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GAMBLING WITH THE HOUSE MONEY AND TRYING TO BREAK EVEN: THE EFFECTS OF PRIOR OUTCOMES ON RISKY CHOICE*

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How is risk-taking affected by prior gains and losses? While normative theory implores decision makers to only consider incremental outcomes, real decision makers are influenced by prior outcomes. We first consider how prior outcomes are combined with the potential payoffs offered by current choices. We propose an editing rule to describe how decision makers frame such problems. We also present data from real money experiments supporting a "house money effect" (increased risk seeking in the presence of a prior gain) and "break-even effects" (in the presence of prior losses, outcomes which offer a chance to break even are especially attractive).
(DECISION MAKING; PROSPECT THEORY; SUNK COSTS; MENTAL ACCOUNTING)

1. Introduction

Imagine that you are attending a convention in Las Vegas, and you walk into a casino. While passing the slot machines, you put a quarter into one machine and, surprisingly, you win $100. Now what? Will your gambling behavior for the rest of the evening be altered? Might you make a few more serious wagers, even if you usually abstain? Suppose instead that you had $100 in cash stolen from your wallet while taking a swim at the pool. How will that alter your behavior? Are either of these events equivalent to discovering, just before entering the casino, that a stock in which you own 100 shares has gone up (or down) one point that day?

Or, consider the case of a manager whose division has lost $10 million under her administration, and who must choose between two projects. Project A will earn a sure $5 million. Project B will earn $20 million with probability 0.5 and lose $5 million with probability 0.5. Does this past history influence the decision? Suppose instead that these projects were described using their final asset positions: *A* produces a sure loss of $5 million and *B* yields a 50% chance to lose $15 million and a 50% chance to earn $10 million. Does this change in description make a difference?

These examples illustrate the basic question investigated in this paper: How is risk-taking behavior affected by prior gains and losses? The question is quite general since decisions are rarely made in temporal isolation. Current choices are often evaluated with the knowledge of the outcomes which have preceded them. Such knowledge can often be a handicap. While students of economics and decision theory are implored to concentrate only on incremental costs, it is well established that real decision makers are often influenced by historical or sunk costs (Arkes and Blumer 1985; Staw 1981; Thaler 1980). Laughhunn and Payne (1984) have investigated the effect of both sunk costs and what they call sunk gains on decisions under uncertainty. We continue here in the same spirit. We begin by recognizing that most decision makers are influenced by prior outcomes. Our goal then is to investigate how prior gains and losses affect choices. We will offer empirical evidence to support the intuitions evoked in the above scenarios. Specifically, prior gains and losses can dramatically influence subsequent choices in systematic ways. For example, we find that under some circumstances a prior gain can increase

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subjects' willingness to accept gambles. This finding is labeled the *house money effect*. In contrast, prior losses can decrease the willingness to take risks. We also find that when decision makers have prior losses, outcomes which offer the opportunity to "break even" are especially attractive.

We attempt to explain these phenomena using a framework based on Kahneman and Tversky's (1979) prospect theory. Their analysis of decision making under uncertainty has led them to conclude that "The location of the reference point, and the manner in which choice problems are coded and edited emerge as critical factors in the analysis of decisions." (1979, p. 288) We agree with this assessment, and our paper extends their earlier work on this topic.

While the ultimate goal of the paper is to investigate the role of prior outcomes on risky choice, we begin with a set of more primitive questions. How are gains and losses encoded by decision makers? When are prior outcomes combined with the potential payoffs of current prospects and when are they ignored or neglected? We formulate several hypotheses about this portion of the decision making process and call the hypotheses *editing rules*. While we will consider many such rules, special consideration is given to a simple rule which suggests that people edit outcomes in the way that makes them happiest. Tests of this rule give it only partial support. These tests lead us to propose another editing rule, the *quasi-hedonic editing hypothesis*. All the editing rules are then tested experimentally by giving subjects real decisions in which they can win or lose money. The experiments provide some support for our proposed quasi-hedonic editing rule, as well as providing interesting new results on decision making in the presence of prior outcomes.

2. Valuing Gains and Losses

All theories of decision under uncertainty make, implicitly at least, some assumptions about how problems are represented. Subjective Expected Utility (SEU) theory, for example, assumes that all outcomes are integrated with current wealth. This amounts to the following editing rule: add every possible outcome to existing wealth; then evaluate gambles in terms of their final end states. Given this editing rule, prior outcomes can only influence choice via a wealth effect, and choices must be invariant across problem descriptions. Thus, SEU theory cannot be used to describe the behavior we observe in our experiments.

Prospect theory, in which outcomes are coded as gains and losses relative to a reference point, and in which problem representation can matter, offers a better framework for analyzing the phenomena under study. Therefore, we begin this section by briefly summarizing prospect theory. Two editing rules consistent with prospect theory are presented, plus two additional editing rules that code gains and losses but are not consistent with prospect theory. One of the nonprospect theory rules portrays decision makers as extremely passive, accepting any problem representation that they are given. The other rule characterizes decision makers as hedonic optimizers, coding outcomes to maximize pleasure and minimize pain. Tests of this rule indicate that it is not consistent with behavior, and so at the end of this section we propose a fifth editing rule based on our empirical findings.

2.1. *Prospect Theory*

Prospect theory uses two functions to characterize choices: the value function, $v(\cdot)$, which replaces the utility function in SEU theory, and the decision weight function, $\pi(p)$, which transforms probabilities into decision weights. The key property of the decision weighting function is that small probabilities are overweighted ($\pi(p) > p$), and that decision weights need not add up to unity (that is, $\pi(p) + \pi(1 - p) \neq 1.0$). For our purposes, however, the value function is of greater interest.

The value function has three important characteristics:

1. It is defined over gains and losses (i.e., changes from the status quo) rather than final asset positions.
2. It is "S" shaped: concave for gains and convex for losses.
3. It displays loss aversion, that is, the loss function is steeper than the gain function, $v(x) < -v(-x)$.

Define a prospect $(x, p; y, 1 - p)$ as a gamble that yields x with probability p and y with probability $1 - p$. Then, according to prospect theory if x and y are of opposite signs (either $x \geq 0 \geq y$ or $y \geq 0 \geq x$), the value of this prospect, V, is given by:

$$V = \pi(p)v(x) + \pi(1 - p)v(y). \tag{1}$$

However, this is not the only representation used in prospect theory. The valuation of prospects is assumed to be preceded by an editing phase in which prospects are simplified. For example, in comparing alternative prospects, decision makers are assumed to look for dominance and select the dominating alternative when the dominance is transparent; outcomes that are extremely unlikely are ignored; and both probabilities and outcomes may be rounded. The editing phase also produces an evaluation rule different from equation (1) for strictly positive or strictly negative options. Kahneman and Tversky state that "In the editing phase such prospects are segregated into two components: (i) the riskless component, i.e., the minimum gain or loss which is certain to be obtained or paid; (ii) the risky component, i.e., the additional gain or loss which is actually at stake." (1979, p. 276)

So, if either $x > y > 0$ or $x < y < 0$, then

$$V = v(y) + \pi(p)[v(x) - v(y)]. \tag{2}$$

In this formulation the certain gain is valued separately, and the value difference between the two risky outcomes is multiplied by the appropriate decision weight.

