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Risk Attitude in Decision Making: In Search of Trait-Like Constructs

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Abstract

We evaluate the consistency of different constructs affecting risk attitude in individuals' decisions across different levels of risk. Specifically, we contrast views suggesting that risk attitude is a single primitive construct with those suggesting it consists of multiple latent components. Additionally, we evaluate such constructs as sensitivity to losses, diminishing sensitivity to increases in payoff, sensitivity to variance, and risk acceptance (the willingness to accept probable outcomes over certainty). In search of trait-like constructs, the paper reviews experimental results focusing on the consistency of these constructs in different tasks as well as their temporal consistency. Overall, the findings show that the most consistent factor is risk acceptance, and they also demonstrate its potential boundaries. These results are modeled with a simple quantitative index of subjective risk. A survey of decisions under risk further reveals that participants exhibit almost no consistency across different tasks in this setting, highlighting the advantage of experiential tasks for studying individual differences.

Keywords: Risk taking; Individual differences; Cognitive style; Experience

1. Introduction

An important debate in psychology concerns the issue of whether people's risk attitude (or their sensitivity to risk) is consistent in different settings or whether it is heavily influenced by environmental cues (see review in Schoemaker, 1993). Within those contending that risk attitude is consistent there are major differences in the conceptualization of risk, which have seldom been contrasted in the context of individual risk preferences and their consistency within the individual. The current paper contrasts three major views

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concerning the nature of the consistent psychological constructs underlying people's risk attitude.

Perhaps the earliest view on this issue is the classical economic approach that addresses risk attitude as sensitivity to differences in payoff variances, referring to the average distance between each of the payoffs and the mean (e.g., Markowitz, 1952; Pratt, 1964). We will refer to this view as the ''risk as variance'' approach. The extension of this approach to individual differences (Preuschoff, Bossaerts, & Quartz, 2006) suggests that the major risk attitude dimension in which people are consistent is the sensitivity to variance. For example, consider the choice between zero and a gamble offering an equal chance to win or lose $100 with equal likelihood (e.g., by a flip of a coin). Under the risk as variance approach, some people would consistently choose the low variance option (zero) and some people would consistently avoid it.

A second more recent view is ''risk acceptance,'' the idea that the tendency of people to prefer (or avoid) risk over certainty is the consistent construct in people's risk attitude (e.g., Brachinger & Weber, 1997). There are different formulations of the risk acceptance approach, which constitutes a revision of the classic economic approach. For parsimony, 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 approach implies that differences in variance between choice alternatives constitute a necessary but insufficient condition for the sensitivity to risk. The other necessary condition for risk sensitivity is the existence of clear differences in the level of (un)certainty, such as when choosing between fixed and probabilistic payoffs. Consistent risk attitude is only exhibited under this condition.[1]

As an example distinguishing the risk acceptance and the risk as variance approaches, consider the choice between two gambles: one offering an equal chance to win or lose $10 with equal likelihood and another offering an equal chance to win or lose $110 with equal likelihood. Under the risk as variance approach people would make this choice according to their sensitivity to variance (which constitutes their risk attitude), while under the risk acceptance approach this situation is not relevant to the risk attitude construct altogether because it does not contrast certain and uncertain outcomes. In other words, the risk acceptance approach implies that the consistent risk attitude construct only reflects the preference of certain (i.e., fixed) outcomes (by some people) or uncertain outcomes (by others). This suggests that differences in variance do not lead to consistent behavior in the absence of certainty.

A different and highly dominant view of risk attitude suggests that it is in fact made up of different latent components that are not directly related to the sensitivity to variance. This view is represented by Prospect theory (Kahneman & Tversky, 1979), which explains people's risk attitude by two main regularities of subjective values: (a) loss aversion—the idea that the perceived magnitude of losses is larger than the perceived magnitude of equivalent gains, and (b) diminishing sensitivity—an implication of Stevens (1957) law asserting that the subjective impact of a change in the absolute payoff decreases with the distance from zero. This idea is captured by prospect theory with a ''value function'' that describes how objective quantities are translated into subjective values. The reference point to which values are compared is at zero, and the function is concave for gains and convex for losses. Thus, diminishing sensitivity implies that large amounts (either gains or losses) are discounted as a function of the distance from zero.[2] Recent cognitive models of individual choice behavior have adopted this view by implementing these factors as constructs that are thought to be consistent at the individual level: (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 (large) outcomes as a function of their distance from zero (e.g., Ahn, Busemeyer, Wagenmakers, & Stout, 2008). We will refer to this view as the ''prospect theory constructs'' approach because it uses the concepts of prospect theory but further suggests that they are consistent within the individual.

Note that the two constructs of loss sensitivity and diminishing sensitivity can be easily mapped to a person's sensitivity to variance. Say, for example, there is a choice between $30 for sure and a gamble producing $10 or $50 with equal probability (e.g., by a flip of a coin). High diminishing sensitivity implies discounting of the larger amount (of $50), thereby making the higher variance option less attractive. In a gamble with same-sized gains and losses, loss sensitivity has a similar role. For example, if all outcomes in the example above are deducted by 30, this gives a sure outcome of 0 and a gamble producing −$20 or $20 with the same probability. A person sensitive to losses (compared to gains) would overweight the loss over the gain outcome and would therefore avoid the higher-variance gamble and opt for the safer sure amount. Nevertheless, as demonstrated below, the prospect theory constructs lead to predictions that differ from those of the risk as variance approach.

Section 2 of the current paper highlights the conflicting predictions implied by the approaches outlined above. Section 3 reviews experiments focusing on people's consistency across different tasks and different experimental sessions, which allow the examination of these predictions. Given the nature of the predictions, all of the reviewed experiments use a within-subject design. Section 4 proposes a simple quantitative index for the emergence of consistency in risk-taking behavior.

