Title

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Risk attitude in decision making: A clash of three approaches

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Abstract

We evaluate the consistency of different constructs affecting risk attitude in individuals' experiential decisions across different levels of risk. Three major views concerning the psychological constructs that underlie risk attitude are contrasted. The first is the classical economic approach which views risk as the sensitivity to differences in variance. The second is the latent components approach suggesting the importance of sensitivity to losses and diminishing sensitivity to marginal increases in payoffs. The third approach, risk acceptance, relates to the willingness to accept probable outcomes over certainty. The results of three studies indicate that: (1) Individuals do not exhibit consistency in their sensitivity to variance (2) Across domains individuals are consistent when deciding between constant versus probable outcomes, refuting the prediction based on diminishing sensitivity. (3) Risk acceptance entails different psychological constructs when the decision involves co-occurring gains and losses. The results are modeled with a quantitative index of subjective risk.

Keywords: risk; choice; individual differences; cognitive style.

Introduction

A dominant view of the psychological construct of sensitivity to risk (or risk attitude) suggests that it in fact represents the consistent sensitivity to different latent components. The most prominent example of this idea is prospect theory (Kahneman & Tversky, 1979) which explains contingent risk taking in different domains by the assumption that subjective values (or utilities) are based on relative judgments reflecting the effect of two main constructs: (a) Loss aversion – the idea that losses loom larger than equivalent gains, and (b) Diminishing sensitivity to marginal changes in payoff – the assertion that the subjective impact of a change in the absolute payoff decreases with the distance from zero. Recent cognitive models of individual choice in decisions from experience (see Hertwig et al., 2004) have adopted this view by implementing these factors as two core components of subjective utility: (a) loss sensitivity – the assumption that individuals weigh gains and losses in a consistent fashion (e.g., Busemeyer & Stout, 2002; Worthy, Maddox, & Markman, 2007), and (b) diminishing sensitivity – the assertion that people are consistent in discounting payoffs magnitudes with the distance from zero (e.g., Ahn et al., 2008).

We contrast this "latent constructs" approach with two alternative views. The first is the classical economic approach that addresses risk attitude as sensitivity to differences in payoff variances (e.g., Pratt, 1964; Preuschoff, Bossaerts, & Quartz, 2006). The second is a recent view which suggests that "risk acceptance," the tendency of people to prefer (or avoid) risk over certainty is a single primitive construct that cannot be further dissected into the effect of gains and losses and the effect of diminishing sensitivity, but does not necessarily reflect sensitivity to variance (e.g., Brachinger & Weber, 1997). There are different formulations of the risk acceptance approach. For simplicity purposes we chose to focus on a simplified interpretation, referring to risk acceptance as the individual's sensitivity to certain versus probable outcomes. Thus, the risk acceptance hypothesis can be viewed as an extreme case of the sensitivity to variance hypothesis. That is, it suggests that the difference in variance is a necessary but insufficient condition of individual sensitivity to risk. The other necessary condition for risk sensitivity is a condition activating the individual's preference for certainty versus uncertainty.

The three aforementioned approaches are related but have distinct predictions that, surprisingly, have not been previously contrasted. The first such prediction involves the consistency between risk taking propensities in the gain and loss domain. Under the latent construct approach, supposing that indeed diminishing sensitivity underlies risk taking between domains, then a negative association is expected between risk taking in the gain and loss domains as implied by the reflection effect (Kahneman & Tversky, 1979). For example, if an individual discounts $1200 to a higher degree than she discounts $600 and is consistent in this diminishing sensitivity then she should be risk averse while choosing between a sure win of $600 and a bet with equal chances to win $1200 or nothing, but should be risk seeking when these values are framed as losses. In contrast, models based on the sensitivity to variance, as well as models of risk acceptance would predict a positive correlation between risky choices in the two domains, as individuals would either seek or avoid variance in both domains. However, the risk acceptance approach will have this prediction only when the choice alternatives also differ in their levels of certainty. These contrasting predictions are examined in Experiment 1.