2.2. *Prior Gains and Losses*

How can prior gains or losses be accommodated in this framework? In their original formulation of prospect theory, and also in their subsequent research, Kahneman and Tversky have stressed that the presence of prior gains and losses raises complicated issues. Indeed, they suggest two ways prior outcomes might be coded. First, all events might be coded separately: ". . . people generally evaluate acts in terms of a minimal account which includes only the direct consequences of the act" (Tversky and Kahneman 1981, p. 456). If this coding is used, prior outcomes have no effect on subsequent choices.

However, Kahneman and Tversky (1979, p. 286) also recognize that "there are other situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo." In these situations, "the outcomes of an act affect the balance in an account that was previously set up by a related act" (Tversky and Kahneman 1981, p. 457). For example, "a person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise" (Kahneman and Tversky 1979, p. 287).

To summarize, prospect theory includes an editing phase in which prospects are simplified and encoded. However, within the prospect theory framework, there is some flexibility in how prospects are edited, particularly when a prior outcome might influence the reference point. In the section that follows, we propose specific alternative representations of prospects that can emerge from the editing phase; we term these *editing rules*.

2.3. *Editing Rules*

To get a sense of the types of problems to which the editing rules might be applied, consider the following choice:

You have just won \$30. Now choose between:

(a) no further gain or loss.

(b) a gamble in which you have a 50% chance to win \$9 and a 50% chance to lose \$9.

This problem is presented in what we term the *two-stage* version since the prior gain of \$30 is presented separately from the gamble.[1] Compare it to the following *one-stage* presentation of the same gamble:

Choose between:

(a) A sure gain of \$30.

(b) A 50% chance to win \$39 and a 50% chance to win \$21.

In contrast to SEU theory, the transformations predicted by the editing rules we consider are contingent on the characteristics of the decision problem. For example, some of the editing rules depend on the signs and magnitudes of the outcomes, and some depend on the problem representation.

2.3.1. *Prospect Theory with Memory.* When prior outcomes are incorporated into the perceived "balance" of the relevant mental account, choices can be affected. In problems such as those above, where the prior gain exceeds the largest potential loss, equation (2) applies. Therefore, the two-stage gamble presented above is edited as:

$$v(21) + \pi(0.5)[v(39) - v(21)]. \tag{3}$$

The way to read this in words is: "If I accept this gamble I win \$21 for sure, plus I have a 50% chance of increasing my gain from \$21 to \$39." The same editing would apply to the one-stage presentation of the gamble.

2.3.2. *Prospect Theory, No Memory.* An alternative editing rule that is consistent with prospect theory is a "no memory" rule which says that prior outcomes are encoded, valued, and then forgotten. Prior outcomes do not alter the coding of subsequent gambles. Under this editing hypothesis, the presentation of the gambles makes a difference. If the gamble is presented in the two-stage version, it will be edited as:

$$\{v(30)\} + \pi(0.5)v(9) + \pi(0.5)v(-9). \tag{4}$$

This can be read as follows: "I have already won \$30. I can now take this gamble which will yield me a 50% chance to gain \$9 and a 50% chance to lose \$9." If the one-stage version is presented, however, then the gamble will be coded as in equation (3), that is, applying prospect theory's equation two. The gamble is edited in this way because in the one-stage presentation there is no prior outcome to be (coded and) forgotten.

2.3.3. *Concreteness.* Another plausible editing rule states that subjects do no active editing per se, but rather accept the problem as presented to them. This hypothesis is suggested by Paul Slovic's (1972) *concreteness* principle: ". . . a judge or decision maker tends to use only the information that is explicitly displayed in the stimulus object, and will use it only in the form in which it is displayed." (p. 14) If the concreteness editing rule is used, then the two-stage version would be encoded the same way as under prospect theory, no memory, i.e., as in (4) above.

The one-stage version would be encoded as

$$\pi(0.5)v(39) + \pi(0.5)v(21). \tag{5}$$

2.3.4. *Hedonic Editing.* The editing rules considered so far characterize decision makers as either mechanical or passive (or both). The rules presume that decision makers take the frames presented to them, as the concreteness hypothesis suggests, or use the

[1] Notice that the wording of this problem does suggest segregating the prior outcome as it is presented separately, but it also suggests that the prior gain is in the same (mental) account as the subsequent choices. In contrast, Kahneman and Tversky have reported results using more neutral wording such as "In addition to whatever you own you have been given 1000, now choose . . ." (Kahneman and Tversky 1979, p. 273). With this wording, subjects may be more likely to consider the prior outcome as being in a different mental account.

same rule irrespective of the signs and magnitudes of the prior and subsequent outcomes. An alternative rule with quite a different flavor is based on the hypothesis that people edit the gambles in a way that would make the prospects appear most pleasant (or least unpleasant). We call this the hedonic editing hypothesis.[2]

The shape of prospect theory's value function implies that the signs and magnitudes of x and y determine whether hedonic editing calls for segregation or integration. The rules for hedonic editing follow from four principles (see Thaler 1985):

1. Segregate gains.
2. Integrate losses.
3. Segregate small gains from larger losses (The "silver lining" principle).
4. Integrate (cancel) smaller losses with larger gains.

The hedonic editing hypothesis assumes that these four principles are applied whenever possible. This hypothesis yields the following editing of the two-stage gamble:

$$v(21) + \pi(0.5)v(18). \tag{6}$$

This can be read as: "If I win the gamble I will win \$21 for sure, and I have a 50% chance to also win another \$18." The hedonic editing hypothesis suggests the same coding of the one-stage gamble.

3. Direct Tests of Hedonic Editing

Of the editing rules proposed so far, the hedonic editing rule is by far the most radical. There are several reasons why one might expect the hypothesis to be false. First, the hedonic editing hypothesis supposes that decision makers are quite active in their editing of potential outcomes. This may require more cognitive effort than decision-makers are willing to expend. Second, hedonic editing predicts that the same coding will be used regardless of the presentation format. There is good reason to believe that presentation matters. Third, hedonic editing is a maximizing process, though perhaps not a rational one. Actual editing may fall short of the hedonic ideal. In spite of these reservations, the hypothesis is worth investigating because it is potentially very powerful. If correct, the hedonic editing hypothesis would provide a canonical representation of any prospect which would make the task of prediction much easier. Also, by discovering the specific ways in which the hypothesis fails, we may be able to formulate alternative (more realistic) hypotheses. Therefore, this section presents tests of the hedonic editing hypothesis, and, based on the results we obtain, offers an alternative editing rule.

3.1. *A Previous Test of the Hedonic Framing Hypothesis*

In a previous paper, Thaler (1985) investigated an issue related to hedonic editing. How do decision makers prefer to have gains and losses framed for them? Do they prefer to have gains segregated and losses integrated as the theory predicts? This was tested in what we will refer to as Experiment 1. Subjects were asked to compare pairs of scenarios, four of which are presented in Table 1. In each case two events occur to Mr. A and a single event occurs to Mr. B. The subjects were asked to judge whether Mr. A or Mr. B was happier (or more upset in the case of losses). The results of the experiment supported the hedonic framing principles in that a majority of subjects selected the frame predicted by the theory.