2. The contrasting predictions

A trait is defined as a habitual pattern of behavior, thought, or emotion (Kassin, 2003). Hence, if a construct is trait-like, then it is predicted to affect behavior across a range of situations, thereby leading to consistency in the individual's behavior when the same task is performed in different conditions. In this section, some specific conditions that enable one to differentiate the predictions of the three aforementioned approaches are outlined. The first such condition involves the consistency between risk-taking propensities in choice between gambles that include only nonnegative payoffs (the gain domain) and choice between gambles that involve only nonpositive payoffs (the loss domain). Under the prospect theory constructs approach, supposing that indeed diminishing sensitivity is consistent, then a negative association is expected between risk taking in the gain and loss domains. For example, say you have two choice problems:

Problem 1 (Gain domain): Choose between getting \$50 for sure and a prospect providing 50% to win \$100 and 50% to get 0.
Problem 2 (Loss domain): Choose between losing \$50 for sure and a prospect providing 50% to lose \$100 and 50% to get 0.

In each problem, there are 100 repeated choices between the safe option and the riskier prospect. Let us imagine two individuals (consistently) differing in their diminishing sensitivity. One individual has no diminishing sensitivity. This means that the subjective value of \$100 is perceived as about twice as valuable as the value of \$50 in both problems. This individual is therefore expected to be ''risk neutral'' in both problems and so equally likely to select the safe and risky options, as their expected values are identical. Now, our second individual has high diminishing sensitivity, meaning that he discounts large amounts. Discounting the large amount in the gain domain (e.g., in Problem 1) results in risk aversion because the large amount is the better part of the risky prospect and is not found very attractive. Discounting the large amount in the loss domain (e.g., in Problem 2) results in risk seeking because the large amount is the worst part of the risky prospect and it is not found very negative. Hence, for the individual with high diminishing sensitivity we would expect risk aversion in the gain domain and risk seeking in the loss domain.

Kahneman and Tversky (1979) found that, on average, people behave like our second individual—showing risk aversion in the gain domain and risk seeking in the loss domain, and termed this observation the reflection effect. The prospect theory constructs approach further assumes that these constructs are consistent within different individuals. This implies that those that are risk averse in the gain domain would be risk seeking in the loss domain. Hence, this approach predicts a negative correlation between risk attitudes in the gain and loss domains at the individual level.

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 gain and loss domains, as individuals would either seek or avoid certainty or variance in both domains. However, the risk acceptance approach will have this prediction only when the choice alternatives contrast certain and uncertain outcomes (as in Problems 1 and 2 above).

The second prediction involves the consistency of the weighting of gains and losses. Under the prospect theory construct of loss sensitivity, a positive correlation should appear between choice problems differing in the magnitudes of gains and losses regardless of factors like variance or certainty. Again, let us use an example to clarify. This example involves problems that include gambles with *both* gains and losses, hence referred to as ''mixed gambles'' (we sometimes refer to this as the mixed domain):

Problem 3 (Mixed-low outcomes): Choose between getting 0 for sure and a prospect providing 50% to win \$5 and 50% to lose \$5.
Problem 4 (Mixed-high outcomes): Choose between getting 0 for sure and a prospect providing 50% to win \$50 and 50% to lose \$50.

Under the prospect theory construct of loss sensitivity, if a person gives more weight to losses than gains, he or she should be risk averse in both of these problems. In contrast, if a person gives more weight to gains than to losses, he or she should be risk seeking in both problems. Therefore, given some individual differences in loss sensitivity, a positive correlation is expected across the two problems (as some people are more risk averse in both problems and some are more risk seeking in both). In addition, the idea of loss sensitivity implies that people will not be consistent in their risk attitude across Problem 1 (Gain) and either Problem 3 (Mixed-low) or Problem 4 (Mixed-high) simply because there are no losses involved in Problem 1.[3]

In contrast, the sensitivity to variance model predicts that the largest consistencies would appear between problems where the alternatives have similar differences between levels of variance. Therefore, in the examples above it predicts positive correlation between choices across Problems 1 and 4, even though Problem 1 involves only gains, and Problem 4 involves losses as well. The reason is that these problems have the same differences in variance between their prospects. Moreover, this approach also predicts that people would exhibit much lower consistency in their choices across Problems 3 and 4, even though both problems involve both gains and losses, because the difference between the alternatives' variance in Problem 4 is much higher than in Problem 3.

The risk acceptance approach predicts choice consistency mostly when there are discernible differences in levels of certainty (e.g., in the choice between fixed and probabilistic outcomes). Accordingly, it also predicts positive consistency between Problems 3 and 4, which contrast a certain outcome with uncertain outcomes. However, it does not predict consistency in conditions that do not involve this contrast. To illustrate, let us present another choice problem:

> *Problem 5* (Mixed-unavoidable uncertainty): Choose between a prospect providing 50% to win $25 and 50% to lose $25 and a prospect providing 50% to win $75 and 50% to lose $75.

In this problem, neither of the alternatives provides certain outcomes. The hypothesized correlations between risk attitudes in Problem 4 and Problem 5 can distinguish between the risk acceptance approach and the sensitivity to variance approach. The latter predicts high consistency in risky choices between the two problems since both problems involve the same difference in the alternatives' level of variance. However, according to the risk acceptance approach people will not exhibit consistent risk attitude across these problems since Problem 4 involves choices between certain and uncertain outcomes, whereas Problem 5 involves choices only between uncertain outcomes.

3. Experimental evidence: Consistency across tasks and time in risk-taking behavior

In a recent paper, we (Ert & Yechiam, 2010) examined the contrasting predictions of the aforementioned approaches to the consistency of people's behavior across different experiential risk-taking tasks. In such decisions, individuals do not get explicit information about the payoff distributions associated with the alternatives they face (e.g., the probabilities and payoff sizes) and learn the relevant distributions from their experience (Hertwig, Barron, Weber, & Erev, 2004). We start the current analysis with a brief summary of these findings and continue with additional experimental evidence in two directions: First, we report new data about consistency across decision problems in description-based tasks, where individuals get written information concerning the characteristics of the decision problem. Second, we review recent studies (e.g., Levin, Hart, Weller, & Harshman, 2007; Yechiam, 2010) addressing similar predictions using a longitudinal design and evaluating the consistency of choices over time.

