A Loss-Sensitivity Explanation of Integration of Prior Outcomes in Risky Decisions

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Romanus, J., Hassing, L., & Gärling, T. A loss-sensitivity explanation of integration of prior outcomes in risky decisions. Göteborg Psychological Reports, 1996, 25, No. 3. An alternative theoretical explanation of integration of prior outcomes in risky decisions is the loss-sensitivity principle stating that a prior outcome is only added to expected losses. An experiment is reported which tested the implication of this principle that there will be less integration with an expected loss when its salience is reduced. A group of 20 undergraduates rated how likely they were to make imaginary roulette bets with less salient expected losses whereas another group with an equal number of undergraduates performed the same type of ratings for imaginary horse-race bets with more salient expected losses. In support of the implication, a prior outcome had a stronger impact in the latter group. A stronger impact was furthermore found for high as compared to low stakes. When the loss was salient, the impact of the prior outcome was greater for subjects who reported that they were in a positive mood than for subjects who reported that they were in a more neutral mood.

Key words: Decision making, sequential choice, mood state.

Introduction

An assumption made in prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991, 1992) is that prospects or options are edited before values are assigned and choices made on the basis of these values. Editing includes framing of outcomes as gains or losses relative to a reference point. Framing also entails segregating or integrating prior outcomes. Kahneman and Tversky (1979, 1984) and Tversky and Kahneman (1981) provide several examples of segregation. In one example subjects were asked to imagine that they have been given $1000 and then to indicate whether they would chose a sure loss of $500 over an equal probability of losing $1000 or nothing. A majority of subjects chose the risky loss exactly as they would do in the absence of the prior outcome (i.e., the amount they were to imagine they were given). If subjects edit the options so that the prior outcome is taken into account, according to prospect theory they would instead choose the sure gain of $500 (i.e., the $1000 they were given minus the sure loss of $500) over an risky gain of $1000 or nothing. However, other research (Arkes and Blumer, 1985; Gärling and Romanus, 1995; Gärling et al., 1994; Laughhunn and Payne, 1984; Romanus et
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al., 1995; Thaler and Johnson, 1990) has demonstrated an impact of prior outcomes on choices. This raises the questions of when, how, and why subjects integrate instead of segregate a prior outcome? Although there are also cognitive explanations (Reviewed in Gärling & Romanus, 1995), we focus here on motivational explanations.

Thaler and Johnson (1990; see also Thaler, 1980, 1985) suggested that prospect theory should incorporate a hedonic editing rule. Whereas other editing rules are employed for the sake of cognitive simplification, the hedonic editing rule integrates or segregates a prior outcome so that value is maximized. In the example above, no effect of the prior outcome should be expected if options are evaluated according to a linear function mapping money on value, that is, if $x$ denotes amount of money and $v$ value, $v(x) = a + bx$. However, since the value function proposed in prospect theory is concave for gains and convex and steeper for losses, the difference in value will change when the prior outcome is added. It is generally true that either $v(x+y) > v(x)+v(y)$ or the reverse. Integrating rather than segregating a prior outcome will therefore lead to a higher or lower value. If the goal of hedonic editing is to maximize value, it should accomplish that the prior outcome is added to some outcomes (integrated) and not added to other outcomes (segregated) before being evaluated. Value is maximized if a loss is added to a loss, but not if a gain is added to a gain. Value is also maximized if a small loss is added to a large gain (a mixed gain). Whether or not value is maximized if a small gain is added to a large loss (mixed loss) depends on the relative sizes of the gain and loss.

An alternative account labeled the renewable resources model was proposed by Linville and Fischer (1991). A basic tenet of this model is that positive outcomes are maximized. Since a gain is believed to buffer a loss, mixed losses and mixed gains are always integrated. On the other hand, beliefs that resources to cope with losses are limited, although renewable, leads to aversion for multiple losses which therefore are segregated. Likewise, gain-savoring resources are believed to be limited but renewable. As a consequence, gains are segregated.