Notice that while the results of Experiment 1 were consistent with principles 1–4 above, this experiment is not a test of the hedonic editing hypothesis. In Experiment 1

[2] There are obvious limits to hedonic editing. For example, we assume that decision makers take the actual outcomes at face value. Also, the only operations we permit are combining and separating. That is, when there are two events x and y, we assume that people either *integrate* the two and code the joint event as $v(x + y)$, or they *segregate* the events and code them as $v(x) + v(y)$.

TABLE 1

Experiment 1, *From Thaler* (1985)

Instructions: Below you will find four pairs of scenarios. In each case two events occur in Mr. A's life and one event occurs in Mr. B's life. You are asked to judge whether Mr. A or Mr. B is happier. Would most people rather be A or B? If you think the scenarios are emotionally equivalent, check "no difference." In all cases the events are intended to be financially equivalent.

(1) Mr. A was given tickets to two lotteries involving the World Series. He won \$50 in one lottery and \$25 in the other. Mr. B was given a ticket to a single, larger World Series lottery. He won \$75. Who was happier?

A: 64% B: 18% No difference: 17% $N = 87$.

(2) Mr. A received a letter from the IRS saying that he made a minor arithmetical mistake on his tax return and owed \$100. He received a similar letter the same day from his state income tax authority saying he owed \$50. There were no other repercussions from either mistake. Mr. B received a letter from the IRS saying that he made a minor arithmetical mistake on his tax return and owed \$150. There were no other repercussions from his mistake. Who was more upset?

A: 75% B: 16% No difference: 8% $N = 87$.

(3) Mr. A's car was damaged in a parking lot. He had to spend \$200 to repair the damage. The same day the car was damaged, he won \$25 in the office football pool. Mr. B's car was damaged in a parking lot. He had to spend \$175 to repair the damage. Who was more upset?

A: 25% B: 70% No difference: 5% $N = 87$.

(4) Mr. A bought his first New York State lottery ticket and won \$100. Also, in a freak accident, he damaged the rug in his apartment and had to pay the landlord \$80. Mr. B bought his first New York State lottery ticket and won \$20. Who was happier?

A: 29% B: 72% No difference: 6% $N = 87$.

subjects simply judged which frame they preferred. The hedonic editing hypothesis is a conjecture that subjects *actively* reframe events and outcomes in a systematic way. Indeed, Experiment 1 suggests additional limits on the hedonic editing hypothesis. If subjects in this study believed that the events would be reframed in a hedonically optimal manner, then they would judge all the pairs of scenarios as equivalent since Mr. A could reframe his situation to be that of Mr. B and vice versa. Another limitation is suggested by the following thought experiment. Imagine you had just received a unexpected gain of \$50. This could be hedonically reframed into two gains of \$25, but why stop there? Why not 50 gains of \$1? Obviously there are some limits to self-deception, and these limits impose constraints on the way events are encoded. The limits of hedonic editing are further explored in below.

3.2. *A Test Based on Temporal Spacing*

To test the hedonic editing hypothesis we need to ask subjects to make choices that reflect their preferences about the framing of events. One way to do this is by giving subjects a choice about the timing of events. For the next experiment, we assumed that the process of segregating a pair of events is facilitated by having the events occur on different days, and conversely that integrating events is easier if the events occur on the same day. We therefore presented another set of subjects with pairs of events and asked them whether they preferred that the events occur "on the same day" or "a week or two apart". The items we used were the same as those used in Experiment 1, plus some additional items. The items and the results are presented in Table 2.

If the premise that temporal separation facilitates segregation is correct (it does seem

TABLE 2

Experiment 2: Hedonic Editing: Temporal Spacing

Instructions: Below you will find three pairs of events. In each case the same events occur, either on the same day (for A) or two weeks apart (for B). You are asked to judge whether A or B is happier, or in the event of two negative events, who is more unhappy. Would most people rather be A or B? If you think the alternatives are emotionally equivalent, check "no difference." In all cases the events are intended to be financially equivalent. (Note: Having the events occur together does not imply that they occur sooner or later than if they were apart. That is not the question. You are only asked to judge whether it is better to have the events separately or together).

(1) The events are:
(i) win $25 in an office lottery.
(ii) win $50 in an office lottery.

Who is happier?

A 25% B 63% No difference 12% $N = 65$

(2) The events are:
(i) receive a letter from the federal income tax authority saying that due to an arithmetical mistake $100 must be paid.
(ii) receive a letter from the state income tax authority saying that due to an arithmetical mistake $50 must be paid.

Who is more unhappy?

A 57% B 34% No difference 9% $N = 65$

(3) The events are:
(i) receive a $20 parking ticket.
(ii) receive a bill for $25 from the registrar because a form was filled in improperly.

Who is more unhappy?

A 75% B 17% No difference 7% $N = 65$

reasonable), then the hedonic editing hypothesis implies that subjects will choose to have the events occur "apart" when segregation would be preferred, and "together" when integration would be hedonically optimal. As the results show, this prediction was only partly confirmed.

The responses to question 1 reveal that for pairs of gains subjects did respond in the way suggested by the hedonic editing hypothesis. Subjects preferred to spread out the arrival of pleasant events, presumably to help segregate the pleasures experienced. Using the same logic, subjects should prefer to have pairs of losses occur on the same day, to facilitate their integration. However, subjects did not express this preference. Rather, in questions 2 and 3 subjects indicated that they prefer to experience the losses separately. We have obtained this result repeatedly, for small or large losses, for nonmonetary as well as monetary losses, and for unrelated and related pairs of events. This result is a severe blow to the hedonic editing hypothesis. By expressing a strict preference for experiencing pairs of losses on different days, the majority of subjects said two things: (i) they do not intend to integrate the second loss of the day with the first one; and (ii) the second loss will actually "hurt" more after the first than it would if experienced alone (if this were not true the subjects would be indifferent between the two options).[3]

[3] Kahneman and Snell (forthcoming) also report anomalous results regarding the loss function. Subjects were asked whether some stimulus (such as a severe headache) was getting better or worse over several days. Most subjects thought the headache was getting worse, i.e., that the "loss function" for headaches was escalating. For such a loss function, subjects should be risk averse. However, most subjects gave risk-seeking responses to choices involving the same stimuli. Kahneman and Snell stress the difference between "experience utility" and

3.3. *Further Tests of the Failure to Integrate Losses*

The failure to actively integrate losses is explored further in Experiment 3. Subjects were asked questions such as: when does losing $9 upset you more, when it occurs by itself, or directly after losing $30? Questions 1–3 were originally administered to a group of Cornell undergraduate psychology students. These questions plus items 4 and 5 were then given to a group of Cornell MBA students. Questions 6–10 were given to a different group of Cornell MBA's. (See Table 3.)

Question 1 investigates whether losses can be integrated with prior gains as hedonic editing entails. Subjects report that the *incremental* effect of losing $9 is less after a gain of $30 than by itself, consistent with hedonic editing.