The second prediction, which is the focus of Experiment 2, involves the consistency of the weighting of gains and losses. Under the latent construct model's assumption of weighting of gains and losses, a positive correlation should appear between choice problems differing in the magnitudes of gains and losses regardless of factors like variance or certainty. In contrast, the sensitivity to variance model predicts that the largest consistencies would appear between problems where the alternatives have the same levels of variance. The risk acceptance approach predicts choice consistency mostly when there are distinguishable differences in levels of certainty, such as in the choice between fixed and probabilistic outcomes. Experiment 3 focuses on the argument that risk acceptance involves a single primitive construct, even when gain domain problems are contrasted with choice problems involving both gains and losses.

Our comparison of different potential accounts for individual consistency in risk taking across tasks is closely related to previous studies of consistency in risk taking (Schoemaker, 1990) and to studies that compared models of risk taking (e.g., Battalio, Kagel, & Jiranyakul, 1990; Wakker et al., 2007). There are two major differences from these previous studies: First, these studies have tended to focus on the latent construct approach and did not systematically investigate alternative approaches to the psychological constructs underlying risk sensitivity. Secondly, these studies have focused on one-shot choices between described prospects, whereas we focus on risk taking in decisions from experience (Hertwig et al., 2004). In such decisions, Individuals do not get explicit information about the distributions that underlie the alternatives they face (e.g., the probabilities and payoff sizes). However, by choosing repeatedly between the different alternatives, and realizing the outcome of each choice (which is drawn from the relevant distribution) they can learn the potential outcomes associated with each alternative and their likelihoods. Previous studies have demonstrated that experience-based decision tasks have many attractive features for studying individual risk taking. It has been shown, for example, that such tasks have high external validity in assessing individual differences in decision making and that they are also relatively more resistant to social desirability than descriptive gambles (see review in Koritzky & Yechiam, 2010).

Experiment 1

The main purpose of our first study was to contrast the "diminishing sensitivity" assertion (appearing in latent component models such as prospect theory) with the "sensitivity to variance" hypothesis, and the "risk acceptance" assertion, by focusing on the main implication of the diminishing sensitivity construct, namely the contingent risk taking in the gain and loss domains. Each participant was presented with four repeated choice tasks, as described in Table 1. Each task included two alternatives and one (referred to as "L") was always associated with lower variance payoffs than the other ("H"). The main within-subject manipulation pertained to the domain in which choices were made. In the Gain condition choice alternatives yielded positive outcomes, whereas in the Loss condition outcomes were negative.

In order to differentiate between the "sensitivity to variance" and the "risk acceptance" hypotheses, the tasks were also distinguished with respect to the difference in the levels of uncertainty. In two of the tasks selecting the safer option eliminated probabilistic outcomes. We refer to these tasks as the "Avoidable Uncertainty" (AU) condition. In the other two tasks uncertainty could not be avoided since both alternatives included probable outcomes. These tasks are referred to as the "Unavoidable Uncertainty" (UU) condition.

The diminishing sensitivity assertion implies negative association between both domains in both the avoidable and the unavoidable uncertainty conditions because high diminishing sensitivity leads to risk seeking in the loss domain and risk aversion in the gain domain. Notice that this assertion also implies positive correlations between the two gain problems, and between the two loss problems. The risk acceptance assertion, however, suggests a positive association between the two avoidable uncertainty problems, and no association between the two unavoidable uncertainty problems. In the avoidable uncertainty problems there are clearer environmental signals concerning the differences in uncertainty level, which supposedly trigger risk acceptance tendencies. Finally, the sensitivity to variance model predicts positive association between all four choice problems due to one option being higher in variance than the other, even in the unavoidable uncertainty problems.

