part of US law to measure damages in natural resource cases where "use-values" (direct economic losses) were not available. Although the Exxon case was settled out of court for $1.15 billion, there is no doubt that the agreement was influenced by a CV study on the topic, estimating lost "existence value" at nearly $3 billion (Portney, 1994, p. 11, citing Carson et al., 1992).

What followed under the attention of large companies and US-congress was a controversy among economists whether and how the CV method should be applied. A panel of experts appointed by the federal Department of Commerce for the National Oceanic and Atmospheric Administration (NOAA) was called to decide on this issue. It consisted of some of the best-known economists like Nobel laureates Kenneth Arrow and Robert Solow. The panel concluded that "CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment" (Arrow et al., 1993). Nevertheless it added a set of guidelines that CV studies would have to follow, including the use of willingness to pay (WTP) instead of willingness to accept (WTA, also called "compensation demanded"):

"The conceptually correct measure of lost passive-use value for environmental damage that has already occurred is the minimum amount of compensation that each affected individual would be willing to accept. Nevertheless, because of concern that respondents would give unrealistically high answers to such questions, virtually all previous CV studies have described scenarios in which respondents are asked to pay to prevent future occurrences of similar accidents. This is the conservative choice because willingness to accept compensation should exceed willingness to pay, if only trivially." (Arrow et al., 1993, p. 4)

The panel also suggests the use of the referendum-style question, which is more realistically asked in the WTP-version (Arrow et al., 1993, p. 4): "Would you be willing to contribute (or be taxed) D dollars to cover the cost of avoiding or repairing environmental damage X?" The use of this referendum-style excludes from the answers any kind of "strategic motives" of participants who might give high WTA and low WTP answers just to influence a possible payment in a direction that would be profitable for them. As respondents to a referendum question can only say *yes* or *no* for a fixed payment, they cannot influence the amount of this payment.

The panel followed a pragmatic way and suggested a method of applying CV that did not produce extremely high values. Among other guidelines it proposed to include reminders that stating a willingness to pay for the policy in question would reduce the responder's amount available to spend on other things. The aim of including reminders like this was probably to lower the answers somewhat, as the tendency of the CV method of producing large values (also in the WTP setting) was seen as not desired.

In the heated debate following the report of the NOAA panel, the question of using WTP or WTA seemed not to matter so much. Most arguments for and against using the CV study were about the reliability of the WTP referendum-question and what it actually measures (cf. Hanemann, 1994 and Diamond and Hausmann, 1994, for two opposing views).

II. Empirical Evidence

A pragmatic reason for excluding the WTA-style question, already in most earlier CV studies, was probably the fact that WTA answers in CV studies seemed unreasonably high: In our own study, subjects value an upgrade for local sewage works on average 428 € in the WTA condition, while they value it at an average of 52 € in the WTP condition (see below).

If there is only one true value, the question is whether hypothetical WTA answers are too high, hypothetical WTP answers too low, or both? To get a *real* willingness-to-pay or willingness-to-accept, one has to set up an experiment where real trades take place. Yet it is difficult to have real trades with public goods, which are usually treated in CV studies. The easiest work-around is to use private goods like consumptions goods that

can easily be traded, and about which one can of course also ask hypothetical valuation questions.

The following section will briefly go over the most important studies, which are also displayed in Table 20. A more detailed overview can be found in Table 24 in the appendix of this chapter.

Table 20: Comparison of hypothetical and experimental valuations

Study	Good	Result
Public goods		
Brookshire and Coursey, 1987	Trees in public park	WTA/WTP falls from 21 (hyp) to 1.8 (real)
Cummings et al., 1995a	Contribution to Citizens guide	Real WTP < hypothetical WTP
Private goods - group I: "pure" private goods (without "no-payment-scenario")		
List and Shogren, 2002	Christmas gifts	Real WTA 1.4 times higher than hypothetical WTA (opposite true for low-valued goods, real/hyp=0.75)
Nape et al., 2003	Wall calendar	Real WTA somewhat lower than hypothetical WTA.
Cummings et al., 1995b	Juicer, chocolate, calculator	Real WTP lower than hypothetical WTP.
Simonson and Drolet, 2004	Toaster, phone, backpack, radio headphone	No hypothetical WTA-WTP-gap - WTA even sometimes smaller than WTP.
Coursey et al., 1987*	Right to avoid bitter liquid	WTA/WTP falls from 4 to 1.8 when moving from hypothetical to real condition
Private goods - group II: with relevance for public (with "no-payment-scenario")		
Rankin, 1990	Hunting permit	Hyp. WTA much higher than real WTA, no difference for WTP.
Dubourg et al., 1994	Car safety	No hyp. compensation high enough for 20 % of respondents. = infinite gap for some respondents
Viscusi et al., 1987	Injury risk caused by toilet bowl cleaner and insecticide	No hyp. compensation high enough for all respondents. = infinite gap for all respondents

**Study could be classified into group II, see text.*

Public Goods

Brookshire and Coursey (1987) found a way to trade with a public good: They ask respondents about the number of trees that should be included in a new public park. Questions start in a hypothetical CV-style, where respondents should state the maximum that they would be willing to pay to increase the number of trees (e.g. from 200 to 225) or the minimum compensation they would demand for a corresponding decrease in the number of trees. Median answers[52] to the hypothetical WTP-question ($9.60) and to the hypothetical WTA-question ($200) differ drastically. In the next step, a detailed auction process was explained to the respondents that would take place, yet the questions were still hypothetical, so no binding commitment had to be made. This way to make real payments more probable drastically reduced "semi-hypothetical" WTA-answers to $30, while "semi-hypothetical" WTP-answers remained around the same level ($11.80).

In the third step, real auctions took place. In the WTP-setting subjects were submitting bids which they finally contributed to a special fund set up to finance the park. In the WTA-setting, subjects were submitting asks they would (and did) get out of the funds' money. Up to five bidding/asking rounds took place in the groups under incentive-compatible conditions[53]. In the final rounds, answers in both groups had significantly decreased: WTP to $5.10, WTA to $7.25. If one calculates the WTA-WTP-gap as a ratio of WTA over WTP, this ratio decreased from 20.8 in the hypothetical setting to 1.8[54] in the experimental setting. This change was mainly driven by a decrease of WTA, the more the option of receiving a payment became real.

