Consistent Constructs in Individuals' Risk Taking in Decisions from Experience

Eyal Ert

Harvard University

Eldad Yechiam *

Technion - Israel Institute of Technology

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* Address all correspondence to Eldad Yechiam, Faculty of Industrial Engineering and Management, Technion, Haifa 32000, Israel, Phone: (972) 4-829-4420, Fax: (972) 4-829-5688, email: yeldad@tx.technion.ac.il.

Abstract:

The current research evaluates the consistency of different constructs affecting risk taking in individuals' experiential decisions across different levels of risk. Specifically, we contrast three major views concerning the psychological constructs that underlie risk taking behavior. 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) Consistent diminishing sensitivity is found within the gain and loss domain, but across these domains individuals seem to be consistent only when deciding between constant versus probable outcomes, suggesting that they reliably differ in their risk acceptance. (3) Risk acceptance appears to entail different psychological constructs when the decision problem involves co-occurring gains and losses.

Keywords: Risk taking; individual differences; cognitive style; experience-based decisions

It is commonly believed that people differ in their risk preferences, and that such differences are stable across different situations (see Kogan & Wallach, 1967; Douglas & Wildavsky, 1982; Sitkin & Weingart, 1995; Byrnes, Miller, & Schafer, 1999; Busemeyer & Stout, 2002; Weber, Blais, & Betz, 2002). Yet experimental studies have typically documented *inconsistency* in individuals' behavioral patterns of risk taking across different task conditions (Slovic, 1972; Keller, 1985; Schneider & Lopes, 1986; Schoemaker, 1990), and domains of life (Weber et al., 2002; Soane & Chmiel, 2005). Thus, the tension between the contextual constraints and individual consistencies in risk taking seems far from being resolved.

The discrepancy between the assertion of personal risk preferences and the inconsistencies highlighted by the behavioral data are open for different interpretations. One interesting view is that risk preference is in part a stable feature of personality or cognitive style but it mostly reflects situational factors such as mood, feelings, and different decision framings (e.g., March & Shapira, 1987).

A more conventional approach suggests that apparently inconsistent risk taking behavior may, in fact, reflect consistent sensitivity to latent components of risk taking. This interpretation implies systematic changes in consistencies in risk taking and the emergence of inconsistencies that are predicted by the effect of latent factors (see related ideas in Mischel & Shoda, 1995). The most prominent example of this approach 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[1]. Recent cognitive models of individual choice in decisions from experience (see Hertwig et al., 2004)[2] have adopted this approach 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; Yechiam & Busemeyer, 2008; see also Worthy, Maddox, & Markman, 2007), and (b) diminishing sensitivity – the assertion that people are consistent in discounting payoffs magnitudes with the distance from zero (Wallsten, Pleskac, & Lejuez, 2005; 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; Markowitz, 1952; Sharpe, 1964; and see recent studies which relate brain activity with perceptions of risk as variance, e.g., Preuschoff, Bossaerts, & Quartz, 2006; Preuschoff, Quartz, & Bossaerts, 2008). We refer to it as the "sensitivity to variance" approach. 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 (Brachinger & Weber, 1997; Keller, Sarin, & Weber, 1986; Schade, Kunreuther, & Kaas, 2001; Sokolowska & Pohorille, 2000). There are different formulations of the risk-acceptance approach, which, interestingly, has not

[1] Of course, risk perceptions are also affected by the subjective weighting of probabilities as demonstrated by Kahneman and Tversky (1979) and Hertwig et al. (2004). In order to isolate factors associated with the value function (effect of losses and size of payoff) we focus on equiprobable (.5) outcomes.

[2] In such situations the decision maker is not given initial information concerning the choice probabilities and outcomes, but rather has to learn them by acquiring experience (by getting feedback after each choice).

been studied in the context of decisions from experience (the focus of the current analysis). We chose to focus on a simplified interpretation of this approach, referring to risk acceptance as the individual's sensitivity to certain versus probable outcomes. Under this formulation, risk acceptance can be viewed as an extreme case of sensitivity to variance. 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 situation activating the individual's preference for certainty versus uncertainty.

