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Influence of Positive Affect on the Subjective Utility of Gains and Losses: It Is Just Not Worth the Risk

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A modification of the procedure originally used by Davidson, Suppes, and Siegel (1956) to measure subjective utility was used to study the influence of positive affect on individuals' perceived value (utility) functions. Results indicated, as expected, that persons in whom positive affect had been induced showed a more negative subjective utility for losses than did controls. This indicates that losses seem worse to people who are feeling happy than to those in a control condition. The subjective utility functions of the two groups did not differ as much, however, when people were considering potential gain. Thus, at least in the situation tested in this study, potential gains did not seem to be more appealing (nor less so) for affect subjects than they did for controls. These findings are discussed in relation to theoretical issues in decision making and work suggesting that positive affect can promote increased sensitivity to losses in situations of potential meaningful loss.

Recent studies have indicated that in risky decision situations, positive affect, compared with a control state, can be associated with an increased preference for avoiding losses. This appears to be true especially in situations involving real rather than hypothetical risk and in situations in which the probability of losing or the amount of potential loss is high. For example, in one study in which gambling preference was assessed in terms of the amount bet in a game of roulette and in which the items being wagered were points representing the subject's credit for participation in the experiment, it was found that persons in whom positive affect had been induced by receipt of a small gift bet more on a gamble with a high probability of winning (83% chance of winning), but significantly less on a gamble with a high probability of losing (17% chance of winning), than did a control group (Isen & Patrick, 1983). In a second study in which the dependent measure was acceptable probability level, parallel results were obtained. When a large amount was at stake (all of a set of 10 chips representing the subject's credit for participating in the study), persons in the positive-affect condition, in contrast to those in a control group, set a higher probability level as the cutoff point for accepting the gamble (Isen & Geva, 1987). Also, in a third series of studies, persons in whom positive affect had been induced by reading a vignette or by receipt of a small gift expressed greater preference in a lottery choice for a $1 ticket rather than a $10 ticket relative to a control group (Isen, Pratkanis, Slovic, & Slovic, 1984). Thus, three different types of assessment tasks have yielded compatible findings, suggesting that persons in a positive affective state are more likely than controls to express preferences or judgments that avoid or minimize potential losses or avoid risk.

These results suggesting conservativeness in betting preferences (avoidance of risky or dangerous bets) are related to the concept of risk as it is used in common language, but the results may not correspond precisely with the concept of risk aversion as it is used in the decision-making literature. A common dictionary definition of *risk* is "the chance of injury or loss" (*Webster's New World Dictionary of the American Language,* 1982, p. 1228), and the results of the studies just described suggest that people in whom positive affect has been induced are especially likely to avoid risk in that sense, avoiding likely loss. In the statistical decision theory literature, however, the construct *risk aversion* is defined with reference to the variability in the possible outcomes of a gamble and refers to avoidance of uncertainty rather than avoidance of loss. A person who is risk-averse in the statistical decision theory sense of the term would avoid a gamble in favor of a sure thing, even when this was not justified by the expected values of the alternatives. That is, a person risk-averse in this sense of the word would prefer a sure-outcome situation (e.g., one in which he or she will get $5 with a probability of 1, which results in an expected value of $5) over a gamble or variable-outcome situation of equal or even greater expected value (e.g., one in which she has a 50% chance of winning $10 and 50% chance of getting $0, which also yields an expected value of $5). Thus, in order to say that positive affect is associated with risk aversion in this sense of the term, one would have to find that positive-affect subjects, compared with controls, were more avoidant of the variable-outcome alternative per se, that is, even when it offered an expected value equivalent to that of the sure-outcome option.

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Moreover, in the statistical decision theory literature, risk aversion is distinguished from the concept of loss aversion. The term *loss aversion* refers to the situation in which people feel that possible losses have more impact than possible gains. It is associated with a steeper utility curve when a person is considering losses than when considering gains. As Kahneman and Tversky (1979) put it, "the aggravation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount" (p. 279). These two concepts, risk aversion and loss aversion, may both be related to the findings described, but it may be helpful to keep these distinctions, as well as that with the common language usage of the term *risk*, in mind as we consider the findings in this area.