3.1. Consistency across the gain and loss domains: Diminishing sensitivity or risk acceptance?

An important implication of the diminishing sensitivity construct to the consistency in people's behavior involves the prediction of a negative consistency across the gain and loss domains. As indicated above, examining the consistency across these domains enables contrasting the ''diminishing sensitivity'' assertion (which is a part of the prospect theory constructs approach) with the ''sensitivity to variance'' and the ''risk acceptance'' assertions.

In Experiment 1 of Ert and Yechiam (2010), each participant was presented with four repeated choice tasks, as described in Table 1. Each task included two alternatives, one (referred to as ''L'') being always associated with lower variance payoffs than the other (''H''). The main within-subject manipulation pertained to the presentation of the outcomes as gains or losses. In the Gain condition choice, alternatives yielded positive outcomes, whereas in the Loss condition outcomes were negative. In order to differentiate between predictions of the sensitivity to variance and risk acceptance approaches, the tasks were further 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'' 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'' condition.

The diminishing sensitivity assertion predicts the emergence of a *negative* association between risk taking in the gain and loss domains in both the Avoidable and Unavoidable uncertainty conditions because high diminishing sensitivity leads to risk seeking in the loss domain and risk aversion in the gain domain. This assertion also predicts positive correlations between the two gain problems, and between the two loss problems. In contrast, the risk acceptance assertion predicts the emergence of a *positive* association between the gain and loss domains in the two Avoidable Uncertainty conditions, and no association between the two Unavoidable Uncertainty conditions. In the avoidable uncertainty problems, there are clearer differences in uncertainty level, which supposedly trigger risk acceptance tendencies. Finally, the sensitivity to variance model predicts positive associations across all four choice problems due to one option being higher in variance than the other, even in the Unavoidable Uncertainty condition.

The participants were informed that they would be playing different games in which they would operate ''computerized money machines'' with two unmarked buttons, and that

Table 1
The payoff schemes of the four conditions of Experiment 1 of Ert and Yechiam (2010) and the average proportion of selections

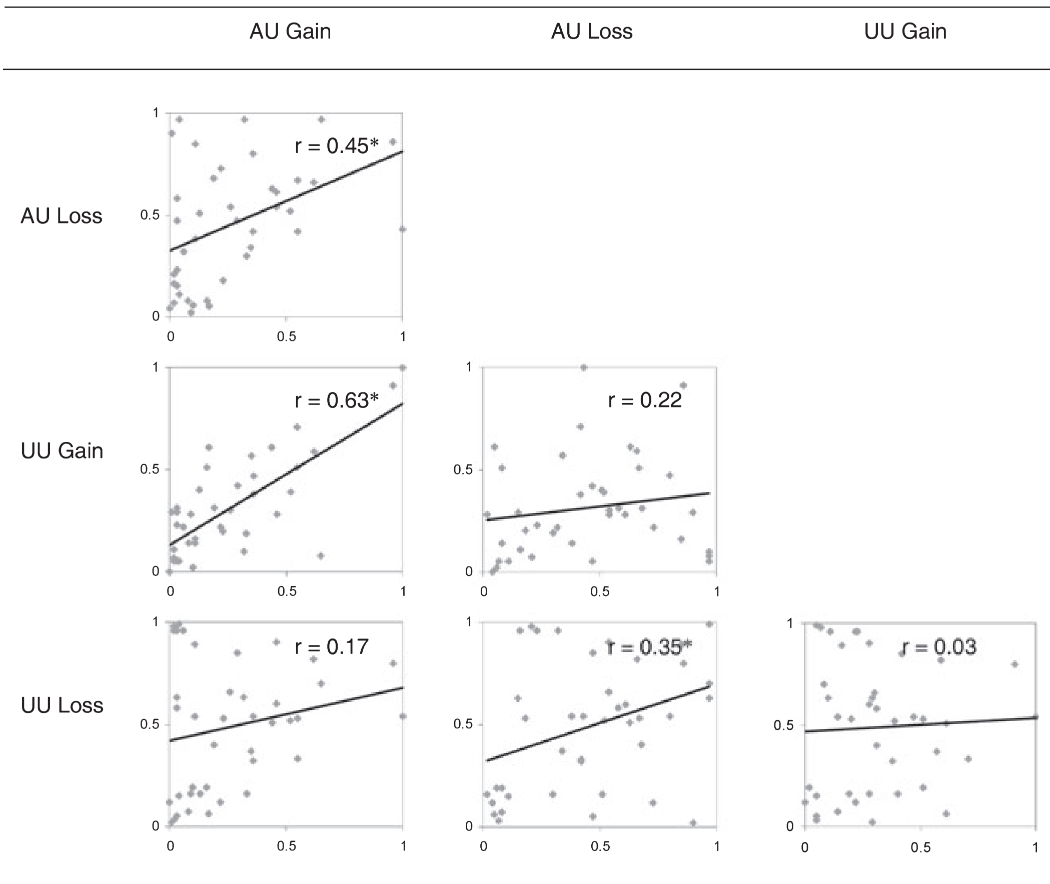
Domain	Condition	Alternative: Payoff	P(H)
Gain	Avoidable Uncertainty	L: Win 600 H: 50% to win 1200, 50% to win 0	0.26
Gain	Unavoidable Uncertainty	L: 50% to win 500, 50% to win 400 H: 50% to win 890, 50% to win 10	0.31
Loss	Avoidable Uncertainty	L: Lose 600 H: 50% to lose 1200, 50% to lose 0	0.45
Loss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

Note. L = Low variance option; H = High variance option; P(H) = The average proportion of H choices across individuals.

their final payoffs would be sampled from one of the ‘‘machines.’’ They 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. Two types of feedback immediately followed each choice: (a) the basic payoff for the choice, which appeared on the selected button for 2 s, and (b) an accumulating payoff counter, which was displayed constantly. 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 NIS per 100 points). 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.

