

Don't aim too high: the potential costs of high aspirations

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Abstract

The higher our aspirations, the higher the probability that we have to adjust them downwards when forming more realistic expectations later on. This paper shows that the costs induced by high aspirations are not trivial.

We first develop a theoretical framework to identify the factors that determine the effect of aspirations on expected utility. Then we present evidence from a lab experiment on the factor that the theoretical analysis finds to be crucial: the adjustment of reference states to changes in expectations. The results suggest that the costs of high aspirations can be significant, since reference states do not adjust quickly to new expectations. We use a novel, indirect approach that allows us to infer the determinants of the reference state from observed behavior, rather than to rely on self-reports.

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1 Introduction

In this paper, we analyze the costs in expected utility that people incur if they form high aspirations without having good information about their future outcomes.

Throughout our lives we form - and derive utility from - plans regarding our future outcomes. These plans are not always based on detailed information. For example, we have a perception of our planned career and future wealth. But we do not possess reliable information on our own abilities, the abilities of others, or the market conditions prevailing in ten years time. This lack of information is reflected in the concept of *aspirations* as it is used in this paper: an individual's plans and hopes that are based on vague information. This contrasts with the view in Selten (1998), where aspirations are based on detailed information, i.e., they are equivalent to *expectations*. More formal definitions of the two concepts are given in section 2.

When time passes by and we obtain better information, our aspirations often prove incorrect. We may learn that we can expect a better or a worse job than the one we aspired for. Or that we will earn more or less money than we thought. How this affects utility depends on how fast we adapt to new expectations. If we adapt relatively quickly, our initial aspirations do not significantly influence the utility we derive from our outcomes: We do not mind having a less prestigious job or earning less than we aspired for while young. If, however, we do not adapt quickly to new expectations, utility is affected. Then we keep on comparing our mediocre wealth to the fortune we dreamed of, that is, not meeting initial aspirations leaves us disappointed. In this case, entertaining high aspirations that are not supported by reliable information induces costs in expected utility. These costs may offset the positive effects that high aspirations may have otherwise, e.g., on motivation or joy from anticipation.

The purpose of this paper is to analyze whether we have to expect such costs. We first develop a theoretical frame to analyze the impact that aspirations have on expected utility. This shows that despite the positive effects that high aspirations can have on utility, their overall effect may be negative. In particular, the net effect on utility depends on one crucial factor: the adaptation of reference states to new expectations. If reference states adapt quickly, no costs of high aspirations must be expected. If they do not adapt quickly, negative effects on utility are possible.

As the main part of the paper we then run a lab experiment to test the adaptation of reference states to expectations. Through analyzing observed behavior we can infer whether people adapt quickly to changes in expectations. In particular, we test whether people's reference states adjust to changes in expectations during the experiment. The results suggest that this is not the case. This implies that the costs induced by high aspirations are not trivial. Aiming high may hurt more than it helps.

The results also add to the ongoing discussion in the literature on how reference states are formed. There is by now broad agreement that utility from (or satisfaction

with) a certain outcome does not only depend on the outcome itself. It also depends on what this outcome is compared to, i.e., the reference state. However, the details of this process are still little understood. For example, there are plenty of suggestions on what forms the comparison level or reference state for an outcome: one's own previous experiences (status quo or habit formation, see, e.g., Campbell and Cochrane, 1999; Gomes and Michealides, 2003), the outcomes of relevant others (social comparison, e.g., Abel, 1990), one's aspirations (e.g. Simon, 1959; Ng and Wang, 2001; van Osch, van den Hout and Stiggelbout, 2006; Lopes and Oden, 1999, McBride, 2007), or one's expectations (e.g., Shalev, 2000; Koszegi and Rabin, 2006). However, little is known about what determines the relevance of these components for a certain situation or individual, or to what extent individuals themselves can influence their reference state.

As its contribution to this debate, this paper focuses on the latter two components: It analyzes experimentally how initial aspirations influence reference states and expected utility when individuals form well-informed expectations later on. Unfortunately, in the literature there is no clear distinction neither between aspirations and reference states (see, e.g., Huck et al., 2007; McBride, 2007), nor between aspirations and expectations (see, e.g., Selten, 1998 and Stutzer, 2004). Hence, some remarks about the terminology used in this paper seem warranted.

First, the adaptation we consider differs fundamentally from what Selten (1998) and Sauermann and Selten (1962) analyze in their Aspiration Adaptation Theory. In particular, we do not analyze the deliberate adaptation of aspirations, e.g., to performance feedback. Rather, we focus on the subconscious adaptation of reference states to changes in aspirations or expectations. This means that we analyze the utility of individuals, not the strategies of organizations, e.g., firms.

Second, we will use the term *reference state* to generally denote the state that an individual compares her existing state or outcome to. Aspirations, in contrast, are one component among others that may influence this comparison state.¹ Our choice has two reasons. On one hand, "reference state" seems a more neutral term to express this state's function as a comparison level for the definition of gains and losses. On the other hand, previous research has credibly put forward components of the reference state, like habituation, which cannot naturally be subsumed under the concept of aspirations. Hence, *aspirations* in this paper are defined as the plans an individual has while detailed information is lacking. Once detailed information is available she forms *expectations*.

We introduce a novel approach to assess differences in people's reference states. Previous empirical and experimental analyses of the reference state have usually relied on survey studies (e.g. Stutzer, 2004, Rizzo and Zeckhauser, 2007). Since surveys

¹Some of the literature on aspirations defines the reference state more narrowly as one special case of the comparison level (e.g. Ng and Wang, 2001).

depend on self-reports in questionnaires, they potentially suffer from untruthful statements of the subjects, both intentionally and unintentionally. For example, people may want to appear less demanding than they are, or may perceive themselves as being less materialistic than they actually are.² In this paper we choose an alternative approach, which derives the determinants of the reference state from observed behavior. In particular, we measure subjects' risk attitudes at several moments in time while controlling for their expectations and previous outcomes. Since existing research suggests a relation between feelings of loss and gain on the one hand, and risk attitude on the other (see, e.g., Kahneman and Tversky, 1979, Staw, 1976, Thaler and Johnson, 1990, Weber and Zuchel, 2005), this approach allows us to infer the factors that influence individuals' reference states from observed behavior towards risk. We do not have to rely on potentially biased self-reports. However, as a control and in order to be able to compare the two approaches, we also assess individuals' reference states and levels of satisfaction directly in a questionnaire.