It is possible to consider the finding that affect influences betting preferences from the perspectives of two leading theories of risky decision making: Kahneman and Tversky's (1979; Tversky & Kahneman, 1981) prospect theory and subjective expected utility (SEU) theory. In SEU theory the expected utility of a gamble is found by taking, for each outcome in the gamble, the product of the utility of the outcome multiplied by the subjective probability of that outcome and summing these terms across all outcomes. The decision maker is assumed to choose the gamble with the highest expected utility. Frequently, SEU theories assume that the subjective probabilities of complementary events add to one, but versions of SEU theory without this requirement have been proposed (Edwards, 1962).

Prospect theory is similar to SEU theory but differs from it in a few potentially important ways. First, the overall value is based on multiplying the value of each outcome by a *decision weight* rather than a probability estimate per se. The decision weights increase monotonically with the objective probabilities of events but are assumed to be larger than the objective probabilities for extremely unlikely outcomes and smaller than the objective probabilities for more likely outcomes. The decision weights for complementary events need not necessarily add to one. In prospect theory, then, the overall value of a gamble is found by taking, for each outcome of a gamble, the product of the value of the outcome multiplied by the decision weight associated with that outcome and summing these terms across all outcomes. Again, the decision maker is assumed to choose the gamble with the highest overall value. Finally, the clearest difference between prospect theory and SEU theory is that prospect theory suggests that people code or respond to gains and losses in terms of their difference from some reference point rather than as a function of their absolute amounts.

Both models take the same general form, then, in that preference for a gamble (G) is assumed to be a function of (a) the values or utilities of the possible outcomes and (b) decision weights (subjective probabilities in SEU theory). Expressed mathematically, for a simple gamble of the form $G = (x, p; y, 1 - p)$, where one obtains outcome x with probability p or outcome y with probability $1 - p$, the expected value of the gamble (G) is assumed in these models to be

$$v(G) = v(x) * \pi(p) + v(y) * \pi(1 - p), \qquad (1)$$

where $v(x)$ is the value of outcome x and $\pi(p)$ is a subjective decision weight that is associated with outcome x. In SEU theory $\pi(p)$ is assumed to be an actual subjective probability estimate.

In order to understand the impact of positive feelings on the decision-making behavior described earlier (i.e., increased cautiousness), SEU or prospect theory would need to postulate that positive affect influences either the utilities (values) of gains or losses or both, the subjective probabilities (decision weights) of winning or losing or both, or both utilities and subjective probabilities. That is, given the results of the Isen and Patrick (1983) and related studies indicating conservative betting preferences under some circumstances (e.g., high potential loss), expectation models such as SEU would need to require that in these situations, a person in a positive affective state, relative to a control subject, must either believe that losing is more likely or have a greater "disutility" (more negative utility) associated with the losing outcome, in order to account for the relatively more conservative behavior that has been observed among these persons when considering losses.

It is also possible that persons in positive affective states differ from controls in this situation because of a difference in the way they value and expect gains rather than in the way they deal with anticipated losses. If so, then in order to account for the findings that positive-affect subjects are more likely than control subjects to avoid loss when loss is likely and salient, expectation models would have to propose that people in positive feeling states think positive events are less likely or would be less valuable if they occurred, relative to control subjects. Although this is theoretically possible, these particular patterns seem implausible and perhaps even incompatible with data we soon discuss, suggesting that people who are feeling happy value that state.

For a number of reasons it is also implausible to propose that persons who are in a positive affective state, relative to controls, believe there is an increased likelihood (subjective probability) of losing. First, there is the theoretical reason: Positive affect has been found to cue positive material in memory (e.g., Isen, Shalker, Clark, & Karp, 1978), and this would suggest, if anything, more optimistic expectations or probability functions. Consistent with this suggestion, Johnson and Tversky (1983) found that persons in whom positive affect had been induced believed that negative events were less likely to occur and that positive events were more likely to occur than did a corresponding group of control subjects. Although the events that they studied were relatively rare ones, it may be that a similar effect would hold true for a broader range of event probabilities. Second, recent data confirm that persons in whom positive affect has been induced believe winning is relatively more likely and losing is relatively less likely, but they also demonstrate avoiding losses in their betting choices (Nygren & Isen, 1985). Thus, the existing data regarding positive-affect subjects' preferences when considering potential losses are not readily interpreted in terms of an impact of affect on probability; that is, an increased expectation of losing or a decreased expectation of winning.