The choice proportions under the different conditions are summarized in the rightmost column of Table 1.[4] The correlations across tasks appear in Fig. 1 (all correlations are between proportions of H selections). The results showed that in the Avoidable Uncertainty 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. In the Unavoidable Uncertainty condition, there was no association between the loss and gain domains ($r = .03$, NS), which further supports the risk acceptance assertion, since in this 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 exhibit reliable diminishing sensitivity to a certain degree.

To summarize, participants exhibited a consistent preference between a constant outcome and a probable outcome in the gain and loss domains, rather than consistent diminishing sensitivity. This suggests that risk acceptance, rather than diminishing sensitivity, modulates the consistency across the gain and loss domains. Additionally, the argument 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.[5]



* p < .05

Fig. 1. The results of Experiment 1 of Ert and Yechiam (2010): scatter plots, linear regression lines, and Spearman correlations. Each dot in the scatter plot shows the proportion of choices from the High variance option of an individual decision maker. The column header denotes the abscissa, and the row header denotes the ordinate (AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty; Gain = Gain domain; Loss = Loss domain).

3.2. Consistency with losses and gains—Is it the product of a weighting parameter?

The second line of predictions that clashes the different approaches involves the question of whether consistent weighting of gains and losses (loss sensitivity) can modulate risk taking in problems involving gains and losses, or whether its effects are due to risk acceptance (or sensitivity to variance) as well. In Ert and Yechiam (2010), this was examined by comparing two conditions: a condition where there is a choice between zero and a gamble involving gains and losses, and a condition where there are two uncertain alternatives (i.e., a choice between two gambles differing in the magnitude of gains and losses).

Under the prospect theory constructs approach the loss-sensitivity construct predicts that individuals would consistently avoid the uncertain alternative with the largest losses. Accordingly, consistency is predicted to be maintained even in the choice between two uncertain options. Similarly, under the sensitivity to variance approach a positive correlation is expected to be maintained for alternatives having 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 (i.e., between zero and a gamble).

The method replicated Experiment 1 only with new choice problems (see Table 2). In two of the tasks, referred to as the ''Avoidable Uncertainty'' condition, selecting the safer option eliminated the probability of losing. In the other two tasks (''Unavoidable Uncertainty'' condition), uncertainty differences between alternatives were smaller and both alternatives included possible losses occurring with the same frequency (but differing in magnitude). A second within-subject manipulation pertained to the payoff size. In condition ''High Payoff,'' the size of all payoffs was doubled by five, compared to the ''Low Payoff'' condition. Consequently in the Low-Payoff condition alternative H was associated with a standard deviation smaller by five than in the High-Payoff condition (*SD* = 100, 500, respectively).

The choice proportions under the different conditions are summarized in the rightmost column of Table 2 and the correlations across tasks appear in Fig. 2. At the aggregate level in both conditions participants did not tend to avoid the riskier alternative and therefore did not exhibit loss aversion (consistent with previous findings in experience-based tasks; e.g., Erev, Ert, & Yechiam, 2008). At the individual level the results reveal that despite showing no loss aversion on average, participants were highly consistent between the Avoidable Uncertainty problems, in which risks could be avoided ($r = .54$, $p < .01$) yet not in the Unavoidable Uncertainty problems, where risks could not be avoided ($r = .13$, NS). Also, the participants did not show consistency across the two High-Payoff and Low-Payoff tasks, inconsistently with implication of the risk as variance. The correlations within each of the

Table 2
The payoff schemes of the four conditions in Experiment 2 of Ert and Yechiam (2010) and the average proportion of selections

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

Note. L = Low variance option; H = High variance option; P(H) = The average proportion of H choices across individuals.

