Starting Points´ Effects on Risk-Taking Behavior

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We formally represent the effects of prior gains and losses in a simple dynamic preference calculus based on prospect theory’s value function and thoughts adapted from aspiration level theories. We investigate our predictions in questionnaire experiments. Since we document a strong effect of prior gains and losses in our main study on entrepreneurial decision making, findings are consistent with a difference between the actual status quo and temporarily invariant aspiration levels. However, the general level of willingness to pay (WTP), differences between gain and loss domains, and preference orders within the gain domain are inconsistent with prospect theory’s prediction. In the loss domain, results are less straightforward but only interpretable on the joint basis of prospect theory, starting point formula, and an additional survival point. Altogether, results are a challenge to prescriptive as well as descriptive models of decision making relying on context-independent value functions. Implications for a further development of descriptive decision theoretic models based on aspiration levels to account for dynamic starting points’ effects are discussed.

Overview of Content

Introduction

According to a number of studies (see e. g. Bowman 1980, 1982; Fiegenbaum and Thomas 1988; Fiegenbaum 1990), managers and entrepreneurs are risk seeking when trying to recover from "losses" in the sense of negative deviations from a certain reference point (if they perceive their situation as "bad"). They are, however, risk averse if they are above such a point (if they perceive their situation as "good"). A similar effect has been reported in the financial markets literature, the so-called "disposition" effect in securities trading (see e. g. Shefrin and Statman 1985; Weber and Camerer 1998; Weber and Zuchel 2001).

Both phenomena have often been explained via prospect theory's value function (Kahneman and Tversky 1979; Tversky and Kahneman 1992; see figure 1) since this function is concave above the reference point implying risk aversion, and it is convex below the reference point implying risk seeking behavior. To account for the above mentioned (dynamic) phenomena, authors have often implicitly referred to some notion of a *reference point that is temporarily invariant*. If a decision maker has to digest a recent loss, she is kind of looking "upwards" to her reference point. If she just experienced a gain, however, she perceives herself being "above" this point.

Looking at this explanation more closely, it implies nothing but a split of prospect theory's reference point into two parts. The first part is the original reference point that determines the location of the origin of the value function. This point could perhaps be interpreted as an *aspiration level* (see e.g. Lewin et al. 1944; March and Shapira 1992) since this is what the decision maker apparently accepted as her initial status quo – valued as zero – earlier.[1] The second part is the actual starting point of subsequent calculations that describes the "new status quo" that has

[1] This is actually a simplification of aspiration level theories (see the next section for more details).

not been adjusted to her zero-level or aspiration level, yet. A decision maker who e. g. faced a recent loss, may not want to accept the loss and temporarily “keeps” her original reference point. The subsequent decision is therefore characterized by a “comparison” between starting and reference points.[2]

Preference orders implied by our thoughts are consistent with mental accounting (Thaler 1985; Thaler and Johnson 1990) for the “aggregation” case. However, “aggregation” does not allow for a direct comparison of subjective valuations of subsequent lotteries *between* loss and gain situations. With aggregation, the valuation of subsequent payments is not corrected for the valuations of prior gains and losses themselves. We do not think that this is necessarily reflecting real decision makers’ evaluations of subsequent payments. Therefore, the starting point formula does correct valuations of subsequent lotteries for starting points’ valuations. Since solely the *subjective value* of any subsequent lottery is calculated, comparisons between gain and loss situations are directly possible. Starting point-dependent preferences may also be useful in a game theoretic context (see Schröder and Schade (2001) and the implications section).

Whereas our findings turn out to be somewhat supportive of our notion of starting and reference point’s differences, prospect theory’s predictions are largely rejected. We are first of all re-analyzing data from an investment experiment that was originally designed for a different purpose. Here, we mainly checked for consistency with our framework. A specific test of all hypotheses is then carried out in our main study on an entrepreneurial decision situation. The next section now provides a formal representation of the dynamic effect of “sticky” reference points or aspiration levels. Our approach will be compared with the predictions of mental accounting. A theorem and hypotheses underlying our study are stated. The subsequent section reports

[2] Note that the interpretation of a reference point as an aspiration level is less straightforward with prior gains.

on the results of our experiments. The two concluding sections contain a general discussion as well as implications for further research.

Starting and reference points' differences: the "dynamic" view

A formal treatment of dynamic starting points' effects within prospect theory's framework is, to our knowledge, missing up to now (but note the similarities to e.g. Helson's (1964) adaptation level theory as well as March and Shapira's (1992) and Shapira's (1996) analyses that are similar in spirit). We suggest a separation of *starting* and *reference points*. We furthermore assume that prospect theory's value function is temporarily anchored in the origin – the initial reference point –, and that the starting point may be situated above or below that point. Subsequent gains and losses from a decision are however calculated relative to the respective individual's starting point.[3] These considerations are captured in the following equation, where for a starting point (prior payment) x_t and a subsequent payment x_{t+1}, the subjective valuation σ of x_{t+1} is given by:

$$\sigma(x_{t+1}) = v(x_t + x_{t+1}) - v(x_t), \qquad (1)$$

with the function v:

$$v(x) = \begin{cases} x^{\alpha} & \text{if} \quad x \geq 0; \\ -\lambda \cdot (-x)^{\alpha} & \text{if} \quad x < 0, \end{cases} \qquad (2)$$

3 The invariance of an aspiration level also with gains has been demonstrated for a high fraction of respondents e.g. by Festinger (1942). The situation is somewhat unclear in our experiment since reaching a recent aspiration level of zero was certain in the win situation of study 2 (see below).

being the prospect theory's value function. The empirical parameters are $\alpha \approx 0.88$ and $\lambda \approx 2.25$ according to Tversky and Kahneman (1992).

