Risk Perception and Acceptance—One Process or Two?

The Impact of Aspirations on Perceived Risk and Preferences

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Abstract. The experiments discussed here are aimed at determining whether risk perception and risk acceptance are two distinct psychological processes. This study is motivated by the idea of a double-criterion model of choice. In particular, in line with risk-value (R-V) models, in which risk is treated as a primitive, it is tested whether risk is independent of aspirations and whether preferences depend on aspirations. In two experiments, 305 university students were presented with pairs of risky projects and were asked to compare their riskiness and select one. The aspiration level, defined as the target return on the project, was set through an explicit instruction. In Experiment 1, a within-subject design was applied, and thus aspirations were set at two different levels. In Experiment 2, with a between-subject design, two different aspiration levels were set for each group. The results indicate that risk ordering is insensitive to changes in aspirations, but preferences are sensitive to those changes. This supports distinctness of risk perception and risk acceptance. The findings are discussed in terms of the CPT and SP/A models and the R-V approach. It appears that double-criterion models provide better and psychologically sounder predictions of subjects' preferences.

Keywords: risk perception, risky choice, aspirations, risk-value models, cumulative prospect theory (CPT), security-potential/aspiration (SP/A) model of choice.

Introduction

The main question raised in the experiments presented here is whether risk perception and acceptance are two distinct psychological processes. This question is related to more general issues of the meaning and status of risk in decision making and psychological accuracy of single-criterion models of risky choice versus models in which choice is a compromise between conflicting criteria.

In the first and dominant approach, the expected utility (EU) model (von Neumann & Morgenstern, 1947), it is assumed that rational behavior under risk is to maximize the average expectation. Its mathematical formulation has been modified many times, resulting in numerous generalizations of the EU model (see Starmer, 2000, for a review), such as rank-dependent utility models (RDU, e.g., Quiggin, 1982) or the prospect theory (PT—Kahneman & Tversky, 1979; CPT—Tversky & Kahneman, 1992). However, the main idea that expected or nonexpected utility is the single criterion for rational choice remains unchanged. Consequently, the idea of risk is embedded in the concept of choice determined by the expected or nonexpected utility.

The second approach is more diverse, but it does have a unifying feature—it acknowledges a conflict behind a risky choice. For example, Allais (1952/1979) illustrated the oversimplification of a one-criterion model of choice (the maximization of EU) by considering a decision maker who might trade off the expected return against the probability of achieving important goals. Markowitz (1959) observed that managerial investment decisions were based on both the expected return and its uncertainty or variability. In his opinion, the second criterion was related to risk. Assuming that higher return and lower risk were preferred, Markowitz (1959) proposed a dual-criterion model of a risky choice, in which the expected return (mean) is traded off against risk (variance).

Allais's idea was developed in psychology by Lopes (1984, 1987, 1990, 1996; Lopes & Oden, 1999), who proposed a dual-criterion model of risky choice called SP/A theory. Lopes's model includes two independent criteria of choice—overall utility and aspiration level. Each criterion may favor different options, leading to a conflict.

Markowitz's idea is the basis for a broad class of the so-called risk-value (R-V) models. (e.g., Bell, 1995b; Bell & Fishburn, 2001; Coombs, 1975; Jia, Dyer, & Butler, 1999; Sarin & M. Weber, 1993). In these models, risky choice is a compromise between two conflicting criteria—risk and value (overall utility).

Modeling risky choice as a conflict has some advantages. First, it does not reduce human hopes, greed, and fears to maximizing expected return (e.g., Coombs, 1975; Lopes, 1987). Second, it leaves room for differences in preferences resulting from individual and situational factors, which may affect either criterion or their relative weights (Coombs, 1975; March & Shapira, 1987, 1992; Mellers, Schwartz, & E. U. Weber, 1997; E. U. Weber & Hsee, 1998; E. U. Weber & Milliman, 1997).

The key issue in validating models of risky decisions as

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a conflict between two criteria, in particular as a conflict between risk and return, is to show that risk judgment and preferences are two distinct processes. One way to do so is to find factors that affect risky choice but not risk perception. In this article, two experiments are presented that demonstrate insensitivity of risk ordering and sensitivity of preferences to changes in one such factor—aspirations. The results are discussed in terms of different mechanisms by which aspirations might impact preferences. These mechanisms are in line with either a single-criterion model (e.g., CPT) or conflicting criteria models (e.g., SP/a and R-V) of risky choice.

The Distinctness of Perceived Risk from Preferences

The distinction between risk perception and risk acceptance is clearly inconsistent with the expected and nonexpected utility models, in which risk is embedded in the idea of choice. Because risk is not treated as a primitive, it cannot be measured independently from preferences. However, in many experiments, subjects judged riskiness, giving reliable risk rates (e.g., Brachinger & M. Weber, 1997). Moreover, judgments made by subjects from different countries were consistent in the sense that they showed the same pattern (Butler, Dyer, & Jia, 2005; Keller, Sarin, & M. Weber, 1986).

Furthermore, in several studies it has been shown that preferences are distinct from risk evaluation (e.g., Lopes, 1984; Luce & E. U. Weber, 1986; Payne, 1975; E. U. Weber, Anderson, & Birnbaum, 1992). In general, negative outcomes and their probabilities have larger influence on risk rates than on preferences (e.g., Luce & E. U. Weber, 1986; Payne, 1975). However, E. U. Weber et al. (1992) demonstrated that the relation between perceived risk and preferences is more complicated. For example, for lotteries with mixed outcomes, some subjects evaluated risk primarily on the basis of the amount of loss, but they used the amounts of both loss and gain to evaluate attractiveness.

On theoretical grounds, attempts to distinguish between a measure of risk and a measure of preference were made by Bell (1988, 1995a and b; Bell & Fishburn, 2001), by Sarin and M. Weber (1993), and by Jia and Dyer (1996; Jia, Dyer, & Butler, 1999). In fact, Bell (1988) regards "risk and return as orthogonal concept" (p. 1421). He further argues that ordering of gambles according to risk is independent of wealth level, whereas wealth impacts preferences. Sarin and M. Weber (1993) adopt similar assumptions in their general R-V model, in which preferences are determined by a trade-off between value and risk.

The role of wealth in decisions was challenged, however, by the prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). In this theory, values of options are estimated in relation not to wealth level but to subjective reference points. These points determine which outcomes are perceived as gains and which as losses. This classification affects preferences because people evaluate gains and losses differently, and losses loom larger than gains.