The finding of hypothetical WTP being somewhat, yet not drastically, higher than real WTP is confirmed by Cummings et al. (1995a) who ask about (and collect) payments for providing a citizen's guide about groundwater pollution to poor households.

Private Goods

The picture for private goods does not follow, at first sight, the same pattern. Concerning WTP, the finding is quite similar: real WTP, elicited in experiments with real

[52] For an increment of 25 trees.
[53] So-called "Smith auction", going back to Vernon Smith. For a list of the various references for the development and testing of this type of auction cf. Brookshire and Coursey, 1987, p. 557.
[54] Over all different treatments, of which only one is displayed here.

trades, is also observed to be somewhat lower than hypothetical WTP, elicited in the CV-style. Yet for WTA, findings differ within the group of private groups. It is therefore helpful to split the studies into two groups according to the question whether there could be public interest in the good (group II) or the goods must be seen as "pure" private goods..

Classification according to a "no-payment-scenario"

Some of the private goods can be seen as having relevance to the general public. In order to decide for which goods this is the case, we define the relevant technical criterion as follows: Can the answer to the valuing question have relevance for a decision, even if the proposed transfer of money (and eventual ownership rights) to/from the respondent does not take place?

While the relevance of this no-payment-condition generally holds for public goods, it can also be true for goods that are conventionally classified as private goods[55]. Take hunting permits, as used by Rankin (1990) as the best example of a private good that fulfils the "no-payment-scenario" criterion and can therefore have relevance for the public: After a survey about valuing hunting permits, a public authority could very well decide on increasing or decreasing the number of issued permits without making any of the direct money transactions that were proposed in the survey.

The clearest example for "pure" private goods are those used by List and Shogren (2002): Subjects are asked (in a hypothetical setting and a real auction) whether they would sell their Christmas gifts. If this transaction does not take place, there is no meaningful importance of the answers that a subject could imagine (other than research on the mechanism itself).

Of course, judgement about this criterion is not always obvious. For details on classifications of the studies in Table 20, see in the appendix of this chapter. It is worth noting that the study by Coursey et al. (1987) could also be classified into group II (with relevance for the public), but was not, in order to remain conservative with respect to our research hypothesis.

[55] according to the standard criteria of "rivalry in consumption" and "excludability"

Group I vs. Group II

After classifying the private good studies into the groups, a clearer pattern emerges concerning WTA answers: Studies in group II (with relevance for the public) find a pattern similar to the one observed for public goods: Very high hypothetical WTA that decrease drastically in a real experimental setting.

Rankin (1990, p. 216) concludes from his comparison between a CV study and real transactions with hunting permits: The WTA responses from the experiment and the contingent valuation study "seem to result from very different processes." WTP answers in the hypothetical and real setting seem similar.

In group I studies ("pure" private goods), WTA responses do not show the same pattern. List and Shogren (2002) even find that their subjects on average *understate* WTA for their Christmas gifts in a hypothetical situation, compared to a real auction.

Summary of findings:

Subjects in public good studies and private good studies with relevance for the public (group II) give much larger WTA answers in hypothetical than in experimental settings. Subjects in studies about "pure" private goods (group I) do not drastically overstate their WTA in a hypothetical setting. WTP answers in all studies are usually somewhat higher in a hypothetical than in an experimental setting, though only on a moderate scale.

The question following from this finding is: What is it that leads to respondents giving these extremely high hypothetical WTA answers in CV studies about public goods and private goods in group II?

III. Hypotheses

In this chapter, we give an overview over the different hypothesis that try to explain different facts known from the CV method. The following hypotheses can be classified into two groups:

1. Explaining the WTA-WTP-gap for CV studies: Loss Aversion in Riskless Choice, Substitution Effects, Decision Uncertainty.
2. Explaining other facts of CV studies that are perceived as irregularities: Warm Glow Hypothesis, Opinion Poll Hypothesis, Hypothetical Bias.

Our own hypothesis (diplayed at the end of this chapter) tries to explain the WTA-WTP-gap, yet draws on some of the arguments used by the hypotheses under 2.

Hypotheses explaining the WTA-WTP-gap:

Loss Aversion in riskless Choice

Brookshire and Coursey (1987) see a strengthening of "loss aversion" as the underlying force behind the increase of the gap in the hypothetical setting. Loss aversion goes back to Thaler (1980) and Tversky and Kahneman (1991) who took it out of the uncertain setting of Prospect Theory (Kahneman and Tversky, 1979). Loss aversion states that people are more sensitive towards losses than towards gains. Therefore they demand higher compensation when selling than what they are willing to spend when buying.

When applying this concept to the CV method, four problems appear:

- Details: The exact reason why loss aversion should be more pronounced in a hypothetical than in a real setting remains unclear; at least Brookshire and Coursey (1987) do not give any details.
- Hypothetical setting and ownership: In a hypothetical setting, ownership over a good is not real, so a loss of a hypothetical endowment could as well be perceived as *less* severe than a loss of a real endowment.
- Public goods and ownership: For public goods, the concept of ownership is hardly feasible, as public goods usually belong to the public by definition. Nevertheless, the proposed move in the WTA case is usually a deterioration

of a public good, so it can be defined as a loss. The proposed amelioration of the public good in the WTP case can be seen as a gain. If we define two states, one good and one bad, the prices and associated moves are: "WTA for the move from the good to the bad state" and "WTP for the move from the bad to the good state".

Yet it is unavoidable that one of the states "good" and "bad" is only hypothetical compared to reality. It is usually the case in CV studies about public goods that in reality, the bad state exists and should be compared to a possible good state that could be achieved[56] through the appropriate actions.[57] Therefore, although the wording in the WTA case points to a possible "loss", the only possible move in reality is in the opposite direction. The argument of respondents considering a possible loss in the WTA situation only holds if they take the starting point they should imagine for real and care more about this hypothetical situation than about reality. If they would be interested more in the possible action in reality, the WTA task must be seen as assigning a monetary value to the proposed action that can in reality only happen in the other direction.