The preference value Φ for any given lottery $L = [p_1, x_1; ...; p_n, x_n]$ (where p_i is the probability for a payment x_i at the point in time t + 1 for all i = 1,…,n), taking into account any starting point (prior payment) x_t, is thus calculated on the basis of :

$$\Phi(L, x_t) = \sum_{i=1}^{n} p_i \cdot [v(x_t + x_i) - v(x_t)]. \qquad (3)$$

Note that probability weighting implied by cumulative prospect theory (Tversky and Kahneman 1992; CPT) is not reflected in this formula since the appropriate weighting is somewhat unclear. Is it e. g. the positive or negative part of the weighting function that is relevant to a gain relative to a negative starting point? Also, how does the weighting function look like in a dynamic context? We are not going to address that issue in this paper.

Starting points' effects on the valuation of a certain amount x_t are demonstrated in figure 1, for two different starting points x_t and y_t, where the first is situated above and the second below the reference point.

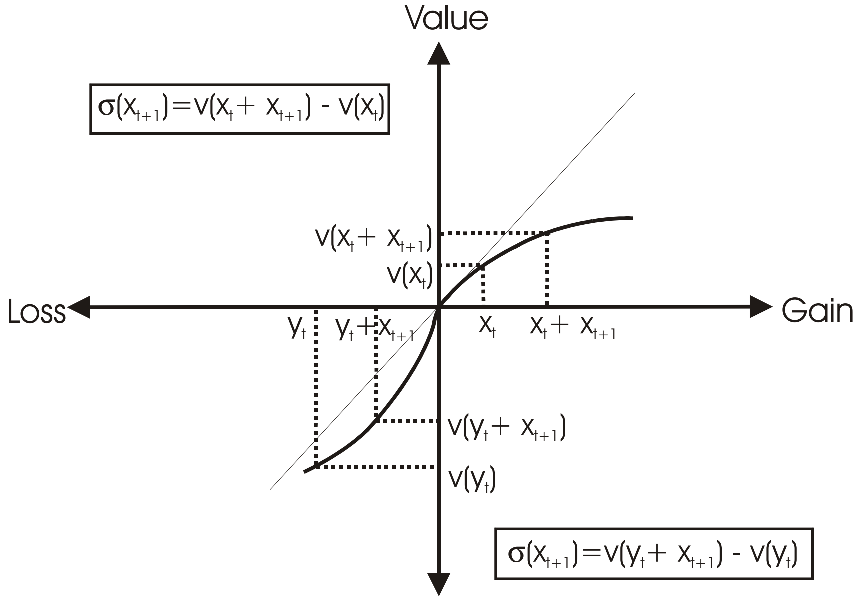

Figure 1: Starting points' effects based on prospect theory's value function

Interpretation: Imagine the starting point being e. g. caused by a gain/loss from a prior investment. Then the subjective valuation of the certain gain of x_{t+1} is smaller with a positive rather than a negative starting point. The prediction is equivalent to the mental accounting principle "aggregation" but with different absolute levels. Other effects on risk-taking behavior with multiple risky outcomes are obvious: A decision maker with a negative starting point will e. g. be risk seeking. To motivate our hypotheses, we now analyze basic characteristics of our new preference function *w* that is implied by (3):

$$w(x_{t+1}) = v(x_t + x_{t+1}) - v(x_t) . \qquad (4)$$

Theorem (Properties of the dynamic value function w): *For the function in* (4) *holds:*

i) *v is* (*strictly*) *concave* $\Leftrightarrow$ *w is* (*strictly*) *concave*,

ii) *v is* (*strictly*) *convex* $\Leftrightarrow$ *w is* (*strictly*) *convex*.

iii) *v is* (*strictly*) *increasing* $\Leftrightarrow$ *w is* (*strictly*) *increasing*

Proof: For a formal definition of a concave (convex) function see A.1 in the appendix. First we show that statement i) holds, for the case of a strictly concave function *v*: Because of (A1) in A.1 for all $x = x_t + x_{t+1}$, $y = x_t + y_{t+1}$ and for all $\delta \in (0, 1)$ it holds:

$$v((1-\delta)(x_t + x_{t+1}) + \delta(x_t + y_{t+1})) > (1-\delta)v(x_t + x_{t+1}) + \delta v(x_t + y_{t+1}), \qquad (5)$$

This is equivalent to

$$v(x_t + (1-\delta)x_{t+1} + \delta y_{t+1}) - v(x_t) > (1-\delta)v(x_t + x_{t+1}) + \delta v(x_t + y_{t+1}) - (1-\delta)v(x_t) - \delta v(x_t). \quad (6)$$

Using the definition of *w* specified in (4), we get

$$w((1-\delta)x_{t+1} + \delta y_{t+1})) > (1-\delta)w(x_{t+1}) + \delta w(y_{t+1}), \qquad (7)$$

and because of A.1, *w* is strictly concave. The reverse relationship also holds: If *w* is strictly concave, (7) and thus (6) hold. Because of the equivalence between (6) and (5), we get for all $x = x_t + x_{t+1}$, $y = x_t + y_{t+1}$ and for all $\delta \in (0, 1)$:

$$v((1-\delta)x + \delta y) > (1-\delta)v(x) + \delta v(y). \quad (8)$$

Thus v is strictly concave. The statement in ii) can be shown accordingly. To show that iii) is correct, we have to look at the equivalence of inequalities: If w a is strictly monotonically increasing function, then

$$\begin{aligned} & w(x_{t+1}) = v(x_t + x_{t+1}) - v(x_t) > v(x_t + y_{t+1}) - v(x_t) = w(y_{t+1}) \\ & \Leftrightarrow v(x_t + x_{t+1}) > v(x_t + y_{t+1}) \Leftrightarrow x_{t+1} > y_{t+1}. \end{aligned} \quad (9)$$