Considering the point of view taken in CPT, psychological distinctness of risk judgment and preferences is investigated here by replacing wealth with a reference point. Specifically, if risk ordering is not affected by changes of the reference point, but preferences are affected, it will suggest that risk judgment and preferences are two distinct processes. In this study, the reference point is taken as the aspiration level.

Why May Aspirations Affect Preferences?

Among different possible reference points, aspirations are particularly interesting because it is psychologically convincing that people consider available options in terms of their compatibility with aspirations—that is, goals that they want to or must achieve. As Simon (1955) put it, outcomes are either satisfactory, if they are above the aspiration level, or unsatisfactory, if they are not. This could be interpreted in at least two ways. Aspirations might be considered as a reference point incorporated in the utility function, as is done in the CPT model. Alternatively, labeling options as either satisfactory or unsatisfactory may be a second criterion for choice, as is the case in the SP/A model. These mechanisms are discussed below.[1]

Aspiration Level (as a Reference Point for Coding Outcomes) Affects Value

In line with CPT, the aspiration level may be a reference point for coding outcomes that are above aspirations as gains and outcomes that are below aspirations as losses. This coding influences the overall utility of options because the utility function has different shapes for gains and for losses (e.g., Heath, Larrick, & Wu, 1999; Larrick, Heath, & Wu, 1999). Because CPT is a one-criterion model, the option with the highest overall utility is also most favored. Thus, aspirations influence preferences by determining first values and then overall utility of different options.

Heath et al. (1999) argued that some phenomena found in goal-setting research could be explained by the value function proposed in CPT under an assumption that goals serve as reference points. They demonstrated that the number of people who preferred a risky option to the sure thing doubled (from 24% to 47%) when people had a specific goal and the sure payoff was below subjects' targets. They got similar results in another experiment (Larrick et al., 1999). Only 11% of subjects, those who had a specific goal that was higher than the sure win, chose the sure-win option. According to the authors' interpretation, subjects who had their goals set higher than the sure win made choices in the domain of losses; hence, they were more willing to take risks.

Lehner (2000) analyzed effects of targets on preferences at the company level. He used statistical data for a period of time not shorter than 10 years for 876 companies representing 14 industries. His results supported previous find-

[1] Another mechanism, perceived risk that depends on aspirations as proposed by Fishburn (1977), is not discussed here because the presented results clearly falsify such relation.

ings by Fiegenbaum and Thomas (1988) and by Fiegenbaum (1990) that companies were risk-averse or risk-seeking depending on their position with respect to the reference level. Moreover, preferences were stable if the relative position of a firm with respect to its reference point remained unchanged over time.

Aspirations as a Second Criterion for Choice

According to the SP/A theory (Lopes, 1990, 1996; Lopes & Oden, 1999), aspirations directly influence choice. A risky choice is made on the basis of two criteria. One is the overall utility of a given option, which results from integrating probabilities and values of outcomes according to the cumulative weighting rule. This evaluation is influenced by a dispositional tendency to focus on security versus potential (SP), which in turn determines the relative weights put to the worst and the best outcomes. The second criterion is the aspiration level A—a subject judges the attractiveness of an option by the probability that it will yield an outcome at or above the aspiration level.

Several empirical findings might be interpreted in terms of the direct impact of aspirations on preferences. The most recent results are reported by Payne (2005). He found that respondents were more sensitive to changes in overall utility of outcomes that either increased the overall probability of a strict gain or decreased the overall probability of a strict loss than to changes in overall utility, which had no such impact on these probabilities. Payne thinks that "in terms of models of risky choice, the present results are most consistent with the SP/A theory" (Payne, 2005, p. 16).

Because SP and A are two different criteria, each may favor a different option, leading to a conflict. How such a conflict is resolved depends on the weights, which a subject puts on both criteria. As proposed by Lopes (1984, 1990, 1996) and by March and Shapira (1987, 1992), the relative weighting of conflicting criteria for choice depends on how people focus their attention. This reasoning was supported in the study of Lopes and Oden (1999). They showed that for sets of lotteries that always or never satisfied the A criterion, SP was a more salient criterion for choice than A. However, the importance of A relative to the SP increased in a set in which A was satisfied to a different degree for different lotteries.

Aspirations and the R-V Approach

Changes in preferences as a result of aspirations might be explained by changes in (1) overall utility described by the S-shaped utility function with aspiration level serving as the reference point or (2) attention paid to different outcomes, which in turn influences choice.

These interpretations have been or could be included in the R-V model. In line with CPT, aspirations would affect preferences through their impact on the V component. "In SP/A theory, the aspiration level participates in a direct assessment of lottery attractiveness . . . and is separate from the decumulatively weighted SP assessment" (Lopes & Oden, 1999, p. 291). If so, one might consider the A criterion as affecting relative weights put on risk and value in trade-off. This is close to the idea that situational factors (e.g., wealth) influence the trade-off function proposed in the previously discussed R-V frameworks.

This idea received empirical support from research on the impact of individual differences and situational factors on risk acceptance. Recently, E. U. Weber, Blais, and Betz (2002), found that individual differences (e.g., sensation seeking, intolerance for ambiguity, gender) influenced risk taking by affecting perception of risk and benefits. However, they also found that situational factors (i.e., the content of decision) influenced trade-off between risk and benefits, as suggested by Sarin and M. Weber in their R-V model. Sokolowska and Tyszka (1995) found that Poles expressed higher acceptance of technological and environmental hazards than did Swedes, even though Poles evaluated dangers of these hazards higher and their benefits lower. This suggests that Poles and Swedes trade off dangers and benefits differently, presumably because of different economic situations, implying differences in wealth level or in aspirations.

Experimental Design

The experiments are designed to test a hypothesis that risk ordering, but not risky choices, remains constant with changes in aspirations. This would give support to the view that risk judgment and preferences are two distinct psychological processes. The second and closely related aspect of the design is to facilitate the analysis of mechanisms by which aspirations affect preferences.

Subjects

At the Warsaw School of Social Psychology, 305 students of psychology participated in two experiments. Of the participating students, 209 took part in Experiment 1, in which the within-subject design was applied, and 96 subjects participated in Experiment 2, in which between-subject comparisons were used. In each group, approximately 60% of subjects were females.

General Scenario

Subjects were presented with the following scenario. Assume that you run a medium-size production company. The company uses parts that are delivered by a supplier. The contract for the delivery of these parts is due to expire, and new conditions proposed by the current supplier are not acceptable. Thus, the company has to sign a contract with a new partner. There are two possible suppliers: A and B. Both offer a better price than the current one. In each case, however, production technology must be adjusted to technical requirements of the products offered by the new suppliers. The time needed to complete these adjustments determines the profitability of the new contract—that is, net profit of the company will either increase or decrease, depending on whether the adjustments are completed on time.