Forty undergraduates (20 males and 20 females) participated in the experiment. The participants' average age was 24 (ranging between 19 and 27). Payoffs ranged between NIS 14 and NIS 26 (NIS 1 = $4.5).

Each participant made 100 choices in each of the four choice problems. The participants were informed that they would be playing different games in which they would operate "computerized money machines" which include two unmarked buttons, and that their final payoffs would be sampled from one of the "machines" but received no prior information about the payoff distributions or the number of trials. Their task was to select one of the machine's two unmarked buttons in each trial. The payoffs in each task were contingent upon the button chosen and were randomly drawn from the relevant distributions described in Table 1. Final take-home amounts were determined according to the accumulating score in one choice problem that was randomly selected at the end of the experiment. The performance score was converted into cash money at a rate of 0.01 agora per 1 point (1 agora = 0.24 cents). The final payoff was then determined by summing this amount with the participation fee (NIS 25).

Two types of feedback immediately followed each choice: (1) the basic payoff for the choice, which appeared on the selected button for two seconds, and (2) an accumulating payoff counter, which was displayed constantly, but was initialized at the beginning of each task. The order of the Gain and Loss conditions was counterbalanced, and the order of the two problems within each condition was randomized. The location of alternatives L and H was randomized across different participants. The measure used in each task was simply the proportion of choices of H across trials. There are therefore four variables in this study (and subsequent ones) conforming to the rate of H choices in each of the four choice problems.

Table 1: Payoff schemes of the four experimental conditions of experiment 1.

Domain	Condition	Payoff	P(H)
Gain	Avoidable Uncertainty	L: win 600 H: 50% to win 1200, 50% to win 0	0.26
Gain	Unavoidable Uncertainty	L: 50% to win 500, 50% to win 400 H: 50% to win 890, 50% to win 10	0.31
Loss	Avoidable Uncertainty	L: lose 600 H: 50% to lose 1200, 50% to lose 0	0.45
Loss	Unavoidable Uncertainty	L: 50% to lose 500, 50% to lose 400 H: 50% to lose 890, 50% to lose 10	0.49

Table 2: Spearman correlations between risk-taking in the different tasks in Experiment 1 (AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty).

		AU		UU	
		Gain	Loss	Gain	Loss
AU	Gain	1.00			
	Loss	.45*	1.00		
UU	Gain	.63*	.22	1.00	
	Loss	.17	.35*	.03	1.00

* p < .05

Results

The choice proportions under the different conditions are summarized in the rightmost column of Table 1. The findings at the aggregate level show that people took more risk in the loss domain than in the gain domain ($t(39) = 3.98$, $p < .001$). There were no significant differences in risk taking between the AU and the UU conditions ($t(39) = 1.41$, NS).

The consistency of individuals' risk taking across the different tasks is presented in Table 2. The results show that in the AU condition there was a positive association between the gain and loss domains ($r = .45$, $p < .01$), which stands in contrast to the diminishing sensitivity hypothesis, and supports the risk acceptance assertion. Taking the UU condition into account, the results show that in this condition there was no association between the loss and gain domains ($r = .03$, NS), which further supports the risk acceptance assertion, since in the UU condition the probabilistic outcome could not be avoided (or accepted). In addition, participants were consistent between the two Gain problems ($r = .63$, $p < .0001$) and between the two Loss problems ($r = .32$, $p < .02$), suggesting that individuals might exhibit diminishing sensitivity to a certain degree.

Therefore, it seems that the reflection effect, implied by the diminishing sensitivity assertion, was not observed at the individual level. Instead, participants exhibited a consistent preference between a constant outcome and a probable outcome across the gain and loss domains. This suggests that risk acceptance modulates the consistency across the gain and loss domain and that diminishing sensitivity alone cannot account for it.

Additionally, the suggestion that the consistent sensitivity to risk is due to mere variance differences cannot account for the null correlations between gain and loss domain problems in the Unavoidable Uncertainty condition. Still, the variance difference in this condition was somewhat smaller than in the Avoidable Uncertainty condition (and thus it could be argued that this produced lower correlations in this condition). In the next experiment we examine problems that have the same exact differences in variance.