With $x = x_t + x_{t+1}$ and $y = x_t + y_{t+1}$ is this equivalent to

$$v(x) > v(y) \Leftrightarrow x > y. \quad (10)$$

This implies that v is monotonically strictly increasing. Herewith, statement iii) is proved. ☐

Unlike mental accounting, where gains will be segregated and losses aggregated because of the pain reduction principle or, more general, *hedonic editing*, no such differences are predicted on the basis of our formula. Moreover, without additional information allowing for a prediction of "sticky" versus flexible reference points[4], we do not predict any differences between mental accounting principles in loss and gain domains. More precisely, our prediction is just different from mental accounting since we expect aspiration levels to be the main driver of differences between prior gains and losses (see also Shapira 1996). Although we are not aware of clear-cut predictions of the "stickiness" of aspiration levels in literature, we feel that they may be related to the following dimensions:

- "Sticky" starting points and aspiration level differences are only likely if prior outcomes are associated with the same tasks as the subsequent decision (see e.g. Lewin et al. 1944).

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4 March and Shapira (1992) e.g. introduce a parameter *a* that characterizes the rate of aspiration level adjustment.

- The shorter a time span between initial and subsequent payments, the more likely the situation will be seen as a continued task, and new status quo will not have been adjusted to zero.

- Affect-rich situations and substantial prior outcomes will lead to more vivid aspiration levels, and adjustment to zero will take longer (for the effect of affects on other decision theoretic variables such as probability weighting see e. g. Rottenstreich and Hsee 2001). [5]

These assumptions will not be tested in this paper but are underlying our experimental scenario in the second study. The following hypotheses, based on the starting point formula and our theorem (and given our assumptions), will be tested in the following:

H1: Preference orders are consistent with formula (3).[6]

Specifically we expect the following characteristics of our function to hold:

H2: With prior losses, payments are consistent with a convex value function (deciders are risk taking).

H3: With prior gains, payments are consistent with a concave value function (deciders are risk averse).

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1 Note that such a dimension may actually differ between prior gains and losses so that "mental accounting" differences may in fact be attributed to this dimension rather than hedonic editing.

6 See appendix A.2.

Findings from questionnaire experiments

Study 1

Motivation and experimental design

We first of all checked data of an existing paper and pencil questionnaire experiment that was carried out on risk perception with private investment decisions. Our starting point formula predicts certain behavioral differences following prior gains and losses. Hypothesis 1 states that preference orders are consistent with our prediction.

Respondents were asked to imagine that they have had invested in securities (stock options), and faced a prior loss or a gain. The prior outcome was varied between-subjects. 73 subjects faced a prior loss of 5,000 DM and 76 subjects a prior gain of 5,000 DM. The participants were then asked to choose between different securities. Each respondent chose eight times between two alternative securities, named A and B. Characteristics of the option pairs are reported in table 1. Further parts of the experiment will not be addressed, here. Questions were presented in the following form:

Example: Because I have won (lost) 5.000 DM, …..

	Gains	**Losses**	**… I prefer …**
Security A:	5,000 DM with 50%	-2,500 DM with 50%	
Security B:	2,500 DM with 50%	0 DM with 50%	

The experiment was carried out with 149 undergraduate students of Johann Wolfgang Goethe-Universität Frankfurt a. M., Germany (median age = 21) in February 2001. It took about 20 minutes. Table 1 shows our option pairs in detail, together with means and standard deviations.

Results

Preference values calculated[7] with formula (3) as well as empirical percentages of preferences of subjects are to be found in table 2. Percentages of indifferent subjects are not reported (they can be calculated by subtracting percentages for options A and B from 100%). Preferences that are in tune with the starting point formula are highlighted separately for gain and loss domains. The high consistency is not surprising since similar preferences are predictable already on the basis of a simple expected value maximization.

However, when predictions came out to be correct with losses *and* gains, *preference differences* between gain and loss situations are compared to differences in the percentages of persons opting for certain alternatives. Or in other words, if a preference for option A should be stronger e. g. in the gain domain on the basis of starting point preferences, we checked whether this was mirrored in the percentages. Fractions of preference value differences in gain and loss domains and correct predictions of the percentages changes are reported in the last column of table 2. Evidence for hypothesis 1 is mixed with only three out of eight percentage changes being in tune with our prediction.

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7 Using prospect theory's parameters based on $ values in 1992 for an experiment based on DM in 2001 is not a problem. For a proof see appendix A.2.