You will be presented with pairs of risky options (related to signing a new contract) and asked to (a) indicate which option is more risky and (b) select one option.

Manipulation of Aspiration Level

The aspiration level was set through an explicit instruction. Subjects were told that because their competitor was not doing well at the moment, the company could increase its market share by introducing a new product. This would be possible if the net profit of the company increased by a specific amount (the target return). It was assumed that this target return was the aspiration level.

In Experiment 1, a within-subject design was applied, and therefore, the aspiration level was set twice through defining the target return at 200,000 PLN ($TR_1 = 200$) and at 300,000 PLN ($TR_2 = 300$).[2] During the experimental session, subjects completed two paper surveys—one for each aspiration level—separated by a short break. They performed an unrelated task during the break. In Experiment 2, the target return was set at 200,000 PLN for group 1 ($N = 46$) and at 300,000 PLN for group 2 ($N = 50$).

Stimuli

In both experiments the same stimuli were used—detailed descriptions of nine pairs of risky options—for signing a new contract either with supplier A or with supplier B. These descriptions contained information about the probabilities of completing the technological adjustment on time or not completing it (yielding, respectively, net profit or loss) and about the amount of payoffs in either case. The pairs of risky options presented to subjects are listed in Table 1.

For each aspiration level, subjects considered six pairs of options. Thus, for the within-subject design of Experiment 1, subjects made 12 comparisons, and for the between-subject design of Experiment 2, subjects in each of the two groups made six comparisons. In Experiment 1, pairs 2, 5 and 8 were presented twice: for the target return set at 200,000 PLN and the one set at 300,000 PLN. In Experiment 2, these pairs were presented to groups 1 and 2.

For each aspiration level, the pairs of options were designed so that Option B (1) always contained outcomes that met or exceeded the target level and (2) was always more risky than Option A according to the well-established criteria—that is, Option B always had higher variance and either lower expected value (EV) or higher amount of loss.

Results

Risk Judgment

As shown in Table 2, a majority of subjects (from 89 to 100%) always judged Option B as more risky than Option A, which is in agreement with the assumptions of the experimental design. In particular, for pairs 2, 5, and 8, which were presented to subjects at both aspiration levels, Option B was considered more risky by at least 90% of subjects, irrespective of whether it met or did not meet the target return. This indicates that risk judgments were stable and independent of aspirations.

Preferences

For each target return, the pairs shown in Table 1 can be divided into two subsets. Choices between options in the first subset do not involve conflict between minimizing risk and pursuing the aspiration level. The positive payoff of the less risky Option A is equal to the target return. Thus, this option should be preferred by everybody but risk-lovers. These pairs were given to test that subjects correctly understood the experimental task and showed commonsense behavior in making easy decisions.

In the second subset, Option A has the positive payoff below the target return. Thus, Option A allows for minimizing risk but not for achieving the aspiration level. Conversely, Option B allows for achieving the aspiration level, but at a higher risk. Preferences for these two subsets are discussed separately.

Table 1. Pairs of risky options presented to subjects

No conflict between aspirations and rational choice			Conflict between aspirations and rational choice		
Target return = 200; WS[(1)]: Exp. 1; and BS: group 1 in Exp. 2					
No	A	B	No	A	B
2	−200, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	1	−100, 0.5; +100, 0.5	−200, 0.5; +200, 0.5
5	−100, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	4	−50, 0.5; +100, 0.5	−200, 0.5; +200, 0.5
8	−300, 0.3; +200, 0.7	−500, 0.3; +300, 0.7	7	−50, 0.3; +100, 0.7	−300, 0.3; +200, 0.7
Target return = 300; WS: Exp. 1; and BS: group 2 in Exp. 2					
No	A	B	No	A	B
3	−300, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	2	−200, 0.5; +200, 0.5	−300, 0.5; +300, 0.5
6	−200, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	5	−100, 0.5; +200, 0.5	−300, 0.5; +300, 0.5
9	−500, 0.3; +300, 0.7	−700, 0.3; +400, 0.7	8	−300, 0.3; +200, 0.7	−500, 0.3; +300, 0.7

Note. [(1)]In all tables, "WS" means "within-subject comparisons" (Experiment 1), and "BS" means "between-subject comparisons" (Experiment 2).

[2] 1 PLN is equal to 0.25 Euro.

Table 2. Risk judgments for two aspiration levels

			Fraction of participants who evaluated B as more risky			
			Target return equals			
	Option		WS[(1)] Experiment 1		BS Experiment 2	
Pair	A	B	+200	+300	+200	+300
1	−100, 0.50; +100, 0.5	−200, 0.5; +200, 0.5	0.889	−	0.873	
2	−200, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	0.986	0.904	0.957	0.900
3	−300, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	−	0.986		0.980
4	−50, 0.5; +100, 0.5	−200, 0.5; +200, 0.5	0.962	−	0.891	
5	−100, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	1.000	0.962	0.957	0.940
6	−200, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	−	0.990		0.960
7	−50, 0.3; +100, 0.7	−300, 0.3; +200, 0.7	0.908	−	0.930	
8	−300, 0.3; +200, 0.7	−500, 0.3; +300, 0.7	0.975	0.928	0.930	0.940
9	−500, 0.3; +300, 0.7	−700, 0.3; +400, 0.7	−	0.990		0.960

Note. [(1)]In all tables, "WS" means "within-subject comparisons" (Experiment 1), and "BS" means "between-subject comparisons" (Experiment 2).

Table 3. Preferences in trivial decisions—fractions of subjects who preferred less risky option

No of pair	Option A	Option B	EV		CPT values[(1)]		Fraction of subjects who chose A	
			A	B	A	B	WS Exp. 1	BS Exp. 2
Target return equals to 200								
2	−200, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	0	0	−199	−218	0.780	0.696
5	−100, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	50	0	−154	−218	0.851	0.848
8	−300, 0.3; +200, 0.7	−500, 0.3; +300, 0.7	50	60	−174	−202	0.828	0.907
Target return equals to 300								
3	−300, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	0	0	−284	−301	0.727	0.760
6	−200, 0.5; +300, 0.5	−400, 0.5; +400, 0.5	50	0	−242	−301	0.909	0.816
9	−500, 0.3; +300, 0.7	−700, 0.3; +400, 0.7	60	70	−264	−291	0.900	0.840

Note. The following parameters were used: $\alpha = \beta = 0.88$, $\lambda = 2.25$, $\gamma = 0.61$, and $\delta = 0.69$. For the reference points 200 and 300, the presented options were either mixed or negative prospects. For mixed prospects, the calculated weights were as follows: $w^-(p) = w(0.5) - w(0) = 0.45$ *or* $w^-(p) = w(0.3) - w(0) = 0.33$ and $w^+(p) = w(0.5) - w(0) = 0.42$ or $w^+(p) = w(0.7) - w(0) = 0.54$. For negative prospects with two losses, the calculated weights were as follows: $w^-(p_{smaller}) = w(1) - w(0.5) = 0.55$ and $w^-(p_{greater}) = w(0.5) - w(0) = 0.45$ or $w^-(p_{smaller}) = w(1) - w(0.3) = 0.67$ and $w^-(p_{greater}) = w(0.3) - w(0) = 0.33$.