Despite the different approaches of what constitutes risk preferences, behavioral measures of risk taking behavior tend to be quite uniform. In the vast majority of the aforementioned studies, regardless of the implemented approach, risk taking is typically operationalized as the rate of choice in (or preference for) the option which is associated with the higher outcome variability. We follow this convention in our studies and analyses as well. Therefore, "risk taking" will be referred to as the rate of choice in the option with the higher variance. It should not be confused, however, with the sensitivity to variance approach according to which differences in perceived variances modulate people's sensitivity to risk.

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-constructs approach, supposing that indeed diminishing sensitivity underlies risk taking between domains, 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, the sensitivity to variance approach predicts a positive correlation between risky choices in the two domains, as individuals would either seek or avoid variance in both domains.[3] The risk-acceptance approach also predicts positive correlation across domains but only when the choice alternatives substantially differ in their levels of certainty. These contrasting predictions are examined in Study 1.

A second distinction between the three approaches, which is the focus of Study 2, involves the consistency of the weighting of gains and losses. The latent-constructs approach assumes that individuals differ primarily in their sensitivity to (weighting of) gains and losses. This assertion implies a positive correlation between choice problems differing in the magnitudes of gains and losses regardless of factors like variance or certainty. In contrast, the sensitivity to variance approach 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. Study 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

[3] Seminal models that relate risk to variance (e.g., expected utility theory) assume diminishing marginal returns (an early example is given by Bernouli 1878/1954) which assumes that every additional dollar has less value to a consumer. Notice that this abstraction leads to the same predictions as the diminishing sensitivity approach in the gain domain but implies opposite patterns in the loss domain (see recent discussion of the similarities and differences between these approaches in Wakker Köbberling, & Schwieren, 2007).

taking (e.g., Slovic, 1972; Schoemaker, 1990) and to studies that compared models of risk taking (e.g., Battalio, Kagel, & Jiranyakul, 1990; Lopes & Oden, 1999; Wakker et al., 2007). There are two major differences from these previous studies: First, these studies have tended to focus on the latent-constructs 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 (also known as "decisions from description") 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 (e.g., Bechara et al., 1994; Levin & Hart, 2003; Yechiam et al., 2005) and that they are also relatively more resistant to social desirability than decisions from description in which the gambles' parameters are fully disclosed (Ronay & Kim, 2006; Koritzky & Yechiam, 2010).[4]

Another interesting and relevant finding in decisions from experience is that individuals do not seem to exhibit loss aversion (Erev, Ert, & Yechiam, 2008; Erev et al., 2010; Hochman & Yechiam, in press; Kermer et al., 2006; Koritzky & Yechiam,

[4] For example, Koritzky and Yechiam (2010) find that asking students to make a good impression (e.g., completing the tasks as part of a job interview) affects their responses to popular personality questionnaires, as well as their risk taking in decisions from description (the focus of Kahneman & Tversky, 1979), but does not affect risk taking in decisions from experience.

2010; Yechiam & Ert, 2007; see also Rozin & Royzman, 2001).[5] Having these results, the reliance of cognitive models of decisions from experience on loss sensitivity as a consistent latent construct (e.g., Busemeyer & Stout, 2002; Yechiam et al., 2005) may seem puzzling. However, since the studies that found no evidence of loss aversion in experience-based tasks focused on the aggregate level (i.e., by averaging across participants), they still allow for the possibility of consistent loss sensitivity at the individual level. Specifically, it might be that no loss aversion at the aggregate level was found since some people are consistently "loss averse," while others are "loss seeking", and these two types of individuals cancel each other when their responses are aggregated. In Experiments 2 and 3 we examine this proposition by exploring whether individuals can be consistent in their response to alternatives producing gains and losses even in the absence of loss aversion at the aggregate level.