Experiment 2

The second experiment was designed to examine whether loss sensitivity indeed modulates risk taking behavior in problems involving gains and losses, or whether its effect are due to risk acceptance (or sensitivity to variance) as well. This was accomplished by contrasting two conditions involving losses and gains: A condition with strong differences in uncertainty level (i.e., the participants could opt for not selecting the gamble and get a sure outcome of zero) and a condition where the differences in uncertainty were smaller (i.e., selecting the safer option decreased the magnitude, but not the frequency of losses). We examined whether participants would still be consistent in their response to losses (across two choice problems) in the latter condition.

Under the latent component approach the loss-sensitivity construct involves pure sensitivity to the magnitude of losses compared to gains. Therefore, consistency is expected to be maintained regardless of the differences in uncertainty. Similarly, under the sensitivity to variance approach a positive correlation is expected to emerge as long as the alternatives maintain the same difference in variance. However, under the risk acceptance approach consistency is only expected to emerge in the condition where there are substantial differences in the level of uncertainty.

Each participant was presented with four repeated choice tasks, as described in Table 3. The tasks involved two conditions differing in the capacity of decision makers to avoid probabilistic outcomes. In two of the tasks selecting the safer option eliminated the probability of losing. We refer to these tasks as the "Avoidable Uncertainty" (AU) condition. In the other two tasks uncertainty differences between alternatives were smaller and both alternatives included possible losses occurring with the same frequency (but differing in magnitude). Accordingly, these tasks are referred to as the "Unavoidable Uncertainty" (UU) condition. A second within-subject manipulation pertained to the level of variance associated with the riskier option. In condition "Low Variance" the standard deviation associated with alternative H (SD = 100) was one fifth of that associated with the corresponding alternative in condition "High Variance" (SD = 500). This enabled us to evaluate the consistency across different levels of variance and compare the consistency in the AU and UU conditions.

Thirty (15 males and 15 females) undergraduate students participated in the experiment. Their average age was 24 (ranging from 20 to 27). Payoffs varied between NIS 25 and NIS 33. The procedure was as in Experiment 1 except that the experiment focused on the tasks described in Table 3, and the conversion rate was 1 agora per 1 point.

Table 3: Payoff schemes of the four experimental conditions of Experiment 2.

Condition	Variance	Payoff	P(H)
Avoidable Uncertainty	Low	L: win 0 H: 50% to win 100, 50% to lose 100	0.64
Avoidable Uncertainty	High	L: win 0 H: 50% to win 500, 50% to lose 500	0.61
Unavoidable Uncertainty	Low	L: 50% to win 50, 50% to lose 50 H: 50% to win 150, 50% to lose 150	0.52
Unavoidable Uncertainty	High	L: 50% to win 250, 50% to lose 250 H: 50% to win 750, 50% to lose 750	0.51

Table 4: Spearman correlations between risk-taking in the different tasks in Experiment 1 (AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty).

		AU		UU	
		Low var	High var	Low var	High Var
AU	Low var	1.00			
	High var	.54*	1.00		
UU	Low var	.07	-.08	1.00	
	High var	.20	.13	.13	1.00

* p < .05

Results

The choice proportions under the different conditions are summarized in the rightmost column of Table 3. At the aggregate level it seems that the participants tended to take more risk in the AU than in the UU condition ($t(29) = 3.15$, $p < .01$). Additionally, in both conditions participants did not appear to exhibit loss aversion, consistent with previous findings in experience-based tasks (e.g., Erev et al., 2008).

Table 4 presents the consistency of individuals' risk taking across tasks. The results reveal that despite showing no loss aversion on average, participants were highly consistent between the AU problems, in which risks could be avoided ($r = .54$, $p < .01$) but not in the UU problems, where risks could not be avoided ($r = .13$, NS).