The results of our experiment suggest that reference states indeed take considerable time to adjust to changes in expectations. We find that observed risk attitudes towards the end of the experiment are significantly influenced by initial aspirations, but not by new expectations. In contrast, self-reported reference states assessed after the experiment are found to depend on both initial aspirations and new expectations. Possible reasons for this difference are discussed in section 5.

The findings imply that high aspirations induce costs in terms of expected utility.

The remainder of the paper is organized as follows. Section 2 theoretically analyzes the impact of aspirations on expected utility and motivates the experimental study. It shows that whether reference states quickly adapt to expectations determines if losses in utility can arise from high aspirations. The experiment is described in section 3. Section 4 gives some descriptive statistics and section 5 shows the results. Section 6 concludes.

2 Theory

This section provides a formal frame to analyze the impact of aspirations on expected utility. It shows the relevance of the factor that is later tested in the experiment, namely the adaptation of reference states to changes in aspirations or expectations.

2.1 Aspirations vs. expectations

Let $X \subset \mathbb{R}$ be the set of possible future outcomes of the individual, with x as its elements. These elements are quantifiable, and preferences over x are monotonic, i.e.,

²On the implications of self-image or self-perception on individual decision making and utility, see, e.g., Akerlof and Kranton (2000).

$x_1 \succeq x_2 \Leftrightarrow x_1 \geq x_2$. For example, X may denote the income or consumption level the individual can achieve. $f(X)$ is the probability distribution on X .

The individual can form *aspirations* x_A , where x_A is one element of X . In particular, aspirations are defined as the plan or perception an individual has regarding the element of X she will receive in the future, while the information about the distribution on X is still vague. Due to this vagueness, an individual's aspirations can differ from the expected outcome that she infers from the information available. In particular, the literature suggests that aspirations are influenced by different "biasing" factors, like social comparison (Stutzer, 2004), self-image (Nauta et al., 1998; Bandura et al., 2001, Pinquart et al., 2004), wishful thinking (Bryce and Olney, 1991) etc. These biases distinguish aspirations from *expectations*, which are formed when detailed information becomes available.³ Expectations are defined as unbiased in the sense that they correctly reflect the available information. This does not rule out, however, that this information is incorrect. In this case, expectations still differ from the true expected outcome.

The relevant feature of aspirations that is captured by this definition is the individual's discretion in forming them. Although she may infer the distribution on X from the available information, this information is vague enough for her beliefs to deviate from the expected value of this distribution.⁴ This results in potential differences between aspirations and expectations. In case of such differences, the individual's beliefs have to adjust from (biased) aspirations to (unbiased) expectations when information becomes more detailed later on.⁵

Referring to the example from the beginning, this means that as long as an individual does not possess detailed information, e.g., about her own abilities and the future labor market, the wage she aspires for can be influenced by her hopes and the perception of herself as an exceptionally productive worker. Once the information about herself and the market becomes detailed enough, she forms correct expectations regarding her future wage given this information.

In the model we formalize aspirations as "based on vague information and potentially biased" and expectations as "based on detailed information and unbiased" in the following way. When there is only vague information, the density function on X as perceived by the individual is relatively flat, i.e., it assigns significant probability mass to the tails of the distribution. When more detailed information becomes available, the density function gets narrower, that is, the tails of the distribution receive less probability mass (see figure 1).

³They also distinguish aspirations in our sense from those in Selten (1998).

⁴Whether the deviation can deliberately be influenced by the individual or is fully determined by character traits and the biasing factors, to our knowledge has not been well researched yet.

⁵The term "belief" is used in a general sense here, as reflecting either aspirations or expectations, depending on the quality of information.

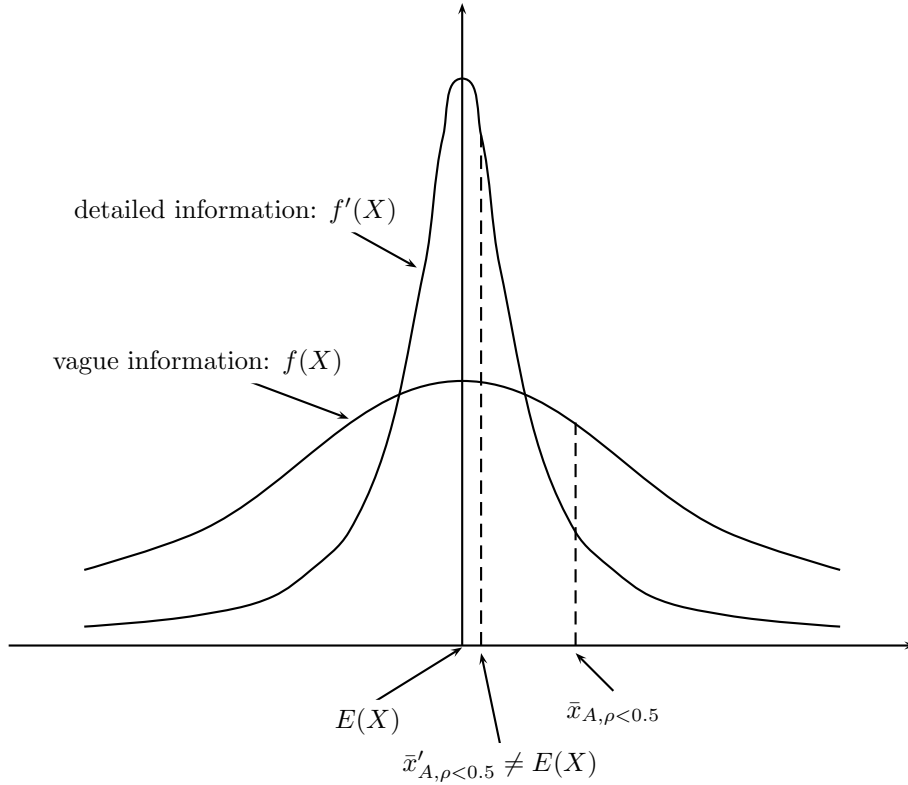


Figure 1: Example of aspirations and expectations: the highest possible aspiration level \bar{x}_A is determined by the level of optimism $\rho < 0.5$. \bar{x}'_A is determined by the same level ($F_X(\bar{x}_A) = F'_X(\bar{x}'_A)$), but more detailed information. Hence, $\bar{x}'_A < \bar{x}_A$. However, \bar{x}'_A is still incorrect: $\bar{x}'_A > E(X)$, that is, aspirations are still biased away from the true expectation.

