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Regret in Economic and Psychological Theories of Choice

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June 2005

Running head: “Regret and choice”

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Abstract

Numerous studies have shown that choice can be influenced by expectations of regret or disappointment (or, for positive outcomes, of rejoicing or elation). Psychological researchers measure these expectations with self-report instruments, economists infer them from observed choice behavior. The present study examines whether the emotion postulates embodied in economic choice models correspond to expected and experienced emotions as measured by self-report. In a laboratory study (N = 50) of student participants playing real-money lotteries, we included questionnaire measures of expected emotions for each possible lottery outcome. These emotion measures are reliable and well-behaved, and modestly predictive of actual choices. They did not, however, conform well to the specific postulates of economic choice models, though they did show some of the juxtaposition effects proposed in such models. Emotional reactions to decision outcomes may be better characterized by broad measures of positive and negative affect than as nuanced mixtures of distinct emotions.

Key words: Regret, disappointment, emotions, decision making, choice, preferences.

Acknowledgments: We are grateful to Lisa Ordóñez, Jochen Reb, Massimo Piattelli-Palmerini, three anonymous referees, and the Editors of this Special Issue for helpful comments on earlier drafts. Financial support was provided in part by Grant # F496200021037 from Air Force Office of Scientific Research.
Research on the role of regret and related emotions in decision making stems from two distinct research traditions. The first originated in the work of economic choice theorists such as Loomes and Sugden (1982) and Bell (1982) and initially focused on regret. In later work Loomes and Sugden (1986) and Bell (1985) extended this analysis to include considerations of disappointment. These efforts aimed to improve the predictive validity of the economists’ standard Expected Utility model of choice by introducing consideration of anticipated emotions. We shall refer to them collectively as the Modified Expected Utility Tradition (MEUT). The second tradition, which we shall refer to as the Psychological Regret Tradition (PRT), originated in psychological inquiry into the antecedents and consequences of experiencing or anticipating feelings such as regret in connection with choice (see Gilovich & Medvec, 1995; Zeelenberg, 1999; Mellers, Schwartz & Ritov, 1999; Connolly & Zeelenberg, 2002, for reviews). Studies in this tradition have established that the anticipation of regret can be a powerful force in shaping decisions (e.g. Simonson, 1992; Connolly & Reb, 2003; Zeelenberg, 1999).

In labeling the two traditions, we do not intend to suggest that either is a single, coherent body of testable theory. Both MEUT and (especially) PRT embrace a variety of empirical and theoretical claims. However, the conceptual and methodological commitments that characterize MEUT are importantly different from those that characterize PRT. Some of these differences appear to have been obscured by shared use of emotion terms such as “regret”, “disappointment”, and the like. In this paper we will examine the correspondence between the technical terms “regret”, “disappointment”, “rejoicing”, and “elation” as used in MEUT and the same words as used by everyday English speakers (and in PRT) to refer to emotions as actually experienced.
Work in MEUT aims to improve the predictive validity of the economists’ standard Expected Utility (EU) model (Savage, 1954). In this EU model, each possible decision outcome has a value or “utility” to the decision maker. The outcome the decision maker actually receives is jointly determined by (a) the alternative she chooses and (b) the state of the world that eventuates – for example, whether the toss of a coin in a gambling game yields a “head” or a “tail”. The decision maker is thought to know the probability of each of the relevant states of the world, and is thus able to assess the expected utility of each decision alternative. This expectation is thought to guide the decision maker’s choice between alternatives.

The core idea of MEUT was to preserve the idea of choice being guided by the expected utility of the outcomes, but to modify the utility of each outcome by introducing two comparison terms. First, the outcome was compared to what would have been received if the other alternative had been chosen. If the comparison was unfavorable, the utility of the focal outcome was reduced, if favorable it was increased. The terms “regret” and “rejoicing” were used to label these utility adjustments. Second, the outcome was compared to the expected value of the alternative of which it was an element. If the outcome fell below the expected value, its utility was further reduced, if above, it was increased. The terms “disappointment” and “elation” were used to label this second pair of adjustments. Thus in the decision problem shown in Figure 1, the utility of the highlighted $0 outcome is reduced both by comparison with the $20 a tail would have generated if Alternative 1 had been chosen (a “regret” adjustment), and by comparison with the $25 expected value of Alternative 2 (a “disappointment” adjustment). Conversely the utility of the $50 outcome would be further augmented by a favorable
comparison with the $20 payoff for a head under Alternative 1 (a “rejoicing” adjustment) and also by comparison with the expected value of Alternative 2 (an “elation” adjustment). (See also Mellers, Schwartz & Ritov, 1999).

MEUT uses the emotion terms for two purposes: to label utility adjustments in a theoretical model and to attach psychological meaning to them. However, no evidence is offered that individuals making these adjustments actually experience the emotions suggested by the labeling. It seems clear that MEUT theorists do, in fact, expect such psychological realism. For example, Loomes and Sugden (1986) claim that when an outcome falls short of or exceeds expectation “…the individual also experiences some degree of disappointment [or] … feels some measure of elation” (p.271: emphasis added), and that the regret and disappointment postulated in their model “… are natural human emotions, and ones that can be recognized through introspection” (p.281). Similarly Bell (1982) imagines a regrettable outcome as leaving the decision maker “… absolutely devastated, … angry and perhaps depressed” (p. 962). While such claims do not necessarily establish that the authors assume an exact correspondence between the way they use these emotion words and the way ordinary people do, they do suggest that technical and lay uses of the terms should roughly correspond. A central purpose of the present study is to examine the extent of this correspondence, particularly as researchers in the PRT tradition do interpret self-report measures in this way.