Also, the participants did not show consistency across the two High-Variance and Low-Variance tasks, inconsistently with implication of the risk as variance. The correlations within each of the two pairs of High and Low variance tasks were small ($r = .07$, .13) and insignificant. This suggests that what makes participants respond consistently to high and low variance alternatives is not their mere variance.

This pattern suggests that the consistency in risk taking with losses is not driven by an accounting balance that inflates gains or losses (e.g., a weighted average of gain and loss amounts) nor is it driven only by sensitivity to variance. Rather, the participants were only consistent when a risky alternative involving losses and gains was contrasted with a safe alternative offering a fixed outcome. This indicates that the consistent construct in the mixed domain involves risk acceptance. Without strong signals of differences in risk level in the form of constant versus probabilistic outcomes, the correlation appears to disappear.

Experiment 3

From the results of Experiments 1 and 2 one can conclude that the main construct modulating people's responses is risk acceptance. Yet an alternative suggestion is that while risk acceptance consistently affects people's responses, this is limited to situations involving no explicit comparisons between gains and losses. Under the latent construct model, in the latter situation risk taking (i.e., selecting the high variance option) is solely due to the weighting of gains and losses and not due to diminishing sensitivity (because diminished sensitivity is balanced for gains and losses). While the pure weighting of gains and losses hypothesis was rejected in Experiment 2, it can still be argued that risk acceptance is an independent psychological construct when gains and losses are explicitly compared. The goal of Experiment 3 was therefore to examine whether risk acceptance is a single psychological construct or whether it implicates a second construct when the outcomes involve frequently appearing gains and losses. This was examined by comparing the consistency of risk taking across Gain and Mixed domain problems (as shown in Table 5). A second within-subject manipulation pertained to the level of risk. In Condition "Low Variance" alternative H was associated with a standard deviation smaller by half than in condition "High Variance" (SD = 1000, 2000, respectively).

Fifty (25 males and 25 females) undergraduate students participated in the experiment. Their average age was 24 (ranging from 21 to 28). Payoffs varied between NIS 20-30. The procedure was as in Experiment 1 except that the experiment focused on the tasks described in Table 5. The conversion rate was 1 agora per 1 point.

Table 5: Payoff schemes of the four experimental conditions of Experiment 3.

Condition	Variance	Payoff	P(H)
Mixed	Low	L: win 0 H: 50% to win 1000, 50% to lose 1000	0.55
Mixed	High	L: win 0 H: 50% to win 2000, 50% to lose 2000	0.56
Gain	Low	L: win 1000 H: 50% to win 2000, 50% to win 0	0.28
Gain	High	L: win 2000 H: 50% to win 4000, 50% to win 0	0.30

Table 6: Spearman correlations between risk-taking in the different tasks in Experiment 3.

		Mixed		Gain	
		Low var	High var	Low var	High Var
Mixed	Low var	1.00			
	High var	.57*	1.00		
Gain	Low var	.06	.11	1.00	
	High var	.14	.14	.55*	1.00

* p < .05

Results

The choice proportions under the different conditions are summarized in the rightmost column of Table 5. The results show that people took more risk on average in the Mixed condition than in the Gain condition under relatively low risk ($t(49) = 4.71$, $p < .01$) and also under higher risk ($t(49) = 2.93$, $p < .05$). This pattern is again inconsistent with loss aversion. It does replicate previous results in experience-based tasks (e.g., Erev et al., 2008).

The consistency of individuals' risk taking across the different tasks is presented in Table 6. The results reveal that participants were highly consistent between the two Mixed problems ($r = .57$, $p < .01$) and between the two Gain problems ($r = .55$, $p < .01$). However, participants were not consistent across the two problems: the association between the proportions of H choices in the two domains was small (average $r = .11$) and insignificant. These results suggest two separate construct for gains and losses of similar magnitudes. Another interpretation rests on the special case of a constant outcome of zero. It might be that the mixed condition was dissociated from the gain condition because participants have a special psychological tendency to respond to the absolute zero.