Preferences in trivial decisions

By choosing Option A in the pairs from the first subset, subjects can both minimize risk and meet the aspiration level. As expected, preferences in these situations are clear—a large majority prefer the less risky option (see Table 3).

Preferences shown in Table 3 are in agreement with the assumption for the rational choice made in the EV model. They also agree with the CPT model: a majority prefer the option that has a better (less negative) CPT value as calculated using the equation and parameters given by Tversky and Kahneman (1992). Here, the target return is treated as the reference point for coding outcomes as gains and losses. Finally, preferences are also consistent with the SP/A model. When there is no conflict between minimizing risk and pursuing the aspiration level, SP and A criteria favor the same selection, which is Option A.

In summary, faced with decisions that do not involve conflict between risk and aspirations, a majority of subjects make risk-averse choices consistent with predictions of all models discussed here. This is precisely what was assumed in the experimental design.

Preferences in decisions with conflict and a single-criterion model of choice (CPT)

Preferences of subjects in the six situations from the second subset are given in Table 4. Recall that Option A is less risky, but only Option B meets the aspiration level. Even a very casual inspection of subjects' preferences leads to the conclusion that the simplicity and consistency of choices observed for trivial situations is absent in this case. This immediately raises a question about how well different models fare in explaining nontrivial decisions and, in particular, whether single-criterion models of choice can

Table 4. Preferences for decisions in which conflict is involved—fractions of subjects who preferred less risky option

No of pair	Option A	Option B	EV		CPT values[1]		Fraction of subjects who chose A	
			A	B	A	B	WS Exp. 1	BS Exp. 2
			Target return equals to 200					
1	−100, 0.5; +100, 0.5	−200, 0.5; +200, 0.5	0	0	−225	−199	0.364	0.304
4	−50, 0.5; +100, 0.5	−200, 0.5; +200, 0.5	25	0	−202	−199	0.567	0.500
7	−50, 0.3; +100, 0.7	−300, 0.3; +200, 0.7	55	50	−182	−174	0.432	0.442
			Target return equals to 300					
2	−200, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	0	0	−313	−284	0.306	0.360
5	−100, 0.5; +200, 0.5	−300, 0.5; +300, 0.5	50	0	−269	−284	0.593	0.510
8	−300, 0.3; +200, 0.7	−500, 0.3; +300, 0.7	50	60	−292	−264	0.522	0.460

Table 5. The situations either with or without conflict that have similar differences in the CPT values between two options—fractions of subjects who preferred option with better CPT

No conflict					**With conflict**				
Pair	Target	Difference in CPT values	Fraction of subjects who chose better CPT		Pair	Target	Difference in CPT values	Fraction of subjects who chose better CPT	
			WS Exp. 1	BS Exp. 2				WS Exp. 1	BS Exp. 2
9	300	27	0.900	0.840	**8**	300	28	0.478	0.540
8	200	28	0.828	0.907	**2**	300	27	0.694	0.640
2	200	19	0.780	0.696	**1**	200	26	0.636	0.696
3	300	17	0.727	0.760	**5**	300	15	0.593	0.510
average		23	0.809	0.801	average		24	0.600	0.597

account for preferences when conflict is involved in decisions.

To address this question, CPT values for both options in each situation have been calculated and are listed in Table 4. At the first sight, it may appear that subjects' preferences are in fair agreement with predictions from the model—four times out of six, a majority of subjects choose the option that also has a better CPT value. However, in the remaining two situations (4 and 8), one half or a slight majority prefer the option that has worse CPT value. Moreover, preferences are not very clear for four out of six choices (situations 4, 7, 5, and 8). The inconsistencies between the observed and predicted choices appear to be meaningful, as illustrated in Table 5. Four situations chosen from Tables 3 and 4 are listed on each side of the table. The differences between the better and the worse CPT value in all these situations are very similar. Thus, it is expected that preferences would also be similar. This is, however, not the case; the fraction of subjects that make choices in agreement with the prediction of CPT is consistently higher on the left side than on the right side. Why is it so? A single-criterion model of choice offers no clues for explaining these differences—all available information is already included in the calculated CPT values. In contrast, the explanation is natural on the grounds of dual-criterion models of choice. No situations on the left side involve conflict between maximizing risk and meeting the aspiration level. As discussed previously, these simple situations lead to straightforward choices. In contrast, all situations on the right side involve conflict, which makes preferences much less clear.

One might suggest that the results in Table 5 could be reconciled by adjusting the CPT parameters within a reasonable range. A closer analysis of the data indicates, however, that this is not possible.[3] This leads to the conclusion that the CPT model does well in simple situations but does not fare nearly as well when conflict is involved. This points to limitations of models of choice based on the single criterion—maximization of expected or nonexpected utility.

[3] This can be clearly seen when considering situations 2 and 3 in the left column versus lotteries 1 and 2 in the right column. All options in these lotteries have a probability of 0.5, which makes the parameters of the probability-weighting function irrelevant for the comparison. Moreover, once the outcomes are adjusted so that the target return becomes the reference point, all lotteries are in the domain of loss (i.e., there are no positive outcomes). This means that only the parameter that defines the shape of the value function for losses is relevant. In the situations in the left column, the lotteries favored by subjects have smaller maximum loss, but the opposite is true for lotteries in the right column. Thus, whether we make the value function more steep or less steep, we cannot achieve agreement with CPT in both columns simultaneously.

Preferences in decisions with conflict and double-criterion models of choice (SP/A and R-V)

From Table 4 it can be seen that the willingness to meet the target return is not constant for all decisions, but instead appears to be inversely related to "irrationality" or difficulty of a decision. When the option that meets aspirations has not only higher variance but also worse EV than the less risky options (pairs 4 and 5), a slight majority of subjects choose the safer option at the expense of not meeting the target return. A similar pattern is observed when the option that satisfies the aspiration level has nearly the same EV but both higher variance and greater amount of loss than the less risky option (pairs 7 and 8). Then subjects' choices are split nearly in half.