- Pattern for private goods: As outlined above, the hypothetical setting has different effects in different studies with private goods. Loss aversion cannot account for this pattern.

Substitution Effect

Hanemann (1991) formally shows that the substitution effect can lead to WTA being much[58] larger than WTP, if there are hardly any substitutes for the public good. This hypothesis is not consistent with the WTA-WTP-gap decreasing so dramatically when moving from a hypothetical to an experimental setting (see above). If respondents

[56] In the case of a pollution that has already happened, achieving the good state is not possible literally, but only in the sense of preventing future pollutions by setting a high fine/litigation sum.
[57] It is theoretically possible to have the opposite situation where the good state exists and the policy proposal is to deteriorate the public good, although no such study is known to the author. In this case, the bad state would be hypothetical.
[58] A simulated setting shows WTA being up to 5 times larger than WTP.

would accept no or only a very high compensation in a hypothetical setting due to a substitution effect, this should be true in an experimental setting as well.

Decision Uncertainty

Li et al. (2002) state that "decision uncertainty" causes WTA to be higher in a hypothetical setting. They assume that the individual does not have a fixed true valuation in his or her mind, but may rather perceive the value to be within a certain interval. Compared to the "true" value, the individual can therefore give a "wrong" answer with a certain probability. This concept seems close to that proposed by Kahneman and Tversky (1984, p. 16) who see individuals forming a "decision value" at the time of the decision and later forming an "experience value", according to the experience of consuming/using the good. While it is very probable that this effect plays a role for the endowment effect measured in experiments (cf. chapter 1 & 2), it seems not to be an appropriate predictor of behavior in CV studies: If one assumes that the decision uncertainty is larger in a hypothetical setting than in a real one, this would lead to a larger WTA-WTP-gap in all CV studies. Yet as shown above, this is not true for several studies with private goods – a pattern which cannot be explained by this hypothesis.

The following hypotheses do not intend to explain the WTA-WTP-gap, but concern other outcomes of CV studies that are perceived as irregularities. As our own hypothesis contains some elements similar to these hypotheses, a brief overview seems necessary.

Other Hypotheses:

Warm Glow / Insensitivity to Scope

The "warm glow" hypothesis (mentioned for example by Arrow et al., 1993) states that respondents do not assign a money value to the exact action or situation proposed in the CV question, but to a more general cause, e.g. of protecting the environment. Respondents are seen to give a monetary value of the "warm glow" that they experience when thinking about this more general cause.

The main supporting facts for this warm glow hypothesis stem from so-called "insensitivity to scope". Insensitivity to scope means that the money answers do not follow the pattern one would expect from real prices when changing the number or size of the object to be evaluated. In real pricing, one expects that WTP as well as WTA increases and decreases with the number/size/quality of the object evaluated. Even if these price moves will not always be proportional to the change in the object, one can hardly argue that the porperty of "sensitivity to scope" is not met in reality. Yet many economists (e.g. Diamond and Hausmann, 1994) argue that when changing the size/scope of an object in a CV question (e.g. "how much are you willing to pay for saving 100 birds" vs. "…saving 1,000 birds"), answers do not change in a way similar to real pricing. Proponents of the CV method (e.g. Hanemann, 1994) dispute that this insensitivity to scope can be inferred from the answers in CV studies.

If the answers do in fact not change with the scope of the object, there must therefore be some determining factor that underlies the answers. The "warm glow" hypothesis states that people have a general will to support a good cause. Whether the question is about saving 100 or 1,000 birds, they feel the same "warm glow" that leads to a similar answer in money terms.

Opinion Poll Hypothesis

Kahneman and Ritov (1994) and Kahneman et al. (1999) make an argument similar to the warm glow hypothesis, yet much more specific: They claim that the answers to CV questions do not reflect economic preferences – real intentions to pay (or receive) money – but instead attitudes that can also be recorded as ratings of political support, importance and personal satisfaction. They even claim that by using psychological

scales, one can discriminate better between different propositions, because they measure that problem-related variance is two to four times larger for the opinion ratings and so allows for more significant and precise rankings. They see the reason for this difference in the fact that conventional attitude measures use a bounded scale whereas the money scale is both unbounded and unfamiliar.

Kahneman et al. (1999) also argue that the move towards referendum questions is not well-founded. They see the higher valuations one can infer from referendum questions compared to open-ended questions not as the result of a decreased incentive problem, but as the result of a strong anchoring effect.

Hypothetical Bias

Economists have undertaken efforts to single out a systematic force that predictably changes respondents' answers when moving from an experimental to a hypothetical setting. This hypothetical bias is generally seen to increase answers, but as Table 20 shows, this is not always true.

Cummings et al. (1995b, 261, fn 5) state a form of misunderstanding as one reason for an upward hypothetical bias for WTP: *"Subjects might view the hypothetical question as asking one type of question (e.g., "would you **ever** pay $ X for this good?"), whereas the real question elicits responses to a different type of question (e.g., "would you pay $ X for this good **right now**?").*"

Summary of existing hypotheses:

- Even if one overlooks semantical problems concerning **loss aversion** in a hypothetical setting and with public goods, the problem remains that loss aversion – as well as a large substitution effect or "decision uncertainty" – cannot explain the entire empirical evidence of hypothetical answers in comparison to experiments.
- Other hypotheses like the "Warm Glow", "Opinion Poll" and "Hypothetical Bias" hypotheses state that respondents in CV studies do not take the question they are facing exactly as economists suppose they do. Instead they might have their own interpretation to which they formulate an answer.

Own Hypothesis:

Disentangling of Payment and Decision

As the hypotheses cited above cannot convincingly explain the WTA-WTP-gap in CV studies, we propose a different explanation. Our hypothesis builds on the assumption that respondents do not only consider the proposal in conjunction with the proposed possible payment, but also without the payment like in an ordinary opinion poll.

Hypothesis: Respondents consider it possible that a decision on the issue is made, yet without payment to/from the respondent. The possibility of a real payment is seen as more unlikely in the WTA situation. Therefore in the WTA situation, more respondents try to influence the supposed decision by giving a high value without paying too much attention to risking a monetary loss[59].