An individual's aspirations x_A are then defined as an element of X such that the cumulative distribution function F_X assigns a probability of at least ρ to outcomes at least as good as x_A :

$$1 - F_X(x_A) \geq \rho \quad (1)$$

ρ forms the cutoff probability down to which the individual “believes her aspirations”. It measures how ambitious or optimistic the individual's aspirations are. ρ ensures that the probability of the individual's outcomes falling behind her aspirations does not exceed a certain level, where this level is determined by the individual's degree of optimism. The vaguer the information, the more probability mass is located at the tails, and the larger is the range of outcomes for which inequality (1) is fulfilled. Accordingly, given a certain ρ , biasing factors like social comparison or self-image can exercise a stronger influence on the individual's aspirations under vaguer information. The case of extremely pessimistic individuals for whom aspirations fall below expectations is not of interest for this paper.

If the density function gets narrower and the best possible realization the individual

can aspire for is below $E(X) + \Delta$, the individual's aspirations turn into expectations.⁶ Δ reflects the notion of "detailed information". For $\Delta = 0$, the individual's aspirations are defined as expectations only if they match the true expected value of X , i.e., if they are correct given the information available (see figure 1). This is the case we consider here.⁷ However, the general argument can be extended to the case of $\Delta > 0$, i.e., "roughly correct" expectations.

Given these definitions, an individual's aspirations can be altered by changes in the biasing factors or their relative weight, or by changing the "level of optimism" ρ . Less optimistic aspirations, for example, would be translated into a higher ρ , that is, aspiring for a more likely, though possibly less preferred outcome.⁸

Consider now the sequence of events in the model (see figure 2). There are three periods. In $t = 1$ the individual receives only vague information and forms aspirations x_A within the range specified by (1). She derives anticipatory utility $u^a(x_A)$, that is, utility from looking forward to the aspired outcome (see e.g., Caplin and Leahy, 2001). In $t = 2$ the individual receives more detailed information and corrects her beliefs from aspirations x_A to true expectations $E(X)$. She again derives anticipatory utility from this expectation, $u^a(E(X))$. Finally, in $t = 3$ the individual receives outcome x as a realization of X . x induces reference-independent ("absolute") utility $u(x)$ and reference-dependent ("relative") utility $v(x|r)$, where r is the reference state.

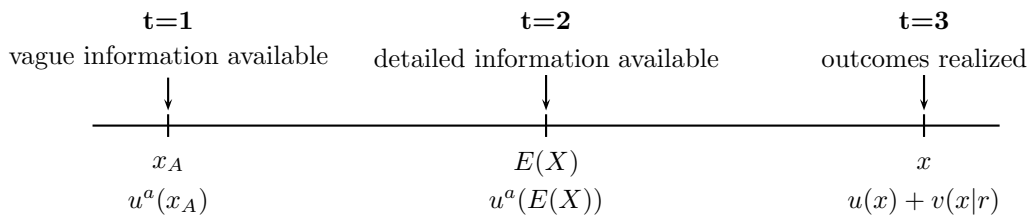


Figure 2: Sequence of events in the model.

This yields the individual utility function

$$U = \underbrace{u^a(x_A)}_{t=1} + \underbrace{u^a(E(X))}_{t=2} + \underbrace{u(x) + v(x|r)}_{t=3}$$

which is based on the following simplifying assumptions:

⁶We do not explicitly consider aspirations that are biased below $E(X)$.

⁷For simplicity, we assume symmetric distributions where the expected value is equal to the median. The argument extends to the general case of skewed distributions.

⁸Note that if the definition of expectations requires correctness, i.e., $\Delta = 0$, this implicitly assumes that more detailed information also leads to an increase in ρ : the better the information the more realistic the individual's perceptions have to be in order for her to "believe in them".

A1: Anticipatory utility is reference-independent.⁹

A2: When deriving anticipatory utility, individuals consider only the absolute utility in $t = 3$, i.e., they do not anticipate reference states.¹⁰ Further, they derive utility only from anticipating the outcomes to be realized in $t=3$, not from anticipating in $t=1$ the anticipatory utility in $t=2$.

2.2 Reference state formation

The reference-dependent utility an individual derives from an outcome x has been specified by Kahneman and Tversky (1979) as $v(x|r)$, where r is the reference that x is compared to. In our model, the individual receives the outcome x in $t = 3$, and compares it to her reference state in $t = 3$, r_3 . This reference state is formed in $t = 1$ and $t = 2$ when the individual first forms aspirations x_A and then expectations $E(X)$. Since this paper focuses on the influence of aspirations and expectations, we will ignore all other factors that may influence the reference state like social comparison or habituation. However, we implicitly allow for these factors to influence the reference state by influencing aspirations.

The timing within periods is as follows. The individual enters each period with a certain reference state. During a period she first receives new information (if there is any). Then she forms aspirations or expectations, depending on the quality of the information. These factors then influence her reference state in the *next* period. This timing reflects the fact that reference states require some positive amount of time for adjustment, i.e., reference states depend on the *past*, rather than the present. Letting the length of a period and the time between periods converge to zero, this setup can account for all specifications of the reference formation process.

The reference state in $t = 3$ can then be written as a function of the reference state in $t = 2$, r_2 , and the individual's aspirations and expectations. Since in our simple setup r_2 can only be influenced by x_A , this means that

$$r_3 = r_3(x_A, E(X)) \quad .$$

To further simplify the model, we will write the reference state in $t = 3$ as being formed by some linear combination of the two influencing factors (and drop the index):

$$r = ax_A + (1 - a)E(X) \quad \text{with} \quad a \in [0, 1] \quad (2)$$

⁹The evidence in Matthey (2006) suggests that it is reference-dependent. However, including this here would unduly complicate the model. It does not influence our main argument, since the effect on anticipatory utility is similar to the one on utility from realized outcomes.

¹⁰Note that there is no evidence on whether individuals actually include reference states in anticipations or not.

The parameter a denotes the impact of the aspirations that the individual holds in $t = 1$ on the reference state she has in $t = 3$ when she has formed new expectations in $t = 2$. If the reference state adjusts quickly to new expectations, then $a \approx 0$ holds. If $a \neq 0$, aspirations continue to influence the reference state for a significant period of time even after detailed information has led to the formation of new expectations.