The observed unclear preferences are predicted in the SP/A model. In line with this model, subjects are expected to be divided between choosing the option that is favored by the A criterion and choosing the option that is favored by the SP criterion. This view is supported by the analysis performed on the data for individual subjects. Facing a conflict between security and aspirations, 10% and 20% of subjects in Experiment 1 and 2, respectively, always make safer choices whereas approximately 35% always favor meeting the target return. According to the SP/A model, this means that preferences of subjects in each of these two groups are determined only by their position on the security-potential dimension and result from relatively stable personality characteristic. All other subjects (roughly 50%) split their choices between options that are safer and options that meet the target return. This indicates that they consider both the SP and the A criterion, but weight them differently depending on a situation.

Finally, the changing fraction of subjects willing to achieve the target return can be explained in terms of trade-off between risk and value. For example, compared with pairs 1 and 2, the less risky options in pairs 4 and 5 have both smaller amounts of loss and higher EV. This reduces their risk and increases their value. Consequently, the increased fraction of subjects who choose this option might be explained on the basis of more favorable risk, more favorable value, or both. However, the results also indicate that value in the R-V model cannot be interpreted simply as EV. If this were so, the less risky options should always be chosen in pairs of options with the same EV. This is, however, not the case. One possible alternative is to interpret the results in terms of trade-off between risk and benefits. This would be consistent with the results in Table 4 and with findings that risk acceptance in mixed, two-outcome lotteries is well predicted by a model that combines risk ratings and the amount of gain (Sokolowska & Pohorille, 2000).

Stability of risk ordering and switch in preferences due to aspiration level

The analysis of switches in preferences for pairs 2, 5 and 8, which were presented to subjects either twice (i.e., for both aspiration levels in Experiment 1) or to both groups (in Experiment 2), directly deals with the different impacts of aspirations on risk ordering and on choices. This is illustrated in Figures 1 through 3. For example, for pair 2, as shown in Figure 1, when the less risky option meets the target return, it is chosen by a majority of subjects (78% and 70% in Experiments 1 and 2, respectively). When the target return increases sufficiently that the option no longer meets aspirations, it is chosen by about 30% of subjects (31% in Experiment 1 and 35% in Experiment 2). This change in preferences of subjects in Experiment 1 is statistically significant (Mcnemar test: Chi-square = 84.99, $p = .000$, $N = 209$) as is the difference in preferences of two groups in Experiment 2 (Chi-square = 11.55, $p = .001$, $N = 95$). Similar patterns of preferences are observed for pairs 5 and 8 (see Figures 2 and 3). All differences are statistically significant (McNemar test in Experiment 1: Chi-square = 37.31 and 42.28, $p = .000$, $N = 202$ and 204; in Experiment 2: Chi-square = 12.86 and 21.50, $p = .000$, $N = 94$ and 92, for pairs 5 and 8, respectively).

For Experiment 1, the analysis of two-way contingency tables (target by choice) based on the proportion of changes due to aspirations to all disconcordant pairs was also performed. As shown in Figures 1–3, the ratio of switches in preferences that meet the target to all switches is 106:113, 56:67, and 75:88 for pairs 2, 5, and 8. All these ratios are significantly different from 0.5 ($z = 9.31$, 6.23, and 6.61; $p = .000$). The results further support the hypothesis that aspirations affect preferences. Recall from the previous discussion that risk orderings remain the same.

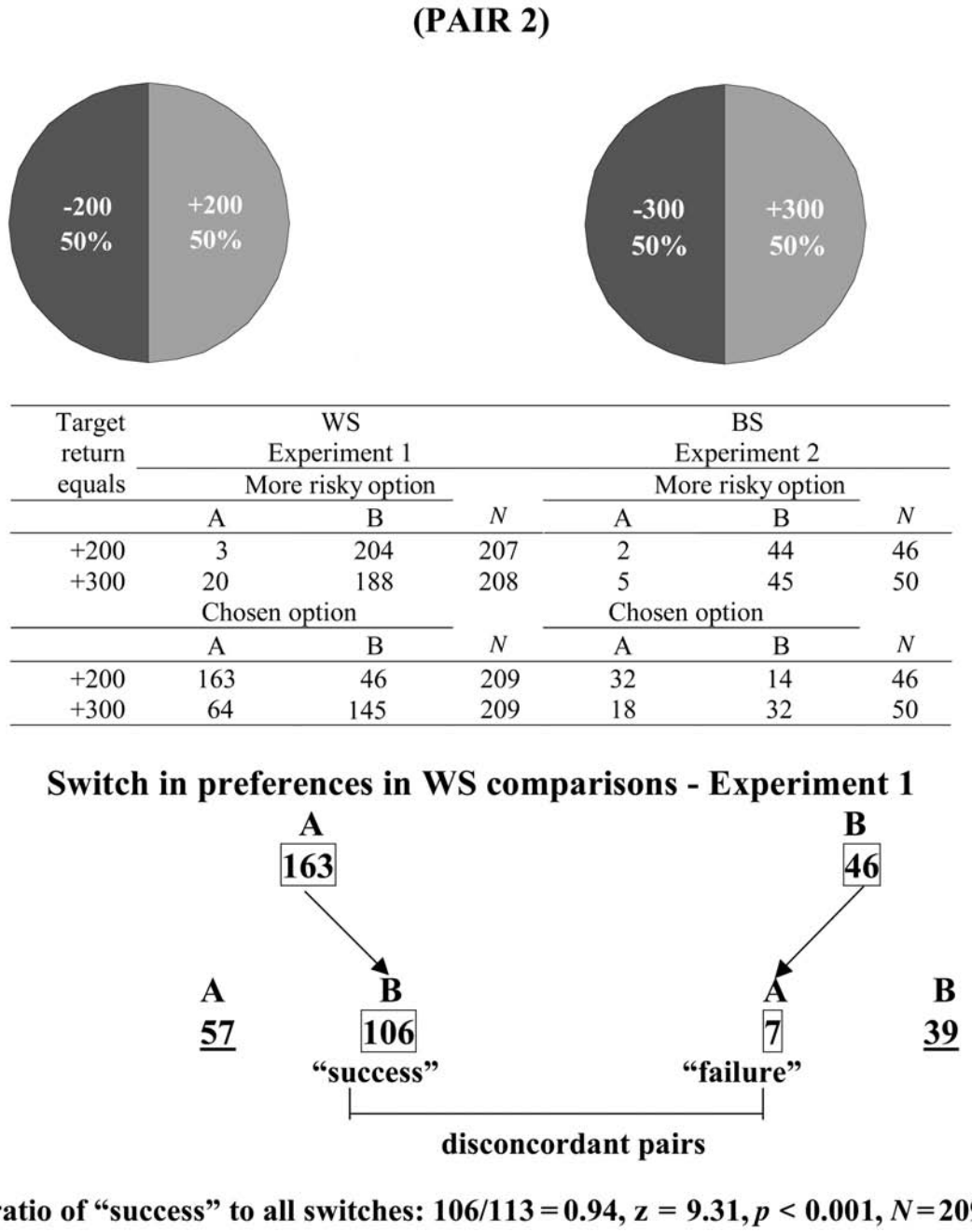
More formally, the issue can be addressed by performing the hierarchical loglinear analysis with two factors—target (200 versus 300) and response mode (risk versus choice), separately for Experiment 1 and Experiment 2. If aspirations affect choice but not risk ordering, then it is expected that the interactions between target return and choice are significant whereas interactions between target return and risk ordering are not. This is indeed the case for all three pairs in both experiments, with the single exception of pair 5 in Experiment 1, in which a significant interaction between the target return and risk was found.[4] The results are summarized in Table 6. Thus, the loglinear analysis clearly points at independence of risk ordering from aspirations and dependence of choices on aspirations.