By asking subjects whether they would prefer two events to occur on the same day (integration) or different days (segregation), empirical support was obtained for the predictions of the renewable resources model (Linville and Fischer, 1991). The events were either financial (monetary losses or gains), academic (successes or failures on exams), or social (positive or negative encounters with people). Almost identical results were obtained within each domain. Some evidence was also found for integration across domains (e.g., if one event was financial and the other social).

In risky decisions avoiding negative outcomes is perhaps more important than attaining positive ones (e.g., Larrick, 1993). It may reflect that anticipated negative events receive increased attention and are processed more comprehensively (Peeters and Czapinski, 1990; Taylor, 1991; Weber, 1994). This reasoning leads to questioning whether the renewable resources model accurately predicts integration of a prior outcome (Gärling and Romanus, 1995). If the goal is to avoid the impact of future negative outcomes rather than to maximize value, expected losses are presumably attended to. Such increased attention involving thorough processing of expected losses may entail adding
prior outcomes. A compatible editing rule of integration/segregation which Gärling and Romanus (1995) labelled the loss-sensitivity principle is to always add a prior outcome to the expected loss rather than to add a prior gain to an expected loss and a prior loss to an expected gain (Table 1). According to the loss-sensitivity principle, the effect of a prior loss is to increase the dissatisfaction with a possible loss, whereas the effect of a prior gain is to decrease it. These predictions were confirmed in a series of previous experiments in which subjects indicated how satisfied they would be with outcomes of gambling choices (Gärling and Romanus, 1995; Gärling et al., 1994; Romanus et al., 1995).

Table 1
Integration of a Prior Outcome Predicted from the Renewable Resources Model and Loss-Sensitivity Principle.

<table>
<thead>
<tr>
<th>Prior gain</th>
<th>Expected gain</th>
<th>Expected loss</th>
<th>Expected gain</th>
<th>Expected loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

In several studies (e.g., Arkes et al., 1988; Isen and Patrick, 1983) it has been shown that risk seeking decreases when subjects consider buying an insurance policy or when they gamble with real, large, or likely losses. A proposed explanation is that the expected loss is salient and therefore attended to. In contrast, risk seeking increases when the loss is made less salient. Since the loss-sensitivity principle implies that integration of a prior outcome depends on attention to the expected loss, it is predicted that a prior outcome will not to the same extent be integrated with an expected loss which is less salient. This prediction was subjected to empirical test in the present experiment.

In the previous experiments by Gärling and Romanus (1995), Gärling et al. (1994), and Romanus et al. (1995), the instructions emphasized the financial outcomes of imaginary horse-race bets. It is conceivable that these instructions increased subjects’ sensitivity to the expected loss. In the present experiment, one group of subjects was presented with essentially identical imaginary bets whereas a second group of subjects was presented with imaginary roulette bets for which the instructions downplayed financial incentives. The effect was assumed to be that the thrill of gambling would dominate gambling choices, thus decreasing sensitivity to an expected loss. In accordance with the loss-sensitivity principle a prior outcome was predicted to be integrated with the expected loss to a lesser extent in the latter group than in the former. In addition to constructing replicates by varying the stakes as was done in previous experiments (e.g., Gärling and Romanus, 1995), a larger variation was accomplished by including
stake as a within-subject factor. This factor was crossed with type of bet since high stakes may make subjects attend to the expected loss even though the instructions attempted to make it less salient.

Another possible explanation of integration of prior outcomes (Laughhunn and Payne, 1984) assumes affective state to play a role. A positive mood has been shown to lead to optimism in judging probabilities (Isen and Geva, 1987; Johnson and Tversky, 1983). The dissatisfaction with an expected loss has also been found to increase (Isen et al., 1988), presumably because positive-mood subjects do not want to jeopardize their mood. In Isen and Geva (1987), the net effect was increased risk aversion. Arkes et al. (1988) found that positive affect increased risk aversion when subjects were offered an insurance policy where the loss was salient. However, increased risk seeking was observed when subjects were offered lottery tickets where the loss was less salient.