#	Option	Payoff	Probability	Mean	Standard Deviation
1	A	5,000 -2,500	0.5 0.5	1,250	3,750
	B	2,500 0	0.5 0.5	1,250	1,250
2	A	5,000 -5,000	0.8 0.2	3,000	4,000
	B	2,500 0	0.6 0.4	1,500	1,224,74
3	A	10,000 -5,000	0.4 0.6	1,000	7,348,47
	B	5,000 -10,000	0.6 0.4	-1,000	7,348,47
4	A	2,500 -5,000	0.8 0.2	1,000	3,000
	B	2,500 -2,500	0.6 0.4	500	2,449,49
5	A	5,000 -5,000	0.5 0.5	0	5,000
	B	2,500 0	0.5 0.5	1,250	1,250
6	A	10,000 -10,000	0.7 0.3	4,000	9,165,15
	B	5,000 -2,500	0.7 0.3	2,750	3,436,93
7	A	5,000 0	0.5 0.5	2,500	2,500
	B	5,000 -2,500	0.6 0.4	2,000	3,674,23
8	A	10,000 -5,000	0.5 0.5	2,500	7,500
	B	2.500 -2.500	0,7 0,3	1,000	2,291,29

Table 1: Option pairs underlying study 1

#	Option	Initial gain (+5.000)		Initial loss (-5.000)		Correct
1	A	**345**	**31.6%**	1,156	18.9%	No
	B	**385**	**64.5%**	924	77.0%	
2	A	***849***	***53.9%***	*2,558*	*43.8%*	No
	B	***462***	***46.1%***	*1,109*	*56.2%*	
3	A	**93**	**85.3%**	**297**	**84.5%**	1.524/506 Yes
	B	**-1.431**	**14.7%**	**-209**	**12.7%**	
4	A	**257**	**56.6%**	**798**	**52.8%**	123/385 No
	B	**134**	**42.1%**	**414**	**43.1%**	
5^{+}	A	**-143**	**18.4%**	**323**	**9.6%**	528/601 Yes
	B	**385**	**81.6%**	**924**	**89.0%**	
6	A	**297**	**32.9%**	**2,114**	**26.0%**	514/199 No
	B	**811**	**64.5%**	**2,313**	**74.0%**	
7*	A	**756**	**85.5%**	**2,024**	**95.9%**	188/290 Yes
	B	**578**	**13.2%**	**1,734**	**4.1%**	
8*	A	***566***	***56.6%***	*1,222*	*38.4%*	No
	B	***293***	***43.4%***	*773*	*58.9%*	

Table 2: Preference values of option pairs in study 1 with different starting points and findings (* indicates that reported difference in percentages between loss and win situations is significant on a 5% level (one-sided); + indicates that difference is marginally significant, i. e. on a 10% level (one-sided)); preference reversals are highlighted in italics

Study 2

Motivation and experimental design

Our main study was specifically designed to test our starting point-point dependent preferences and the resulting hypotheses, and to allow for direct comparisons with other theoretical predictions. We opted for a simple entrepreneurial situation that may be judged as less dependent from specific experience with the decision situation, e. g. with stock markets. Potential drivers of starting and reference points' differences outlined in the theory section such as an affect-rich situation were also taken care of. The first experiment did not lead to many significant differences between gain and loss situations thus making any analyses of starting points' effects difficult. To overcome this and other potential limitations of this study, we opted for four basic characteristics of our study:

- WTP instead of option pair comparisons: This method leads to data that directly allow for judging individuals' behavior as either risk averse, risk neutral, or risk prone. Direct comparisons between gain and loss preferences are also possible. To account for extreme risk aversion, negative WTP could also be stated (in fact willingness to accept). This was also important since most of our selected alternatives should be attractive with prior losses *or* gains having an effect, *only* (see below)! Decision makers "segregating" subsequent payments from prior payments should view most of the alternatives as unattractive (WTP < 0).

- Different way of framing: The first experiment implemented the loss and gain situation in a too transparent way by repeating the starting situation before each option pair selection. We are confident that this way of introducing the starting point may have lead just to the opposite as expected: People became aware of the fact that they are expected to react to the starting point and therefore "opposed" again the manipulation. In this study, the starting point is only mentioned once, at the beginning of the experiment.

- Construction of "critical" alternatives: In order to allow for strong starting points' effects, alternatives have to be chosen in a way that preference values differ a lot between gain and loss situations. We selected alternatives on the basis of preference values calculated with our starting point formula. All alternatives have the same expected value, and three alternatives have (approximately) the same variance. This enabled us to check for the adequacy of alternative theoretical explanations of our findings. We also manipulated the skewness of the alternatives.

Subjects were asked to imagine that a friend offered the opportunity to use his small food stand at a swimming lake near Berlin for *two weekends*. The *first weekend* is already over. The sale was either successful with a gain of 6.000 DM or a failure with a loss of 6.000 DM (between subjects factor). Gains and losses of the second (and last) weekend are dependent on weather conditions. If the weather will be good, many people will be coming to the swimming lake and buy some food. If the weather will be bad, however, less people will come to the lake. There are three possible weather situations: bad weather conditions with a probability of 30%, moderate weather conditions with 40%, and very good weather conditions with a probability of 30%. Subjects had to choose between four different food categories to sell: ice cream, cake, beverages, and sandwiches. Outcomes of the four alternatives with different weather conditions are reported in table 3. Respondents were asked to state WTP separately for each of the four food categories. Qualitative predictor variables were added (e. g. subjective ratings of average success chances and risks). The selected alternatives and the first three moments of each distribution are reported in table 3.

	p_1 = 0.30	p_2 = 0.40	p_3 = 0.30	Mean	Std. deviat.	Skewness[8]
L_1: ice cream	-4,800	2,800	4,400	1,000	3,854	-.7755
L_2: cake	-4,000	1,000	6,000	1,000	3,872	.00
L_3: beverages	-1,000	1,000	3,000	1,000	1,549	.00
L_4: sandwiches	-2,700	-500	6,700	1,000	3,841	.6883

Table 3: Alternative investments

We had 243 second year business students at Humboldt-Universität zu Berlin, Germany, participating in our questionnaire experiment in May 2001. The experiment took about 45 minutes.