One can imagine three **scenarios** following a CV study:

1. **Nothing happens:** After the study is completed, neither a decision on the issue treated in the CV study (e.g. improve a public good) nor a money transaction is made.
2. **Full transaction:** Either in the study/experimental setting or at some point afterwards, a decision is made and the corresponding money transactions with the respondent/concerned people is made.
3. **No-payment scenario:** After the study is completed, only the decision is made, but no direct money transactions with people take place.

If scenario 1 ("nothing happens") is true, a respondent's answer clearly does not matter at all and she might even try to answer in the easiest way in terms of cognitive effort.

In scenario 2 ("full transaction") respondents would like the decision and the money payment to follow their true "economic preferences", so would give the money values that they really associate with the proposed options.

[59] More precisely, by stating WTA too high, they would risk not receiving a monetary gain.

In scenario 3 ("no-payment-scenario"), respondents would like the decision to follow their attitude toward the proposed options. This attitude might either be in favour or against an action, indifference towards the decision or some attitude in-between these extremes. If the attitude corresponds to "strongly in favour" or "strongly against", this would translate into an infinite or zero monetary answer, because a simple "yes" or "no" like in an opinion poll is not possible on the monetary scale. As the question asked in CV studies mostly concerns improvements of public goods and most people can be assumed to be in favour of this, answers with high values would be very likely in this scenario.

The hypothesis forwarded here is that in a study or an experiment, respondents form beliefs about the intention and consequence of the study, corresponding to scenarios 1-3 above. In a survey about buying or selling a mug, the no-payment-scenario does not hold much relevance. If the question is about valuing a proposal to protect the environment, the no-payment-scenario is not only possible but might very well be considered very likely[60]. Therefore, in all real (experimental) settings and hypothetical settings for "pure" private goods, the no-payment-possibility is discarded that would dramatically increase the WTA-WTP-gap.

Yet how does the no-payment-scenario increase the WTP/WTA-gap? The crucial **assumption** here is that **respondents' attitude towards scenario 2 ("full transaction") involving payments is different in the WTP and WTA setting**.

In the **WTA case**, respondents consider this scenario where they receive money from the government or a public authority as **very unlikely**, as examples of such behavior are very rare. Especially receiving large sums seems almost impossible to ever happen. Respondents focus on possibility 3 ("no-payment-scenario"). Saying "no" to a deterioration of public goods means giving a high value as an answer – so even a "refusal" or almost infinitely high value can make sense here, in contrast to economists thinking of these answers as irrational. In our study, 6 of 30 subjects refused to name a value in the WTA treatment, while only 1 of 30 subjects refused in the WTP treatment. One subject in the WTA treatment indicated that "no compensation would be high enough" (and 5

[60] Experimenters usually do not state their true intention of researching the method, as they probably are afraid this would erode people's motivation (they would perceive it as scenario 1 – „nothing happens").

subjects simply refusing to state a WTA amount without comment, compared to no missing WTP answers).

In the **WTP situation**, this "full transaction"-scenario is **not seen as completely impossible**. Paying money to the government or other public entities, also for special causes, is not completely unlikely and happens every now and then in reality. Respondents might also associate ordinary tax increases with the proposed payments which are certainly not unrealistic at all.

If respondents to the WTP question consider the payment scenario 2 ("full transaction") as more likely than the WTA group, this will lead their answers to be a compromise between answers to scenario 2 (considering the real monetary value) and to scenario 3 (giving an answer in an opinion poll). Respondents to the WTA-question will weight the opinion poll answer more, leading to much higher answers, as most people will want to say "yes" to an amelioration of a public good (corresponding to an infinite answer to the value question). WTA-respondents only focussing on the opinion-poll might very well refuse to accept any payment.

Evidence exists that WTP-respondents do not exclude scenario 2 ("full transaction") from happening: Jorgensen et al. (1999, p.141) report that about half of their respondents to their CV study refuse payment. When these respondents are asked for the reason, at least 85 % of the answers are consistent with the notion of respondents taking the possibility of having to pay for real[61], indicating that at least 40 % of respondents of the whole sample take the payment scenario for real.

Summary of Own Hypothesis:

Subjects take the possibility of receiving a payment less serious than the possibility of having to make a payment. Therefore, in the WTA setting, their answers rather reflect their general opinion on the matter, expressed on a monetary scale. As people can be assumed to have a positive attitude towards ameliorating a public good, these answers are higher than the WTP answers, for which respondents take the possibility of a real expenditure into account and therefore must consider reducing this possible expenditure.

[61] The most frequent types of answers were „I pay enough already" and "I can't afford to pay at the moment".

IV. Own Survey

Research Question

Do people consider having to pay to the government for an improvement in a public good as more likely than receiving a payment from government in case the project is rejected?

Method

A survey with the Contingent Valuation method was carried out at the beginning of a behavioral experiment with 60 participants (that is examined in chapter 1). As subjects answered the 2-page survey at the beginning of the experiment, any influence of the content of the experiment on the outcome of the survey can be excluded (except that they were recruited for an "economic study of behavior").

A translation of the instructions and the original instructions in German can be found in the appendix. Design of the questions followed a WTA and a WTP design, including an additional manipulation ("no-payment-reminder"):

The questionnaire first described that a project exists to improve the water quality of the Isar River that crosses Munich. Sewage works in Munich should be upgraded with disinfecting devices in order to make bathing in the Isar safe at almost any time.

The questions then followed both the referendum and open question form: Subjects were first asked how they would vote in a referendum about a payment to the government of 50 € for the upgrade (WTP treatment) or in a referendum about payment of 50 € from the government if no upgrade is undertaken (WTA treatment).

The second question directly asked for the maximum (minimum) they would accept as a payment in such a referendum. Clearly, these answers are biased ("anchored" according to Kahneman et al., 1999) by the amount of 50 € given in the referendum. Yet, as this bias influences all settings, this is not a problem for our research question.

After the valuation question, subjects were asked how likely they considered that the proposed payment (to the government in the WTP setting, from the government in the WTA setting) would indeed one day take place together with the proposed measure.