In contrast, question 2 yields results inconsistent with hedonic editing principle 2 (integrate losses). A large majority of subjects say that losing $9 hurts more after losing $30 than alone. As in Experiment 2, the responses are clearly inconsistent with active integration of losses (as long as the loss function is convex), yet subjects do not answer as if they were ignoring the initial loss, as pure segregation would imply. Rather, this situation appears to provoke a complex reaction in which the initial loss increases the loss aversion associated with subsequent losses.

It is instructive to compare the responses to question 2 with those for questions 3 and 4. Here a small majority say that the $9 hurts less after the large $250 (or $1000) loss than alone. These results rule out one alternative explanation of the responses to question 2, i.e., that the subjects misunderstood the instructions. If subjects incorrectly responded by choosing the option based on an evaluation of total utilities instead of the incremental utility of the $9, then they would have overwhelmingly picked (b) on questions 3 and 4. Questions 5 and 10 are particularly interesting. Together they suggest that the effect of a prior loss on the disutility of a subsequent loss is a function with an inverted U shape. The loss of $9 hurts more after a $36 loss than after a $9, but less after $1000 loss than after a $30. A tentative interpretation of this set of results is that while a small to moderate loss may sensitize the individual to further losses of roughly the same magnitude, a large loss may numb the individual to additional small losses.[4]

Items 6–10 are used for a parametric exploration of these effects, manipulating the amount of the prior loss. The results suggest that the responses are not very sensitive to the exact value of the prior loss, as long as it is of the same magnitude as the subsequent loss. None of the differences among items 6–10 are significant, nor are these items significantly different from question 2.

To summarize, Experiments 2 and 3 present mixed evidence on the hedonic editing hypothesis. While subjects do seem to actively segregate gains, and cancel losses against larger gains, they do not appear to integrate losses. Also, subjects do not actively reframe the problems presented in Experiment 1 to make them all equivalent, suggesting that presentation mode plays an important role in the final editing of outcomes. In light of these results, we propose another editing rule consistent with what we have observed.

3.4. *Quasi-Hedonic Editing Hypothesis*

The results of Experiments 2 and 3 refute the hedonic editing hypothesis on two counts. First, the hypothesis provides too active a characterization of the editing process. This suggests that to generate a more accurate description of the editing process, the hypothesis should be modified to make it closer to the concreteness editing rule in which no active rewriting is done by decision makers. Specifically, we propose that when subjects

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"decision utility." The difference between 2 or 4 days of headaches may sound greater than the difference between 8 and 10, even though the experience of the extra two days of headaches would be worse in the latter instance. The relationship between their results and ours deserves attention.

[4] The large prior loss also produces a contrast effect which makes the subsequent small loss seem smaller.

TABLE 3

Experiment 3: Subjective Reactions to Losses

Consider the following two events: (a) you lose $\$x$. (b) you lose $\$x$ after gaining $\$y$. We are interested in the emotional impact of the loss of $\$x$ in both cases. Are you more upset about the loss of money when it occurs alone (a), or when it occurs directly after a gain (b)? Of course you are happier in total in (b), but we are interested only in the incremental impact of the loss. Below you will find several questions of this type. In each case please compare the incremental effect of the event described. If you feel there is no difference you may check that, but please express a preference if you have one.

Part A

1. (a) You lose $9.
   (b) You lose $9 after having gained $30.
   The loss of $9 hurts more in:

Cornell Undergrads N = 137	(a) 84%	(b) 10%	No difference 6%.
Cornell MBA's N = 87:	(a) 70%	(b) 9%	No difference 21%.

2. (a) You lose $9.
   (b) You lose $9 after having lost $30.
   The loss of $9 hurts more in:

Cornell Undergrads N = 137	(a) 22%	(b) 75%	No difference 3%
Cornell MBA's N = 87:	(a) 13%	(b) 55%	No difference 31%.

3. (a) You lose $9.
   (b) You lose $9 after having lost $250.
   The loss of $9 hurts more in:

Cornell Undergrads N = 137	(a) 54%	(b) 37%	No difference 9%
Cornell MBA's N = 87:	(a) 39%	(b) 38%	No difference 23%.

Part B: Cornell MBA's N = 87

4. (a) You lose $9.
   (b) You lose $9 after suffering a loss of $1000.
   The loss of $9 hurts more in (a) 50% (b) 33% No difference 17%.

5. (a) You lose $9 after suffering a loss of $30.
   (b) You lose $9 after suffering a loss of $1000.
   The loss of $9 hurts more in (a) 51% (b) 38% No difference 21%.

Part C: Cornell MBA's N = 81

6. (a) You lose $9.
   (b) You lose $9 after suffering a loss of $9.
   The loss of $9 hurts more in (a) 7% (b) 64% No difference 28%.

7. (a) You lose $9.
   (b) You lose $9 after suffering a loss of $18.
   The loss of $9 hurts more in (a) 11% (b) 65% No difference 23%.

8. (a) You lose $9.
   (b) You lose $9 after suffering a loss of $36.
   The loss of $9 hurts more in (a) 12% (b) 62% No difference 26%.

9. (a) You lose $9.
   (b) You lose $9 after suffering a loss of $45.
   The loss of $9 hurts more in (a) 14% (b) 65% No difference 21%.

10. (a) You lose $9 after suffering a loss of $9.
    (b) You lose $9 after suffering a loss of $36.
    The loss of $9 hurts more in (a) 7% (b) 68% No difference 25%.

are presented choices in the one-stage format (e.g., choose between sure gain of $30 and a 50–50 chance to win $39 or $21) they do not actively segregate the sure gain.

Second, both experiments reveal that subjects have difficulty integrating losses. Therefore, we propose that when faced with a two-stage gamble involving a prior loss, subjects will not integrate subsequent losses with the initial loss. (However, after prior gains, subsequent losses *will* be integrated with (cancelled against) the prior gain.)

We call this the *quasi-hedonic* editing hypothesis because it follows the hedonic editing rules only part of the time. According to the quasi-hedonic editing hypothesis, the two-stage version of the gamble described above will be rewritten as:

$$\pi(0.5)[v(30) + v(9)] + \pi(0.5)v(21).^{5} \tag{7}$$

In words this reads: "I have a 50% chance to win \$30 and win \$9, and a 50% chance to win just \$21." The one-stage version will yield the same coding used in the concreteness formulation, that is equation (5).

Consider now the same gamble with the exception that the \$30 prior gain is replaced with a \$30 prior *loss*. The quasi-hedonic editing hypothesis predicts that the two-stage version of this gamble will be encoded as:

$$\pi(0.5)[v(-30) + v(-9)] + \pi(0.5)[v(-30) + v(9)]. \tag{8}$$

Notice that here both the gain and the loss are segregated from the prior loss. Once again the one-stage version yields a concreteness encoding.

4. Editing Rules and Risky Choice

The tests of the hedonic editing hypothesis presented in §3 were useful in establishing the ways in which the actual editing diverges from the hedonic ideal. The quasi-hedonic editing hypothesis represents our own initial effort at a descriptive theory of editing. However, this hypothesis and the others we have presented should really be evaluated in the domain of risky choice, the ultimate topic of interest.