The results of our three studies indicate that the latent-constructs approach falls short from accounting for decisions from experience, but so do the sensitivity to variance approach and the risk-acceptance approach. We find, instead, evidence for two independent risk-acceptance factors: one for losses or gains, and another for mixed outcomes. These findings raise important questions as to whether the latent-constructs and sensitivity to variance approaches can be used in modeling individuals' risk sensitivity.

[5] This was demonstrated even when the payoffs are determined based on a (randomly determined) single trial, suggesting that the phenomenon is not due to an accumulation of payoff effect (Erev et al., 2008). Interestingly, recent studies of one-shot decisions from description show that even in these situations loss aversion is not general (Ert & Erev, 2008, 2009; Simmons & Novemsky 2009). These studies show, for example, that loss-averse like behavior occurs in specific situations (e.g., when the risky alternative is offered as an alternative to a status quo; see Ert & Erev, 2008), but not in others. These new findings suggest that loss aversion might be context dependent rather than a general cognitive mechanism.

1. Experiment 1. Bridges across domains: Diminishing sensitivity, sensitivity to variance, or risk acceptance?

As noted earlier, the latent-constructs approach is composed of two main constructs: diminishing sensitivity (to marginal changes in payoff) and loss aversion. The main purpose of our first study was to contrast the "diminishing sensitivity" assertion with the sensitivity to variance and risk-acceptance approaches, 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 predictions of the sensitivity to variance and the risk-acceptance approaches, the tasks were also distinguished with respect to the difference in their 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 problems 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 approach, 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 (in the form of the contrasting alternatives offering constant or probable outcomes) which supposedly trigger risk-acceptance tendencies. Finally, the sensitivity to variance approach 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.

1.1. Method

Forty undergraduates (20 males and 20 females), from the faculty of Industrial Engineering and Management at the Technion, 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 distribution that underlies each alternative, and were not informed about the number of trials (The complete instructions appear in Appendix 1). 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. Specifically, on each trial a payoff was randomly selected from the payoff distribution of the selected alternative from the relevant problem. 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. This was implemented to decrease potential noise resulting from a diversification bias (Rubinstein, 2000; Ayal & Zakay, 2009) and income effects across different tasks (Cho & Luce, 1995). 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). The overall length of the experiment was approximately 30 minutes.

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 of risk taking 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.

1.2. 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 (i.e., chose the H option more frequently) 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 assertion, and supports the predictions of the risk-acceptance approach. 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 predictions of the risk-acceptance approach, since in the UU condition the probabilistic outcome could not be avoided (or accepted).[6]

In addition, participants were consistent between the two problems in the Gain condition ($r = .63$, $p < .0001$) and between the two problems in the Loss condition ($r = .32$, $p < .02$), 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 domains 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

[6] Arguably, the prospect theory value function allows for no correlation between the gain and loss domain under the assumption of that the degree of diminishing sensitivity (the curvature of the value function) differs between gains and losses. Yet, no variation of the model could explain the positive high correlations found across these two domains under the AU condition.

condition). In the next experiment we examine problems that have the same exact differences in variance.

2. Experiment 2: Contrasting loss sensitivity with risk acceptance

The second experiment was designed to examine whether loss sensitivity, the second proposed construct under the latent-constructs approach, indeed modulates risk taking behavior in problems involving gains and losses, or whether its effect is 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-constructs approach the loss-sensitivity construct involves pure sensitivity to the magnitude of losses compared to gains. Therefore, the 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 payoff magnitude. In condition "High Payoff" the size of all payoffs was doubled by five, compared to the "Low Payoff" condition. Consequently, the standard deviation associated with alternative H (SD = 100) in the Low-Payoff condition was one fifth of that associated with the corresponding alternative in the High-Payoff condition (SD = 500). This enabled us to evaluate the consistency across different levels of variance and compare the consistency in the AU and UU conditions. Under the sensitivity to variance approach the highest correlations are expected between the two low-payoff problems, and the two high-payoff problems. These pairs have the same variance differences between the H and L alternatives, as noted above. [7]

2.1. Method

Thirty (15 males and 15 females) Industrial Engineering and Management undergraduate students participated in the experiment. The participants' average age was 24 (ranging from 20 to 27). Payoffs were contingent upon the participants' choices, varying between NIS 25 and NIS 33 (NIS 1 = $4.5).