PRT shares with MEUT an interest in regret associated with decision outcomes, although it has found it useful to distinguish such outcome regret from regret associated with the decision process or the decision itself (Connolly & Zeelenberg, 2002; Inman &
Zeelenberg, 2002). PRT also shares with MEUT the view that this outcome regret is centrally a result of a comparison process in which the actual outcome is compared to some referent. However, while models in the MEUT generally consider only one comparison outcome, the outcome of the foregone alternative, PRT has identified a number of other possible comparisons that can affect outcome regret: alternative outcomes that can be readily imagined (e.g. Kahneman & Miller, 1986), outcomes received by others (e.g. Ordóñez, Connolly & Coughlan, 2000), outcomes narrowly missed (e.g. Gilbert, Morewedge, Risen & Wilson, 2004), the predecisional status quo (Connolly, Ordóñez & Coughlan, 1997) and others.

After enjoying some initial empirical success (e.g. Loomes, 1988; Loomes, Starmer & Sugden, 1991), MEUT work associated with regret stalled following a demonstration by Starmer and Sugden (1993) that most of its empirical evidence was flawed by a laboratory artifact referred to as “event-splitting” ¹. (The artifact is controlled for in our design: see also Harless, 1992). Our concern here is not with further testing MEUT models of choice behavior, but only with the way that tradition conceptualizes the emotions people anticipate and experience in given situations. How closely do these claims correspond to the emotions people report anticipating and experiencing? We will use MEUT’s conceptualization of regret and related emotions, and its characteristic embodiment in a simple laboratory gambling game, to explore the relationship between the game’s payoff structure and the emotions participants expect, and actually experience, for different outcomes.

MEUT models typically imply:
a. Monotonicity: Positive emotions increase, and negative emotions decrease, as the payoffs with which they are associated get larger.

b. Juxtaposition: Regret is determined (only) by comparison of an outcome with the outcome of the foregone alternative (i.e. by between-alternative comparison) and disappointment (only) by comparison with the expected value of the alternative of which it is a part (i.e. by within-alternative comparison).

c. Mixed emotions: It is not possible to experience simultaneously both regret and rejoicing, or both disappointment and elation, associated with a given outcome.

d. Null effects: When one outcome is equal in value to another with which it is to be compared, neither regret nor disappointment will be experienced, nor will elation or rejoicing.

e. Emotional distinctiveness: Since regret and disappointment (and rejoicing and elation) are driven by different comparisons, they will not in general show large positive correlations with one another.

(A somewhat more formal statement of the postulates driving these implications is given in the Appendix).

In order to test these implications of the MEUT postulates we incorporated questionnaire self-reports of expected and experienced emotions into an otherwise standard MEUT experimental procedure. The hybrid experiment is described in the following section.
Method

Overview

Undergraduate students participated in a three-part experiment, which culminated in their playing a lottery of their choice for real money, with a chance to win up to US$30. They first expressed preferences between twelve pairs of lotteries displayed in matrix format. They then picked one pair at random, and ultimately played the lottery they had chosen from this pair. For the selected lottery pair and its complement (described below), participants rated the emotions they would expect to feel if each of the six possible outcomes eventuated. Finally, they played their chosen lottery for real money. They were then paid any winnings they had earned, and completed the emotion scales again for the outcome they actually received.

Task

The experimental task presented the participants with a series of choices between two lotteries: Lottery A, which offered a 30% chance to win $30, and Lottery B, which offered a 70% chance to win a smaller sum: $6, $8, $10, $12 or $14. Lottery pairs were presented in two different matrix formats, which we refer to as “overlapped” and “disjoint”. An example of each format is shown in Figure 2 for the lotteries offering a $10 payoff for Lottery B. In disjoint format, Lottery A pays only if a number between 1 and 30 is drawn, Lottery B only if a number between 31 and 100 is drawn, so the payoff ranges are distinct. In overlapped format Lottery B pays for a draw between 1 and 70, thus overlapping with the 1 – 30 payoff range for Lottery A. In the disjoint format, a win implies that the player would have received nothing if she had made the other choice, and
a loss means that a win would have been ensured by making the other choice, thus
maximizing the opportunity for within-column comparisons. In overlapped format these
contrasts are less stark, at least for the outcomes between 1 and 30. These alternative
formats are thought to facilitate the matrix-column comparisons proposed by MEUT
(Harless, 1992).

[FIGURE 2 ABOUT HERE]

Our numbering convention for the six cells is also shown in Figure 2. Possible outcomes
of Lottery A fall in Cells 1, 2, and 3, and are always $30, $0 and $0. Outcomes of Lottery
B fall in Cells 4, 5, and 6. The non-zero B payoffs appear in Cells 4 and 5 in the
overlapped format and in Cells 5 and 6 in the disjoint format, with $0 in the remaining
cell.

Participants

Participants were recruited from undergraduate business courses at a large
university in the Southwestern U.S. with promises of course credit and a chance to win
up to $30 in a gambling experiment that would take about 30 minutes. The experiment
was described as part of a study of how people feel about simple money lotteries. It was
made clear that winning money was a real possibility, and that the participants incurred
no risk of losing their own money. Students volunteered eagerly and experimental sign-
up sheets were quickly filled. A total of 50 students participated.

Procedure

Participants were scheduled in groups of up to six per session, with an
experimenter and one or two assistants running each session. All responses were
anonymous, with (signed) consent forms and payment agreements kept separate from the
(unsigned) experimental questionnaires. All participants in a session were seated in the same room in full view of one another.