We use two methods to test the editing rules. First, some of the rules imply that the presentation format does not influence choices. These results are tested by doing between-subject comparisons of responses to alternative representations of the same problem. Second, the various editing hypotheses make different predictions about the role of prior outcomes on risky choice. Some rules, for example, predict that (relatively small) prior outcomes have no effect on choice, as in SEU theory. To test these implications, we conduct within-subject comparisons by asking subjects to make contingent choices for each of several possible initial outcomes.

The next section describes the experimental procedures, with the following section evaluating the results in terms of the editing rules.

4.1. *Experimental Design*

Investingating the influence of prior gains and losses on subsequent risky choice presents certain methodological problems. The ideal experiment is one in which subjects make actual choices for real money. However, an experiment in which subjects can lose money creates some ethical dilemmas. We have dealt with this issue as follows. Subjects were invited to participate in an experiment in which they would make several choices (no more than eight), each with a prior gain or loss (e.g., "you have won/lost X, now choose between gamble A and a sure outcome B). Only one of the choices presented to the subjects would actually be played, and the chances that any one problem would be selected varied such that the most attractive choices (i.e., those with large prior gains)

[5] As we have indicated above, the results of Experiments 2 and 3 indicate that subjects not only segregate losses which follow prior losses, but that the subsequent losses are actually more painful than they would be in the absence of the prior loss. This could be accommodated in the theory by indexing the value function on prior losses. If $v(-x|-y)$ denotes the value of a loss of x following a loss of y then the prior results suggest that $v(-x|-y) < v(-x)$. Modifying the theory in this way complicates the notation somewhat and only strengthens the results discussed below, so we have retained the simpler formulation.

were the most likely to be selected. Participation was always voluntary. This procedure allowed us to expose subjects to actual potential losses even though few would actually lose money.

Our initial efforts using this design met with mixed success. Only about a third of the subjects agreed to participate in the experiment for real money (the others answered the questions on a hypothetical basis), and these real-money subjects proved to have extremely risk-seeking preferences. Since the goal of our study is to examine the effect of prior outcomes on risky choice, the subjects who agreed to play for real money were not very interesting since they tended to take the risk-seeking choice at almost every opportunity.

Learning from these experiences, we designed Experiment 4 in an attempt to elicit almost complete participation from a large undergraduate class. Our experience suggested two reasons why subjects were unwilling to participate: First, fear of losing money (even though the expected value of the game was significantly positive), and second, confusion—the experiment is complicated, and subjects were worried that they might not understand exactly what was going to happen. In addition, we observed that the participation rate for female subjects was much lower than for males. In light of these factors we designed Experiment 4 with the following changes: (i) The chance of having to play a gamble in which the subject could lose money was drastically reduced to 0.04. (ii) The stakes in the gambles involving losses were reduced. (iii) Subjects were told that if they did lose money, they could perform clerical work to pay off their debt at the rate of $5.00 per hour. (iv) Two $100 bonuses were promised, one to be paid to one of the ten subjects selected to play out their gambles, and another to be paid to someone who agreed to play but was not selected as one of the ten. (v) In addition to careful written instructions, the experimenter also gave extended verbal instructions. (The instructions are available from the authors.) (vi) Students who did not wish to participate for real money did not get to participate at all. (vii) The experimenter was female. While it is impossible to know which of these changes were important, the package worked extremely well. The experiment was conducted in a large introductory economics class at Cornell, and virtually every student (roughly 98%) agreed to participate.

The result of this experiment largely replicated the results we had obtained previously for the subjects who answered hypothetical questions (either as a subset of subjects who declined to play for real money, or as participants in an experiment in which everyone answered just hypothetical questions). The results of Experiment 4 are reported in Table 4 and the results of similar items from previous experiments using hypothetical questions are reported in Table 5. (The items in Table 5 differ by a factor of either 2 or 4 from the items shown in Table 4.)

In Experiment 4, and most of the other experiments reported in Table 5, half the subjects received questions in a two-stage version while the other half received questions in a one-stage format. Two types of gambles were used. In the first, subjects were offered a fair 50–50 gamble (a 50% chance to win $\$x$ and a 50% chance to lose $\$x$) vs. the status quo. The second gamble offered a choice between a sure gain of $\$x$ and a one-third chance to win $\$3x$ (and a 2/3 chance to win nothing).[6] Each of these gambles were combined with four levels of initial outcomes (in Experiment 4 these were: +$15, $0, −$2.25, −$7.50).

4.2. *Evaluating the Editing Rules*

Before we examine the results of Experiment 4 in detail, it is useful to notice the prominent features of the data. It is obvious that both presentation format and prior

[6] Experience indicates that there is an advantage to using only choices that offer equal expected values. Especially when subjects must make a series of choices, if gambles differ on expected value some subjects will adopt a maximize-expected-value strategy for answering the questions. When expected values are equal, subjects are forced to think more deeply about the questions and decide what they really prefer.

TABLE 4
Experiment 4

Initial Outcome	Two-Stage Gambles Choices: Payoff	Two-Stage Gambles Choices: Prob.	Percent Risk Seeking: N = 95	Percent Risk Seeking: N = 111	One-Stage Gambles Choices: Payoff	One-Stage Gambles Choices: Prob.
	$0	1			$15	1
1. +$15	$4.50	0.5	77	44	$19.50	0.5
	−$4.50	0.5			$10.50	0.5
	$0	1			$0	1
2. +$0	$2.25	0.5	41	50	$2.25	0.5
	−$2.25				−$2.25	0.5
	$0	1			−$2.25	1
3. −$2.25	$2.25	0.5	69	87	$0	0.5
	−$2.25	0.5			−$4.50	0.5
	$0	1			−$7.50	1
4. −$7.50	$2.25	0.5	40	77	−$5.25	0.5
	−$2.25	0.5			−$9.75	0.5
	$5	1			$20	1
5. +$15	$15	0.33	72	68	$30	0.33
	$0	0.67			$15	0.67
	$5	1			$5	1
6. +$0	$15	0.33	61	71	$15	0.33
	$0	0.67			$0	0.67
	$5	1			+$0.50	1
7. −$4.50	$15	0.33	32	57	$10.50	0.33
	$0	0.67			−$4.50	0.67
	$2.50	1			−$5.00	1
8. −$7.50	$7.50	0.33	71	70	$0	0.33
	$0	0.67			−$7.50	0.67

outcomes influence choice. Consider, for example, problems 1 and 4. There is more than a 30% shift in preferences between the one-stage and two-stage versions of each problem. The framing manipulation also has a dramatic influence on choice in problem 7. Similarly, the prior outcomes clearly influence choices, particularly in the two-stage versions of the problems. (Compare problems 1 and 3 with 2 and 4, and compare problem 7 with 5, 6, and 8.)

The result that presentation format matters allows us to reject two of the editing rules: prospect theory with memory and hedonic editing. For the class of problems considered here, these editing rules imply that decision makers adopt the same frame regardless of the presentation format, contrary to what we observe.