Results

Table 4 shows calculated preference values based on formula (3). Comparisons of these values state our hypotheses on actual WTP according to hypothesis 1 (we do not look at absolute values, obviously[9]).

	Initial gain (6,000 DM)	Initial loss (-6,000 DM)
L_1: ice cream	253	822
L_2: cake	263	898
L_3: beverages	301	726
L_4: sandwiches	271	831

Table 4: Preference values based on formula (3)

8 The skewness was calculated as mean/(std. deviation)^3. A negative value indicates a concentration with positive outcomes, a positive value indicates a concentration with negative outcomes.

9 See A.2 in the appendix.

WTP was considerably spread with a number of very extreme values! Therefore we focus on medians (that also match the median decider prediction of prospect theory), on rank comparisons, and on non-parametric significance tests. Results are reported in table 5.

	Initial gain (+6,000) n = 118		Initial loss (-6,000) n = 125		Significance (MWU[10])
	Median	Mean rank of gain WTP in total group	Median	Mean rank of loss WTP in total group	
L1	1,000	136.39	1,000	104.01	.000
L2	950	134.00	750	106.35	.002
L3	800	129.91	500	110.33	.026
L4	800	136.41	500	102.59	.000

Table 5: Median WTP, mean ranks and significance levels for the four alternatives in both win and loss situations

Note that, although predicted preference values are always in favor of the loss situation, WTP is never higher in the loss situation in our sample. In contrast, preferences are strictly higher in the gain situation on the basis of mean ranks. Since a general consistency between predictions and preferences is not to be found, *hypothesis 1 has to be rejected.*

Table 6 reports mean ranks of our alternatives, separately for loss and gain situations. Note that all within-subjects comparisons are highly significant.

[10] The abbreviation MWU refers to the non-parametric Mann-Whittney-U test.

	Mean ranks in gain situation (within-subjects) n = 118	Mean ranks in loss situation (within-subjects) n = 125
L1	2.84	2.86
L2	2.68	2.68
L3	2.10	2.39
L4	2.38	2.07
Significance (Friedman tests):	.000	.000

Table 6: Within subjects mean ranks of alternatives in win and loss situations

Preference orders are inconsistent with the prediction derived from 3, and the situation is somewhat unclear with respect to hypothesis 2, as we are going to show. With all means being equal, the lower variance of L3 allows for a direct determination of an average decider's risk preferences within gain and loss domains. Table 7 reports, based on a simple μ-σ comparison as a simplified test criterion, predicted relative preferences for L3 that would be consistent with risk aversion and risk seeking.

Risk seeking	L_3 is worst
Risk aversion	L_3 is best

Table 7: Relative preferences for L3 for risk seeking and risk averse deciders

Comparing the preference orders reported in table 7 with our findings, *WTP values in the win situation are consistent with risk seeking behavior or a concave value function. This contradicts hypothesis 3. This hypothesis is therefore rejected.*

With losses, the situation is less straightforward. Preference orders are first of all surprisingly similar between gain and loss situations. Only L3 and L4 are reversed. Since L3 is the "critical" alternative for judging risk preferences, here, preferences are first of all judged as inconsistent with risk seeking behavior in the loss situation. Note, that L4 is all but a "regular" alternative, though. First of all, the highest gain possible in L4 (6,700 DM), is the only payment of all alternatives surpassing the origin. Second, and perhaps more important, the left-sided skewness may not be in favor of this alternative. As demonstrated by Unser (2000), such alternatives are not much liked by real decision makers. Also, Lopes (1987) as well as March and Shapira (1987; 1992) argue that decision makers may, in certain situations, shift their attention to a second reference point: the *survival point*. Such a shift of attention may be very plausible if decision makers are already in a substantial loss situation and if, in addition, an alternative is also skewed having more weight with negative payments as is the case with alternative L4. Leaving out L4, L3 is in fact the worst alternative. L1 and L2, both having a higher variance, are favored. Therefore, decision makers' preferences may in fact be judged as consistent with risk seeking behavior in the loss domain for constant and right-sided skewness of the alternatives' distributions. *Consequently, although the situation is somewhat complicated, we have a tendency to accept hypothesis 2.*

To further analyze consistency of findings with our hypotheses, we additionally split the entire group of respondents into subgroups based on the following variable. Respondents were asked the following, simple question:

"Which role has it played in your decision that you had already encountered a gain/loss of 6,000 DM?" Answers were given on a 11-point rating scale.

The intuition for asking this question is very straightforward. Persons reporting a high impact of prior losses/gains are expected to be the framed ones and react according to the starting point formula. Others, reporting that the framing was unimportant are a zero group that is not influenced and may treat the subsequent lottery *segregated* from the prior payment, i. e. may be described by regular prospect theory's preference values (or even as risk neutral). To analyze the effects of these different groups, only extreme values were integrated. About the lowest third of answers were labeled as unaffected persons, the highest third as affected persons. Our eventual grouping can be derived from figure 1. Zero groups in gain and loss domains were later collapsed since differences in WTP were not significant.