The experimenter first reviewed the written instructions for the experiment, which described the experimental procedures and the forms of display to be used. The purpose here was to preview the sequence of the experiment, and to explain the matrix form of display for the lotteries. It also introduced the response scales the participants were to use. The experimenter made a prominent show of a clear plastic cash-box containing several hundred dollars to add further credibility to the promise that winnings would really be paid in cash. The instructions also emphasized that there are no “right answers”, other than the participant’s thoughtful decision as to which lottery from each pair of lotteries he or she found more attractive.²

The experiment consisted of three parts. In the first part participants were given booklets showing, one to a page, twelve pairs of monetary lotteries in matrix form, labeled “Lottery A” and “Lottery B” as in Figure 2. The pages were headed “Problem 1”, “Problem 2”, and so on; the participant’s “problem” on each page was to decide which lottery of each pair he or she preferred. Participants were told that the lotteries would be resolved by randomly drawing a chip numbered from 1 to 100. Below the matrix was an eleven-point response scale running from −5 (labeled “Definitely A”) through 0 (labeled “No preference”) to +5 (labeled “Definitely B”). The participant was asked to indicate which of the two lotteries he or she preferred by circling one number on the scale. It was explained that 0 was a legitimate response only if the participant felt genuinely balanced between the two lotteries, and that if such a response were to be selected for real play the experimenter would resolve the choice by flipping a coin. The experimenter reminded the
participants frequently to be careful in their choices since they would be playing one of these games for real in a few minutes. The two $6 lotteries were repeated to allow assessment of test-retest stability. Problem order was arranged so that overlapped and disjoint forms alternated, the Lottery B payoffs were in neither ascending nor descending order, and the overlapped and disjoint versions of the same Lottery B payoff were spaced six pages apart. Participants completed these initial assessments in 5-10 minutes.

In the second part of the experiment each participant was given a 12-sided die that would determine which of the twelve pairs would be the “real” task, to be played for real money. The participant rolled the die, and was given two questionnaires, one corresponding to the problem he or she had selected for real play, the other the corresponding overlapped or disjoint form of the same Lottery B payoff. (We refer to this as the “sister” problem). For example, if the participant’s real-play selection was Problem 1 (in which Lottery B was a $10 payoff, overlapped with A), he or she was given the Problem 1 and Problem 7 questionnaires, since Problem 7, the “sister” problem, offers a Lottery B with the same $10 payoff as Problem 1, but disjoint from A, as in Figure 2.

The questionnaires consisted of six pages, each showing the problem matrix with a different cell picked out in yellow highlighter. The participants were asked to imagine their feelings if they were to end up in this cell. For example, when Cell 1 (the $30 payoff from Lottery A) was highlighted, the participant was asked: “How would you feel if you had chosen Lottery A and a ticket between 1 and 30 was drawn (i.e. if you ended up in the yellow highlighted cell)?” Six emotion scales were offered: Regret, Happiness, Disappointment, Elation, Sadness, and Rejoicing. On each the participants were asked to indicate how much they would feel this emotion, by circling one number on a six-point
scale running from 0 (labeled “None”) to 5 (labeled “A great deal”). Each participant thus gave six emotion ratings for each of 12 possible outcomes: the six outcomes in the “real problem” payoff matrix and the six in the “sister problem” matrix. Completing these ratings typically took less than 10 minutes.

In the final part of the experiment the participant played the “real” lottery. The problem chosen earlier by rolling the die was presented again and the participant indicated whether or not he or she wished to change or keep the lottery originally chosen. (This option was not mentioned in the earlier instructions, to maintain incentive compatibility). After making a final choice, the participant drew a poker chip, numbered from 1 to 100, from a large cardboard box and showed it to the experimenter. Any winnings resulting from the participant’s choice of lottery and the chip drawn were immediately paid in cash, and the participant completed the six emotion scales a final time for the outcome actually received. They were then thanked, debriefed and released.

Results

Monotonicity

A minimal test for useful emotion measures is that, other things equal, positive emotions should increase, and negative emotions decrease, as the payoff with which they are associated gets larger. We examine this property for the emotion ratings for Cells 4 and 6. Each participant completed emotion ratings for all six cells of a disjoint and an overlapped problem presentation for one randomly selected value of $B. We can thus combine Cell 4 ratings from overlapped and disjoint formats to sample the entire $B payoff range from $0 to $14 juxtaposed with a $30 $A payoff, while a similar combination
for Cell 6 samples the same B payoffs but juxtaposed with a $0 A payoff. Mean emotion scores for the two cells are shown in Figure 3. 3

[FIGURE 3 ABOUT HERE]

The self-report emotion measures appear broadly consistent with the monotonicity requirement. The three positive emotions (rejoicing, elation and happiness) all generally increase as payoff increases, while the negative emotions (regret, disappointment and sadness) all tend to decline. (The evidence here is admittedly rather coarse, since sample sizes are quite small. The suggestion of a peak at around $10 for elation is not statistically reliable, since only 7 participants drew the $10 B payoff, 7 drew the $12 payoff, and 11 the $14 payoff).

Juxtaposition

Figure 3(a) shows that, contrary to MEUT postulates, B payoffs are expected to generate similar levels of the three positive emotions whether they are juxtaposed with a $30 (Cell 4) or a $0 (Cell 6) A payoff (though, as we show below, an index comprising these three measures does show juxtaposition effects). Juxtapositions do appear to affect each of the individual negative-emotion measures, which are generally higher in Cell 4 (A payoff $30) than in Cell 6 (A payoff $0) (see Figure 3(b)). As postulated by MEUT expected regret is higher for a $0 B payoff when it is juxtaposed with a $30 A payoff rather than with a $0 A payoff (M = 3.12, 1.84; paired t-test, t(49) = 4.69, p < .001). Similarly, expected regret for positive B payoffs is higher when the payoffs are juxtaposed with the $30 A payoff than with the $0 A payoff. (Aggregating all positive B payoffs to improve sample size: M = 1.32, 0.58; t (49)= 3.63, p < .001). However, similar differences are also found for disappointment (for $0 B payoff: M = 3.36, 2.64;
Mixed Emotions

For two-option choices MEUT postulates that, since rejoicing is associated with column winners and regret with column losers, the same outcome cannot simultaneously generate both regret and rejoicing. Similarly, an outcome cannot simultaneously generate both disappointment and elation. Our data suggest that these postulates do not hold for expected emotions as measured by self-report. For example, Figure 4 shows mean expected rejoicing for Cells 1, 4, 5 and 6. (Cells 2 and 3 are not plotted. They invariably pay $0, and invariably show low mean levels of expected rejoicing: 0.38 and 0.40 on our 0-5 scales). Cell 1, a consistent $30 payoff and a consistent column winner, is plotted against Cell 4 payoffs, contrast with which would be expected to show rejoicing effects – that is, the $30 payoff should generate more rejoicing when the B payoff is $0 than when it is $14. Figure 4 shows predictably high levels of expected rejoicing in Cell 1, the $30 payoff, (mean = 4.29), but with no evidence of a juxtaposition effect from the size of the Cell 4 B payoff. The rejoicing at the $30 payoff in Cell 1 is independent of the payoff available in Cell 4.