In accordance with the results obtained by Isen and Geva (1987), subjects should be less likely to gamble if they react to a prior gain with positive affect. However, the reverse was observed in the experiments by Gärling and Romanus (1995), Gärling et al. (1994), and Romanus et al. (1995). A possible explanation for this difference may be that the fictitious horse-race betting did not elicit affective reactions. A salient anticipated loss may still be experienced more negatively by subjects who are in a positive mood than by subjects who are in a neutral mood (e.g., Isen and Geva, 1987).

If subjects who are in a positive mood process an expected loss more comprehensively when it is salient than do subjects in a neutral mood, an implication of the loss-sensitivity principle is that the former subjects will to a larger extent integrate a prior outcome with a salient expected loss. This implication was also subjected to test in the experiment. Subjects filled out a mood adjective check list three times during a session. Those subjects who consistently reported a positive mood were compared to those who consistently were in a more neutral mood.

Subjects were asked to rate how likely they were to gamble, either when imagining that they had encountered a prior gain, a prior loss, or no prior outcome. The ratings of likelihood of gambling is assumed to be an increasing function of the difference in utility ($u$) between gambling and not gambling. The former may in turn be related to the sum of the satisfaction with winning and the dissatisfaction with losing, multiplied by a decision weight related to the probability ($\pi(p)$) of each of the outcomes\(^1\), that is,

$$u(\text{gambling}) = \pi(p)v(\text{winning}) + \pi(1-p)v(\text{losing}).$$

If the prior outcome is only added to the loss as the loss-sensitivity principle predicts, a prior gain is expected to increase and a prior loss to decrease the ratings of likelihood of gambling. For low stakes and for roulette bets where economic incentives are downplayed, no or a weaker effect of the prior outcome is expected.

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\(^1\)This expression derives from prospect theory (Kahneman and Tversky, 1979). However, predictions would not differ qualitatively if it is replaced by an expected-utility rule.
In accordance with previous results (e.g., Isen and Geva, 1987), when there is no prior outcome, subjects in a positive mood are expected to be more likely to gamble than subjects in a neutral mood when they make horse-race bets with more salient expected losses. The reverse is expected when subjects make roulette bets with less salient expected losses. For high stakes the pattern of results for roulette bets may not differ from horse-race bets if high stakes induce subjects to attend to the loss. According to the loss-sensitivity principle, subjects in a positive mood are furthermore expected to be less likely to gamble than neutral-mood subjects when making horse-race bets after having lost, but more likely to gamble after having won. The reverse pattern was expected for roulette bets with low stakes.

Method

Subjects

Forty undergraduates at Göteborg University participated as subjects in return for the equivalent of $7 in payment. An equal number of men and women were randomly assigned to two groups which each consisted of 20 subjects.

Materials

Subjects were presented with 12 fictitious horse-race or roulette bets. In four of the bets subjects were asked to imagine that they had not gambled in the first race or round (no prior outcome), in another four bets (prior-gain condition) that they had gambled and won $20, $40, $60, or $80 (converted from Swedish Crowns at a rate of 1 SEK equal to $0.15) in the low-stake condition and $80, $160, $240, or $320 in the high-stake condition, and in still another four bets (prior-loss condition) that they had gambled and lost $10, $20, $30, or $40 in the low-stake condition and $40, $80, $120, or $160 in the high-stake condition. In the second race or round subjects were instructed that if they staked $12, $24, $36, or $48 in the low-stake condition and $48, $96, $144, or $192 in the high-stake condition, they had an estimated 50% chance of winning twice as much.