Discussion

Perceived Risk and Preferences are Distinct Psychological Processes

For an overwhelming majority of subjects, risk ordering has been found to be consistent and stable. It is clearly independent of a shift in the target return. Previously, it was shown that risk judgment was consistent when outcomes were mathematically transformed. For example, for

[4] In this pair, eight subjects pointed to Option A as more risky when aspirations were set as 300, but no subject considered it more risky when aspirations were set as 200. It is enough to change this number from zero to one for the interactions between the target return and risk to become insignificant. It is well known that loglinear analysis tends to predict spurious interactions if populations in some groups are very close to zero.



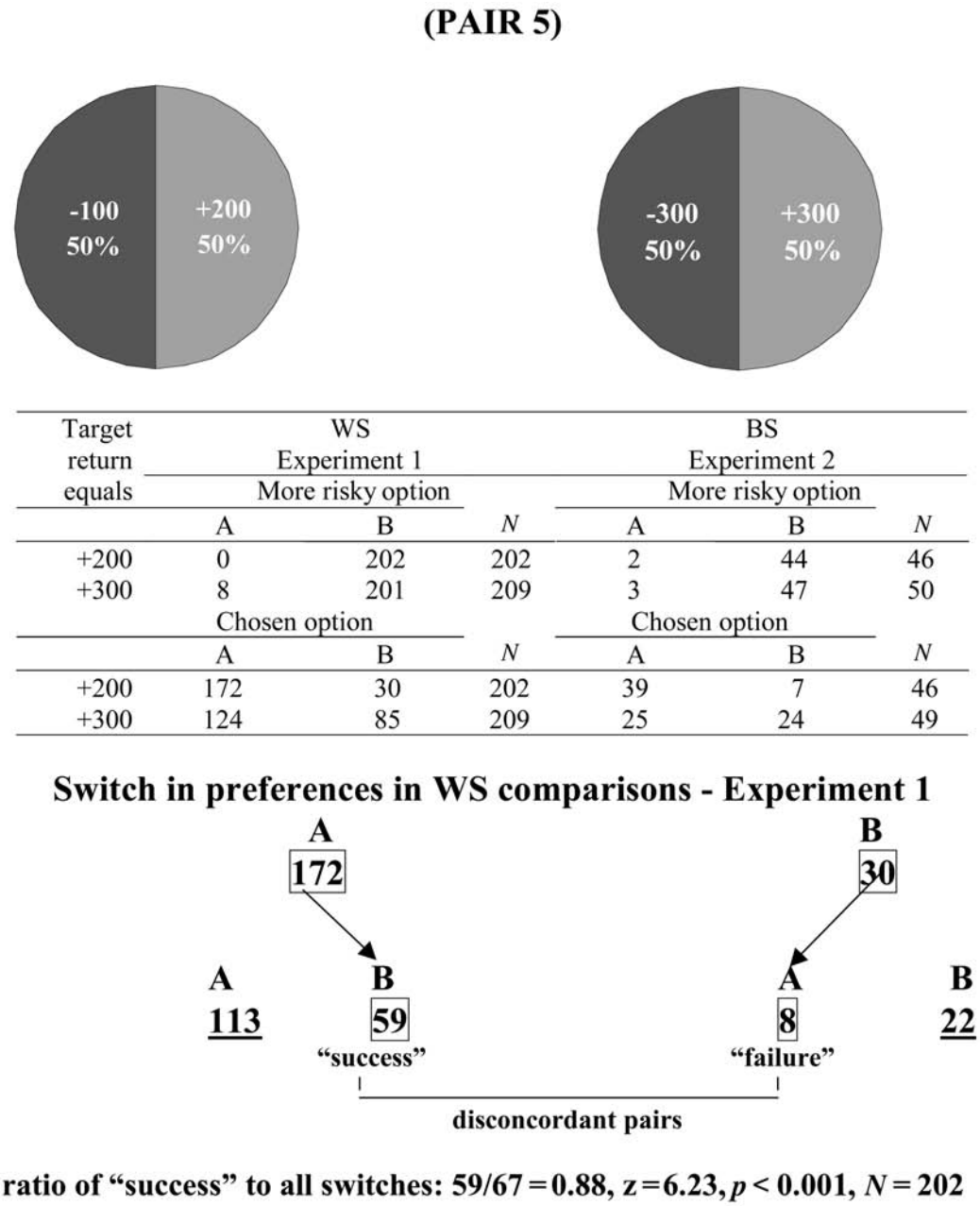
Target return equals	WS Experiment 1			BS Experiment 2		
	More risky option			More risky option		
	A	B	*N*	A	B	*N*
+200	3	204	207	2	44	46
+300	20	188	208	5	45	50
	Chosen option			Chosen option		
	A	B	*N*	A	B	*N*
+200	163	46	209	32	14	46
+300	64	145	209	18	32	50

Figure 1. Risk judgment and choice under two aspiration levels and switches in preferences in Experiment 1.

a majority of subjects, risk ranking within a set of lotteries did not change when the same constant was added to all payoffs of these lotteries (e.g., Butler, Dyer & Jia, 2005; Keller et al., 1986). The results presented here allow for extending this property to psychological translations of outcomes, such as the change of aspirations.[5]

In contrast, preferences are unstable. They are sensitive to both mathematical (e.g., Lopes & Oden, 1999; Payne, Laugham, & Crum, 1980) and psychological (e.g., Payne, Laugham, & Crum, 1981) translations. The latter dependence is also apparent from this experiment in that the shift of the aspiration level causes the switch in preferences.