(Table 21 below gives an overview over the possible results of the proposed referendum.)[62]

Table 21: Consequences of referendum in WTP vs. WTA setting

	WTP-style question	WTA-style question
Upgrade	Payment from people & upgrade	No payment (from government) & upgrade
No upgrade	No payment (from people) & no upgrade	Payment from government to people & no upgrade

No-payment-reminder: In 2 of the 4 treatments (half of the WTP and half of the WTA treatments), a special reminder was added to the text of the question: "Please be aware of the fact that there are no plans to ask for payments (offer payments) for doing the upgrade (not doing the upgrade). This question solely intends to measure how much people in Munich value the water quality in the Isar."

Results

Table 22 provides an overview over the main results. The general pattern of our results follows that of the results of many other contingent valuation studies reported in the literature: Rejection of the public project in the WTP referendum is significantly higher (10 of 29 answers) than in the WTA referendum (3 of 29 answers). Note that answers to a referendum-style question cannot be attributed to "strategic motives" (trying to decrease payment in the WTP setting and increase payment in the WTA setting): Respondents could just say "yes" or "no" to the project at a fixed price of 50 €, so they could not influence this price. From significantly higher rejection rate in the WTP referendum, one can conclude that respondents have on average lower WTP than WTA: 10 of 29 respondents have WTP < 50 €, while only 3 of 29 respondens in the other group have WTA ≤ 50 €.

[62] The probability questions did not ask for the same state concerning the upgrade, as the alternatives (no upgrade & no payment for WTP, upgrade & no payment for WTA) must be considered familiar types of decisions. The focus here was on the more unusual states which involve the payment.

Answers given to the open question (where "strategic motives" cannot be excluded) are also significantly lower in the WTP-setting (mean 52 €, median 50 €) than in the WTA setting (mean 428 €, median 200 €; for test scores see Table 22).

The answers to the question "How likely do you think it is that the proposed payment will take place?" show three stark outliers in the WTA-treatment with "no-payment"-reminder at 80, 80 and 90 % (see Figure 21). All other answers in this treatment together have a mean of only 3.3 percent. A report of one subject during the survey might hint at the source of these outliers: The subject asked whether the question was about the payment being made *given that such a referendum would take place*. This misconception might have rose because the "no-payment"-reminder together with the already unlikely WTA setting let people believe that the question could only be of hypothetical nature and not about whether they would expect such a payment in reality.

In the presence of these outliers (which increase the mean probability answer in the WTA-no-payment treatment by 16 percentage points), looking at medians is helpful: Both WTA samples show comparably low medians of 1 and 0.01 percentage points. The median of the whole WTA sample (1 %) is also much lower than the mean answer (14 %), while for the WTP sample these two measures are much closer (mean 24 %, median 20 %).

Table 23 shows the results of several tests: Our hypothesis that probability answers are lower in the WTA than in the WTP treatments is confirmed by a Wilcoxon Rank-Sum test of different medians. After deleting the 3 outliers named above, the significance-level of the t-test also falls below 5 % (from 5.4 % to 0.0 %).

As the "no-payment"-manipulations did not lead to a significant decrease in the perceived likelihood of a payment in both WTP and WTA treatment (t-tests and Wilcoxon-rank-tests fail with only the t-test for the WTP-manipulation with p=0.09 being somewhere close to significance), only results for the whole WTP and WTA samples, including in both groups answers with and without "no-payment reminder" are shown.

Table 22: Answers in own contingent valuation survey

		WTP	WTA
Referendum	for upgrade	19	26
	against up-grade	10	3
	(abstention)	1	1
	answers	30	30
2*2 Chi-sq test	Chi-sq		4.858
	p-value		0.028
Max/Min Amount	Mean	52 €	428 €
	(std. error)	6.93	118.80
	Median	50 €	200 €
Probability of pay-ment	Mean	24	14
	(std. error)	4.39	4.75
	Median	20	1

Table 23: Testing of hypotheses

	setting	mean	t-test: p-value (one-sided)	median	Wilcoxon rank-sum test (p-value)
WTA vs WTP amount (max/min)	WTA	428 €		200 €	
	WTP	52 €	0.002	50 €	0.000
probability of pay-ment	WTA	14		1	
	WTP	24	0.054*	20	0.002
			*0.000 without 3 outliers		

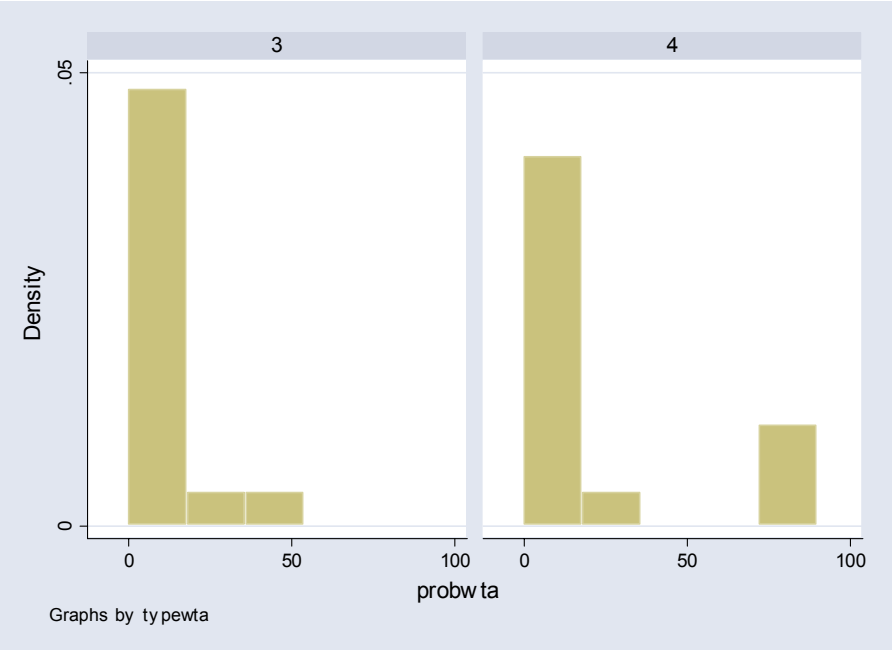

Figure 21: Histogram of probability answers in both WTA settings

Normal treatment (left) and "no-payment" treatment (right) with the outliers at 80, 80 and 90.