The basic participation fee was NIS 30. The procedure and instructions were identical to the one described in Experiment 1 (see Appendix 1) except that the

[7] Alternatively, if the sensitivity to variance is only triggered for high variances, the highest correlation is expected between the two high-payoff tasks, which have the largest difference in variance between choice options (the same prediction is made in Experiment 3; both of these predictions were refuted, however).

experiment focused on the tasks described in Table 3, and the conversion rate was 1 agora per 1 point (1 agora = 0.24 cents).

2.2. 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: They did not make fewer selections, on average, from the alternative (H) producing losses compared to the alternative producing no losses (L) in the AU condition. Moreover, they did not make fewer selections from the alternative producing relatively larger losses (H) in the UU condition. This is consistent with previous findings in experience-based tasks (e.g., Erev et al., 2008; Kermer et al., 2006; Yechiam & Ert, 2007).

The consistency of individuals' risk taking across different tasks is presented in Table 4. The results reveal that 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-payoff or low-payoff problems, inconsistently with implication of the sensitivity to variance approach. The correlations within each of the two pairs of high and low payoff 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.

3. Experiment 3: A single risk-acceptance construct or a different one for losses?

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-constructs approach, 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 when the gains and losses are of the same magnitude). 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 similar gains and losses. This was conducted by comparing the consistency of risk taking across gain domain problems and mixed domain problems (as shown in Table 5). As in study 2, a second within-subject manipulation pertained to the payoff magnitude. In condition "High Payoff" payoffs were doubled by two, compared to the “Low Payoff” condition. Consequently in the Low-Payoff condition alternative H was associated with a standard deviation smaller by half than in the High-Payoff condition (SD = 1000, 2000, respectively).

If risk acceptance is a single construct then we should expect positive consistency across all four choice problems (in the gain and mixed domains) since all of them involve a choice between a constant outcome and probabilistic outcomes. In contrast, the latent-constructs approach predicts a correlation between the two gain domain and the two mixed problems but no correlation across domains. Finally, the sensitivity to variance approach again predicts that the highest correlations would be within the two high-payoff problems and low-payoff problems across domains.

3.1. Method

Fifty (25 males and 25 females) undergraduate students, from the faculty of Industrial Engineering and Management, participated in the experiment. The participants’ average age was 24 (ranging from 21 to 28). Payoffs were contingent upon the participants’ choices, varying between NIS 20 and NIS 30 (NIS 4.5 = USD 1). The procedure and instructions were identical to the one described in Experiment 1 (see Appendix 1) except that the experiment focused on the tasks described in Table 5. The conversion rate was 1 agora per 1 point (1 agora = 0.24 cents).

3.2. 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 both in the Low-Payoff condition ($t(49) = 4.71$, $p < .01$) and High-Payoff condition ($t(49) = 2.93$, $p < .05$). This pattern is again *inconsistent* with loss aversion. It does replicate previous results in experience-based tasks (e.g., Erev et al., 2008). Erev et al. (2008) interpreted the results in the gain domain by suggesting that when a risky alternative has large outcomes (i.e., in the gain domain), these outcomes are discounted due to diminishing sensitivity, leading to less risk taking than in an equivalent mixed domain.

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 mixed and gain problems: the association between the proportions of H choices in the two domains was small (average $r = .11$) and insignificant.