The fact that prior outcomes influence choices in the two-stage versions of problems 1–4 is counter to the predictions of the no-memory version of prospect theory and of the concreteness hypothesis. Both these editing rules imply that the initial outcome is ignored and so predict risk averse choices for all four problems because of loss aversion, that is, because $v(x) < -v(-x)$.

Thus the first four editing rules are explicitly refuted by the data presented in Table 4. The quasi-hedonic editing hypothesis does much better. None of the results are directly inconsistent with quasi-hedonic editing, and many are predicted by the hypothesis. Unfortunately, the predictions of quasi-hedonic editing are often ambiguous, making direct testing difficult. For example, consider problems 1 and 4. Quasi-hedonic editing and

TABLE 5

Results from Experiments Using Hypothetical Questions

Problem number	Format type	Initial Outcome	Sure Outcome	Gamble	Sample	% Risk-seeking
1.	2-stage	$30.00	$0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 44$	70
		30.00	0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 75$	82
		7.50	0.00	($2.25, 5, −$2.25, 5)	C-BA $N = 117$	81
		7.50	0.00	($2.25, 5, −$2.25, 5)	UBC-BA $N = 68$	72
	1-stage	—	30.00	($39, 0.5; $21, 0.5)	C-MBA $N = 46$	43
		—	30.00	($39, 0.5; $21, 0.5)	C-MBA $N = 46$	44
4.	2-stage	−30.00	0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 75$	40
		−30.00	0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 122$	36
		−7.50	0.00	($2.25, 0.5; −$2.25, 0.5)	C-BA $N = 117$	33
		−7.50	0.00	($2.25, 0.5; −$2.25, 0.5)	UBC-BA $N = 69$	33
	1-stage	—	−30.00	(−$39, 0.5; −$21, 0.5)	C-MBA $N = 46$	72
		—	−30.00	(−$39, 0.5; −$21, 0.5)	C-MBA $N = 70$	69
3.	2-stage	−9.00	0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 75$	63
			0.00	($9, 0.5; −$9, 0.5)	C-MBA $N = 122$	57
	1-stage	—	−9.00	(0, 0.5; $18, 0.5)	C-MBA $N = 70$	71
7.	2-stage	−9.00	10.00	($30, 0.33; 0, 0.67)	C-MBA $N = 122$	34
		−9.00	10.00	($30, 0.33; 0, 0.67)	C-MBA $N = 117$	39
8.	2-stage	−30.00	10.00	($30, 0.33; 0, 0.67)	C-MBA $N = 122$	60
			10.00	($30, 0.33; 0, 0.67)	C-MBA $N = 117$	54

Note for Table 5. C-MBA indicates Cornell MBA students. C-BA indicates Cornell undergraduate students. UBC-BA indicates University of British Columbia undergraduate students.

prospect theory make the same predictions for the one-stage version of the problem, namely risk seeking for losses and risk aversion for gains. For the two-stage problems the theories diverge. For problem 4, with the prior loss, the quasi-hedonic editing hypothesis predicts that risky choice will be less attractive in the two-stage formulation since $\pi(0.5)[v(-7.50)+v(-2.25)]+\pi(0.5)[v(-7.50)+v(2.25)]<\pi(0.5)v(9.75)+\pi(0.5)v(5.25)$. To see this, cancel the π terms and rearrange to obtain: $v(-2.25)+v(+2.25)<v(-9.75)+v(-5.25)-2v(-7.50)$. Note that the left-hand side is negative (loss aversion) and the right hand side is positive since v is convex in losses. Thus the shift toward risk aversion in the two-stage formulation compared to the one-stage is predicted by quasi-hedonic editing.[7]

For the two-stage prior gain (problem 1), again it is possible to show that the shift toward risk seeking when we move from the one-stage version to the two-stage version is predicted by quasi-hedonic editing. We must show that $\pi(0.5)[v(15)+v(4.50)]+\pi(0.5)v(11.50)>\pi(0.5)v(19.50)+\pi(0.5)v(11.50)$, which is obviously true because of the concavity of v in the domain of gains.[8]

In evaluating the implications of Experiment 4 for the editing rules we must stress that this experiment was not designed as a test of the quasi-hedonic editing rules. Rather, the quasi-hedonic editing rule emerged as an attempt to formalize the results of Experiments 2 and 3, and to construct an editing based explanation of the results of Experiment 4 and the earlier experiments reported in Table 5. We do not claim that it is the only model consistent with these data. This caveat notwithstanding, the data have interest whether or not we have the correct theory to explain them. The next section examines the results in more detail.

5. Choice in the Presence of Prior Losses

In addition to providing a basis for evaluating potential editing rules, Experiment 4 reveals three empirical results worthy of direct attention. These are (i) risk aversion after prior (two-stage) losses; (ii) risk seeking after prior (two-stage) gains; and (iii) changes in risk taking behavior when one outcome (certain or risky) can allow decision makers to "break even." This section addresses each of these results in turn.

5.1. *Prior Losses*

The convex shape of the loss function in the prospect theory predicts that people will generally be risk seeking in the domain of losses (for simple prospects). This prediction is repeatedly found in the empirical work reported by Kahneman and Tversky and others (e.g., Hershey and Schoemaker 1980; Hershey, Kunreuther and Schoemaker 1982; Payne, Laughhunn and Crum 1980; and Slovic, Fischhoff and Lichtenstein 1982). If prior losses were facilely integrated with subsequent outcomes, we would expect decision makers to be risk seeking for complex losses, just as they are for simple prospects involving losses. The quasi-hedonic editing hypothesis suggests something different. Because integration is not automatic, an initial loss might cause an increase in risk aversion, particularly when the second choice does not offer the opportunity to break even. Indeed, the results of Experiments 2 and 3 suggest that a prior loss might even sensitize people to subsequent

[7] Does quasi-hedonic editing predict actual risk aversion for this problem? To show that, we need to have $\pi(0.5)[v(-7.50)+v(-2.25)]+\pi(0.5)[v(-7.50)+v(2.25)]<v(-7.50)$, or rearranging terms, we need $\pi(0.5)[v(2.25)+v(-2.25)]<v(-7.50)-2\pi(0.5)v(-7.50)$. This will be true if $2\pi(0.5)\approx 1.0$, which seems plausible.

[8] Again, the prediction as to whether actual risk seeking will be observed depends on the proximity of the π function to the identity line at $p=0.5$. To show that decision makers will prefer the risky choice we need to show that $\pi(0.5)[v(15)+v(4.50)]+\pi(0.5)\,v(11.50)>v(15)$. This is true so long as $[v(4.50)+v(11.50)]/v(15)>[1-\pi(0.5)]/\pi(0.5)$, which will be true if $\pi(0.5)\approx 0.5$, the same condition needed in the previous footnote.

losses of a similar magnitude. (Recall that subjects reported that the loss of \$9 would hurt more after an initial loss of \$30 than if it had occurred by itself.) This increase in loss aversion would tend to produce risk aversion for gambles that risk additional losses.

To investigate this question we used Problem 4. In Experiment 4, 60% of the subjects chose the risk averse option on this problem, and 60–67% of the subjects in the other experiments chose likewise. (In fact, even a majority of the real money subjects in the previous experiments were risk averse on this particular problem.)