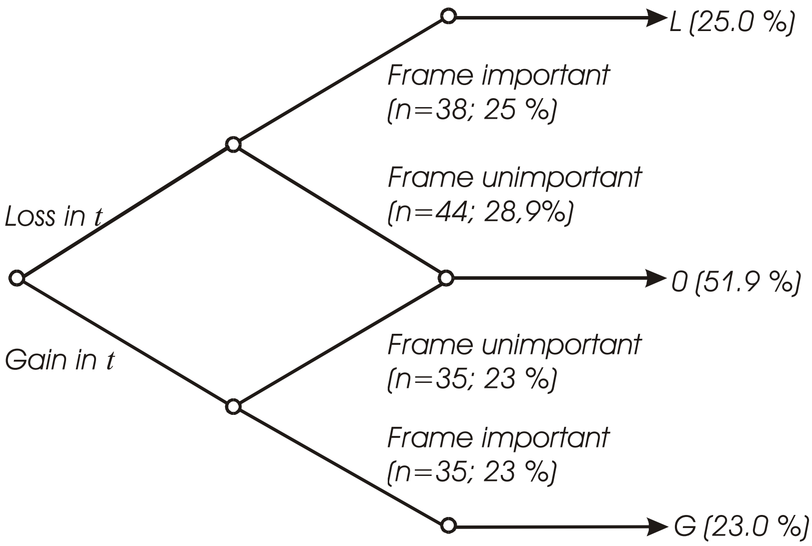

Figure 1: Groupings

Figures 2-5 report on interactions effects between loss versus gain situations and frame important versus unimportant groups (all interactions effects are highly significant (two-sided) for L1, L2, and L4 in an ANOVA; p-levels: .003 for L1, .004 for L2, .001 for L4, and marginally significant for L3: .053 for L3).