This situation suggests that the effect of positive feelings on preference judgments may well involve a change in the perceived utility of a loss or gain. That is, people who are feeling happy may regard an anticipated loss as more unpleasant than do those in a more neutral state. (Theoretically, it is also possible that the effect could be attributed to a reduction in the utility of a potential gain but, as noted earlier, this seems unlikely and harder to reconcile with other data.) Moreover, this effect on perceived utility of losses must be large enough to offset the lower subjective probability of a loss that has been observed to result from positive affect. The reason for this proposed change in the utility function in the domain of losses may be that persons who are feeling good are in danger, if they lose the bet, of losing their pleasant affective state, as well as any tangible resources that are in the balance.

This suggestion, that positive affect results in more extreme negative utilities associated with losses, is supported by empirical data from other domains that indicate that people who are happy act to maintain their positive states. For instance, although it has been widely observed that happiness tends to promote helping and generosity to others, it has also been found that if the helping opportunity is presented as one that will destroy the subject's own good feeling state, persons in whom positive affect has been induced tend to help less than control subjects (e.g., Isen & Simmonds, 1978). For another example, Mischel, Ebbesen, and Zeiss (1976) found that persons who had experienced success, to a greater extent than those in a control group, preferred to look at and had better memory for positive rather than negative self-relevant information.

These findings have been interpreted as indicating that happy persons are motivated to maintain their positive feelings, and this interpretation is compatible with the suggestion being made here, that persons in whom positive affect has been induced have a more negative subjective utility associated with loss. (Although they do not address directly the matter of the utility of gains, these findings are possibly compatible with the suggestion that positive affect, if it does influence the utility of gains, increases this utility rather than decreases it. These then, would not support an interpretation of the affect-cautiousness finding as resulting from an effect on utility of gains, because they point in the opposite direction.)

Thus, we propose that positive affect influences utility of losses, and we focus for the time being on this effect rather than on any possible effect on utility of gains. That is, the data suggest that persons who are happy behave as if they have more to lose in the same situation, and therefore it appears that a potential loss may seem more aversive to them. This also suggests that in the more formal framework of prospect theory or SEU theory, the utility function for positive-affect subjects should be relatively steeper in the losses end than that for control subjects. This study was designed to examine these hypotheses by estimating the subjective utilities associated with potential losses and gains for persons in control and positive-affect conditions. The procedure we used, developed by Davidson, Suppes, and Siegel (1956), allowed for a straightforward, quantitatively based methodology for estimating these subjective utility functions.

Method

Subjects

One hundred and ten undergraduate students at Ohio State University volunteered to participate in this study in partial fulfillment of the requirements of their introductory psychology course. We randomly assigned the students to one of two conditions—positive affect ($N = 53$) or control ($N = 57$)—with men and women being approximately equally distributed across the two conditions.

Procedure

Up to 3 subjects could come to the laboratory at the same time, but each person participated individually, seated at a separate computer terminal. We initially told the subjects that they would be asked to make choices between pairs of gambles and that after they had indicated all of their preferences, 10 of the choice situations would be randomly sampled and played. The gamble that they would play in each pair would be the one preferred by them in the paired comparison. We gave each subject 20 poker chips, representing his or her credit for participating, and told subjects that they would be gambling with this credit (not money) in the randomly selected gambles. We then told them that as a result of the gambling, they might either lose their credit hour, retain it, or gain an additional credit. At this point we gave all subjects the opportunity to withdraw from the study without penalty. None did so.

The procedure used in this study was a modification of that developed originally by Davidson et al. (1956) to estimate utility. It involved determining the indifference point in sequences of pairs of gambles in order to estimate the subjective utility associated with various outcomes. On each trial we presented subjects with 2 two-outcome gambles and asked them to indicate which of the two they preferred.

A two-outcome gamble is one in which a person is told that she or he will win or lose a certain number of points if one event occurs and another number of points if the other possible event occurs. For example, in one gamble a person may stand to lose 5 if A occurs or lose 5 if B occurs (this is a sure-loss situation); in another, she or he may win 5 if A occurs or lose 10 if B occurs. Our procedure required subjects to choose between gambles (situations, not alternative outcomes) in a series of such pairs. We recorded choices as either a 1 or a 2 for Gambles 1 and 2, respectively.