Discussion

Our hypothesis outlined above is confirmed: In the WTA setting, respondents do not really expect that the proposed payment could happen in reality: the median answer to the probability question is 1 %. In contrast, the perceived likelihood of such a payment happening in reality is significantly larger in the WTP-setting (median answer 20 %). Our conclusion is that subjects in the WTA-setting answer more like in an opinion poll, leading to higher answers than in the WTP-setting, as most people can be assumed to be in favour of ameliorating public goods.

Also for private goods that can be relevant for the public, respondents will tend to give extreme answers if they want to express their opinion on the issure (e.g. are in favour of increasing the number of hunting permits issued, improving safety for cars, or decreasing the poisoning risk of toilet bowl cleaners). For "pure" private goods, subjects are not concerned that the valuations they report in the survey might influence a relevant decision. There is simply no relevance of the value reported for, say, a toaster, other than a person buying or selling this toaster in reality. Therefore, even when respondents

do not think the payment that is proposed in the survey question will ever take place, there is no reason to believe that this leads to extremely high answers, as stated above.

Taking our results and those of Brookshire and Coursey (1987) together, suggests the following: When respondents are asked in a purely hypothetical setting, they do not take payment in the WTA question seriously, while they do not completely disregard the possibility of payment in the WTP question. When the survey is altered in order to make payment seem more likely (as in Brookshire and Coursey's "semi-hypothetical" setting where an auction was described, yet did not take place), respondents take payment also in the WTA treatment more seriously, so answers decrease. When a real auction takes place, e.g. the payment option is certain in both cases, WTA decreases further. As respondents' attitude in the WTP treatment also changes from taking the payment more seriously to taking it for granted, WTP decreases as well when moving from a "semi-hypothetical" to a real setting.

Although subjects in the hypothetical WTP-setting take the possibility of a real payment more serious, our median probability answer of 20 % indicates that they attach more weight to the no-payment-scenario than to the possibility of the full transaction. The inevitable conclusion that *both* WTA and WTP answers do not reflect true economic preferences leads to the question whether there are alternatives to the contingent valuation method.

V. Alternatives to Contingent Valuation

Even if one does not take answers to CV studies as expressions of "real economic preferences", one could still use them as a cheap substitute for a general referendum. Diamond and Hausmann (1994, 60) argue against this and state that public policy should take public concern into consideration, but also rely on advice of experts. They cite evidence that answers to referendum-style CV-questions are not a good predictor for a real referendum that is usually preceded by campaigns intended to inform and persuade voters.

Kahneman and Ritov (1994, p. 230) even argue against the jury system to assess damages. *"It is remarkable that the jury system appears designed to enhance rather than minimize the deficiencies of human judgement."* They propose that juries only agree on a statement about the severity of punishment that the judge translates into an amount of money. This might sound reasonable, yet might inevitably lead to one of two problems: If the judge's transformation of the jury's statement into an amount of money is strictly rule-based, the jury will know in advance the amount of money it sets, de facto retaining this power. If this transformation is not strictly rule-based, the judge will de facto get this power, reducing the power of the jury to a statement of "guilty" or "not guilty".

Another option might be a generally more rule-based method to assess damages in litigation, for example taking into account the costs that avoiding the damage would have caused. A multiple, say 50 or 100, of this yearly cost[63] for a firm of an average size, could be considered the appropriate damage sum.[64] The advantage of such a system over a fixed regulation in every area is that it requires less regulating effort ex-ante and that innovations in the technology of avoiding accidents are automatically taken into account.

[63] If an accident happens that could have been avoided without costs, this must be considered purely human error. The costs to be considered in this case would be the introduction of a control or check system that would do the best to avoid the human errors that could lead to disaster, such as the checklist-systems for pilots.

[64] This should in the optimum lead to a situation where firms incur the costs if they otherwise expect an accident to happen with a probability of at least 1/50 (1/100) per year.

Conclusion

A large body of evidence confirms that the gap between willingness to accept (WTA) and willingness to pay (WTP) in contingent valuation surveys is much higher than economic theory would suggest. A closer look at the evidence shows that it is the WTA answer measured for public goods that is unreasonably high, compared with all other answers, including control answers from experiments and answers for private goods.

A key issue to understand the disparity is respondents' attitude towards the possibility of a real payment. Subjects in our study thought of a real payment in the WTA setting being extremely unlikely. In the WTP setting, in contrast, subjects did not consider a real payment as completely unlikely.

The fewer the respondents take the payment scenario seriously, the more they will behave like in an opinion poll – with the only difference that they give their answer on a monetary scale. As most people can be assumed to be in favour of improving public goods, this biases their answers upward. This "hypothetical bias" is stronger for WTA answers, yet also exists for WTP answers.

In the light of this bias, the neglect of WTA in most CV studies does not seem to have been the worst choice. It is, however, questionable whether the answers one gets from WTP questions are a useful input for public policy or damage assessment in environmental litigation. It seems more advisable to rely on expert advice in both cases and on real referenda for public policy, while a more rule-based damage assessment in court seems advisable.

Appendix

Details and Classification of Studies

Table 24: Details for studies shown in Table 20.

Study	Good	Hyp/real WTA	Hyp/real WTP	ratio
Public goods				
Brookshire and Coursey, 1987	Trees in public park	Hyp: $200, less hyp: 30, real: 7.3	Hyp: 9.6, less hyp: 11.8, real 5.1	20.8 (hyp) to 1.8 (real)
Cummings et al., 1995a	Contribution to Citizens guide		Prob. of WTP>$10 is 19 % higher in hyp	
Private goods - group I: "pure" private goods (without "no-payment-scenario")				
List and Shogren, 2002	Christmas gifts	WTA Real/hyp=1.4! (hyp lower!) Low-valued goods: 0.75		
Nape et al., 2003	Wall calendar	WTA<x in real treatment 27 perc pts more likely		
Cummings et al., 1995b	Juicer, chocolate, calculator		hypothetical to real, WTP falls: Juicers: Yes-responses fall from 41 % to 16 % (buy at $8), Chocolates – from 42 % to 4 % ($3.50) and Solar Calculator from 21 % to 8% ($3).	
Simonson and Drolet, 2004	Toaster, phone, backpack, radio headphone	Hyp. WTA	Hyp. WTP	WTA/WTP from 0.75 to 1 → WTA lower!
Coursey et al., 1987	Right to avoid bitter liquid	Hyp: 9.5 Hyp (informed): 10.5 Real: 4.6	2.5 2.5 2.6$	Hyp: 3.8 4.2 real 1.8
Private goods - group II**:** with relevance for public (with "no-payment-scenario")				
Rankin 1990	Hunting per-	Hyp:22 % sold	Real & hyp: 75 % not	No common

	mit	Real: 59 % sold	bought (same result)	basis for real/hyp WTA, but for WTP
Dubourg et al., 1994	Car safety	Refusals: 20 %.		2 to 6.2*
Viscusi et al., 1987	injury risk caused by toilet bowl cleaner and insecticide	Refusals: almost all respondents!**	$0.65 to 1.84	