2.3 Effect of aspirations on utility

High aspirations may increase the individual's motivation to work hard, and hence enable her to achieve better outcomes. In addition, aiming high may have a positive signalling effect on others, which by inducing support, trust, etc., may also increase the individual's expected outcome. Referring again to the wage example, aspiring for a top level job may make the individual work longer hours, and expressing a strong belief in her success may make others believe in the abilities and determination of the individual. In order to account for such effects, we assume that when aspirations are higher, the individual achieves an outcome distribution which is at least as good as when aspirations are lower. However, we assume the positive effect of high aspirations to be sub-proportional: an increase of one unit in aspirations leads to an increase in expected outcomes of less than one unit, and meeting higher aspirations is never more likely than meeting lower aspirations.¹¹ Aspiring for a 50.000 Euro higher wage increases the expected wage by less than 50.000 Euro, and actually achieving this wage is no more likely than achieving the lower wage when aspirations are lower. It should be noted that these effects are not the primary focus of the paper, and we will not elaborate on them. They are included in the model in order to test whether in spite of their existence negative net effects can occur.

The individual's expected utility over periods $t = 1$ to $t = 3$ is then given as:

$$E(U) = u^a(x_A) + u^a(E(X)) + \int_x u(x)dF_X + \int_x v(x|ax_A + (1-a)E(X))dF_X$$

The individual's optimal aspirations are given by

$$\frac{\partial E(U)}{\partial x_A} = \frac{\partial u^a(x_A)}{\partial x_A} + \frac{\partial u^a(E(X))}{\partial x_A} + \frac{\partial \int_x u(x)dF_X}{\partial x_A} + \frac{\partial \int_x v(x|r)}{\partial x_A} = 0$$

Since high aspirations increase expected outcomes by means of motivation and signalling we get that

$$\frac{\partial u^a(x_A)}{\partial x_A} > 0 \quad , \quad \frac{\partial u^a(E(X))}{\partial x_A} > 0 \quad \text{and} \quad \frac{\partial \int_x u(x)dF_X}{\partial x_A} > 0 \quad .$$

¹¹A formal treatment of this effect is available from the authors upon request.

This means that there only exists a local optimum if $\frac{\partial \int_x v(x|r)}{\partial x_A} < 0$. Otherwise, expected outcomes and anticipatory utility reach their maximum if aspirations are maximized. Accordingly, only if the effect of an increase in aspirations on expected reference-dependent utility is negative, an increase in aspirations may lead to a decrease in overall utility. If a negative effect of x_A on $\int_x v(x|r)$ can be ruled out no costs of high aspirations on individual utility must be expected.

This effect of an increase in aspirations on reference-dependent utility has two opposing components. First, similar to the effect on $u^a(\cdot)$ and $u(\cdot)$, higher aspirations increase expected reference-dependent utility through increasing expected outcomes:

$$\frac{\partial \int v(x|ax_A + (1-a)E(X))dF_X}{\partial E(X)} > 0$$

Second, for $a > 0$, an increase in x_A increases the reference state, which reduces expected utility.¹² As the result, for outcomes above the increased reference state utility decreases but is still positive. For outcomes between the initial and the increased reference state former gains turn into losses, while for outcomes below the initial reference state existing losses become even larger. Hence,

$$\frac{\partial \int v(x|ax_A + (1-a)E(X))dF_X}{\partial r} < 0$$

Accordingly, the net effect of an increase in aspirations on reference-dependent utility is ambiguous: On the one hand, expected utility increases since expected outcomes increase. On the other, it decreases as a result of the influence of initial aspirations on the reference state and of loss aversion (the difference in utility functions for losses and gains).

The important result is that if $a \approx 0$, i.e., reference states quickly adjust to new expectations, reference-dependent utility is zero, and the effect of high aspirations on expected utility is unambiguously positive (no local optimum in aspirations).

The question whether the reference state quickly adjusts to new expectations, i.e., whether $a \approx 0$, is tested in the experiment described in the next section. Note that we do *not* test the complete model, since testing for the parameter a is sufficient to show whether high aspirations can lead to losses in expected utility. In particular, we do not test whether a motivation effect of high aspirations exists.

3 Experiment

3.1 Design

The general idea of the experiment is the following: At the first stage we assess the subject's aspirations regarding the payoff from the experiment before they have

¹²The increase in x_A also increases the reference state through increasing $E(X)$, but by definition of r this effect never increases r above $E(X)$.

detailed information about their payoffs. At the second stage we reveal this information, but induce different expectations regarding these payoffs (through different lotteries). Then we give subjects time to adjust to their expectations. Next we assess subjects' risk attitudes, before they actually receive their payoffs. At the third stage we assess whether subjects feel they made a gain or a loss through analyzing systematic differences in their risk attitudes. This allows us to make inferences on the factors that influence subjects' reference states, in particular on the impact of their initial aspirations vs. the expectations they formed during the experiment. At the fourth stage we ask for subjects' reference states in survey form. Note that each subject played the four stages only once.

The next paragraphs describe the different stages of the experiment in detail. All four stages and the order of events are also depicted in figure 3.

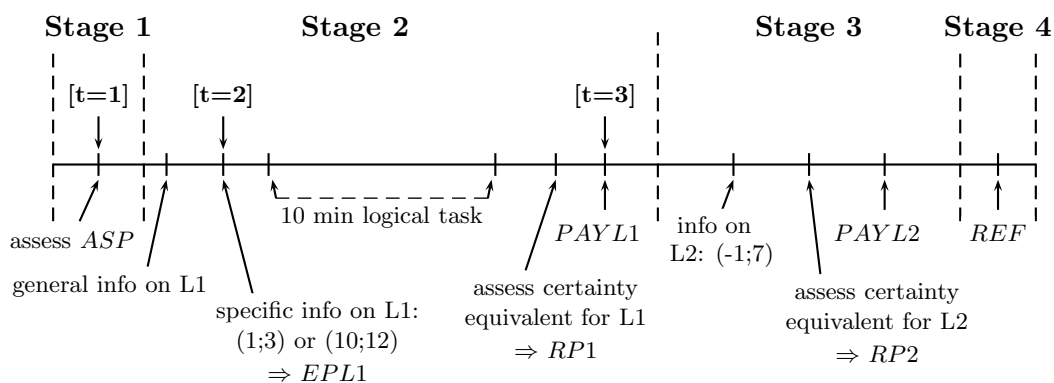


Figure 3: Order of events in the experiment. The times in squared brackets show which events in the experiment reflect which moment in the model.