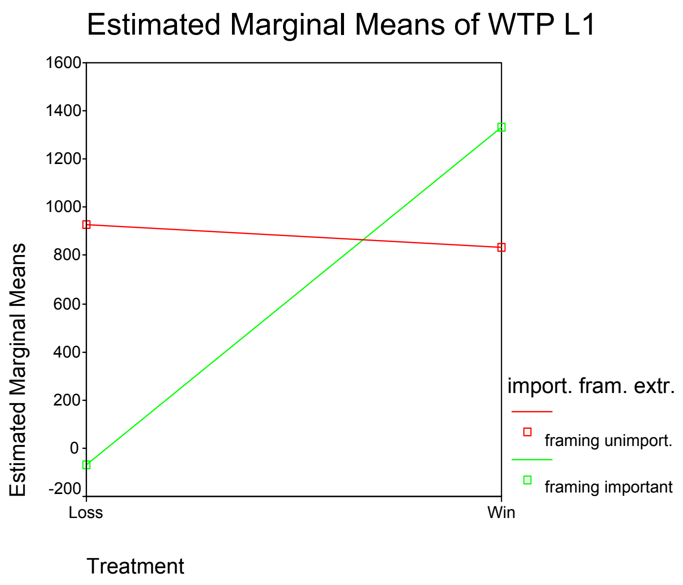

Figure 2: WTP for L1 in groups with different framing importance

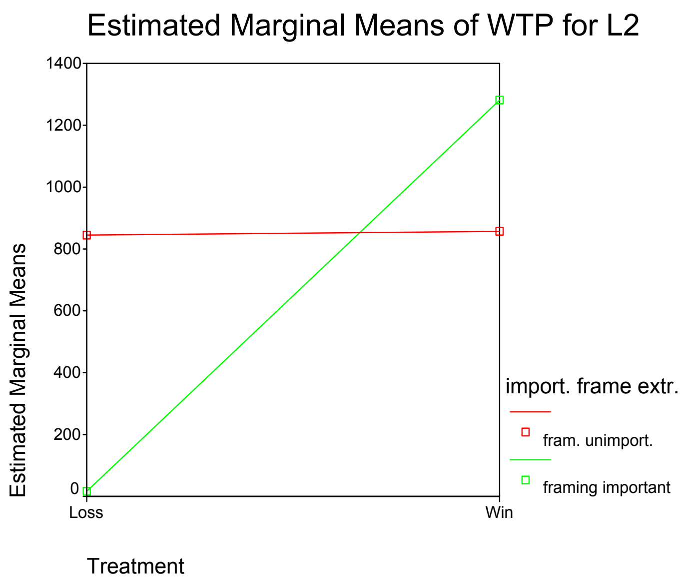

Figure 3: WTP for L2 in groups with different framing importance

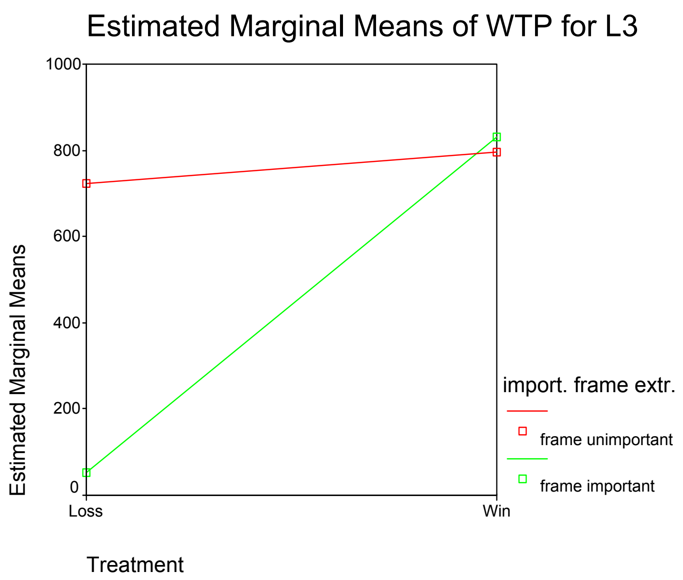

Figure 4: WTP for L3 in groups with different framing importance

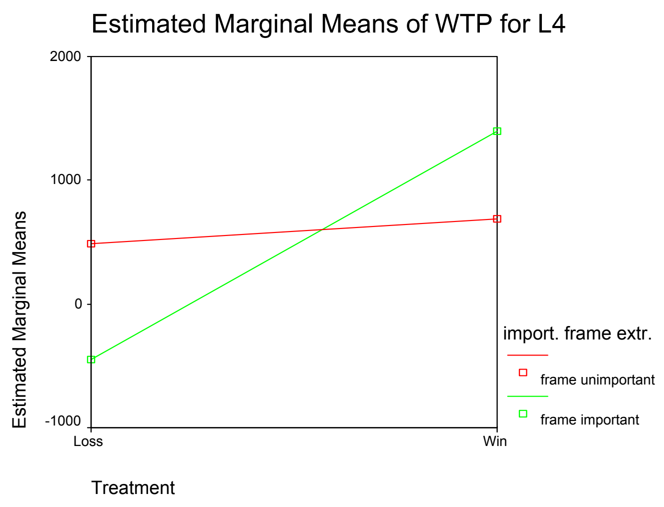

Figure 5: WTP for L4 in groups with different framing importance

Looking at figures 2-5, the deviations from a "neutral", segregated point is somewhat stronger for losses rather than gains. Or in other words, whereas losses are always leading to a much lower WTP in the framed rather than the neutral group, gains are not important at least with L3. Here, the framed group does not pay more than the unaffected group. Since this is the low risk alternative, one gets the impression that even the unaffected group may not be risk averse with gains. To investigate this prediction more carefully, separate analyses over preference orders are carried out for the different groups. Since WTP does not differ significantly between loss and gain domains for any of our alternatives in the unaffected groups (this should be the case by "definition"), these subjects are collapsed for further analyses.

Thus we are now analyzing preference orders of our four alternatives based on mean ranks for the following three groups: (1) persons that clearly felt being in a loss situation (loss persons), (2) persons that clearly felt being in a gain situation (gain persons), and (3) persons that are unaffected by prior payments (neutral persons). Since behavior of the last group could be consistent with "segregation", preference values are calculated on the basis of prospect theory with a reference point being equal to the aspiration level being equal to zero: $\Phi_v(L_j) = \sum_{i=1}^{3} p_i \cdot v(x_i)$ for j ∈ {1, 2, 3, 4}. Calculated preference values are reported in table 8.

	$p_1 = 0.30$	$p_2 = 0.40$	$p_3 = 0.30$	$\Phi_v(L_i)$
L_1: ice cream	-4.800	2.800	4.400	-257
L_2: cake	-4.000	1.000	6.000	-189
L_3: beverages	-1.000	1.000	3.000	224
L_4: sandwiches	-2.700	-500	6.700	-221

Table 8: Preference values Φ_v based on prospect theory for "segregation",

i. e. independent from a starting point

Note that the preference values reported in table 8 are interesting per se. Without any prior gain *or* loss (!), only L3 should be attractive and lead to a positive WTP (see the remark in A.2). As easy to see, respondents being unaffected by a prior loss or gain (i. e. segregating the subsequent lottery) have a high WTP for all alternatives. *Thus our findings clearly contradict prospect theory's prediction already with respect to the general level of WTP for L1, L2, and L4.*

Table 9 now finally reports preference orders based on mean ranks for the three groups of loss persons, gain persons, and neutral persons.

	Loss group N = 37 (one missing)	Neutral group N = 75 (four missing)	Win group N = 34 (one missing)
	Mean ranks		
L1	2.81	2.69	2.81
L2	2.69	2.77	2.79
L3	2.39	2.47	1.50
L4	2.11	2.07	2.90
P-level (Friedman tests)	.034	.001	.000

Table 9: Mean ranks of alternatives in loss, win, and neutral groups

According to table 9, win group results are about consistent with results based on the entire group of respondents in the win treatment. But L4 is much favored. In the loss group, the situation is similar to the original loss treatment group. Again, L4 is disliked. The same applies to the neutral group that apparently perceives the situation similar as the loss group (although paying much more according to figures 2-5). L4 is the alternative with the left-sided skewness. Our survival point interpretation offered above seems to be appropriate since L4 is liked a lot when shifted away from the loss region (i. e. in the win group). L3 is the low risk alternative, and mean ranks are never better than at the third place. Therefore in none of our three groups, we find a clear consistency with risk-averse behavior. This, again, is in contradiction with prospect theory's predictions. With loss aversion playing a role, at least the "neutral" group should have ranked this alternative much higher.

4. General discussion

Our results are somewhat consistent with aspiration levels – underlying our starting point formula – playing a role with prior gains and losses. We do not find much evidence for prospect theory being the appropriate model for dynamic decision situations, however. Specifically, only the tendency to be rather risk seeking in the loss scenario is consistent with prospect theory and mental accounting. But even here, the full explanation may want to take into account a second aspiration level, i. e. a survival point or some notion of a "fear of bankruptcy". With gains, results are somewhat consistent with the house money effect (Thaler and Johnson 1990). However, this effect is actually inconsistent with prospect theory and mental accounting (at least according to the original approach of Thaler (1985) that was closest to prospect theory's predictions). Note that we also do not find evidence for a break-even effect occurring to be expected when referring to Thaler and Johnson's approach since alternatives allowing to break even in the loss situation are not favored over others.

Moreover, the general level of WTP – when compared to calculated preference values – is far too high, especially in the neutral group that might be interpreted as segregating prior and subsequent payments and should actually be described by standard prospect theory. Finally, WTP differences between gain and loss scenarios are in the opposite direction as predicted by prospect theory.