We set up the two-outcome gambles as follows: We told subjects that in each gamble one outcome would be obtained if the event E occurred and that the other outcome would be obtained if the event E did not occur. We never specified the event E, but we did tell subjects that it had a true probability of one half. (Pilot data indicated that such instructions produced no bias between these two alternatives of E and *not* E; subjects indeed weighted the two events equally.)[1] On each trial one gamble had both outcomes fixed at a specified number of points; the other gamble had one fixed outcome and one that was varied. For each of eight series of trials, we asked subjects to compare the fixed-outcome gamble with another that was modified each time by changing the number of points in the variable outcome. The subjects' task on each trial was simply to indicate which gamble they preferred. Because events E

[1] The key for the Davidson, Suppes, and Siegel (1956) procedure is to find an event, E, which has a probability of occurrence of .5, that is, an event for which an individual says $\pi(p) = \pi(1 - p)$. In other words, the event E and the event *not* E (i.e., the complement of the event E) are weighted as being subjectively equivalent in probability. To show that E and *not* E are weighted equally likely, it must be shown that an individual is indifferent between playing the pair of gambles $G = (x, E; y, not\ E)$ and $G' = (x, not\ E; y, E)$. Two independent tests of trials in a pilot study indicated that E and *not* E as we defined them had this property.

Given this equivalence in probability, Equation 1 reduces to $v(G) = c * [v(x) + v(y)]$, where c is now a constant and $c = \pi(p) = \pi(1 - p)$. Once E has been found, the measurement procedure reduces to one of manipulating the outcomes in pairs of gambles until the individual judge finds the pair of gambles to be subjectively equivalent, the point at which both are equally preferred or not preferred. At that point the gambles should have the same perceived utility.

Table 1
Construction Sequence for the Eight Trials

Trial	Gamble 1 Get	Gamble 1 Get	Gamble 2 Get	Gamble 2 Get	Subjective utility
1	−10	−10	−*A*	+10	−3
2	+10	+10	−10	+*B*	+3
3	−*A*	+10	−*C*	+*B*	−5
4	−10	+*B*	−*A*	+*D*	+5
5	−*A*	+*B*	−*C*	+*D′*	+5
6	−10	+*D*	−*A*	+*E*	+7
7	−*A*	+*B*	−*C′*	+*D*	−5
8	−*C*	+10	−*F*	+*B*	−7

and *not E* had probabilities fixed at .5 and these events were weighted by the subjects as equivalent in probability, we could determine subjective utilities by noting the number of points necessary in the variable-outcome gamble for subjects to change their preference ordering between the fixed-outcome and variable-outcome gambles, indicating an indifference or equivalence point for that pair of gambles. That is, we noted the number of credit points that were assigned to the variable outcome when the subjects' choices indicated a change in preference at that point value.

The sequence of pairs of gambles used in this study is presented in Table 1. Each of the eight situations presented in Table 1 actually consisted of a series of a minimum of 11 trials that would lead to the estimation of a value on the subjective utility scale. For example, in the first situation the subjects were faced with one gamble for which they would lose 10 points if *E* occurred and 10 points if *E* did not occur. This, then, was a sure-loss gamble. We described the alternative gamble in the pair as resulting in a loss of *A* points if *E* occurred and a gain of 10 points if *E* did not occur. We varied the number of points associated with *A*, in random order, from −10 to −50 in order to find the value at which the subjects were indifferent between the gambles (−10, −10) and (−*A*, +10).

The points associated with *A* were determined by DSS, a computer algorithm written for this study.[2] The algorithm first computes the number of points for −*A* that would be obtained if the subject adhered to expected value theory. In the example we are using, this number is −30 points. In other words, according to expected value theory, one should be indifferent between playing the sure-loss gamble (−10, −10) and the gamble (−30, +10), each having an expected value of −10 points. The DSS program then picks two other numbers for −*A* on each side of −30 that are *n* points apart. For the first part of the process, $n = 10$, and five gambles were created with −*A* ranging from −50 to −10. Each of these five gambles was paired with the fixed gamble (−10, −10) and was presented in a different random order for each subject.