However, expected rejoicing plots for Cell 4 (always a column loser) and Cells 5 and 6 (never column losers) are indistinguishable from one another. All rise steadily with payoff, reaching values above 3.0 for the $10, $12 and $14 payoffs, clearly violating a
strict reading of the MEUT postulate that rejoicing is a distinct emotion associated only with column winners. The Figure 4 data suggest more plausibly that self-reports of rejoicing should be interpreted as reflecting overall utility, positively related to payoff size and unaffected by inter-alternative comparisons.

[FIGURE 4 ABOUT HERE]

Recall also from Figure 3(b) that participants expected modest but non-zero levels of regret for the Cell 4 payoffs, so both rejoicing and regret were associated with these intermediate-value payoffs. Similarly, Figure 3 shows that several Cell 4 payoffs are expected to generate non-zero levels of both disappointment and elation, again violating MEUT postulates. While the extreme outcomes ($30 and $0) are expected to produce only positive or only negative emotions, intermediate outcomes are, in many cases, expected to produce mixtures of both. Again it is difficult to reconcile these self-reports of mixed emotions with a strict reading of MEUT postulates.

Column and Row Ties

In the overlapped version of the matrix, a column tie occurs between Cell 3 ($0 A payoff) and Cell 6 ($0 B payoff). MEUT postulates, wrongly, that no regret will be expected in either cell. In fact participants expected moderate levels of regret in both cells – means 2.14 (N = 49) in Cell 3, and 1.88 (N = 49) in Cell 6. Correspondingly, MEUT postulates that, given a row tie, disappointment will be equal in the two tied cells. We noted earlier, in discussion of Figure 3(b), that expected disappointment over a $0 outcome in Cell 4 was significantly higher than expected disappointment over the same $0 outcome in Cell 6. In both tied cases, then, expected emotion strength clearly violates the postulates of MEUT.
**Emotional Distinctiveness**

MEUT postulates two distinct emotional continua: regret/ rejoicing, and disappointment/elation. This postulate can be tested by examining the expected emotions in Cell 5, which offers a range of B payoffs between $6 and $14 in both overlapped and disjoint problem formats. Pearson product-moment correlations among the six expected emotion measures are shown in Table 1. The “real” and “sister” problems provide quasi-independent replications.

[TABLE 1 ABOUT HERE]

The pattern of these correlations does not suggest that our participants make nuanced distinctions between regret and disappointment, or between rejoicing and elation. Rather the data suggest a simpler underlying structure: a “negative emotion cluster”, comprising regret, disappointment, and sadness, and a “positive emotion cluster” comprising rejoicing, elation, and happiness. Simple indices formed from these clusters show Cronbach’s alpha’s of between .74 and .85, reliabilities that many researchers would regard as satisfactory for measurement purposes. The scale intercorrelations are probably inflated by the measures’ proximity on the questionnaire, as well as by the likelihood that items in each cluster may reflect the overall outcome utility as well as a specific emotion. They are also consistent with more substantive psychological processes such as the affect heuristic (Slovic, Finucane, Peters, & MacGregor, 2002) and the “risk as feelings” work of Loewenstein, Weber, Hsee & Welch (2001), in which momentary affect might influence both choices and anticipated emotion ratings. Given the sample and measurement limitations of the underlying data, we do not propose to pursue this factor structure in detail here, but Table 1 does strongly suggest that, in contrast to the
distinct emotions proposed by MEUT, anticipated emotions in this setting are better described in terms of two broader, less differentiated clusters, one of positive, the other of negative, emotions.

We also examined the realism of the emotional expectations reported by our participants. The evidence suggests that participants in this task were good at predicting their emotions. Correlations between emotions predicted before and reported after playing the chosen lotteries were large and positive: .92 for rejoicing, .95 for elation, and .96 for happiness; and .66 for regret, .76 for disappointment, and .75 for sadness (all significantly different from zero, p < .001). These correlations are rather higher for the positive emotions than for the negative emotions, perhaps suggesting that the latter are more complex and difficult to predict. Overall, however, the expectations on which most of our analysis has focused appear to be realistic: Participants’ predictions of how they would feel correspond reasonably well with their reports of how they actually did feel about the lottery outcome each actually received.

Though predicting choices was not the primary focus of this study, we did examine the preferences participants expressed as a function of B payoff and presentation format (overlapped vs. disjoint). Unsurprisingly, the popularity of Lottery B increased steadily with increasing $B$, from 26% when $B = $6 to 98% when $B = $14. Contrary to MEUT predictions (see Starmer & Sugden, 1993: 238), the disjoint form of Lottery B was consistently preferred to the overlapped form (t(49) = 3.30, p = .002 two-tailed). (See Table 2).