In the invitation to the experiment it was stated that the experiment would last about one hour and that participants would earn 12 Euro on average. At the first stage, subjects stated a price for which they would have been prepared to abstain from the experiment. This serves as a proxy for their initial aspirations regarding the payoffs in the experiment, and is denoted with ASP . It represents time $t = 1$ in the model. The price was assessed through an interval method: As the first step, all subjects were asked whether they would abstain from the experiment if they instead received 15 Euro, but had to stay in the lab. Those who preferred the money were offered a lower price next. Those who preferred to take part in the experiment were offered a higher price next. This method was continued until subjects had specified their preferences up to one Euro cent. The interval method was explained in detail in the instructions, and a quiz ensured that all students had understood it. During the experiment, we assessed all prices by the interval method. While the elicitation of initial aspirations ASP was hypothetical, other prices were paid out. Whether assessed prices were to be paid out or not was clearly indicated before the respective

decision.

At the second stage, subjects were informed that they would later participate in a lottery. Half of the subjects received a lottery that would pay either 10 or 12 Euro with equal probability. The other half received a lottery that would pay either 1 or 3 Euro with equal probability. Once they had received detailed information regarding their lottery, they could easily calculate their expected payoff, *EPL1*. This represents time $t = 2$ in the model.

Subjects did not know what lottery the other participants received, or whether they received a lottery at all. After all subjects had learnt the features of their lottery, they had to perform a logical task. This task - completing series of numbers - lasted for 10 minutes and did not influence pay offs. It was included in order to give the participants time to adjust their reference states to the expected payoff from the lottery they would take part in, i.e., to adapt to the new expectation. Although this time is not too long, it was not short relative to the overall duration of the experiment (about 1h) or in relation to the amount of money involved. Further, due to some other tasks (e.g., determination of the certainty equivalent, see below) the true time between forming expectations about the lottery and actually receiving the payoff was about 15 minutes. As the next step we assessed subjects' certainty equivalent of the lottery they had received. From this we calculated the risk premium, *RP1*, as the difference between expected payoff and certainty equivalent.¹³ Afterwards, the lotteries were played out and subjects received their payoffs, *PAYL1*, i.e., 1, 3, 10 or 12 Euro. This point represents time $t = 3$ in the model. The payoffs determined subjects' nominal gain or loss, *GoLL1*: Individuals who received either 1 or 10 Euro lost relative to the expected payoff from their lottery, while individuals who received either 3 or 12 Euro won. Note that for this first lottery certainty equivalents were not paid out (and subjects were informed about this).

The third and fourth stage of the experiment do not represent events of the model anymore. They are only used to assess the influences on subjects' reference states. At the third stage, subjects received a second lottery, which was the same for all. In this lottery, subjects would either have to pay 1 Euro from their previous payoffs or be paid 7 Euro extra with equal probability.¹⁴ We then assessed the subjects' certainty equivalent for this second lottery, which was to be paid out (and subjects were aware of this). The risk premium indicated by this choice is denoted *RP2*. Next, we used a Becker-DeGroot-Marschak mechanism to determine whether subjects would receive their certainty equivalent or the payoff from the lottery. The participants who took part in the lottery then flipped a coin, which determined their payoff. The others received their certainty equivalent. The payoff from the second lottery, *PAYL2*, was

¹³Terms like "certainty equivalent", "price" etc. were not used in the experiment. See the appendix for a translated version of the instructions.

¹⁴That subjects can make nominal losses here is not a problem since all subjects received the same lottery, and risk attitudes were analyzed *relative* to other subjects, rather than in absolute terms.

then added to the one from the first lottery.

Finally, at the fourth stage we asked our subjects, which payoff from the experiment they would have been satisfied with. This payoff is used as a (self-reported) proxy for their reference state at the end of the experiment, *REF*.

After the experiment had ended subjects filled in a questionnaire. There, they were asked how satisfied they had felt with their payoff from the first lottery (*SatisfactionL1*) right after they received it. As usual, we also collected data on age, gender, subject of study and previous experience with experiments.

48 students of Technical University Berlin and Humboldt University Berlin participated in the experiment. The sessions took place at Technical University Berlin in December 2006. The experiment was programmed and conducted with the software *z-Tree* (Fischbacher, 2007).

3.2 Method

The aim of the experiment is to analyze whether reference states quickly adjust to changes in expectations. As we cannot directly observe individual reference states, and do not want to rely on the subjects' self-reports, we use an approach which allows us to infer differences in reference states indirectly from observed differences in risk attitudes. In particular, we test which parameters influence subjects' risk attitudes in the second lottery. From this we can infer the influences on their reference states at the time when they receive their payoffs from the first lottery, which represents $t = 3$ in the model. Accordingly, in terms of the model this means that we can infer the influences on r . The rationale of the approach is explained in detail next.

Previous research implies that people's risk attitude depends on whether they are in the domain of losses or gains. In different contexts, individual's have been found to react differently to risk, depending on whether they have previously made losses or gains, or depending on whether they expect to make losses or gains. Staw (1976) observed behavior he calls "escalation of commitment", where losses in past situations lead to higher risk taking than gains. In similar, i.e., sequential situations, Thaler and Johnson (1990) find the opposite: after making gains, people become less risk averse, a behavior the authors term the "house money effect". A recent study by Weber and Zuchel (2005) indicates that the opposing effects may arise as a result of different frames of the decision situation. This would also be consistent with the finding of Kahneman and Tversky (1979) that when facing losses, people become more risk loving than when facing gains.