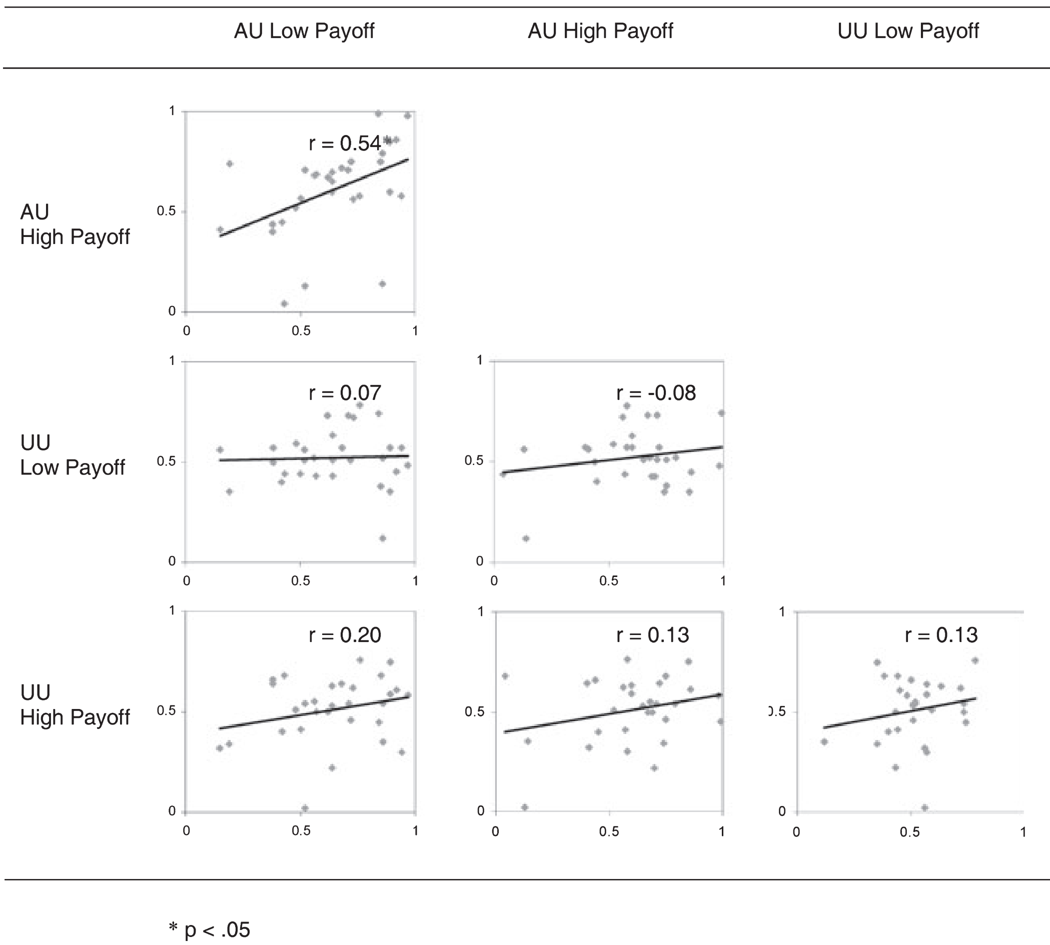


Fig. 2. The results of Experiment 2 of Ert and Yechiam (2010): scatter plots, linear regression lines, and Spearman correlations. Each dot in the scatter plot shows the proportion of choices from the High variance option of an individual decision maker. The column header denotes the abscissa, and the row header denotes the ordinate (AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty).

two pairs of High and Low payoff tasks were small and insignificant, even though the two problems in of these pairs have the same level of variance.

This pattern suggests that the consistency in risk taking with losses is not driven by the mere sensitivity to losses or by the sensitivity to variance. As opposed to the prediction of both approaches, the participants were only consistent when choosing between a risky alternative involving uncertain losses and gains and a safe alternative producing a fixed outcome. This indicates that the consistent construct in the mixed domain involves risk acceptance, as the consistency in risk taking only emerges where the available alternatives are clearly distinguished in their level of uncertainty.

3.3. A single construct of risk acceptance?

In the previous sections, we have reviewed findings showing that the construct of risk acceptance is useful for predicting individual-level consistencies, yet it may not be a single primitive construct. In the third experiment described in Ert and Yechiam (2010), we examined 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 evaluated by comparing the consistency of risk taking across Gain and Mixed domain conditions (as shown in Table 3). A second within-subject manipulation pertained to the level of risk. In condition ''High Payoff,'' all payoffs were twice as high as in the ''Low Payoff'' condition.

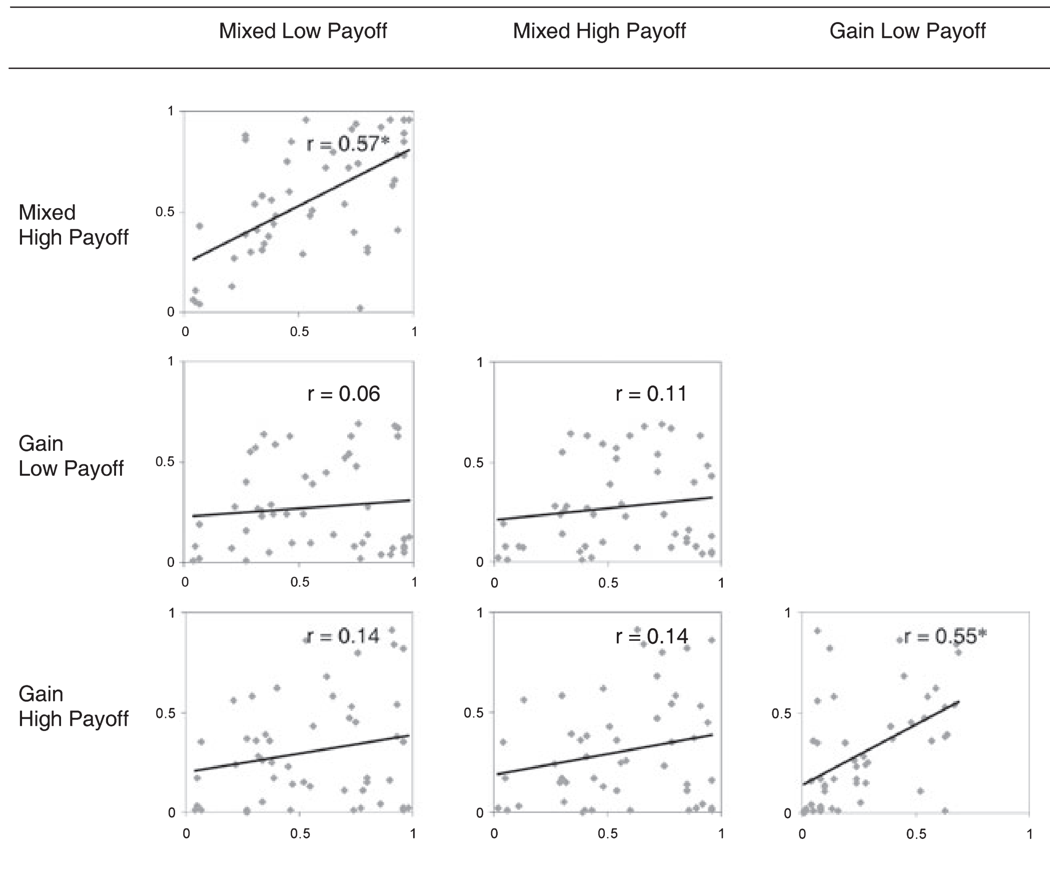
The choice proportions under the different conditions are summarized in the rightmost column of Table 3 and correlations across tasks appear in Fig. 3. The results show that on average, people took more risk in the Mixed condition than in the Gain condition, even though in the Mixed condition risk taking led to losses—Low Payoff: $t(49) = 4.71$, $p < .01$; High Payoff: $t(49) = 2.93$, $p < .05$. Thus, the participants in these tasks do not exhibit loss aversion, as previously shown in other experience-based tasks (e.g., Erev et al., 2008; Koritzky & Yechiam, 2010).

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 Gain and Mixed problems: The correlations across these problems were small (average $r = .11$) and insignificant. These results suggest two separate constructs, one for gains and losses of similar magnitudes, and another for gains only. Given the large positive association found between risk acceptance in the gain and loss domains, this suggests that the latter construct is relevant to the loss domain as well. Another interpretation rests on the special case of a constant outcome of zero. It might be that risk attitude in the Mixed problems was independent from that exhibited in the Gain problems because participants have a special psychological tendency to respond to the absolute zero.