[TABLE 2 ABOUT HERE]
To check for format effects on anticipated emotions, we used the clusters identified in Table 1, and computed simple index scores for positive and negative emotion clusters for each cell of the payoff matrix, for both overlapped and disjoint formats. Cell means are shown in Table 3. They show clear effects for format. In addition to the obvious contrasts involving Cells 4 and 6 (where comparing overlapped and disjoint formats involves comparing a $0 payoff to a positive $B payoff), two other format effects were found. The $30 payoff in Cell 1 shows a marginally higher positive emotion score in overlapped format (Cell 4 = $B) than in disjoint format (Cell 4 = $0), the reverse of what would be expected if the larger contrast generated rejoicing. And the $0 payoff in Cell 3 attracted less negative emotion in the overlapped format (where Cell 6 = $0) than in the disjoint format (where Cell 6 has a positive payoff $B), suggesting a contrast effect of the MEUT-regret type.

Four other comparisons show these regret-type contrast effects. Positive emotions are reliably lower in Cell 4-overlapped than in Cell 6-disjoint, though both cells offer the same value of $B (M = 8.94, 9.86; t(48) = 2.52, p=.015). They are also lower in Cell 4-disjoint than in Cell 6-overlapped, though both offer the same $0 payoff (M = 1.29, 1.88; t(48) = 2.18, p = .034). Negative emotion scores for these two cells show the complementary pattern. Cell 4-overlapped is reliably more negative than Cell 6-disjoint, (M = 3.06, 1.27; t(48) = 3.83, p < .001), and Cell 4-disjoint is more negative than Cell 6-overlapped (M = 9.06, 6.51; t(48) = 3.89, p < .001). All four comparisons indicate that an outcome in Cell 4 (paired with an A outcome of $30) is reliably less positive, and more negative, than is the same outcome in Cell 6 (where it is paired with an A outcome of $0).
There is thus considerable evidence that these coarse measures of overall positive and negative emotions do show between-alternative contrast effects of the type proposed in MEUT-regret thinking.

The data do not, however, show any support for the MEUT-disappointment proposal of within-alternative contrast effects. All $0 payoffs are, by definition, below the expected value of the alternatives in which they appear, so the MEUT-disappointment mechanism would predict more negative emotion for the $0 payoffs in Lottery A (EV = $9) than in the $6 version of Lottery B (EV = $1.80). Our data, however, do not show this for contrasts such as those between Cell 3 and Cell 6 (M = 6.94, 7.44; t(15) = 1.14, ns) or between Cell 2 and Cell 6 (M = 7.88, 7.44; t(15) = 0.54, ns) in overlapped format. To the limited extent that our data test MEUT-disappointment predictions, they offer no support.

In a final analysis we added a net (positive – negative) emotions score (NES) to the equation using $B alone to postulate preference for Lottery B. For the “real” problems, the prediction equation yielded an adjusted $R^2$ of .34 (F(2,46) = 13.29, p < .001), with significant beta weights for both $B and NES. For “sister” problems, the adjusted $R^2$ was .33 (F(2, 46) = 13.06, p < .001), with a significant beta weight for $B but not for NES. Measures of anticipated emotions, then, can help predict option preferences over and above knowledge of outcome dollar values alone.

**Discussion**

These results support two main conclusions. First, asking experimental participants to report on their emotional expectations in connection with a decision they are about to make yields reasonable results. The measures so obtained are roughly
monotonic in the monetary value of the outcomes, they cluster together in interpretable ways, they show clear evidence of inter-outcome comparisons, they correlate well with the actual emotions the participants report when they receive the outcomes, and they may aid in predicting preferences, beyond knowledge of dollar value of outcomes. They are thus not to be lightly dismissed as “cheap talk”, the standard economists’ complaint against self-report evidence of this sort.

The second conclusion is that the elements of the theory of specific emotions embodied in the Modified Expected Utility Tradition (MEUT) do not correspond very closely to the specific emotions anticipated and experienced by our participants, as measured by simple self-report measures. MEUT postulates that regret is driven by comparison of the outcome received to what one would have received by choosing the other alternative. We found such a juxtaposition effect, but it was not unique to regret. It appeared also in measures of disappointment and sadness. MEUT postulates that a given outcome may generate regret or rejoicing but not both, and disappointment or elation but not both; we found several instances in which participants expected mixtures of both. MEUT postulates no necessary correlations between regret and disappointment, or between rejoicing and elation. We found both pairs of measures significantly correlated. MEUT postulates that when the ticket drawn yields identical outcomes for both alternatives, no regret is experienced for either outcome. We found, to the contrary, that when the dollar payoff is low there is significant regret associated with both outcomes in such a pair. MEUT postulates that identical outcomes within an alternative will generate identical levels of disappointment. We found such identical pairs showing significant differences in disappointment. In short self-report emotion measures such as those we
used seem to yield reasonable, well-behaved results, but results largely inconsistent with the conceptualization of specific emotions proposed by MEUT.

Much better consistency is achieved if we relax the assumption of specific, discrete emotions such as “regret”, “disappointment” and so on, and consider instead broader, less differentiated clusters of positive and negative emotions. The intercorrelations among our measures strongly suggest that our subjects are using the emotion measures in this way. Further, scores based on such clusters show some important juxtaposition effects of the sort specified in MEUT-regret theory. (We found no support for the within-alternative comparisons proposed in MEUT-disappointment theory, but disappointment was not the primary focus of the experiment and our conclusions here are more tentative). We also found evidence that these emotion-cluster scores can help predict option preferences, beyond the prediction achieved using outcome dollar values alone.

We noted earlier that MEUT theorists use terms like “regret” both to label utility adjustments in a formal model and to attach psychological meaning to the adjustments. Our evidence supports the former usage, but not the latter. Comparisons across choice alternatives do indeed appear to modify outcome evaluations somewhat as MEUT proposes, and these modifications can affect overall preferences between alternatives. The modifications do not, however, appear to correspond to self-reports of regret, disappointment, sadness, and so on, but rather to less differentiated clusters of positive and negative emotions that may be indexed by the specific emotion scores.