Mood Measurement

Mood was measured by administering a 38-item shortened version of a mood adjective check list which has been standardized in Swedish and subjected to extensive psychometric analyses (Sjöberg et al., 1979; Persson, personal communication). For each adjective, subjects indicated on a 4-point scale ranging from 2 to -2 the degree to which it described how they felt at the moment. By summing across an approximately equal number of adjectives, scores are obtained on three scales labeled pleasantness, activation, and tension. For each
scale, approximately half of the adjectives have positive loadings and the remaining have negative loadings.

**Procedure**

Subjects served in groups of four or less. They filled out the mood adjective check list before receiving a first booklet with bets, then once again before receiving a second booklet, and finally a third time after having completed the second booklet. A session lasted for approximately 35 minutes.

Different cover stories were given to subjects in the different groups. In the group that made horse-race bets, subjects were asked to imagine that this was one of the monthly occasions when they gambled at a horse-race track to earn extra money to supplement their income. In the group that made roulette bets, subjects were asked to imagine that they were playing roulette in a nice restaurant in the company of friends, and that they could afford financial losses.

A bet was presented on each page in the booklets. The first two bets were always fillers, then all the target bets were presented according to individual random orders with an additional ten fillers interpolated in the sequence at irregular intervals. The fillers consisted of bets with an equal probability of winning and losing the same amount. The purpose of the fillers was to conceal the structure of the bets and to counteract stereotypical responding. Bets with high stakes were presented in one booklet and bets with low stakes in another booklet. The order was counterbalanced across subjects.

For each target and filler bet, subjects rated the likelihood of gambling on a scale from completely certain they would not gamble (10) to completely certain they would gamble (90). The midpoint of 50 was defined as equally likely to gamble as not to gamble.

**Results**

**Mood Classification**

Responses to the mood adjective check list were summed for each scale. Separate ANOVAs with block (first vs. second vs. third) as a single within-subject factor only yielded a reliable effect on tension, $F(2, 72) = 3.76, p < .05$, $MS_e = .20$. In this case, tension increased from the first to the second block. Product-moment correlations between first and second, second and third, and first and third blocks were moderate to high across the different scales (ranging from .53 to .91).

Since there were no important differences between blocks, the scores were averaged over blocks for each scale. Correlations across all subjects showed that pleasantness correlated .70 with activation and -.63 with tension, while the latter correlated -.49 with each other. Since pleased, glad, optimistic, and their antonyms made up the pleasantness scale, it is reasonable to assume that this scale corresponds to the pleasantness scale of Lewinsohn and Mano (1993). The
correlational pattern as well as the adjectives making up the other scales suggested that activation corresponded to positive affectivity and tension to negative affectivity (Lewinsohn and Mano, 1993; Watson and Tellegen, 1985). None of these scales therefore constituted a pure measure of arousal. By classifying subjects on the basis of their scores on the pleasantness scale, the resulting groups may also have differed in activation and tension. However, there should be no systematic differences in arousal if this dimension is independent of pleasantness (Lewinsohn and Mano, 1993).

Subjects were divided into two groups based on a median split on the pleasantness scale. Table 2 gives means and SDs of all three mood scales for each group and experimental condition, respectively. As can be seen, on average subjects in both mood groups are in a positive mood, activated, and relaxed. However, as indicated by separate 2 (mood: positive vs. neutral) by 2 (type of bet: horse-race bets with more salient expected losses vs. roulette bets with less salient expected losses) ANOVAs, there were reliable mood differences in pleasantness, $F(1, 36) = 45.17, p < .001, MS_e = .82$, activation, $F(1, 36) = 18.07, p < .001, MS_e = .91$, and tension, $F(1, 36) = 20.93, p < .001, MS_e = .96$, respectively. Neither the main effects of type of bet nor any interactions with this factor were significant at $p = .05$.

Ratings of Likelihood of Gambling

All ratings were transformed by subtracting 50 so that positive values corresponded to likelihood of gambling and negative values corresponded to likelihood of not gambling.