* Answers of subjects excluded who report that no WTA would be sufficient

** p. 477: In pretests for the experiment, subjects were not willing to accept any price reduction (WTA setting) even for the smallest of several proposed increases in the risk that the product might poison the user. For the experiment, the proposed risk increase was reduced further. Nevertheless, ¾ of the respondents still refused any amount of price reduction (i.e. would not even take the product for free).

Classification of Private Good Studies

- Nape et al. (2003) offer a wall calendar and ask about (real and hypothetical) selling prices. The only possible relevance of a no-payment-scenario could be that of deciding whether or not to introduce such a calendar into the market – even if subjects' concern about this question existed, it is probable that it would not be strong.
- In the study done by List and Shogren (2002) there clearly is no meaning of a no-payment-scenario, as explained above. As questions are about objects that belong to the respondents already, nothing could be undertaken with them without permission of the responder.
- Cummings et al. (1995b) ask for valuations of a juicer, chocolates and a calculator. As in Nape et al. (2003) above, the only meaning in a no-payment-scenario would be that of introducing such a product with the same weak implications to relevance of such a decision to respondents.
- Coursey et al. (1987) ask subjects to consider tasting a bitter liquid, an unpleasant but harmless experience. As the hypothetical questions precede the real experimental setting for all subjects, it cannot be excluded that subjects would consider it possible that they might later be asked to taste the bitter liquid without monetary compensation. In the second part of the experiment, they were indeed asked to taste the liquid, if only a few sample drops instead

of holding the full one-ounce-cup in the mouth for 20 seconds. By assigning a high monetary value to the option of not tasting the liquid, subjects might have thought to avoid drinking the liquid. As this seems a possibility, yet not a strong one, the study is still classified as without no-payment-scenario.

- Duburg et al. (1994) ask subjects to value safety features of cars that affect the probability of accidents and injuries. One can imagine easily that in reality, these safety features could be altered without any payment to/from people, so again the no-payment-scenario makes sense. Respondents might be concerned that, if they value the safety features very low, car manufacturers might diminish their efforts to improve these saftery features. Therefore, respondents might abstract from payments they would consider when really buying a car and rather answer as in an opinion poll asking "do you want car manufacturers to improve safety features?".
- Viscusi et al. (1987) ask subjects to value risks connected to a toilet bowl cleaner and an insecticide. Similarly to the study by Dubourg et al. (1994) just mentioned, features of these products could of course be altered without the proposed money transactions.

Other comments to the studies

Duburg et al. (1994) and Viscusi et al. (1987) are seen as evidence of an increase of the WTA-WTP-gap in a hypothetical setting, although they do not experimentally elicit real answers. Yet it can be seen as common sense that the attitude of no compensation (i.e. reduction of the purchase price) being sufficient for decreased safety features does not carry through in reality. People buy products such as toilet bowl cleaners, insecticides and cars even without exact knowledge of safety statistics and even at the full price.

Simonson and Drolet (2004, researching on the anchoring effect) find hypothetical WTA answers being lower than hypothetical WTP answers for ordinary consumer goods. This could lead to one of two conclusions: in a corresponding experiment, the gap would also not be present (or even be reversed), or if it would be present as usual, hypothetical WTA answers would have been lower than the true answers (and/or the opposite for WTP answers).

Instructions of own Study

Questionnaire

** Comments between asterisks **

Survey

Water Quality of the Isar River

(The Isar River runs through Munich, where the survey took place *)*

Since the year 2000, there has been an ambitious government project in the state of Bavaria to improve the water quality of the Isar River. The aim of the project is to ensure bathing in the Isar without any health considerations. To that aim, sewage works are being upgraded with disinfection devices, starting in Bad Tölz (* a town further up the Isar River *). The disinfection device kills almost all germs in the sewage with ultraviolet light without any harmful effect on people and the environment, as extensive studies have shown. Where sewage is cleaned by the new system, the water quality of the Isar has indeed reached bathing water quality (except in times of heavy rainfalls).

(The program does indeed exist in reality exactly as described here.*)*

However, the upgrades are quite costly.

Our question:

Imagine you were an elective resident of the city of Munich and would be asked in a referendum as follows:

****WTP-Treatments:****

„Do you agree to upgrade sewage works with cost sharing by the residents of Munich? In case of approval of the referendum, every resident of Munich over 18 years would have to pay a one-time cost sharing fee of 50 €. In case the referendum is refused, the upgrade would not take place.“

Optional („no-payment-reminder“)

Note: The possibility of a payment connected to the upgrade of the sewage works is purely hypothetical and is only assumed for the purpose of this survey. There are no plans to propose payments for the upgrade of sewage works in Munich or even to introduce such payments. The purpose of this survey is exclusively to measure how important water quality of the Isar River is to the residents of Munich.

Please indicate, how you would answer in such a referendum:

1. Answer (please mark with a cross): ☐ Approval ☐ Rejection ☐ Abstention

What would be the **maximum** that you would be willing to pay as a resident of Munich for the upgrade of the sewage works, if every resident would have to pay this amount and the upgrade could not take place otherwise?

2. Answer: _____ €

How likely do you consider it that all residents of Munich aged 18 and over will indeed one day have to pay 50 € for the upgrade of the sewage works?

Answer: Probability of _____ % (0 to 100)

How likely do you consider that the amount you gave as the 2nd answer will have to be paid?