5.2. *Prior Gains: The House Money Effect*

According to the quasi-hedonic editing hypothesis, risk aversion can be observed after prior losses because subsequent losses are not integrated with the prior outcome. In the case of prior gains, the opposite effect is predicted. After a gain, subsequent losses that are smaller than the original gain can be integrated with the prior gain, mitigating the influence of loss aversion and facilitating risk-seeking. The intuition behind this effect is captured by the expression in gambling parlance of "playing with the house money." Gamblers often use this phrase to express the feeling of gambling while ahead. The essence of the idea is that until the winnings are completely depleted, losses are coded as reductions in a gain, as if losing some of "their money" doesn't hurt as much as losing one's own cash. As in the case of prior losses, the one-stage formulation does not create this same sense of being ahead in the mental account, so for the one-stage version, the risk aversion prediction of prospect theory is expected.

The results for Problem 1 are consistent with these predictions. In the two-stage version of the question, 77% of the subjects in Experiment 4 were risk seeking, while only 44% were risk seeking when given the one-stage presentation. Similar results were obtained in the previous experiments using hypothetical questions. In the two-stage version 70–82% of the subjects were risk seeking while only 43–44% of the subjects were risk seeking in the one-stage case.

A recent study by Battalio, Kagel, and Komain (1988) provides an independent replication of the house money effect. In their experiments, any subject who was offered a gamble involving losses was endowed with \$30 at the beginning of the experiment. This is equivalent to our subjects being "ahead \$30." One of the gambles offered a 50% chance to win \$10 and a 50% chance to lose \$10. This problem is virtually identical to our problem 1, with the stakes multiplied by a factor of two as they were in some of our earlier experiments reported in Table 5. They found that 21 of 35 subjects (60%) accepted this gamble. Interestingly, only 15 of the 35 subjects accepted a 50–50 chance to bet \$20, suggesting that the house money effect may diminish as the size of the potential loss approaches the initial stake.[9]

5.3. *Break-Even Effects*

In their original formulation of prospect theory, Kahneman and Tversky (1979) address the question of how initial losses will affect subsequent choices: "A change of reference point alters the preference order for prospects. In particular, the present theory implies that a negative translation of a choice problem, such as arises from imcomplete adaptation

[9] In another item, Battalio et al. asked their subjects to choose between gamble *A* which offered a 70% chance to lose \$6 and a 30% chance to win \$14, or gamble *B* which offered a 70% chance to lose \$3 and a 50% chance to win \$6. Of the subjects choosing for real money (who had been endowed the \$30), 61% chose *A*, while only 42% of the subjects making hypothetical choices (who had not been told anything about an initial endowment) selected *A*. Battalio et al. also observed risk seeking for gambles offering only positive outcomes and a large probability of gain. For example, when asked to choose between a sure \$17, and a gamble offering a 70% chance to win \$10 and a 30% chance to win \$30, 26 of 32 subjects (81%) chose the gamble. These subjects had previously been endowed with \$5. These results may also be produced by a type of house money effect, though not necessarily related to the initial endowment.

to recent losses, increases risk seeking in some situations. Specifically, if a risky prospect $(x, p; -y, 1-p)$ is just acceptable, then $(x-z, p; -y-z, 1-p)$ is preferred over $(-z)$ for $x, y, z > 0$, with $x > z$. The well-known observation that the tendency to bet on long shots increases in the course of the betting day provides some support for the hypothesis that a failure to adapt to losses or to attain an expected gain induces risk seeking." (pp. 286–287)

As we have seen, a prior loss does not always induce risk seeking. The empirical demonstrations of risk seeking in the presence of losses provided by Kahneman and Tversky were always accompanied by an opportunity to get back to the original reference or "break-even" point. We believe that this is very important. Thus, while an initial loss may induce risk aversion for some gambles, other gambles, which offer the opportunity to break even, will be found acceptable.

In analyzing the influence of break-even effects, the race track example cited by Kahneman and Tversky is quite instructive. Notice that neither a shift toward risk seeking nor the failure to adapt to losses is sufficient to explain the preference toward betting on long shots at the end of the betting day. A risk-seeking bettor who is behind by (say) $30 could bet $30 on an even money favorite as a method of getting even. However, the increased loss aversion produced by prior losses may render this strategy unappealing. A $2 bet on a 15–1 long shot offers a more attractive chance at breaking even because it does not risk losing significantly more money.

More generally, we expect that when prior losses are present, gambles which offer the prospect of changing the sign of the status of the current account will be treated differently from those which do not. There are several reasons, a priori, to expect options which offer the opportunity to "break even" to be different. First, these gambles allow the decision maker to cancel, or ignore, part of the outcomes. As Kahneman and Tversky (1979) argue, cancellation supplies decision makers with an appealing way of reducing problem complexity. When breaking even is possible, integration is facilitated; thus, risk seeking in the domain of losses should occur. Also, the ease of integration should reduce the effect of framing manipulations, yielding similar choices in either presentation format. To test these ideas, consider Problems 3, 7, and 8 in Tables 4 and 5.

In Problem 3, risk seeking now predominates, and the differences between the behavior observed in the two versions of the problem are smaller. Subjects in the two-stage condition selected the risk-seeking option 69% of the time, while 87% of the subjects in the one-stage condition selected this choice. Thus, it appears that when outcomes allow decision makers to break even, a different frame, possibly encouraged by cancellation, is adopted.

Problems 7 and 8 show the importance of the break-even point. In Problem 7, where the certain outcome yields a small net gain, the risk averse choice receives about a two-thirds preference for the subjects receiving the two-stage version. In contrast, 57% of the subjects in the one-stage condition selected the risk-seeking choice. The editing interpretation of these results is that the sure outcome in the two-stage case is particularly attractive because it *eliminates* a loss as well as yielding a trivial gain $[-v(-\$5) + v(\$0.50)]$.

In Problem 8, where it is necessary to gamble to break even, about 70% of the subjects selected the risk-seeking alternative in either frame. Again the possibility of cancellation suggests that the alternative frames will be coded the same way.

6. Discussion

6.1. *Alternative Explanations*

There are at least two other plausible explanations for why we obtain the result that people are risk averse for some gambles when they have had a segregated prior loss and risk seeking after a segregated prior gain. First, the initial loss could create a negative affect, the initial gain a positive mood. Isen and her colleagues (1982) have demonstrated quite strong effects of mood upon risk-taking behavior. Second, the initial loss could possibly induce a negative "hot hand" effect (Gilovich, Valone and Tversky 1985). Subjects might feel that they aren't very luck that day, and that their actual chance of winning is lower than the stated probability. We admit to finding both of these potential explanations appealing. However, a telling argument against these (and many other) alternative explanations is that they do not adequately explain the reversals we observe when the problems are reframed. While one might argue that hot-hand or mood effects are not as strong in the one-stage formulation, the marked change seems supportive of the quasi-hedonic editing interpretation.