Table 3
The payoff schemes of the four conditions of Experiment 3 of Ert and Yechiam (2010) and the average proportion of selections

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

Note. L = Low variance option; H = High variance option; P(H) = The average proportion of H choices across individuals.



* p < .05

Fig. 3. The results of Experiment 3 of Ert and Yechiam (2010): scatter plots, linear regression lines, and Spearman correlations. Each dot in the scatter plot shows the proportion of choices from the High variance option of an individual decision maker. The column header denotes the abscissa, and the row header denotes the ordinate (Mixed = Mixed domain with both gains and losses; Gain = Gain domain).

3.4. Experience- versus description-based studies

The Ert and Yechiam (2010) study focused on experience-based decisions. A single previous study by Schoemaker (1990) examined the consistency across the gain and loss domains using description-based decisions, where the participants get a verbal account of the probabilities and outcomes. The results showed a positive correlation similar to that obtained in Ert and Yechiam (2010), but it was smaller and not statistically significant. Accordingly, it is not quite clear whether the findings described above are robust to description-based decisions, which are the most commonly used format in current decision science.

For examining this issue, we conducted a survey where 139 students, participating in an introductory psychology course, voluntarily completed a questionnaire in which they were asked to choose among gambles conforming to the eight decision problems reported in Tables 2 and 3 above. We focused on these problems because they cover all the payoff domains and additionally allow the comparison between avoidable risks and unavoidable risks. The prospects outcomes and probabilities were described on a paper sheet (in the same format used by Kahneman & Tversky, 1979) and respondents were asked to mark their preferred choice in each of the hypothetical decision problems. Nine versions of this survey were administered, and in each of them the problems were randomly ordered.

The results of this survey are presented in Table 4. For conciseness, we have averaged across the high and low payoff problems. The aggregate proportions of risk taking show two main observations: (1) risk aversion in the gain domain and risk seeking in the loss domain, consistent with the reflection effect; (2) no loss aversion in any of the mixed gambles (in line with recent studies of low stake decisions under risk, e.g., Birnbaum & Bahra, 2007; Ert & Erev, 2008, 2010; Koritzky & Yechiam, 2010).

Surprisingly, participants showed only moderate degrees of consistency between the different tasks. The only consistencies were observed between the two gain domain problems ($r = .22$, $p < .05$) and the two loss domain problems ($r = .31$, $p < .01$), suggesting some support to the idea of consistent diminishing sensitivity within the gain and loss domains. Nevertheless, consistent with the results of Ert and Yechiam (2010: Experiment 1) and Schoemaker (1990), no negative association was observed across domains, in contrast to the diminishing sensitivity assertion.

Additionally, in most cases the tendency to select the risky option in mixed gambles was independent from that exhibited in the gain and loss domains. However, in one case this was breached, as in the Unavoidable Uncertainty condition risk taking in the gain domain was slightly but significantly associated with risk taking in the mixed domain ($r = .21$, $p < .05$). The results show no relationship between the mixed problems and no relationship between the avoidable risk problems. Thus, no support was found for either the loss sensitivity or the risk acceptance construct in decisions from description.

Table 4
Average proportions of selections and Spearman correlations between risk taking in the different items of the description-based survey

	P(H)	AU Mixed	UU Mixed	AU Gain	UU Gain	AU Loss	UU Loss
AU Mixed	0.57	1.00					
UU Mixed	0.53	.14	1.00				
AU Gain	0.38	−.11	−.02	1.00			
UU Gain	0.38	−.14	.21*	.22*	1.00		
AU Loss	0.46	−.08	.05	.08	.03	1.00	
UU Loss	0.59	−.13	−.08	−.08	.04	.31*	1.00

Note. AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty; P(H) = The average proportion of choices from the High variance option across individuals.

*$p < .05$.

3.5. Consistency across time in experiential decisions

Consistency across tasks is an indicator that is often used for assessing whether a construct is trait-like (e.g., Ashton & Vernon, 1995). Another indicator for traits is the consistency across time. Its advantages are that it diffuses the effect of any situation-specific variable that leads to consistency in a given experimental session (Deinzer et al., 1995). The current section addresses the temporal consistency of the constructs modulating cross-domain risk taking. Perhaps the most surprising regularity in the studies reviewed above is the positive consistency across the gain and loss domains. It suggests that the trait-like construct implicated in experiential behavior involves risk acceptance rather than diminishing sensitivity (as the latter construct predicts negative consistency across domains). If risk acceptance for different domains is indeed a trait, then it is expected to also be consistent across different experimental sessions.

In an impressive study, Levin et al. (2007) studied the consistency of risk-taking behavior in an experiential task, known as the cups task, across a 3-year period. This was assessed for a sample of adolescents as well as for their parents. The cups task was administered in two versions: a gain and a loss domain. Using the results as indices of risk sensitivity, risk acceptance and diminishing sensitivity can be approximated by aggregating risk-taking tendencies across domains. Under the risk acceptance construct the consistent construct is said to be the risk-taking level in the loss domain *plus* the risk-taking level in the gain domain (denoting the fact that both are manifestations of the same construct). Under the diminishing sensitivity argument the consistent construct is the risk-taking level in the loss domain *minus* the risk-taking level in the gain domain. This reflects the posited reflection effect at the individual level.

The cups task is somewhat more complex than the previously reviewed tasks as it contains both descriptive and experiential information concerning the payoffs. Participants are shown the outcomes hidden behind a cup and choose between obtaining sure outcomes or guessing the location of the ''outcome cup'' among several identical cups. Following each choice, the participants receive feedback. The Levin et al. (2007) study used a $3 \times 2 \times 2$ design with this task. First, the value of the risky option was advantageous, disadvantageous, or neutral compared to the safe option. Second, the probability of winning (or losing) in the risky option was .5 or .2. Finally, the outcomes were framed as either gains or losses. For conciseness, we pool the results of the first two conditions and focus only on the comparison of the gain and loss domains.