A quantitative index of subjective risk

The results of the current studies support the "risk acceptance" approach although suggesting that the psychological construct of risk acceptance could be different in a domain with both gains and losses. Yet a more challenging goal is to use these findings in an attempt to develop a quantitative index for what makes people respond consistently to risk. Individual differences studies indicate that a trait should be measured in a situation when it is relevant, which therefore involves a decision between a non-trivial amount of risk and a very low amount of risk. Therefore, the subjective difference in the risk of the alternatives is expected to lead to increased behavioral consistency in risk taking levels. We evaluated two quantitative indices for the emergence of consistency based on such subjective differences. A simple index was based on the idea that variance differences lead to consistency. According to this idea, the larger the differences in variance, the better a person differentiates between alternatives; and is thus more consistent in his or her risk taking behavior.

An alternative account involves the assumption that differences in subjective risk level (and therefore individual consistency) increase as a function of differences in variance but also decrease as a function of the distance from zero. This actually incorporates the two constructs that received only limited support in the experimental studies (sensitivity to payoff variance and diminishing sensitivity to marginal returns) into one construct that was largely supported by the experimental data (risk acceptance). This account can lead to a following index for subjective risk differences:

$$S = S_{diff} / \sum(|p_i \cdot x_i|) \qquad (1)$$

Where S is the Risk-Difference Signal (RDS), S_{diff} is the difference in standard deviation of the two distributions, p_i is the probability for each outcome i and and x_i is its size.

Under both accounts the risk differences in a problem pair are assumed to aggregate as follows:

$$C = S_1 \cdot S_2 \qquad (2)$$

This yields a parameter-free index C (of predicted consistency). The problems of Studies 1-3 were re-arranged into 18 pairs (representing all possible pairs within each study), and the risk difference in each pair was determined according to the two alternative indices. Then, the predictive ability of the two indices was determined by calculating the correlations between the predicted consistency of each pair and its actual consistency in risk level. The variance based index produced a correlation of 0.23, while the RDS index produced a correlation of 0.37 when predicting the consistency across all 18 comparisons.

A post-hoc version of the RDS, which differentiates non-mixed (gain or loss domain) from mixed (gain and loss) problems and is otherwise identical to the original index was also examined. It yields an average correlation (between predicted and actual consistency) of 0.80 for 14 relevant pairs: $r = 0.68$ for non-mixed problems ($n = 7$) and 0.91 for mixed problems ($n = 7$). For the variance-based index the correlations are only 0.47 and 0.63, respectively.

Thus, the results of the current three studies cannot be interpreted by a parsimonious model resting just on variance differences. Rather, two additional assumptions must be made: (a). Subjective risk differences decrease as a function of the distance from zero, and (b). Two constructs of risk acceptance should be assumed: one for gain or loss domain problems and a unique construct for mixed outcomes.

Discussion

The main purpose of the current study was to shed light on the constructs leading to internal consistency in individuals' risk taking in experience-based decisions. Three approaches were contrasted: One suggesting that loss-sensitivity and diminishing sensitivity are the main factors that underlie individual differences in risk taking (see Busemeyer & Stout, 2002; Ahn et al., 2008), the other suggesting that the acceptance or the rejection of uncertainty is the principle factor modulating people's risk taking (Brachinger & Weber, 1997), and the third suggesting that sensitivity to differences in variance guides risk preferences (e.g., Pratt, 1964). To our knowledge, no previous studies have systematically evaluated the contrasting predictions of these approaches for the consistency of individual predispositions.