The implications of these findings for work in the PRT are inevitably more piecemeal, given the multiplicity of loosely integrated theories in this tradition. A theory of
decision-related emotions that is both psychologically realistic and usefully predictive of choice will require:

a. *A reconsideration of the supposed distinction between regret and disappointment, at least as the two terms refer to the evaluation of specific outcomes.* We have argued elsewhere (e.g. Connolly & Zeelenberg, 2002; Reb & Connolly, 2004) that regret theories benefit greatly from a clear specification of what is being regretted. When the target is the decision process it is easy to imagine that the considerations that drive regret, such as the care and thoughtfulness of the process, might be very different from those that might associate disappointment with the process. Self-blame for a poor decision process is, we would argue, a hallmark element of decision-process regret. It is not clear that it is similarly central to the experience of disappointment. However when the focus of regret is, as here, on the outcomes themselves, it is plausible (and certainly consistent with the present evidence) that a single evaluative dimension compounding regret, disappointment, and general sadness is more appropriate. Earlier studies such as van Dijk, Zeelenberg and van der Pligt (1999) that show partial independence of regret and disappointment are based on measures that do not specify a target, and that are thus likely to tap feelings about both process and outcomes. Disappointment and regret about process may well be substantially independent of one another. On the present evidence they are substantially confounded when they refer to outcomes only.

b. *A reconsideration of the regret/rejoicing and disappointment/elation polarities.* We know of no careful psychometric study establishing these polarities, and the evidence in the present study does nothing to reinforce their existence. We found situations in which participants assessing an intermediate-value outcome expected to experience mixtures of
the supposedly polar emotions. The mixtures are not unreasonable. A given outcome
might simultaneously generate both rejoicing ("$12 is nice pay for 15 minutes’ work")
and regret ("Too bad I didn’t collect that $30 big prize").

c. A reconsideration of the assumption that positive and negative emotions respond to
situational factors in mirror-image ways. For example, most PRT researchers have
assumed that a favorable comparison generates positive emotions while an unfavorable
comparison generates negative emotions. Our finding was that all three of our negative
emotion measures were influenced by comparison with the outcome of the non-chosen
alternative, but none of the individual positive emotion measures were. This is consistent
with several lines of evidence showing that negative outcomes stimulate more cognitive
activity than do positive outcomes (e.g. Taylor, 1991; Peeters & Czapinski, 1990) and
that rejoicing and elation may be less potent than regret and disappointment, and less
driven by comparison effects (Landman, 1987; Mellers, Schwartz, Ho & Ritov, 1997).
(There exists a very extensive technical literature concerned with the structure of
emotions, their distinctiveness, intercorrelation, and antecedents (for example, Frijda,
1993; Russell & Barrett, 1999). In full development the issues raised here about decision-
related emotions will need to be integrated into that larger literature. Meanwhile we hope
to achieve some progress towards the limited goal of predicting choices by the quite
simplistic steps sketched here.)

The findings of our study are, of course, subject to the usual cautions concerning
student participants performing unfamiliar tasks for small incentives under laboratory
conditions. In the present case these concerns were somewhat mitigated by the use of
procedures borrowed from economic experimentation: no deception of participants,
transparent procedures, adequate financial incentives. We saw no evidence that any participants suspected that the experimental arrangements and payoffs were other than as described, and they all appeared to be highly involved and motivated to make careful decisions. The only significant disadvantages to following these procedures were that they limited the tasks we could use to simple gambling games, and that they imposed a budgetary constraint on the sample size we could use. Our self-report emotion data are, of course, quite limited. They reflect responses on simple one-item scales, with a given subject completing the same six scales repeatedly for 12 possible lottery outcomes. It is unlikely that the responses reflect deep thought or emotional nuance. They do, however, appear to be sufficiently robust to suggest useful directions for theoretical development.

Within the limitations noted our results weaken many of the assertions of MEUT as to when specific emotions will be experienced, at least to the extent that these assertions are tested by self-report data. At the same time they give significant support to the idea that cross-alternative comparisons of the MEUT-regret type are important. Both findings provide further grist for PRT’s descriptive mill. Our data suggest that participants do not make any great distinction between regret and disappointment in assessing their feelings towards different outcomes, but combine them with sadness into a single cluster of negative emotions (and, for elation and rejoicing, with happiness, into a single cluster of positive emotions). Both clusters appear to be roughly monotonic in the money value of the outcomes, but are not mutually exclusive, so that intermediate-valued outcomes may generate both positive and negative emotions. The emotions participants anticipate for particular outcomes correspond well to the emotions they report actually experiencing when those particular outcomes eventuate. And even coarse indices of these
emotion clusters can contribute usefully to predicting actual choices. In short, our results suggest a descriptive model of decision-related emotions related to, but rather different from, that proposed by current MEUT. Significant work remains to establish the form and parameters of the new model, but if achieved it would represent a significant synthesis of two research traditions that are currently less connected than they appear.
Footnotes

1. The event-splitting problem can be visualized as follows. In Figure 2, in the disjoint format, there is no formal reason to separate the 31-70 draws from the 71-100 draws, and most experimenters presented the options as simply a 1-30 event (in which A wins), and a 31-100 event (in which B wins). However, in the overlapped format, the distinction between 1-30 and 31-70 is required, so that the $10 payoff for Lottery B appears twice, as two subevents. This splitting of the $10 payoff into two events appears to have generated most or all of the preference shifts originally thought to have been generated by juxtapositions between the outcomes. See Starmer and Sugden (1993) for more extensive discussion. Note that, in our presentations of the payoff matrices, the B outcome is split in both disjoint and overlapped formats, so no artifact arises.

2. Half the questionnaires included the following paragraph, which was also read aloud by the experimenter:

   “In making your choice between Lottery A and Lottery B, you might want to think about the emotions you would feel when the ticket is drawn. For example, how would you feel if you had chosen Lottery A and a ticket between 1 and 30 came up? How about if you had chosen Lottery B? Thinking about these emotions may help you to decide which of the two lotteries you find more attractive”.