What these results have in common is that depending on whether people experience/expect a loss or a gain, they react differently to risk. Hence, the factors that influence people's sentiment of loss and gain also influence their risk behavior. This

is what matters for our approach. Any sentiment of loss or gain depends on three factors: First, a person’s actual payoff. Second, her reference state. Together, these form the ”objective” gain or loss. Third, her individual experience of this objective gain or loss, i.e., her degree of loss aversion. This forms her ”subjective” gain or loss, that is, her utility from winning or losing. In the experiment, the objective gain or loss in $t = 3$ is determined by the subjects’ payoffs in the first lottery, PAYL1, and their reference states when they receive these payoffs. The subjects’ subjective gain or loss is approximated by assessing their satisfaction with the outcomes of the lottery, SatisfactionL1.¹⁵

Now we can imagine two scenarios:

1. The individual’s reference state in $t = 3$, i.e., when she receives the payoffs from the first lottery, is determined by the expected payoff from this lottery. This means that her sentiment of loss or gain depends on whether she receives the high (3 or 12 Euro) or the low (1 or 10 Euro) payoff in her respective lottery. Accordingly, her risk attitude in the second lottery, RP2, is influenced by whether she won or lost *within* her first lottery (GoLL1).
2. The individual’s reference state in $t = 3$ is determined by her initial aspirations. Whether she experiences a loss or a gain therefore depends on whether she receives a high (10 or 12 Euro) or a low (1 or 3 Euro) payoff relative to her aspirations. Accordingly, her risk attitude in the second lottery is influenced by her aspirations (ASP) and by whether she received the good or the bad lottery, i.e., the expected payoff from her first lottery, EPL1.

Finally, asking subjects at the very end for the amount they would have found ”satisfactory” served as a control for the self-report approach of assessing reference states. In contrast to the initial aspirations, this amount includes neither a risk premium nor a gambling premium. In this sense, it is a cleaner proxy for the reference state at the end, than ASP is for the aspirations at the beginning. However, since subjects already knew their payoffs at the time we assessed REF, endowment effects and hindsight bias may have been present.

3.3 Hypotheses

The hypotheses are derived from the two scenarios described above.

Hypothesis 1: The risk premium in the second lottery does not depend on whether subjects received a loss or a gain in the first lottery, relative to the expected payoff from this lottery.

¹⁵Note that since ‘SatisfactionL1’ was only assessed at the end of the experiment, it may suffer from hindsight bias. This had to be accepted since asking for subjects’ satisfaction during the experiment would have focused their attention on their level of satisfaction, which could have biased the results.

If hypothesis 1 is rejected, the new expectations in $t = 2$ influence people’s reference state in $t = 3$. This would imply that there is at least some adaptation to new expectations within reasonable time, i.e., within the 10 minutes of the logical task. This reflects scenario 1 above, i.e., $a < 1$ in equation (2) of the model.

Hypothesis 2: The risk premium in the second lottery does not depend on subjects’ initial aspirations and their expected payoff in the first lottery.

If hypothesis 2 is rejected, people’s initial aspirations continue to influence their reference states even after the 10 minutes of the logical task. This would mean that adaptation to new expectations requires considerable time. This reflects scenario 2 above, i.e., $a > 0$ in the model.

Note again that the link between people’s reference states and the hypotheses is based on the assumption of a relationship between sentiments of gain and loss on one hand and risk attitude on the other. Although the details of this link (the sign of the effect) are not crucial for our argument, *some* relation has to be assumed that is shared by the majority of the subjects.

4 Description of the data set

Our data set contains 48 individuals who participated in our experiments. Their characteristics are summarized in table 1. The descriptive statistics show that the average participant has an age of 23 and has been studying for almost 6 semesters, i.e. nearly three years. Most of our participants are male (around 70%), have not participated in any experiment before (around 65%) and have at some point followed a course in economics (around 62%). The average profit which was earned in the experiment is 13.77 Euro (plus a show-up fee of 3 Euro).

Although we did give our subjects some information on the expected payoff from the experiment (12 EUR), aspirations as indicated by ASP have an average value of 16.68 Euro. Furthermore, they differ widely. There are several possible reasons for that. First, people may not have noticed the information in the invitation regarding the expected payoff and instead derived their aspirations from some more general distribution. Second, they may have discounted the relevance of the information as being general information regarding the experiments that take place in the lab. Third, in the months before our experiment, several other experiments took place in the lab. Some of our participants may have participated in these experiments or may have heard from others who participated, and then extrapolated from (higher) average payoffs there. Fourth, since the payoff from the experiment is uncertain when ASP is assessed, some people may subtract a risk premium from their true aspirations. Fifth, the amount people state may include compensation for the utility they would derive

Variable	
<i>Personal Characteristics</i>	
Age (years)	23.5625
Female	0.2917
Semester	5.7917
Experience	0.3542
Econ	0.6250
<i>Payoff in the experiment</i>	
Profit	13.7708
ASP	16.6785
N	48

Table 1: Descriptive Statistics.

from their participation in the experiment, that is, the fun of gambling.¹⁶ Sixth, people may expect the true average payoff, but be overoptimistic regarding their own performance in the experiment.

5 Results

Remember [As said above?], the first hypothesis we want to test states that the risk premium in the second lottery does not depend on whether individuals received a gain or loss in the first lottery relative to the expected payoff from this lottery. We use the indicator of nominal gains and losses in the first lottery, *GoLL1*, as explanatory variable to test against this first hypothesis. If the estimated coefficient is not statistically different from zero we cannot reject hypothesis 1 and conclude that individuals do not adapt to new expectations. In contrast, if the estimate is different from zero, this implies that there is some adaptation to expectations within the time of our experiment. Concerning the sign of the estimated coefficient we have no clear expectation: the house money effect (Thaler and Johnson 1990) implies a negative sign, while prospect theory (Kahnemann and Tversky, 1979) and the escalation of commitment effect (Staw 1976) imply a positive sign (see section 3.2).

The second hypothesis we test is that the risk premium in the second lottery does not depend on subjects' initial aspirations and their expected payoff in the first lottery. To test against this hypothesis we include the individuals' initial aspirations, *ASP*, and the difference between these aspirations and the expected payoff in the first lottery, *DIFFL1*. To calculate *DIFFL1* we use the expected payoff (*EPL1*) rather

¹⁶For some people, this utility may have been negative, if they enjoy writing emails or reading a book more than participating in the experiment.

than the received payoff (PayL1) in order to avoid that the level of the payoff (high or low) enters the regression conjoint with losses and gains in the lottery. In addition, we include the subjects' stated satisfaction with the payoff from the first lottery (SatisfactionL1). This variable captures the emotional reaction of the subjects, given their aspirations and their nominal gains and losses relative to either their aspirations (DIFFL1) or expectations (GoLL1).

To control for the individual's general risk attitude we also include the risk premium of the first lottery (RP1).