[5] This does not mean that risk perception cannot be affected by individual dispositions such as anxiety or sensation seeking, cultural differences (e.g., Johnson, Wilke, & E.U. Weber, 2004; E.U. Weber & Hsee, 1998), or other factors.

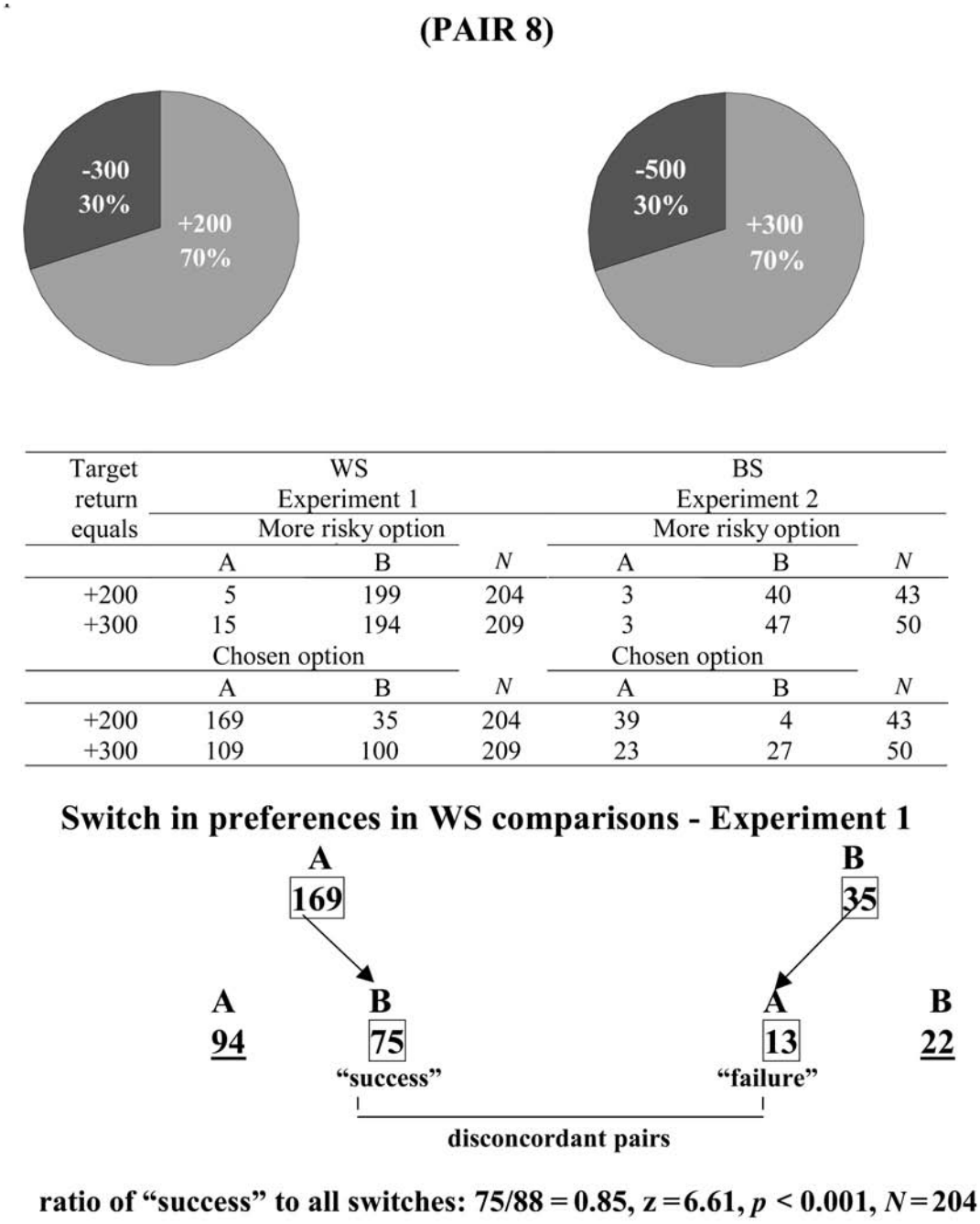


Target return equals	WS Experiment 1 More risky option A	B	*N*	BS Experiment 2 More risky option A	B	*N*
+200	0	202	202	2	44	46
+300	8	201	209	3	47	50
	Chosen option			Chosen option		
	A	B	*N*	A	B	*N*
+200	172	30	202	39	7	46
+300	124	85	209	25	24	49

ratio of "success" to all switches: 59/67 = 0.88, z = 6.23, $p < 0.001$, $N = 202$

Figure 2. Risk judgment and choice under two aspiration levels and switches in preferences in Experiment 1.

Taken together, these two findings lead to the conclusion that risk judgment and preferences are two distinct psychological processes. This distinction is especially relevant to the R-V model of preferences. This model may be criticized on the grounds that introducing risk as a primitive is unnecessary. Because both risk and preferences are functions of the same mathematical variables (outcomes and probabilities—see the review by Brachinger and M. Weber, 1997), it might be simpler to base a model of choice directly on expected or weighted utility rather than to introduce an intermediate variable such as risk (Coombs & Lehner, 1981, 1984). As observed by Jia and Dyer (1996), such risk models "create a dilemma in distinguishing between a measure of risk and a measure of preference" (p. 1693). By demonstrating distinctness of risk ordering and preferences, the present findings support psychological validity of the R-V approach. This empirical evidence is stronger than previous findings, which demonstrated that positive and negative outcomes and their probabilities are weighted differently in risk judgment and in choice (e.g., Luce & E. U. Weber, 1986; E. U. Weber & Bottom, 1990).



Target return equals	WS Experiment 1 More risky option			BS Experiment 2 More risky option		
	A	B	*N*	A	B	*N*
+200	5	199	204	3	40	43
+300	15	194	209	3	47	50
	Chosen option			Chosen option		
	A	B	*N*	A	B	*N*
+200	169	35	204	39	4	43
+300	109	100	209	23	27	50

Figure 3. Risk judgment and choice under two aspiration levels and switches in preferences in Experiment 1.