Suppose that the sequence of gamble choices 1, 1, 1, 2, 2 had been obtained in the paired comparisons for a subject. This would indicate that the subject preferred Gamble 1 (the sure loss of 10 points) when the possible loss in Gamble 2 was −50, −40, or −30 but switched to Gamble 2 when its possible loss was less than −30. Thus, this subject's indifference or equivalence point should be between −30 and −20 points.

Once this 10-point range was determined, the algorithm switched to 2-point intervals, and a similar random presentation process with six gambles was repeated, with the losing amount being either −30, −28, −26, −24, −22, or −20. Suppose here that the subject's choices were 1, 1, 2, 2, 2, 2. This would indicate that the sure loss was preferred when the possible loss in the second gamble was −30 or −28, but Gamble 2 was preferred when the possible loss was −26 or less. The indifference point was then taken to be −27, halfway between −28 and −26.

Clearly, not all subjects are expected to be perfectly reliable in this procedure. Thus, the algorithm needed to have contingencies built in to handle error. The simplest problem occurred when either the initial set of five value points for *A* (e.g., −50, −40, −30, −20, and −10) or a later set of six numbers (e.g., −30, −28, −26, −24, −22, and −20) resulted in all 1s or all 2s. In this case, the next higher set of five or six point values (when all 1s occurred) or the next lower set (when all 2s occurred) was used. This continued until a switch from 1s to 2s or from 2s to 1s was obtained.

A more serious error occurred when inconsistencies were found in a sequence. For example, suppose in the example just given that the last 6 trials, when ordered by smallest to largest variable outcome, had resulted in choices of 1, 1, 2, 1, 2, 2, respectively. The algorithm looks at ordered trials *t* and *t* + 1. As long as the response in trial *t* + 1 is at least as large as that for trial *t*, no inconsistency has occurred. In the example here, all is fine until the third and fourth trials. When these errors are detected the trials are presented over again in a random order. If they now result in a 1, 1 or a 1, 2 or a 2, 2 sequence, the indifference point is found as before. If the error is still found an additional trial on either side is examined. Finally, if the inconsistency persists the indifference point is found by averaging the two observed switches from 1s to 2s.

In this process we were finding the estimate of the credit points associated with −*A*, the value at which the two gambles in the first series were determined empirically to be equivalent in subjective utility units. We first assigned a utility of +1 to +10 points and a utility of −1 to −10 points.[3] After we found −*A* we could then determine the utility value associated with −*A* (which then corresponded to an empirically determined number of points) by substituting in the formula in Equation 1

$$\pi[.5]*(-1) + \pi[.5]*(-1) = \pi[.5]*(+1) + \pi[.5]*v(-A), \quad (2)$$

making $v(-A) = -3$. That is, −*A* points corresponded to a utility of −3. Thus, we were able to determine for our two groups of subjects how many points (i.e., how great a loss) would be associated with a utility of −3. In a manner comparable to that for Situation 1 in Table 1, we next found a value for +*B* by comparing the gambles +10, +10 and −10, +*B*, yielding the number of points that were associated with a utility of +3. We then used these utilities of −*A* and +*B* in Situations 3 through 8 to determine other points on the subjective utility scale. We found an estimate for −*C* and one for −*C′* that each had a value of −5, two estimates +*D* and +*D′* with the utility of +5, an estimate of +*E* with a utility of +7, and an estimate of −*F* with a utility of −7. We found the two pairs of estimates, −*C* and −*C′* and +*D* and +*D′*, in order to test for the accuracy of the Davidson et al. (1956) estimation procedure. We expected that these independent estimates would result in similar point values in each pair, for +5 and for −5 on the subjective utility scale.

We gave all subjects instructions about gaining and losing credit hours, as described earlier. Following completion of the instructions and immediately prior to the beginning of the choice task, we gave subjects in the affect condition a small bag of candy, an affect inducer that has been used effectively in a number of studies (e.g., Isen & Geva, 1987; Isen, Johnson, Mertz, & Robinson, 1985; Isen et al., 1984). We told subjects that the gift was a small token of appreciation for their willingness to volunteer for this study. Following completion of the study there was a full debriefing. After we told subjects that they were not really

[2] The program DSS was written by T. E. Nygren in Fortran IV for use on a Data General Nova 3 computer system. A version is currently being modified in Fortran 77 for use on an IBM PC and related MS-DOS machines. A copy of the program can be obtained from the author.