The findings of the three studies have important implications for the definition of subjective risk. Throughout the paper, and following the common convention in experimental studies of risky decisions in general and decisions from experience in particular, we have associated risk taking behavior with choices of the option with the higher variance as our point of departure. Nevertheless, our findings show that differences in variances alone do not drive individual consistencies in choosing the risky (higher variability) option. Rather, we have highlighted a second necessary condition: the presence of certainty. We view this finding as an example of a more general factor modulating individual consistencies, involving the extent to which the alternatives differ in their level of (un)certainty, with the case of certainty versus uncertainty being an extreme contrast along this axis. It appears that such a contrast is necessary in order to obtain consistency in risk taking even in problems that are relatively similar in terms of their payoff domain (e.g., the mixed domain problems of Experiment 2).

Additionally, the results of Experiment 1 confirmed the predictions of the risk acceptance construct for the consistency across domains (gains versus loss outcomes). In particular, this construct indicates positive consistency across domains, implying that people who take risks with gains also take risks with losses. This pattern contradicts the prediction based on diminishing sensitivity, which implies a negative correlation across domains (as explained above). It appears that the more consistent construct is risk acceptance.

In conclusion, as in previous examinations of individual risk taking, this construct was found to be consistent only in limited settings. Only in 6 out of 18 possible comparisons between simple experiential decision tasks did the participants exhibit consistency in their risk taking levels. Yet the current analysis also shows that the consistencies found are far from being coincidental, and it sheds light on the factors that modulate this behavioral consistency. A construct that seems to trigger the consistent tendency to take risk is the "risk acceptance" factor denoting individuals' sensitivity to differences in risk level when such differences are clearly perceived (such as in a decision between a constant outcome and a riskier prospect). When differences in risk level are less clear, lower consistency between different decision problems is observed.

References

Ahn, W.Y., Busemeyer, J.R., Wagenmakers, E.J., & Stout, J.C. (2008). Comparison of decision learning models using the generalization criterion method. *Cognitive Science*, *32*, 1376-1402.

Battalio, R.C., Kagel, J.H., & Jiranyakul, K. (1990). Testing between alternative models of choice under uncertainty: Some initial results. *Journal of Risk and Uncertainty*, *3*, 25-50.

Brachinger, H.W., & Weber, M. (1997). Risk as primitive: A survey of measures of perceived risk. *OR Spectrum, 19*, 235-250.

Busemeyer, J.R., & Stout, J.C. (2002). A contribution of cognitive decision models to clinical assessment: Decomposing performance on the Bechara gambling task. *Psychological Assessment*, *14*, 253-262.

Erev, I., Ert, E., & Yechiam, E. (2008). Loss aversion, diminishing sensitivity, and the effect of experience on repeated decisions. *Journal of Behavioral Decision Making, 21*, 575-597.

Hertwig, R., Barron, G., Weber, E.U., & Erev, I. (2004). Decisions from experience and the effect of rare events in risky choice. *Psychological Science*, *15*, 534-539.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*, 263-291.

Koritzky, G., & Yechiam, E. (2010). On the robustness of decision tasks to response distortion. *Journal of Behavioral Decision Making*, *23*, 83-99

Pratt, J.W. (1964). Risk aversion in the small and in the large. *Econometrica*, *32*, 122-136.

Preuschoff, K., Bossaerts, P., & Quartz, S.R. (2006). Neural differentiation of expected reward and risk in human subcortical structures. *Neuron*, *51*, 381-390.

Schoemaker, P.J.H. (1990). Are risk-attitudes related across domains and response modes? *Management Science*, *36*, 1451-1463.

Wakker, P.P., Köbberling, V., & Schwieren, C. (2007). Prospect-Theory's diminishing sensitivity versus economic's intrinsic utility of money: How the introduction of the Euro can be used to disentangle the two empirically. *Theory and Decision*, *63*, 205-231.

Worthy, D. A., Maddox, W.T., & Markman, A.B. (2007). Regulatory fit effects in a choice task. *Psychonomic Bulletin and Review*, *14*, 1125-1132.