The temporal consistency results of Levin et al. (2007) appear in Table 5. As can be seen, the consistency across sessions was higher for the ''risk acceptance'' factor (Loss + Gain) than for the ''reflection'' factor (Loss − Gain). This was observed for both parents and children. These results suggest that the more prominent latent construct modulating consistent risk taking across the gain and loss domains is risk acceptance.[6]

Similar results were obtained in a study by Yechiam (2010). In this study, the participants performed variants of the Avoidable Uncertainty Gain and Loss problems described in Table 1. The tasks were performed in two sessions that were conducted about 3 months apart. The correlation across sessions for the ''risk acceptance'' factor was .21 ($p < .05$), while the correlation for the ''reflection'' factor was .14 and not statistically significant.

Table 5
Temporal consistency in the Levin et al. (2007) study: Correlations between the aggregated risk-taking in the Loss and Gain domain tasks (''risk acceptance'') and the difference between risk levels in these domains (''reflection'')

	Loss + Gain (Risk Acceptance)	Loss − Gain (''Reflection'')
Parents	.29*	.20
Children	.38*	.30*

Note. The results are shown for a sample of parents and their children (n = 62).
*p < .05.

Taken together, these results point to the fact that the ''risk acceptance'' factor possesses superior temporal consistency, suggesting that it may be reasonable to treat it as a behavioral trait.

4. Quantitative summary

4.1. A quantitative index of subjective risk

The results of the reviewed studies support the ''risk acceptance'' approach though suggesting that the psychological construct of risk acceptance could be different in a domain with both gains and losses. Perhaps 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 where it is relevant (Tett & Guterman, 2000), which therefore involves a decision between a nontrivial 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, thus leading to more consistency 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 of outcomes from a certain outcome with the gamble's expected value. This leads to having the largest subjective distance between certain and uncertain outcomes (consistent with the risk acceptance assertion). This account can be formalized by the following index for subjective risk differences:

$$S = S_{diff}/\Sigma[|p_i \cdot (x_i - \bar{x})|] \quad (1)$$

Where S is the Risk-Difference Signal (RDS), S_{diff} is the difference between the standard deviations of the two distributions, p_i is the probability for each outcome i and x_i is its size, and $\bar{x}$ is the expected value of the gamble.[7] Note that this index is different from the coefficient of variation (Hendricks & Robey, 1936; Weber, Shafir, & Blais, 2004) which has only the expected value in the denominator. First of all, the coefficient of variation does not imply that the certainty of outcomes affects perceived differences in risk level. Second, using the coefficient of variation is not applicable for gambles with expected value that is near zero or negative.

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

$$C = S_1 \cdot S_2 \tag{2}$$

This yields a parameter-free index C (of predicted consistency). The problems reviewed in Section 3 (from Ert & Yechiam, 2010) were rearranged 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 .21, while the RDS index produced a correlation of .37 when predicting the consistency across all 18 comparisons.

A post-hoc version of the RDS, which differentiates nonmixed (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 .80 for 14 relevant pairs: r = .68 for nonmixed problems (n = 7) and .91 for mixed problems (n = 7). For the variance-based index the correlations are only .47 and .63, respectively.

Thus, the results of the task consistency experiments cannot be interpreted by a parsimonious model resting just on variance differences. Rather, two additional assumptions must be made: (a) subjective risk differences decrease with the distance from the certain outcome having the same expected value as the gamble, and (b) two constructs of risk acceptance should be assumed: one for gain or loss domain problems and a unique construct for mixed gambles.

4.2. A similarity-based index

An alternative model for the results of the current experiments involves the postulated effect of the similarity of payoffs on behavioral consistency (Altman, Bercovici-Boden, & Tennenholtz, 2006; Michalski, Carbonell, & Mitchell, 1986). For example, the gambles in Table 1 are highly similar across the gain and loss domains: They use the same payoff magnitudes and are differentiated only by their payoff sign. One could argue that this might have led to the behavioral consistency across domains in Ert and Yechiam (2010). To examine whether these experimental results are driven simply by the similarity of the payoffs in each condition, we examined the predictions of a model assuming that people are consistent whenever outcomes are similar (following the approach of Michalski et al., 1986).

The quantitative predictions of two versions of a similarity-based model were tested. Under one variant of the model it is assumed that the participants can identify the safe and risky alternative, and mere similarity in payoffs between the two alternatives drives the consistency results (this will be referred to as the pure-similarity model); formally:

$$C = -\Sigma(X_i - X_j) \tag{3}$$

Where C is the similarity-based predicted consistency prediction, and X denotes the outcome vectors for choice problems i and j (in each problem, the outcomes were ordered from the safe to the risky alternative and from the highest to the lowest payoff, and the similarity of each pair of outcome was calculated). A second variant of the model was examined under which there is insensitivity to the payoff sign. Under this model:

$$C = -\Sigma(|X_i| - |X_j|) \tag{4}$$

Namely, whenever the same outcome is presented in terms of gain or loss it is considered identical (this will be referred to as the absolute-similarity model).

As in the models described above, the problems presented in Tables 1–3 were rearranged into 18 pairs, and the fit of the two similarity-based models was determined by calculating the correlations between the similarity of each pair and its consistency in risk level. For the pure-similarity model, a correlation of only .17 was found. For the absolute-similarity model, assuming that rewards and penalties of equal magnitudes are treated alike, the results were even worse, indicating a correlation of .02 between similarity and consistency. These correlations were not significantly improved by dividing the problems into pure and mixed gains and losses. Thus, the results suggest that what drives the consistency findings is not mere similarity of payoffs. Rather, as noted above, the differences in uncertainty and the distance from certainty provide a better index for individual consistency.