This allowed us to check for possible effects of priming respondents to think about their emotional reactions. All subjects in a given experimental session received the same priming instructions. The results showed no differences between primed and unprimed participants, and results were therefore pooled for all other analyses.
3. MEUT treats the total utility of an outcome as the sum of three terms: its “choiceless” utility, a regret/rejoicing utility and a disappointment/elation utility. It seems unlikely that a subject rating, say, her “rejoicing” at receiving a certain payoff would be able to separate the three elements and give a response reflecting only the second component. More plausibly (and consistent with our data) the rejoicing measure should be read as reflecting total outcome utility. Disentangling the component corresponding to the rejoicing term in MEUT thus requires comparison with other outcomes that are differently juxtaposed. For example, the rejoicing ratings for a $12 outcome in Cell 4 and in Cell 6 might both reflect the same choiceless utility (for $12) and the same elation utility (for exceeding the $8.40 expected value of the B lottery). However, the Cell 4 outcome is juxtaposed with an A payoff of $30, while the Cell 6 outcome is juxtaposed with a $0 A payoff, so MEUT’s rejoicing component, if present, should be reflected in a difference between the Cell 4 and the Cell 6 rejoicing ratings (see Figure 4). Similar arguments apply to other emotion ratings in other cells.
References


Table 1: Correlations among emotion scores for Cell 5 in “real” and “sister” problems.

<table>
<thead>
<tr>
<th></th>
<th>Regret</th>
<th>Disapp’t</th>
<th>Sadness</th>
<th>Rejoicing</th>
<th>Elation</th>
<th>Happiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regret</td>
<td>1.00</td>
<td>.58**(.66**)</td>
<td>.56**(.35*)</td>
<td>-.17(-.26)</td>
<td>-.17(-.17)</td>
<td>-.11(-.18)</td>
</tr>
<tr>
<td>Disappointment</td>
<td>1.00</td>
<td>.62**(.45*)</td>
<td>-.32*(-.41*)</td>
<td>-.16(-.16)</td>
<td>-.12 (-.29*)</td>
<td></td>
</tr>
<tr>
<td>Sadness</td>
<td>1.00</td>
<td>-.28(-.20)</td>
<td>-.13(-.14)</td>
<td>-.10(-.24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rejoicing</td>
<td></td>
<td>1.00</td>
<td>.74**(.67**)</td>
<td>.63**(.67**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elation</td>
<td></td>
<td></td>
<td>1.00</td>
<td>.59**(.58**)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happiness</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Cell entries are correlations for “real” problems, with “sister” problems shown in parentheses)

For all cells: N = 49;  * = p<.05;  ** = p<.01
Table 2: Proportion of subjects preferring A, preferring B, or indifferent, for overlapped and disjoint versions of the B Lottery.

<table>
<thead>
<tr>
<th>B lottery payoff</th>
<th>Prefer A</th>
<th>Indifferent</th>
<th>Prefer B</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 Overlapped</td>
<td>78%</td>
<td>0%</td>
<td>22%</td>
<td>100</td>
</tr>
<tr>
<td>Disjoint</td>
<td>69%</td>
<td>0%</td>
<td>31%</td>
<td>100</td>
</tr>
<tr>
<td>$8 Overlapped</td>
<td>58%</td>
<td>0%</td>
<td>42%</td>
<td>50</td>
</tr>
<tr>
<td>Disjoint</td>
<td>48%</td>
<td>2%</td>
<td>50%</td>
<td>50</td>
</tr>
<tr>
<td>$10 Overlapped</td>
<td>12%</td>
<td>2%</td>
<td>86%</td>
<td>50</td>
</tr>
<tr>
<td>Disjoint</td>
<td>8%</td>
<td>0%</td>
<td>92%</td>
<td>50</td>
</tr>
<tr>
<td>$12 Overlapped</td>
<td>12%</td>
<td>0%</td>
<td>88%</td>
<td>50</td>
</tr>
<tr>
<td>Disjoint</td>
<td>4%</td>
<td>0%</td>
<td>96%</td>
<td>50</td>
</tr>
<tr>
<td>$14 Overlapped</td>
<td>2%</td>
<td>0%</td>
<td>98%</td>
<td>50</td>
</tr>
<tr>
<td>Disjoint</td>
<td>2%</td>
<td>0%</td>
<td>98%</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: Lottery A offers ($30, .3) and is relatively riskier. Lottery B offers ($B, .7), and is relatively safer. Both $6 lottery pairs were repeated, to assess test-retest reliability of preference scores, so sample size is 100 for these lotteries.
Table 3: Positive and Negative Emotion-Cluster Scores by Cell for Overlapped and Disjoint Problem Formats.

<table>
<thead>
<tr>
<th>Format</th>
<th>Disjoint</th>
<th>Overlapped</th>
<th>t(48)*</th>
<th>p (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive Cluster:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell 1 ($30)</td>
<td>12.86</td>
<td>13.12</td>
<td>1.99</td>
<td>.052</td>
</tr>
<tr>
<td>Cell 2 ($0)</td>
<td>1.57</td>
<td>1.24</td>
<td>-1.63</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 3 ($0)</td>
<td>1.41</td>
<td>1.49</td>
<td>0.30</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 4 ($0/$B)</td>
<td>1.29</td>
<td>8.94</td>
<td>13.18</td>
<td>.001</td>
</tr>
<tr>
<td>Cell 5 ($B)</td>
<td>9.76</td>
<td>9.76</td>
<td>0.00</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 6 ($0/$B)</td>
<td>9.86</td>
<td>1.88</td>
<td>-12.77</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Negative Cluster:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell 1 ($30)</td>
<td>0.43</td>
<td>0.37</td>
<td>-.32</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 2 ($0)</td>
<td>8.02</td>
<td>8.00</td>
<td>-.05</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 3 ($0)</td>
<td>8.12</td>
<td>6.63</td>
<td>-3.18</td>
<td>.003</td>
</tr>
<tr>
<td>Cell 4 ($0/$B)</td>
<td>9.06</td>
<td>3.06</td>
<td>-10.15</td>
<td>.001</td>
</tr>
<tr>
<td>Cell 5 ($B)</td>
<td>1.24</td>
<td>1.24</td>
<td>0.00</td>
<td>ns</td>
</tr>
<tr>
<td>Cell 6 ($0/$B)</td>
<td>2.17</td>
<td>6.51</td>
<td>8.00</td>
<td>.001</td>
</tr>
</tbody>
</table>