Table 2

<table>
<thead>
<tr>
<th>Type of bet and mood</th>
<th>Horse race (more salient loss)</th>
<th>Roulette (less salient loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral (n=8)</td>
<td>Positive (n=12)</td>
</tr>
<tr>
<td>Mood scale</td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Pleasantness</td>
<td>0.44 0.81</td>
<td>1.59 0.25</td>
</tr>
<tr>
<td>Activation</td>
<td>0.52 0.31</td>
<td>1.18 0.39</td>
</tr>
<tr>
<td>Tension</td>
<td>-0.20 0.85</td>
<td>-0.63 0.53</td>
</tr>
</tbody>
</table>

As Table 3 shows, consistent with previous research demonstrating effects of positive mood on risk seeking (e.g., Isen and Geva, 1987), when subjects in a
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positive mood made horse-race bets with more salient expected losses they were less likely to gamble after no prior outcome than neutral-mood subjects were. The reverse was true when subjects made roulette bets with less salient expected losses. However, in a 2 (mood: positive vs. neutral) by 2 (type of bet: horse-race bets with more salient expected losses vs. roulette bets with less salient expected losses) by 2 (stake: high vs. low) by 3 (prior outcome: no prior outcome vs. prior loss vs. prior gain) mixed ANOVA with repeated measures on the last factor, the interaction between mood and type of bet did not quite reach significance ($p < .20$).

As predicted by the loss-sensitivity principle, subjects were more affected by prior outcome when they made horse-race bets than when they made roulette bets. The interaction between type of bet and prior outcome was nearly significant, $F(2, 72) = 2.40, p < .10, MS_e = 179.26^2$. Also in line with the principle, subjects in a positive mood were more affected by prior outcome than neutral subjects when they made horse-race bets and less when they made roulette bets. The interaction involving mood, type of bet, and prior outcome was significant, $F(2, 72) = 5.71, p < .01, MS_e = 179.26$. Tukey post hoc tests showed at $p = .05$ that subjects in a positive mood who made horse-race bets rated that they were reliably less likely to gamble in the prior-loss condition than in the prior-gain condition and the no prior outcome condition respectively, and that they were reliably more likely to gamble in the prior-loss condition than in the no prior outcome condition. However, for subjects in a positive mood who made roulette bets, the only significant differences were between the prior-loss and prior-gain conditions. The groups differed reliably in the no prior outcome and prior-loss conditions, respectively. In contrast, both groups of neutral-mood subjects were reliably more likely to gamble in the prior-loss than in the prior-gain condition. A difference was that for subjects who made roulette bets, although not for subjects who made horse-race bets, the prior-loss condition differed reliably from the no prior outcome condition. As a consequence, a reliable group difference was only found in the prior-loss condition.

In support of the loss-sensitivity principle, subjects rated that they were less likely to gamble for high stakes in the prior-loss condition than they rated that they were for low stakes in the same condition (Table 4). This was substantiated by a significant interaction between stake and prior outcome, $F(2, 72) = 3.83, p < .05, MS_e = 50.42$, followed by a Tukey post hoc test which was significant at $p < .05$. Gambling was also rated reliably more likely for low than for high stakes in the condition with no prior outcome. For both high and low stakes, all

Table 3

| Mean Ratings of Likelihood of Gambling in each Condition Related to Type of Bet and Mood. |

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$^2$The interaction was marginally significant in an ANOVA which excluded the mood factor, $F(2, 76) = 3.07, p = .05, MS_e = 207.29$. 
Type of bet and mood

<table>
<thead>
<tr>
<th>Condition</th>
<th>Horse race (more salient loss)</th>
<th>Roulette (less salient loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral (n=8)</td>
<td>Positive (n=12)</td>
</tr>
<tr>
<td>No prior outcome</td>
<td>7.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Prior loss</td>
<td>4.4</td>
<td>-4.7</td>
</tr>
<tr>
<td>Prior gain</td>
<td>12.7</td>
<td>25.1</td>
</tr>
</tbody>
</table>

Pairwise differences were reliable between no prior outcome, prior loss, and prior gain. The only additional significant effect involving stake was the interaction with type of bet, \( F(1, 36) = 12.58, p < .001, MS_e = 225.0 \). As Tukey post hoc tests showed, a significant increase from low to high stakes for subjects making horse-race bets was paralleled by a smaller, although significant decrease for subjects who made roulette bets. For high stakes subjects rated that they were reliably more likely to gamble at roulette (\( M = 13.0 \)) than at the horse-race track (\( M = 2.7 \)), while the reverse was true for low stakes (\( M = 13.0 \) compared to \( M = 9.2 \)).