5. Discussion

In his 1993 study, Schoemaker made the observation that ''Behavioral decision theory research on risk-taking has largely abandoned the trait approach in favor of situational and information processing models (e.g., Goldstein & Einhorn, 1987; Payne, 1973; Tversky & Kahneman, 1974; Tversky, Sattath, & Slovic, 1988). Risk-taking is considered to be mostly a function of the task, people's decision frames, and their information processing strategies, rather than a function of individual predispositions.'' In contrast, though, in other areas of Psychology ''the pendulum appears to be swinging back'' (Schoemaker, 1993) and the trait approach has again become popular with the introduction of frameworks such as the Five Factor Model (Goldberg, 1993; McCrae & Costa, 1987) and Three Factor Model (Eysenck & Eysenck, 1985), which combine individual traits into composites or aggregates and exhibit correlations up to .7 with composite measures of behavior across situations (see e.g., Kenrick & Funder, 1988).

The current review and analysis suggests two reasons for the failure of the trait approach in decision making. The first reason is the use of only a single approach for examining consistency across situations. As we have seen, the predictions of prospect theory (Kahneman & Tversky, 1979) alone did not produce constructs that are consistent (e.g., diminishing sensitivity and the sensitivity to losses vs. gains). The predictions of the risk acceptance model (Brachinger & Weber, 1997) alone were also not sufficient to explain the entire set of data. The results showed that only an integrated approach, using two risk acceptance constructs for pure gain/loss domains or mixed domains was adequate for explaining the emergence of consistency in risk-taking behavior.

The results of our survey of decisions under risk suggest another reason for the failure of previous studies in decision making to identify reliable behavioral traits, related to the way that information concerning choice outcomes is conveyed. The most prominent paradigm in decision-making science is the description-based paradigm (Weber et al., 2004). Yet, in our survey, as in Schoemaker (1990), individuals exhibited very little consistency between description-based problems presented in different domains. In the reviewed studies, consistency was only exhibited for the experience-based paradigm. These results suggest that previous attempts to find consistency in risk taking at the individual level using behavioral paradigms (Schoemaker, 1990) or models (Keller, 1985; Schneider & Lopes, 1986) might have failed because of their choice of the description-based decision paradigm. The reasons for the effect of task type on consistency are yet to be clarified. One possible explanation for these differences is that when risk is more explicit (such as while choosing between described gambles) people exhibit more social desirability, making individual data harder to evaluate (Koritzky & Yechiam, 2010). Another explanation is that experience-based decisions trigger ''hot'' decision-making processes that more closely approximate decision makers' behavior in everyday situations, and their behavioral traits as well (Figner, Mackinlay, Wilkening, & Weber, 2009; Weller, Levin, Shiv, & Bechara, 2007).

The most important finding reviewed here in experience-based decisions is that people exhibit positive consistency between the gain and loss domains when making a choice between a constant outcome and a probabilistic one. We view this finding as an example of a more general factor modulating individual consistencies in risk attitude, involving the sensitivity to differences in certainty, with the case of certainty versus uncertainty being an extreme contrast along this axis. The suggestion that risk acceptance across the gain and loss domains is consistent was also useful for predicting the emergence of consistency across different sessions (Levin et al., 2007; Yechiam, 2010). The theoretical importance of the positive consistency is that its existence contradicts the prediction based on diminishing sensitivity, which implies a negative correlation across domains (due to the reflection effect, as explained above).

Future studies should elaborate the conditions for perceiving differences in risk level that lead to consistent behavior. The current modeling results show that the emergence of such differences cannot be summarized under a simple model based on differences in the variance of the relevant gambles. The (Avoidable and Unavoidable) Loss conditions in Experiment 2 had the same difference in variance, but the consistency was substantially different when one outcome was zero and another was not. To account for this finding, it must be assumed that the consistency decreases as a function of the distance from certainty. This finding has implications for the definition of risk and variance, and it suggests, as previously argued (Weber et al., 2004) that variance alone does not drive the subjective feeling of risk.

The assumption that risk level is also affected by the distance of the payoffs from certainty was embedded in the Risk Difference Signal (RDS) index and enabled it to predict the emergence of consistency across different pairs of choice problem. Future tests of this model can examine the consistency of risk taking in situations involving unavoidable risk with larger differences in risk level. The RDS index predicts the emergence of consistency in this situation as well.

The current review thus suggests that the search for trait-like constructs in behavioral decision making may be productive, though leading to different theoretical conclusions from those based on the study of decision making at the population level. For example, we have replicated the reflection effect at the aggregate level, but we have shown that at the individual-consistency level it does not exist. We believe that for research into the traits of decision making to continue productively, such dualities must be accepted, rather than seen as counter-examples. It appears that there is a substantial gap between the variables affecting decision making at the population level and the consistent traits of decision making.

Notes

1. Accordingly, in the problem presented above (choice between zero and a gamble offering an equal chance to win or lose $100) the risk acceptance approach predicts that people would behave consistently because it involves a dilemma between certain and uncertain outcomes. This particular choice problem therefore does not distinguish the predictions of the risk as variance and risk acceptance approaches.
2. Of course, additional components proposed in prospect theory reflect biases in the perception of probabilities. In the current paper, we keep the objective probability constant across the studies and focus on the perception of values as a starting point for assessing the psychological constructs implicated in risk sensitivity.
3. Diminishing sensitivity also does not imply consistency across problems because in mixed gambles, which involve both gains and losses, the outcomes are of the same size and thus are equally discounted irrespectively of whether there is high or low discounting of large payoffs.
4. The findings at the aggregate level show that people took more risk in the loss domain than in the gain domain—$t(39) = 3.98$, $p < .001$. Thus, interestingly, at the population level the reflection effect was substantiated. There were no significant differences in risk taking between the Avoidable Uncertainty and the Unavoidable Uncertainty conditions—$t(39) = 1.41$, NS.
5. The experiment described in Section 3.2 replicated this finding with problems having the same exact difference in variance.
6. Still, for the children at least there was significant consistency also in the diminishing sensitivity construct. Another relevant finding is that a reanalysis of the correlation

between the Gain and Loss domain conditions of this study reveals a positive correlation as in Ert and Yechiam (2010).

7. In our simple examples, the probabilities are identical for the different outcomes and therefore the expected value equals the average value of the different outcomes produced by a given gamble.

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