[3] Because a utility function can be identified only up to an arbitrary linear transformation (i.e., is on an interval scale), two points (corresponding to utilities of +1 and −1) can be arbitrarily assigned point values as starting points for this procedure without any loss of generality (Davidson, Suppes, & Siegel, 1956, pp. 26 and 58–59).

Table 2
Mean Differences and Standard Errors in Utility Estimates on Replicated Trials for Affect and Control Subjects

Group and trial	*M*	*SE*	*t*	*df*	*p*
Affect					
4 vs. 5	4.74	4.74	1.00	52	>.30
3 vs. 7	1.79	2.55	0.70	52	>.50
Control					
4 vs. 5	11.09	5.66	1.96	56	<.10
3 vs. 7	5.97	3.46	1.72	56	<.10

gambling their credit hour, we asked them to indicate if they had made their ratings on the basis of the belief that they would be actually playing for their credit hour. None of the subjects indicated that he or she knew or had a strong belief prior to participating that there would not actually be gambling.

Results

We conceived of Trials 3 and 7, which each estimated the point on the utility curve equal to −5, and Trials 4 and 5, which each estimated the point with a value of +5, as being something similar to reliability checks on the procedure. If the utility estimation procedure is accurate, then the two estimates in each pair should be close. Table 2 shows the results of this check. Dependent sample *t* tests indicated, as expected, that the mean differences obtained in each of these two comparisons were not significant for each subject group ($p > .05$ in each case).[4]

Table 3 shows the means and differences in means for each group on the eight trials. The best-fitting curve through these points for each group is shown in Figure 1. The curve for each group is based on a polynomial regression analysis using the general linear model procedure, GLM, in the statistical package, SAS. For each group of subjects the entire curve was best approximated by a cubic equation. The proportion of variance accounted for in the subjects' data (i.e., their point estimates) by the best-fitting cubic equation and as measured by R^2 was found to be .788 for the affect group and .807 for the control group. This cubic component in the equations indicates for both groups significant nonlinearity or curvature in the subjects' utility functions, a point that we discuss in more detail later.

Table 3 also shows the results of the planned-comparison univariate *F* tests between the affect and control groups for each of the four trials in the gains and losses ends of the curve, respectively. For the losses end of the curve, where subjects were making choices about outcomes with negative perceived utilities, there was a clear and significant trend consistent with greater avoidance of losses for the affect subjects than for controls. Each of the four negative subjective utility estimates in Table 3 (Trials 1, 3, 7, and 8) was significantly smaller for the positive-affect group. These differences remained significant even when we used the more restrictive Bonferroni procedure to control the familywise error rate for these four comparisons at a conservative alpha level of $p = .10$. (This guaranteed that the alpha level for each comparison was no greater than .025). For each negative utility value (−3, −5, and −7), a significantly smaller number of points was needed to reach those respective utility values for the positive-affect subjects than for the controls. This means that among positive-affect subjects, a smaller loss in points had the same negative value or impact that a larger loss had for control subjects.

In the gains end of the utility function (Trials 2, 4, 5, and 6), the differences between the affect and control groups were not significant, although there was a suggestion of a trend toward a higher utility function for the positive-affect subjects at the largest point (+7) on the curve. A smaller number of points was needed for the affect group in order to achieve the same utility of +7 (115.15 vs. 136.04), $F(1, 108) = 3.07, p < .085$. However, again based on the conservative Bonferroni procedure for reducing familywise error, this result did not approach significance. Thus, although the trend is visible in the gains end of Figure 1, the overall picture would suggest that if gains are also more valuable to people who are feeling happy than to controls, the effect is not strong and may apply only to relatively large values.