6.2. *Applications*

There is a large literature describing the effect of sunk costs on choice behavior (e.g., Arkes and Blumer 1985; Staw 1981; Thaler 1980). For example, in an investment context, subjects seem more willing to invest in a faltering venture when they have previously committed funds to it (Staw 1976). Our work suggests several circumstances under which the impact of sunk costs could be either minimized or exacerbated. Specifically, the observed effects might be substantially altered by reframing the options in two-stage or one-stage formats. Also, when options present the opportunity to "break even," tendencies toward risk-seeking in the domain of losses might be enhanced. Thus, we would expect investments in failing enterprises to be particularly prevalent when there is a hope, however dim, that one outcome might eradicate existing losses. However, the current analysis also suggests an important converse. Managers of profitable enterprises, flush with initial successes, will be more risk seeking. We know of no empirical investigations of this house-money hypothesis, but it represents an interesting research opportunity.[10]

Another potential domain for applying this research is in the study of investor behavior. The break-even effect suggests that individuals are averse to closing an account that shows a loss. This aversion can produce a reluctance to sell securities that have declined in value. Such a reluctance is observed in trading behavior. Shefrin and Statman (1985), Lakonishok and Smidt (1986), and Ferris, Haugen, and Makhija (1988) have all documented that volume for shares that have declined in value is lower than for shares that have increased in value. This result is particularly notable because the tax code provides investors an incentive to sell losers and hold winners. (Investors can use losses to offset gains and reduce their taxes, while they have to pay capital gains taxes on winners.)

6.3. *Conclusions*

The results presented in this paper raise interesting issues concerning conditions when integration and segregation occur. While we have shown that integration is not always spontaneous, we have also indicated that it does occur in special cases, such as when losses can be offset against larger gains, and more generally whenever cancellation is possible. We believe that a variety of interesting factors affect integration and, subsequently, choice. For example, the importance of cancellation suggests that when the equivalence of outcomes is transparent, integration might occur. Factors such as compatibility in the nature of outcomes may also affect the impact of prior outcomes. For example, a prior outcome is less likely to have an effect if it were expressed in a different currency than the current decision.

Extensions to multiattribute choices also raise interesting issues. A prior outcome that is coded in a different mental account is less likely to influence a choice (see the theater ticket example in Kahneman and Tversky 1984). It seems plausible that the failure to integrate losses observed in our experiments would be even stronger across attributes. That is, a loss in one domain will increase the loss aversion felt with respect to other domains. (Which hurts more: a toothache alone, or a toothache after being rejected for

[10] It is possible to interpret Roll's (1986) "hubris" hypothesis of corporate takeovers as consistent with the house money effect.

a new job?) If this is true, then in negotiations it will be particularly difficult to obtain concessions from a side that has already agreed to accept a loss.

Perhaps the most important conclusion to be reached from this research is that making generalizations about risk-taking preferences is difficult. General tendencies can be reversed by a simple reframing of options. This result points out how difficult it is to predict behavior. The question that has yet to be answered is: How do people spontaneously frame options they face in the world? One method, tried by Fischhoff (1983), is to pose alternative frames to subjects and ask them which feel more natural. However, as Fischhoff notes, this approach has some problems. Additional research paradigms are needed to investigate this important issue.[11]

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References

ARKES, H. R. AND C. BLUMER, "The Psychology of Sunk Costs," *Organizational Behavior and Human Decision Processes*, 35, 1 (1985), 124–140.

BATTALIO, R. C., J. H. KAGEL AND J. KOMAIN, "Testing between Alternative Models of Choice under Uncertainty: Some Initial Results," forthcoming, *J. Risk and Uncertainty*.

FISCHHOFF, B., "Predicting Frames," *J. Experimental Psychology: Learning, Memory and Cognition*, 9 (1983), 103–116.

FERRIS, S. P., R. A. HAUGEN AND A. K. MAKHIJA, "Predicting Contemporary Volume with Historic Volume at Differential Price Levels: Evidence Supporting the Disposition Effect," *J. Finance*, 43 (1988), 677–697.

GILOVICH, T., R. VALLONE AND A. TVERSKY, "The Hot Hand in Basketball: On the Misperception of Random Sequences," *Cognitive Psychology* 17 (1985), 295–314.

HERSHEY, J. C. AND P. J. H. SCHOEMAKER, "Risk Taking and Problem Context in the Domain of Losses: An Expected-Utility Analysis," *J. Risk and Insurance*, 47 (1980), 111–132.

———, H. C. KUNREUTHER AND P. J. H. SCHOEMAKER, "Sources of Bias in Assessment Procedures for Utility Functions." *Management Sci.*, 28 (1982), 936–954.

ISEN, A. M., B. MEANS, R. PATRICK AND G. P. NOWICKI, "Positive Affect and Decision Making," In M. S. Clark & S. Fiske (Eds.). *Affect and Cognition*, Erlbaum, Hillsdale, NJ, 1982.

KAHNEMAN, D., AND J. SNELL, "Predicting Utility," forthcoming in, R. Hogarth, *Insights in Decision Making*, University of Chicago Press, Chicago.

———, AND A. TVERSKY, "Prospect Theory: An Analysis of Decisions under Risk," *Econometrica*, 47 (1979), 263–291.

———, AND ———, Choices, Values, and Frames," *Amer. Psychologist*, 39 (1984), 341–350.

LAKONISHOK, JOSEF, AND SEYMOUR SMIDT, "Capital Gain Taxation and Volume of Trading," *J. Finance*, 41 (1986), 951–974.

LAUGHHUNN, D. J. AND J. W. PAYNE, "The Impact of Sunk Outcomes on Risky Choice Behavior," *INFOR* (Canad. J. Oper. Res. and Information Processing), 22 (1984), 151–181.

PAYNE, J. W., D. J. LAUGHHUNN AND R. CRUM, "Translation of Gambles and Aspiration Level Effects in Risky Choice Behavior," *Management Sci.*, 26 (1980), 1039–1060.

ROLL, R., "The Hubris Hypothesis of Corporate Takeovers," *J. Business*, 59 (1986), 197–216.

SHEFRIN, H. AND M. STATMAN, "The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence," *J. Finance*, 40, 3 (1985), 777–790.

SLOVIC, P., "From Shakespeare to Simon: Speculations—and Some Evidence—About Man's Ability to Process Information," Oregon Research Institute Research Bulletin, April 1972.

———, B. FISCHHOFF AND S. LICHTENSTEIN, "Response Mode, Framing, and Information-Processing Effects in Risk Assessment," In R. Hogarth (Ed.), *New Directions for Methodology of Social and Behavioral Science: Question Framing and Response Consistency*, Jossey-Base, San Francisco, 1982, 21–36.

STAW, B. M., "Knee-deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Alternative," *Organizational Behavior and Human Performance*, 16 (1976), 27–44.

———, "The Escalation of Commitment to a Course of Action," *Acad. Management Rev.*, 6, 4 (1981), 577–587.

THALER, R. H., "Toward a Positive Theory of Consumer Choice," *J. Economic Behavior and Organization*, 1, (March 1980), 39–60.

———, "Mental Accounting and Consumer Choice," *Marketing Sci.*, 4, 3 (1985), 199–214.

TVERSKY, A. AND D. KAHNEMAN, "The Framing of Decisions and the Psychology of Choice," *Science*, 211 (1981), 453–458.