Do we have to reject prospect theory as a descriptive model of choice in general? Probably not, since this theory was not designed for describing behavior in dynamic decision situations, and even the neutral group, although unaffected by the frame, may have felt being in a dynamic context, and may therefore have behaved differently from the predictions of prospect theory.

5. Implications for further research

Further research may want to treat valuations of (subsequent) payments in a dynamic scenario as an entirely unique research question rather than trying to apply and modify existing models of decision making in non-dynamic contexts. Developing a dynamic theory of decision making based on aspiration levels (Lewin et al. 1944) may be judged as most promising. Hypotheses on the stickyness of aspiration levels as well as on functional forms relevant for the evaluation of payments following a prior gain or loss may benefit from such an approach (and may differ much from the functional forms relevant in non-dynamic decision situations). In the current version of the starting point formula, we were taking into account only one aspiration level, called *action goal* by Lewin et al. (1944). Further developments of starting points' preferences may at least also want to take into account so-called *ideal goals* (Lewin et al. 1944) and *survival points* (March and Shapira 1992).

All these thought imply nothing else but treating the entire value function as inherently context dependent with prior gains and losses being the perhaps most important context factor. Our hypotheses concerning the factors potentially influencing the stickyness of aspiration levels may also be analyzed in future experiments; such findings are important to judge which are the situations where our basic idea may lead to appropriate hypotheses about real decision makers' behavior in dynamic contexts.

Appendix

A.1: Formal definition and characterization of concave and convex functions

Definition: If I is a nonempty interval of real numbers, then a real valued function f is *concave* if

$$f((1-\delta)x+\delta y) \geq (1-\delta)f(x)+\delta f(y), \qquad \text{(A1)}$$

for all x, $y \in I$ and all $\delta \in (0, 1)$. It is defined as *strictly concave* if a strict inequality holds for $x \neq y$. If the inequality holds for the relation "≤" then f is defined as *convex* (and *strictly convex* for "<").

Remark: A concave or convex function f can be characterized by its second derivatives:

i) $f^{''} < 0 \Rightarrow f$ *is strictly concave*,

ii) $f^{''} > 0 \Rightarrow f$ *is strictly convex.*

As easy to see, prospect theory's value function v in (2) is strictly concave for $x \geq 0$ and strictly convex if $x < 0$.

A.2 Independence of preference orders from positive scalar transformations of value function's arguments

The parameterizing of prospect theory's value function took place for US $ and in 1992. In the present study the decision makers had the selection between lotteries in DM. If we use preference values implied by the parameters of a median decision maker based on the study of Tversky and Kahneman (1992), a critic could stress that we would have to consider a conversion factor for currency, inflation rates, chewing force development etc. If we capture all these effects by multiplying value function's arguments with a real factor $c > 0$, we have to show, that this has no effect on a given preference order:

Lemma: *Let* $c > 0$, *and* x_t *is a real number. Then for the lotteries* $L_1 = [p_1, x_1; ...; p_n, x_n]$, $L_2 = [q_1, y_1; ...; q_n, y_n]$ *with the starting point* x_t *and* $L_3 = [p_1, c \cdot x_1; ...; p_n, c \cdot x_n]$,

$L_4 = [q_1, c \cdot y_1; ...; q_n, c \cdot y_n]$ *with the starting point* $c \cdot x_t$ *applies:*

$$\Phi(L_1) \geq \Phi(L_2) \Leftrightarrow \Phi(L_3) \geq \Phi(L_4), \qquad \text{(A2)}$$

where Φ *is the preference value defined in* (3)

Proof: Using (3) we get:

$$\Phi(L_3) = \sum_{i=1}^{n} p_i \cdot [v(c \cdot x_t + c \cdot x_i) - v(c \cdot x_t)] \qquad \text{(A3)}$$

and

$$\Phi(L_4) = \sum_{i=1}^{n} q_i \cdot [v(c \cdot x_t + c \cdot y_i) - v(c \cdot x_t)], \qquad \text{(A4)}$$

where v is prospect theory's value function, defined in (2). It is

$$v(c\cdot x)=\begin{cases}(c\cdot x)^{\alpha}\\ -\lambda\cdot(-c\cdot x)^{\alpha}\end{cases}=\begin{cases}c^{\alpha}\cdot x^{\alpha} & \text{if } x\geq 0\ ,\\ -\lambda\cdot c^{\alpha}\cdot(-x)^{\alpha} & \text{if } x<0,\end{cases}=v(c)\cdot v(x). \qquad \text{(A5)}$$

Therefore, we have:

$$\Phi(L_3)=v(c)\cdot\sum_{i=1}^{n}p_i\cdot[v(x_t+x_i)-v(x_t)]=v(c)\cdot\Phi(L_1) \qquad \text{(A6)}$$

and

$$\Phi(L_4)=v(c)\cdot\sum_{i=1}^{n}q_i\cdot[v(x_t+y_i)-v(x_t)]=v(c)\cdot\Phi(L_2). \qquad \text{(A7)}$$

Because $v(c) > 0$, we have the equivalent condition in (A1). □

Remark: Note, that in connection with (A5) and for $c > 0$ the preference value $\Phi_v(L_1)=\sum_{i=1}^{n}p_i\cdot v(x_i)$ for a given lottery $L_1=[p_1,x_1;...;p_n,x_n]$ has the same sign like the preference value $\Phi_v(L_2)=\sum_{i=1}^{n}p_i\cdot v(c\cdot x_i)$ for the lottery $L_2=[p_1,c\cdot x_1;...;p_n,c\cdot x_n]$.

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