(*: paired samples)
Figure captions

Figure 1: Payoff matrix for a hypothetical coin-toss gambling game

Figure 2: Payoff matrices in disjoint and overlapped formats when B payoff is $10, and cell numbering convention

Figure 3(a): Mean positive emotion scores for Cells 4 and 6

Figure 3(b): Mean negative emotion scores for Cells 4 and 6

Figure 4: Mean expected rejoicing for Cells 1, 4, 5 and 6 as a function of cell payoff
### Outcome of coin-toss

<table>
<thead>
<tr>
<th></th>
<th>Heads (p=.5)</th>
<th>Tails (p=.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>$50</td>
<td>$0</td>
</tr>
</tbody>
</table>

**Player’s choice:**

Figure 1: Payoff matrix for a hypothetical coin-toss gambling game
**Disjoint format:**

<table>
<thead>
<tr>
<th></th>
<th>1-30</th>
<th>31-70</th>
<th>71-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lottery A</td>
<td>$30</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Lottery B</td>
<td>$0</td>
<td>$10</td>
<td>$10</td>
</tr>
</tbody>
</table>

**Overlapped format:**

<table>
<thead>
<tr>
<th></th>
<th>1-30</th>
<th>31-70</th>
<th>71-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lottery A</td>
<td>$30</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Lottery B</td>
<td>$10</td>
<td>$10</td>
<td>$0</td>
</tr>
</tbody>
</table>

**Cell numbering:**

<table>
<thead>
<tr>
<th></th>
<th>1-30</th>
<th>31-70</th>
<th>71-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lottery A</td>
<td>Cell 1</td>
<td>Cell 2</td>
<td>Cell 3</td>
</tr>
<tr>
<td>Lottery B</td>
<td>Cell 4</td>
<td>Cell 5</td>
<td>Cell 6</td>
</tr>
</tbody>
</table>

*Figure 2: Payoff matrices in disjoint and overlapped formats when B payoff is $10, and cell numbering convention*
Figure 3(a): Mean positive emotion scores for Cells 4 and 6
Figure 3(b): Mean negative emotion scores for Cells 4 and 6
Figure 4: Mean expected rejoicing for Cells 1, 4, 5 and 6 as a function of cell payoff
Appendix: The emotional postulates of the Modified Expected Utility Tradition (MEUT).

(Note: We have coined the term “MEUT” to refer to a body of work in economic models of choice associated with Loomes, Sugden, Bell and others, as described in the main text. A somewhat more formal statement of the main assertions of this tradition is presented here).

**Regret/rejoicing:** Consider a payoff matrix such that, if state $S_i$ eventuates, the player receives $\$A_i$ if he chose option A and $\$B_i$ if he chose option B. Let $R(.)$ denote the regret and $J(.)$ the rejoicing a player experiences on receipt of a given outcome in a given cell of the matrix. MEUT (e.g. Bell, 1982; Loomes & Sugden, 1982) postulates:

a. If $A_i = B_i$, $R(A_i) = R(B_i) = 0$, and $J(A_i) = J(B_i) = 0$. That is, there is neither regret nor rejoicing when column cells are equal, as only within-state comparisons can cause these emotions.

b. If $A_i > B_i$, then $R(A_i) = 0$, and $R(B_i)$ is positive and increases monotonically with $(A_i - B_i)$; and conversely if $A_i < B_i$. Similarly, $J(B_i) = 0$, and $J(A_i)$ increases monotonically with $(A_i - B_i)$; and conversely if $A_i < B_i$. That is, regret is associated only with the column loser, and rejoicing only with the column winner, and each increases monotonically with the size of the win or loss. It follows that no outcome can have both regret and rejoicing associated with it.

c. If, for a second state $S_j$, $A_i = A_j$ and $B_i = B_j$, then $R(A_j) = R(A_i)$ and $R(B_j) = R(B_i)$. Similarly, $J(A_j) = J(A_i)$ and $J(B_j) = J(B_i)$. That is, both regret and rejoicing are associated only with the outcome itself and the column outcome with which it is compared, so if the
same two outcomes occur in another column, the associated regret and rejoicing will be
the same.

**Elation/Disappointment:** Let $E(.)$ denote the elation and $D(.)$ the disappointment a
player experiences on receipt of a given outcome in a given cell of the matrix. If the
possible outcomes from lottery $A$ are $A_1, \ldots, A_i, A_j, \ldots$ and the lottery has an expected
value of $A^*$, MEUT (e.g. Bell, 1985; Loomes and Sugden, 1986) postulates:

a. For any outcome $A_i$ below the expected value, $A^*$, $E(A_i) = 0$, and $D(A_i) > 0$ and
increases monotonically with $(A^*- A_i)$. Also $E(A^*) = D(B^*) = 0$. That is, elation is
associated with outcomes above EV, disappointment with outcomes below EV, and
disappointment is monotonically increasing with the disparity between the payoff and
expected value.

b. If two outcomes $A_i$ and $A_j$ are equal, then $E(A_i) = E(A_j)$ and $D(A_i) = D(A_j)$. That is,
elation and disappointment are influenced only by other possible outcomes of a given
alternative, not by outcomes of other alternatives.
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