Relation of the Results to the Two Mechanisms by which Aspirations Might Affect Preferences

Aspirations and Value

As has already been shown (see Table 5), the results raise concerns about the accuracy of CPT-based predictions of preferences in nontrivial situations. Some of these concerns extend to versions of the R-V model, in which strong assumptions are made about the risk-preference relations. Jia and Dyer (1996) proposed a standard measure of risk consistent with the expected value theory, which links perceived risk and preferences. Most recently, Butler et al. (2005) tested the basic assumptions of their model. One assumption requires the inverse relation between risk rates and preferences for lotteries with zero expected value. Indeed, 71% of their subjects preferred lotteries with EV = 0, which were also perceived as less risky. In the same experiment, the authors also tested the original and the generalized preference independence conditions assumed in their model. The original condition requires that prefer-

Table 6. The three-way contingency table and results of the hierarchical loglinear analysis with two factors—target (200 versus 300) and response mode (risk ordering versus choice) for pairs 2, 5, and 8

		WS Experiment 1						BS Experiment 2					
		Chosen option						Chosen option					
Target return	More risky option	Pair 2		Pair 5		Pair 8		Pair 2		Pair 5		Pair 8	
		A	B	A	B	A	B	A	B	A	B	A	B
+200	A	0	3	0	0	0	5	1	1	1	1	2	1
	B	162	42	172	30	169	30	31	13	38	6	37	3
+300	A	0	20	0	8	0	15	0	5	0	3	1	2
	B	64	124	124	77	109	85	17	27	24	21	21	25

Hierarchical Loglinear Analysis

Term deleted from the saturated model	df	Difference in LR χ^2 due to deletion of a given term:	*p*	Difference in LR χ^2 due to deletion of a given term:	*p*	Difference in LR χ^2 due to deletion of a given term:	*p*	Difference in LR χ^2 due to deletion of a given term:	*p*	Difference in LR χ^2 due to deletion of a given term:	*p*	Difference in LR χ^2 due to deletation of a given term:	*p*
Target Risk Choice	1	0.000	1.000	0.000	1.000	0.000	1.000	1.366	0.242	0.723	0.395	0.465	0.495
Target Risk	1	**1.877**	**0.171**	**5.044**	**0.025**	**0.011**	**0.918**	**0.178**	**0.673**	**0.261**	**0.610**	**0.500**	**0.480**
Target Choice	1	**85.625**	**0.000**	**19.182**	**0.000**	**40.401**	**0.000**	**10.751**	**0.001**	**13.512**	**0.000**	**24.015**	**0.000**
Risk Choice	1	24.955	0.000	14.862	0.000	41.639	0.000	3.54	0.060	5.047	0.025	1.197	0.274

ences be stable for two lotteries with the same EV when the same constant is added to all outcomes. The authors observed high consistency of subjects' responses with this condition for lotteries in either positive or negative domain, but not for lotteries with mixed outcomes. To account for this discrepancy, they introduced the generalized independence condition. In the spirit of the CPT model, they allowed for switch in preferences when outcomes of a lottery are translated from the gain to the loss domain or vice versa.

The pattern of preferences observed in the present experiment is neither the inverse of risk judgment nor an example of the reflection effect. This conclusion does not depend on whether the reference point is taken as the status quo or as the aspiration level. If the reference point is considered to be the status quo, all lotteries have mixed outcomes, and lotteries in pairs 1 and 2 have EV = 0. In pair 1, a majority of subjects chose the more risky option. For pair 2, a majority of subjects chose the option that meets aspirations, no matter whether the option was less or more risky (see Tables 3 and 4). This is inconsistent with the assumption that preferences and risk are inversely related for lotteries with EV = 0. Alternatively, one might consider any change in the aspirations level to be a mathematical translation of a lottery (i.e., subtraction of a constant from all outcomes). Thus, for both aspiration levels, no outcomes of the analyzed lotteries are positive, so subjects always make choices in the domain of loss. Then the observed switches in preferences are inconsistent with both the original and generalized independence conditions for preferences. This might be considered an additional hint that the switches in preferences result from the relative importance of conflicting criteria rather than from changes in the global value of an option.

Aspirations and Conflicting Criteria of Choice

When there is no conflict between minimizing risk and aspirations, a majority of subjects make risk-averse choices. However, when the less risky option fails to meet the target return, subjects either choose in favor of aspirations or do not show clear risk-averse or risk-seeking preferences. Such inconsistencies are explicitly predicted in the SP/A model when the conflict between security weighting and aspirations is involved. Either criterion could be more or less salient depending on characteristics of the lotteries (e.g., an increase in the amount of loss can shift attention from the A to the SP criterion, as observed in pairs 2 and 8).

Aspirations might also affect security versus potential weighting and, by doing so, influence trade-off between risk and value in the R-V model of preferences. Such an interpretation is in agreement with findings of E. U. Weber and Milliman (1997) and Mellers, Schwartz, and E. U. Weber (1997). For a variety of decision domains (gambling, stock market, and commuting decisions), they have shown that within- and between-subject differences in risk preferences may result not only from differences in risk perception but also from differences in the attitude toward perceived risk or, in other words, in the trade-off coefficient. Most recently, Johnson, Wilke, and Weber (2004) have found that Germans are more willing than Americans

to take ethical risks. The risk-return regressions have shown similar effect of perceived risk on the willingness to take risk in both populations, but the impact of expected benefits on risk taking is higher in the German population than in the American population. Thus, this cultural difference could be explained by higher weights placed by Germans on expected benefits in risk-value trade-offs.

Conclusions

The results indicate that aspiration level is a factor that may affect preferences but does not affect risk judgments. Thus, the observed switch in preferences due to changes in the aspiration level is not caused by the change in perceived risk of different options. This supports the hypothesis that risk judgment and preferences are two distinct psychological processes, as assumed in the R-V approach. A corollary to the finding about the independence of risk judgments on aspirations is that risk cannot be interpreted as not achieving the target return.

The results from both experiments are remarkably consistent, no matter whether a within-subject or between-subject design was used. This consistency implicitly indicates that there is no strong influence of risk judgment on preferences. If this were the case, the choices of subjects in groups 1 and 2 of Experiment 2 would be similar.

The results also indicate that a single-criterion model of choice does not predict well the preferences in decisions involving conflict, no matter whether aspirations are or are not included as the reference point in coding and weighting outcomes. The models in which two conflicting criteria for choice are assumed seem to be more promising in accounting for preferences as the aspiration level changes. Currently, however, these models do not provide tools for making quantitative predictions about people's choices in specific situations. Further research is needed to determine which individual and situational factors are responsible for weighting the conflicting criteria.

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