Using the data set described in the previous section our basic estimating equation is given by:

$$RP2_i = \alpha + \beta GoLL1_i + \gamma ASP_i + \delta DIFFL1_i + \theta SatisfactionL1_i + \eta RP1_i + u_i \quad (3)$$

where α is a constant, and β , γ , δ , θ and η are the coefficients we want to estimate. u_i is an error-term for which $E[u|x]$ is assumed to be zero.

The regression results (and robust standard errors corrected for heteroscedasticity) are given in table 2.

RP2	coefficient	p-value
GoLL1	-0.6821	0.170
ASP	-0.1307	0.040
DIFFL1	0.0894	0.101
SatisfactionL1	-0.4866	0.055
RP1	0.6304	0.227
constant	1.6162	0.151

Table 2: OLS-regression for the risk premium of the second lottery (robust standard errors, R-squared = 0.1882).

The results show that the indicator of nominal gain or loss (GoLL1) has a negative but insignificant effect on the risk premium in lottery 2. Hence, *hypothesis 1 cannot be rejected*. This provides some evidence that subjects' reference states do not adjust quickly to new expectations.

In contrast, we find that subjects' initial aspirations (ASP) have a significant influence on the risk premium in the second lottery. Hence, *hypothesis 2 can be rejected* at the 5% significance level. This implies that initial aspirations continue to influence subject's reference states. The coefficient of DIFFL1 is not significant, which may be due to the fact that all but 5 subjects have a positive DIFFL1 ($ASP_i \geq EVL1_i$), i.e., there is too little heterogeneity in this variable.

In sum, the results suggest that there is very little adjustment of the subjects' reference states to new expectations during the experiment. Even though we cannot directly test for a , we can infer from our regression analysis that the adjustment process is slow, which implies that $a \ll 1$ for reasonable periods of time.

Further, the results show that the individuals' risk attitude is influenced by their subjective level of satisfaction with their payoffs - given their objective gains and losses. This supports the view that an individual's *sentiment* of loss or gain ultimately influences her risk attitude, rather than only nominal measures.

Note that the coefficient of the risk premium of the first lottery is positive (as expected) but not significant. This is presumably due to the fact that part of the general risk attitude is captured in ASP ($\text{corr}(\text{ASP}, \text{RP1}) = -0.34$), which dilutes the impact of RP1.

Next, we want to examine the interdependence between initial aspirations, new expectations and self-reported reference states at the end of the experiment. For this purpose, we regress the subjects' reported reference state at the end of the experiment (REF) on their initial aspirations, as well as on their expected payoffs in the first lottery (expected payoffs in the second lottery where the same for all subjects). To control for endowment effects, since REF was assessed after subjects knew their overall payoffs (PROFIT), we control for this variable. If initial aspirations continue to influence the reference state at the end of the experiment, we expect the coefficient of ASP to be positive. The same applies to subjects' expectations. Finally, if endowment effects occur, the coefficient of PROFIT is also expected to be positive.

The equation we estimate can be summarized by:

$$REF_i = \alpha + \beta ASP_i + \gamma EVL1_i + \eta PROFIT_i + u_i \quad (4)$$

where, again, α is a constant, β , γ and η are the coefficients we want to estimate, and u_i is an error-term for which $E[u|x]$ is assumed to be zero.

The results of our regression are given in table 3.

REF	coefficient	p-value
ASP	0.3253	0.001
EVL1	0.0630	0.770
PROFIT	0.2980	0.081
constant	3.3455	0.065

Table 3: OLS-regression for the self-reported reference state (robust standard errors, R-squared = 0.3774).

The results support those of the observed-behavior approach. The initial aspirations continue to influence the reported reference state at the end (large significant effect), while an influence of the expectations the subject's formed during the experiment cannot be shown (small and insignificant effect). In addition, we find a considerable endowment effect, i.e., a large positive effect of PROFIT. Its statistical significance is weak, however, presumably due to the correlation with EVL1.

In summary, the experiment provides strong evidence against the hypothesis that aspirations do not influence reference states once new expectations are formed: we find that $a > 0$. We do not find evidence for an adaptation of reference states to new expectations. Of course, this does not mean that no adaptation takes place. However, even for small amounts it seems to take much longer than the period we analyze in the experiment.

6 Conclusion

Aiming high and working hard is the chosen path of many people in industrialized countries. This paper shows that there may be a cost involved in this approach.

We first show theoretically that if people do not quickly adapt to new expectations, high aspirations can induce losses in expected utility. Although other parameters can be relevant for the *size* of the loss in utility, whether adaptation happens quickly is shown to determine whether losses can occur or not.

As the next step, we use a lab experiment to test whether reference states indeed adapt quickly when new expectations are formed. The results indicate that this is not the case, which implies that significant losses in expected utility can arise when people maintain high aspirations.

Our results also show that additional research concerning the formation of reference states is needed, as reference states cannot be explained with expectations alone. Since aspirations are found to influence reference states beyond the formation of expectations, further research into the factors that influence aspirations is required.

Appendix

Instructions

The following experiment is part of a research project which is financed by the Deutsche Forschungsgemeinschaft (German Research Foundation). It aims at analysing economic decision behaviour.

You can earn a considerable amount of money within this experiment. The amount of money depends on your decisions. Hence, it is very important to read these instructions carefully and thoroughly.

Please note that these instructions are only intended for you. You are not allowed to circulate any information to other participants. By the same token you are not allowed to talk to other participants during the whole experiment. If you have any questions please raise your hand. We will then pass by and answer your question. Please do not ask your question(s) aloud in any case. If you violate these rules we are forced to cancel the experiment.

Procedure

The experiment lasts for about 60min. It consists of several parts. In each of these parts you solve problems or make decisions. In each case, the respective decisions and problems will be carefully explained on the screen. Please note that your experiment's payoff does not only depend on your decisions. It is also influenced by random decisions made by the computer.

Not all of your decisions influence the amount of money that is paid out to you at the end of the experiment. If the decisions' results are paid out this is explicitly announced before you make these decisions. The other decisions and problems are not relevant for your payoff.

All figures in the decisions that are relevant for your payoff are given in Euro. They are paid out to you in exactly the given amount at the end of the experiment. Additionally, you receive 3 Euro for your participation.