Answer: Probability of _____ % (0 to 100)

(These answers were not analysed. *)*

WTA-Treatments

„Proposal A: Upgrade of the sewage works in the city of Munich with UV-devices.

Proposal B: Waiving of the upgrade of sewage works in Munich with UV-devices. Payout of 50 € to every resident of Munich aged 18 years and over."

Optional („no-payment-reminder")

Note: The possibility of a payout in case of no upgrade is purely hypothetical and is only assumed for this survey. There are no plans to propose or even make payments in case of not upgrading sewage works in Munich. The purpose of this survey is exclusively to measure how important water quality of the Isar River is to the residents of Munich.

Please indicate how you would answer in such a referendum:

1. Answer: I am for ☐ Proposal A ☐ Proposal B ☐ Abstention

What would be the **minimum** payout to every resident of Munich that would let you accept proposal B?

2. Answer: _____ €

How likely do you consider it that all residents of Munich aged 18 and over will one day indeed receive a payout of 50 €, because the upgrade has been waived?

Answer: Probability of _____ % (0 to 100)

How likely do you consider that the amount you gave as the 2nd answer will be paid out?

Answer: Probability of _____ % (0 to 100)

**** Original version in German ****

Umfrage

Wasserqualität der Isar

In Bayern gibt es seit dem Jahr 2000 ein ehrgeiziges staatliches Projekt, um die Wasserqualität der Isar zu verbessern. Das Ziel des Programms ist es, dass das Baden in der Isar für jedermann bedenkenlos möglich ist. Hierzu werden, beginnend in Bad Tölz, Klärwerke mit Desinfektionsanlagen ausgerüstet, in denen ultraviolettes Licht die schädlichen Keime im Abwasser fast vollständig abtötet. Das Verfahren hat für Mensch und Umwelt keine schädlichen Nebenwirkungen, wie umfangreiche Untersuchungen belegen. In dem Bereich, in dem die Abwässer durch das neue System gereinigt werden, ist die Wasserqualität der Isar tatsächlich zum Baden uneingeschränkt geeignet (ausgenommen in Zeiten von starken Regenfällen).

Die Aufrüstung des neuen Klärsystems ist jedoch kostspielig.

Unsere Frage:

Stellen Sie sich vor, Sie seien wahlberechtigte/r Bewohner/in Münchens und würden in einem Referendum wie folgt befragt:

**** WTP-Treatments ****

„Stimmen Sie der Aufrüstung der Kläranlagen mit UV-Anlagen bei Kostenbeteiligung der Bürger in München zu? Im Falle einer Annahme des Referendums müsste jeder Bewohner Münchens über 18 Jahre eine einmalige Kostenbeteiligung von 50 € zahlen. Im Falle der Ablehnung würde die Aufrüstung nicht stattfinden.“

**** Optional („no-payment-reminder“) ****

Hinweis: Die Möglichkeit einer Zahlung in Verbindung mit der Aufrüstung der Kläranlagen ist rein hypothetisch und wird nur für diese Umfrage angenommen. Es gibt keinerlei Pläne, tatsächlich Zahlungen für die Aufrüstung der Kläranlagen in München vorzuschlagen, geschweige denn durchzuführen. Durch diese Umfrage soll lediglich gemessen werden, wie wichtig den Münchnern/-innen die Wasserqualität der Isar ist.

Bitte geben Sie an, wie Sie in einem solchen Referendum antworten würden:

1. Antwort (bitte ankreuzen): ☐ Dafür ☐ Dagegen ☐ Enthaltung

Was wäre das **Maximum**, das Sie bereit wären als Bürger/in Münchens für die Aufrüstung der Kläranlagen zu bezahlen, wenn jede/r Münchner/in diesen Beitrag leisten müsste und die Kläranlagen ansonsten nicht aufgerüstet werden könnten?

2. Antwort: _____ €

Für wie wahrscheinlich halten Sie es, dass alle Bürger/-innen Münchens über 18 Jahre tatsächlich irgendwann einen Beitrag von 50 € für die Aufrüstung der Kläranlagen bezahlen müssen?

Antwort: Wahrscheinlichkeit von _____ % (0 bis 100)

Für wie wahrscheinlich halten Sie es, dass der von Ihnen als 2. Antwort genannte Betrag gezahlt werden muss?

Antwort: Wahrscheinlichkeit von _____ % (0 bis 100)

**** WTA-Treatments ****

„Vorschlag A: Aufrüstung der Kläranlagen im Stadtgebiet Münchens mit UV-Anlagen.

Vorschlag B: Verzicht auf die Aufrüstung der Kläranlagen in München mit UV-Anlagen. Ausschüttung von 50 € an jeden Bewohner Münchens über 18 Jahre.“

**** Optional („no-payment-reminder“) ****

Hinweis: Die Möglichkeit einer Ausschüttung bei Nicht-Aufrüstung der Kläranlagen ist rein hypothetisch und wird nur für diese Umfrage angenommen. Es gibt keinerlei Pläne, tatsächlich Auszahlungen für die Nicht-Aufrüstung der Kläranlagen in München vorzuschlagen, geschweige denn durchzuführen. Durch diese Umfrage soll lediglich gemessen werden, wie wichtig den Münchnern/-innen die Wasserqualität der Isar ist.

Bitte umkreisen Sie die Antwort, die Sie in einem solchen Referendum geben würden:

1. Antwort: Ich bin für ☐ Vorschlag A ☐ Vorschlag B ☐ Enthaltung

Was wäre das **Minimum** an Ausschüttung für jede/n Bewohner/in Münchens, das Sie dazu bewegen würde, Vorschlag B zu akzeptieren?

2. Antwort: _____ €

Für wie wahrscheinlich halten Sie es, dass alle Bürger/-innen Münchens über 18 Jahre tatsächlich eines Tages die Summe von 50 € erhalten, weil auf die Aufrüstung der Kläranlagen verzichtet wird?

Antwort: Wahrscheinlichkeit von _____ % (0 bis 100)

Für wie wahrscheinlich halten Sie es, dass der von Ihnen als 2. Antwort genannte Betrag pro Person ausgeschüttet wird?

Antwort: Wahrscheinlichkeit von _____ % (0 bis 100)

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