These results do not support the predictions of the sensitivity to variance approach, as the correlations between tasks with the same difference in variance level were small and insignificant. The results also cannot be explained under the assumption of a single risk-acceptance construct. Rather, there appears to be a separate construct for gains and losses of similar magnitudes. Another interpretation of these results 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. In any event, it cannot be argued that a single construct of risk acceptance modulates risk taking behavior even if a constant outcome is compared with a riskier one.

5. General 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; Wallsten et al., 2005; Ahn et al., 2008), the other suggesting that the acceptance or the rejection of uncertainty is the principle factor modulating people's risk taking (e.g., Weber et al., 2002), 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 results of Experiment 1 confirmed the predictions of the risk-acceptance approach for the consistency across domains (gains versus loss outcomes). In particular, individual differences in risk acceptance imply positive consistency across domains, such that people who take risks with gains also take risks with losses. This pattern contradicts the prediction based on the diminishing sensitivity, which implies a negative correlation across domains (as explained above). However, some consistency in diminishing sensitivity was observed, as participants exhibited high correlation between problems within the gain and loss domain (even though they involved risks that could not be avoided). This shows that individual differences in diminishing sensitivity in the current context tend to be domain-specific (as previously proposed by Abdellaoui, 2000), which seems to suggest that the construct of diminishing sensitivity has a limited effect in driving consistency across choice problems that are quite different.

Also in Experiment 1, the findings clearly showed the effect of differences in uncertainty on individual consistencies across domains. The sensitivity to variance approach predicted positive consistency across the gain and loss domains regardless of differences in uncertainty. However, consistency across domains was only observed for a condition where uncertainty was avoidable, as predicted by the risk-acceptance approach.

Experiment 2 focused on the construct of the sensitivity to gains and losses. It was shown that when the choice problems implicate differences in variance but no possibility of avoiding probabilistic risks, no consistency appears at the individual level. This suggests that in previous studies (e.g., Ahn et al., 2008; Yechiam & Busemeyer, 2008) what has appeared as consistency in the mere weighting of gains and losses might actually be a form of risk acceptance. Without a situation that contrasts certainty (i.e., constant outcomes) with some level of risk, the consistency of the sensitivity to losses (compared to gains) is eliminated. This further supports the notion of risk acceptance versus the latent-constructs approach.

Finally, the last experiment contrasted an assumption of a single “risk acceptance” primitive to the suggestion that when gains and losses are explicitly compared, individuals’ consistencies might differ. The results showed that indeed individuals’ risk taking was different for a mixed decision problem involving both gains and losses and for a problem in the gain domain. This does not imply complete domain specificity because we have seen, in Study 1, a positive correlation between the gain and loss domain. Rather, it implies that the mixed condition with symmetric gains and losses seems to involve an independent psychological construct. Further studies should examine whether this is due to the explicit comparison of gains and losses or to preferences that involve zero outcomes.

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, suggesting that variance level does not solely determine the subjective feeling of risk. Rather, we have highlighted a second necessary condition: the presence of certainty. [8] 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 current findings suggest that risky behavior should be considered, at least to some extent, as being driven by a cognitive style, as the correlations across choice problems reached up to .60 in some cases. Of course, this can be interpreted in a “half empty glass” eyes as well. For example, Slovic (1972) found moderate correlations (up to .64) for risk taking levels under different elicitation methods (e.g., certainty equivalents versus probability equivalents) and concluded that risk taking is to a large extent a situational factor. However, when one compares the consistency of risk taking levels to that observed for other behavioral traits measured in different contexts, one does not get correlations that are generally much higher. For example, in their seminal paper, Funder and Colvin (1991) obtained

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[8] Interestingly even prospect theory (Tversky & Kahneman, 1992) allows certainty to have special role by not defining how extreme probabilities are perceived subjectively. Wakker and Tversky (1995) filled this gap by assigning higher decision weights to certainty. Although these abstractions cannot account for the current results (e.g., the “reversed reflection” pattern in study 1), they seem to support the idea that certainty has a special role in risk perception. Another related idea is Payne’s (2005) call for incorporating overall probabilities of winning and losing into models of risk taking.

correlations that reached up to .70 in individuals' characteristic social behavior assessed in different contexts.