Table 4
Mean Ratings of Likelihood of Gambling in each Condition for high and low Stakes.

<table>
<thead>
<tr>
<th>Condition</th>
<th>High stakes</th>
<th>Low stakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No prior outcome</td>
<td>5.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Prior loss</td>
<td>-1.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Prior gain</td>
<td>18.1</td>
<td>17.6</td>
</tr>
</tbody>
</table>
Discussion

The results of several previous experiments (Gärling and Romanus, 1995; Gärling et al., 1994; Romanus et al., 1995) supported the loss-sensitivity principle in showing that subjects integrated a prior outcome only with an expected loss when evaluating the outcomes of a current choice. The present experiment investigated the implication of the loss-sensitivity principle that when an expected loss is less salient subjects do not integrate the prior outcome with the expected loss as they would otherwise do. The results confirmed this implication in that less integration was observed when the financial incentives were made less salient in a fictitious betting task. Also confirming the implication, less integration was found when the stakes were low as compared to when they were high.

Extending the findings of previous studies of how an induced positive mood influences risky choices (Isen, 1987), the present results were more consistent with the loss-sensitivity principle for subjects who were in a positive mood. If, as has been suggested (Isen, 1987), subjects in a positive mood process salient losses more thoroughly, then subjects in such a mood should to a larger extent integrate the prior outcome with an expected loss which is salient. The results of the present series of experiments (Gärling and Romanus, 1995; Gärling et al., 1994; Romanus et al., 1995) differed from those obtained in previous research on mood effects in the respect that the prior outcomes did not seem to elicit affective reactions. This is understandable given that the bets were fictitious. However, the comparison of subjects classified on the basis of self-reported mood was consistent with the results of previous research in which mood differences were induced. Even though such consistency in results was observed, measuring rather than manipulating mood makes it difficult to rule out alternative explanations since subjects who report that they are in a positive mood may differ preexperimentally in other respects from those subjects who report that they are in a more neutral mood.

Mood has been shown to influence judgments of the probability of outcomes (Johnson and Tversky, 1983). Such influences could account for why subjects in the present experiment rated that they were less likely to gamble after a loss and more likely to gamble after a gain. However, this explanation is not plausible if it is necessary that subjects react affectively to the prior outcomes. Furthermore, in previous experiments (Gärling and Romanus, 1995; Gärling et al., 1994; Romanus et al., 1995), the loss-sensitivity principle was directly supported by subjects’ ratings of how satisfied they were with the expected outcomes of gambling choices. These ratings should not have been affected by the probability of the outcomes.

Like the loss-sensitivity principle, the renewable resources model (Linville and Fischer, 1991) predicts that subjects will rate that they are less likely to gamble after a loss and more likely to gamble after a gain. However, ratings of satisfaction with outcomes of gambling choices in previous experiments (Gärling and Romanus, 1995; Gärling et al., 1994; Romanus et al., 1995) supported the loss-sensitivity principle rather than the renewable resources model. In addition,
the renewable resources model neither predicts the present effects of the manipulation of salience of the expected loss, nor does it predict the present effects of mood. This does not preclude that the renewable resources model accounts for integration under such conditions when a decision maker attempts to maximize value rather than to minimize negative outcomes. An important task for future research is to identify these conditions. As has been shown, value appears to be maximized by decision makers who are in a positive mood when expected losses are not salient. However, there may be many other conditions when a decision maker maximizes value.

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