Lotteries

Two times in the experiment you can take part in a lottery. You receive payoffs from these two lotteries. In each of the two lotteries there are two different payoffs, a higher and a lower one. In each case, you receive only one of these payoffs. Which payoff you receive depends on chance. The chance to receive the higher payoff is as big as the chance to receive the lower payoff. This can be visualised as follows:

In a big pot there are 100 balls. Out of these 100 balls 50 balls are white and 50 balls are black. By chance, one single ball is drawn out of the pot. If this ball is white you get the higher payoff. If the ball is black you get the lower payoff.

For example, if the lottery is a lottery in which you can earn either 5 or 10 Euro, you can imagine the following: If a white ball is drawn out of the pot with 100 balls, you will receive 5 Euro. If a black ball is drawn out of the pot with 100 balls, you will receive 10 Euro.

Decision process

After you have been offered a lottery within the experiment, we ask you which fixed amount of money we would have to offer you so that you are willing to abstain from participating in the lottery. Your decision between the participation in the lottery and the fixed amount of money is taken according to a procedure that will be explained to you in detail in the following.

Let us assume - like in the example above - that you can receive either 5 or 10 Euro in the lottery. The chance that you receive 5 Euro is thereby as big as the chance that you receive 10 Euro. Please note that this lottery is only an example. It does not show up in the experiment!

First of all we ask you whether you would abstain from participating in the lottery if you could receive a fixed amount of money of 7.50 Euro instead. If you prefer receiving 7.50 Euro to participating in the lottery, then click on "yes". If you prefer participating in the lottery to receiving 7.50 Euro, then click on "no".

The next question is very similar to the first one. The only difference is that now you are not offered 7.50 Euro but another fixed amount of money. For example, we offer you 8.75 Euro or 6.25 Euro in the second step. We then again ask you whether you would be ready to abstain from the lottery for a fixed amount of money of 8.75 Euro or 6.25 Euro, respectively. If you prefer receiving this amount of money to participating in the lottery, then click on "yes". If you prefer participating in the lottery to receiving 8.75 Euro or 6.25 Euro, respectively, then click on "no".

These questions are repeated according to this schema several times, whereat we offer you different fixed amounts of money. All these amounts of money are at least as big as the lower payoff of the lottery. And they are not exceeding the higher payoff of the lottery. For the lottery in the example, in which you either receive 5 or 10 Euro, this means: The fixed amounts of money that we offer you for abstaining from the lottery vary between 5 and 10 Euro.

In the first lottery in the experiment we would only like to know for which fixed amount of money you would be ready to abstain from the lottery. However, in any case, you participate in the lottery.

In the second lottery you can effectively abstain from your participation in the lottery. You then receive a fixed amount of money. For this purpose we identify the price against which we "exchange" the lottery. This is done according to a certain mechanism which is explained in the following paragraph.

Determination of the exchange price

First, the computer randomly determines the price for which we exchange the lottery. This price lies in the same range as the amounts of money you are offered during the decision process. For the lottery in the example, this means that the price lies in the range between 5 and 10 Euro.

All amounts in this range have the same chance to be drawn as exchange price. This means the chance that the price is 6.00 Euro is just as high as the chance that it is 8.43 Euro. But it also means that the chance that the price is above 8.43 Euro is far smaller than the chance that it is above 6.00 Euro. This is because there are far more possible prices between 6.00 Euro and 10.00 Euro than between 8.43 Euro and 10.00 Euro.

The decisive question is then the following: In the decision process, did you abstain from the lottery at an amount which was below or just as high as the price? If yes, you will receive the price and not participate in the lottery. If not, you will not receive the price, but participate in the lottery. You will then receive the low or the high payoff with equal chance.

Consider again the lottery in the example, in which you receive either 5 or 10 Euro. Assume that a price of 6.23 Euro is drawn. When asked whether you wanted to abstain from the lottery for an amount of 6.23 Euro or less - did you choose the fixed amount? Then you will receive 6.23 Euro and not participate in the lottery. Did you choose the lottery? Then you will not receive the 6.23 Euro. You will participate in the lottery and have equal chances to receive 5 or 10 Euro.

Note! If you do not participate in the lottery, you do **not** receive the lowest amount at which you abstained from the lottery. You receive the price that the computer draws randomly. This means that all participants in the experiment who do not participate in the lottery receive the same amount of money! This means that your choice to abstain from the lottery in exchange for a certain fixed amount does **not** determine the size of the fixed amount you receive. It determines the **chance** that you receive the price that the computer determines, rather than to participate in the lottery. If you abstain from the lottery at lower amounts, you increase the chance to receive the price and do not participate in the lottery. If you abstain from the lottery only at higher amounts, you increase the chance to not receive the price but participate in the lottery.

The described mechanism is called Becker-DeGroot-Marschak mechanism. With this mechanism it is optimal for you to state honestly for every fixed amount whether you prefer to participate in the lottery or to receive the fixed amount.

We will now give you more examples of the mechanism.

Example 1:

You can participate in a lottery in which you have equal chances to either have to pay 2 Euro or receive 12 Euro. You decided to abstain from the lottery for all fixed amounts higher than or equal to 3 Euro. For fixed amounts below 3 Euro you preferred to participate in the lottery.

1. The computer randomly draws a price of 4.50 Euro. Since for this amount you decided to abstain from the lottery you receive the price of 4.50 Euro and do not

participate in the lottery. 2. The computer randomly draws a price of 1.35 Euro. Since for this amount you preferred to participate in the lottery, you do not receive the price. You participate in the lottery, and either pay 2 Euro or receive 12 Euro. Both with equal chance.

Example 2:

You can again participate in a lottery in which you have equal chances to either have to pay 2 Euro or receive 12 Euro. You decided to abstain from the lottery for all fixed amounts higher than -0.50 Euro. For fixed amounts below -0.50 Euro you preferred to participate in the lottery.

1. The computer randomly draws a price of -0.70 Euro. For this amount you preferred to participate in the lottery and not receive the fixed amount. Accordingly, you do not pay the price of 0.70 Euro. You participate in the lottery, and either pay 2 Euro or receive 12 Euro. 2. The computer randomly draws a price of -0.35 Euro. For this amount you decided to rather pay the price and abstain from the lottery. Accordingly, you pay the price of 0.35 Euro and do not participate in the lottery.

As mentioned before, the exchange price is only drawn for your decision regarding the second lottery. For the first lottery you merely complete the decision process as described above. You will complete this decision process in two more parts of the experiment. The decisions you have to make there are described in detail in due time.

Please complete now carefully the questions below, to ensure that you understood the described procedures.

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