Perhaps more importantly, the current findings clarify the conditions for where consistencies in risk taking are expected to run high. They suggest that the crucial factor in this respect is the differences in uncertainty level between the available alternatives. A condition that is particularly conducive to behavioral consistency in this respect is when a constant outcome is contrasted with a risky outcome.

In addition to clarifying the psychological constructs modulating consistent risk taking behavior, the current findings also shed light on the value and limitations of complex decision tasks used for assessing individual differences in risk taking. Experimental decision tasks that have been shown to possess high external validity, such as the Iowa Gambling Task (see Bechara et al., 1994), the Lane Task (Lane et al., 2004), and the Go/No-go Discrimination Task (Newman et al., 1985) have an interesting common feature, in that they include the possibility of eliminating or significantly reducing the level of uncertainty. This is justified by the finding that unavoidable uncertainties indeed impair the consistency in risk taking exhibited otherwise. One should also note, though, that these complex tasks often have both gains and losses, implying that they study just one facet of risk acceptance. Studying risk acceptance in pure gain and loss domains (e.g., as in Levin & Hart, 2003) might yield another interesting and potentially important dimension of individuals' risk taking preferences.

6. Conclusions

As in previous examinations of individual risk taking, this construct was found to be consistent only in limited settings (Slovic, 1972; Keller, 1985; Schneider & Lopes, 1986). 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.

Appendix 1: Complete instructions

Initial instructions:

“In this experiment you will play several different games, independent of each other. In each game you will be operating a ‘computerized money machine’ that includes two unmarked buttons. Pressing on a button will result in a gain or a loss of several points, which will be set according to the button chosen. Your objective in this experiment is to earn as many points as you can. There might be differences between the buttons regarding the gains and losses that each one might produce. At the end of the session one game will be randomly selected. Your final payoff will be the sum of the points you earned in that game. Each point will be converted to 1 Agora”. [9]

Instruction Screen before the beginning of each of the tasks:

”Notice, you are about to begin a new game. This game is different from the previous game. Good luck.”

Following this instruction screen was a 30 seconds pause before participants could start the new task.

At the end of the experiment participants were told which game was selected randomly and were informed of their final payoff (the payoff earned in the selected game).

[9] This was set for Experiment 2 and 3. For Experiment 1 the conversion rate was different, as noted above.

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Table 1: The payoff schemes of the four experimental conditions of experiment 1.

Domain	Condition	Alternative: Payoff	Proportion of H choices
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	
		Gains	Losses	Gain	Losses
AU	Gains	1.00			
	Losses	.45*	1.00		
UU	Gains	.63*	.22	1.00	
	Losses	.17	.35*	.03	1.00

* $p < .05$

Table 3: The payoff schemes of the four experimental conditions in Experiment 2.

Condition	Payoff magnitude	Alternative: Payoff	Proportion of H choices
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

Table 4: Spearman correlations between risk-taking in the different tasks in Experiment 2 (AU = Avoidable Uncertainty; UU = Unavoidable Uncertainty).

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

* p < .05

Table 5: The payoff schemes of the four experimental conditions of experiment 3.

Condition	Payoff Magnitude	Alternative: Payoff	Proportion of H choices
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

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

		Mixed condition		Gain condition	
		Low Payoff	High Payoff	Low Payoff	High Payoff
Mixed condition	Low Payoff	1.00			
	High Payoff	.57*	1.00		
Gain condition	Low Payoff	.06	.11	1.00	
	High Payoff	.14	.14	.55*	1.00

$p < .05$

Figure 1: An Example of the Experimental Screen in Study 1 (Loss domain, condition Avoidable Uncertainty).

Note: The left button yields either 0 or -1200 with equal probability. The right button yields -600 each time it is selected (the outcome shown is for trial 1).