Figure 1 shows that for both the affect and control groups a concavity exists in the gains end of the curves, indicating the typical marginally decreasing utility curve. This means that as the number of points to be gained increases, the added value of a constant increase (e.g., 10 points) decreases. Hence, as predicted by prospect theory, because of such subjectively diminishing returns, both groups would be expected to exhibit some moderate risk-averse behavior in the gains end as points or wealth accumulate. A polynomial regression analysis of the gains end of the curve supported this expectation for both groups. For the affect group there were significant linear, $F(1, 263) = 669.08, p < .001$, and quadratic, $F(1, 263) = 4.41, p < .037$, components to the curve. For the control group the fit was equally good, with the quadratic component being more prominent, $F(1, 283) = 864.27, p < .001$, for linear and $F(1, 283) = 13.23, p < .001$, for quadratic, respectively.

In the losses end, in which the groups' functions were found to diverge significantly, nonetheless for both groups there was an interesting difference in curvature from that observed at the positive end of the curve. A polynomial regression analysis of the losses end of the function showed that the linear trend was significant for both groups, $F(1, 260) = 900.77, p < .001$, and $F(1, 278) = 1069.71, p < .001$, for the affect and control groups, respectively, but the quadratic trend was not, $F(1, 260) = 1.75$, $p > .18$, for affect and $F(1, 278) = 1.65, p > .20$ for control. This indicates that for these data the losses end of the curve did not begin to exhibit the corresponding marginally decreasing utility property found in the gains end.

Thus, at least over the range of point values used in this study,

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[4] The near significance of these differences for the control subjects was not of concern for three reasons: (a) The experimentwise Type I error rate for these four comparisons at a per-comparison rate of .10 was .34; (b) an identical replication of these same trials for a control group of 70 subjects from another study yielded results similar to those found here for the affect group, differences that did not approach significance; and (c) a power analysis based on Cohen's (1977) criterion of a moderate effect size of .5 indicated that our sample size of 57 would have produced a power of approximately .97.

Table 3
Mean Point Values Associated With Each Utility Level: Affect Versus Control Groups

Trial	Utility	Affect mean	Control mean	Mean difference	*SE*	Univariate *F*	*p*
				Losses function			
8	−7	−70.14	−85.64	−15.50	6.48	5.72	.019
7	−5	−53.70	−66.88	−13.18	6.05	6.46	.013
3	−5	−51.91	−60.91	−9.01	4.28	7.15	.009
1	−3	−33.55	−38.60	−5.05	2.69	5.28	.024
				Gains function			
2	+3	36.34	37.46	1.12	3.60	0.10	.757
5	+5	68.79	72.14	3.35	9.79	0.12	.733
4	+5	73.53	83.23	9.70	6.48	2.24	.137
6	+7	115.15	136.04	20.88	11.91	3.07	.082

the curvature (convex for losses) suggested by prospect theory was not observed on average. However, it may be that the range of values studied in this experiment might not have been large enough to have allowed the convexity in the function to have appeared.

Regarding loss aversion, as defined by Kahneman and Tversky (1979) and described by us in the introduction, there was clearly a tendency in both groups for people to exhibit this property. Recall that loss aversion means that losing a given number of credit points has a greater disutility than winning the same number of points has a positive utility value. In the graphic representation of the utility function in Figure 1, this means that the losses end is significantly steeper than its counterpart in the gains end. This can be shown by comparing the respective mean point estimates for the subjective utilities of +3 with −3, +5 with −5, and +7 with −7. In order to determine whether this loss aversion was equally pronounced in the two affect conditions of our study, we conducted a 2 × 3 (Groups × Utility Levels) mixed analysis of variance across subjects on difference scores between positive and negative utility levels. We obtained these difference scores by finding at each utility level (3, 5, and 7) the difference between each subject's point estimates for the positive and negative ends (between +3 and −3, +5 and −5, and +7 and −7). This difference represents loss aversion (the tendency for the minus values to be smaller in absolute value than the plus). For example, if a subject's point estimates for +3 (estimated in Gamble 2) and for −3 (estimated in Gamble 1) were found to be +40 and −30, respectively, then the difference (loss aversion) score at +3/−3 would be 10 (absolute value). This means that it would take a gain of +40 points to equal in impact the impact of a loss of only −30 points. If loss aversion in the Kahneman and Tversky (1979) sense were not present in the subject's data, then one would expect that if he or she associated +40 points with a utility of +3, he or she should associate −40 points with a utility of −3, yielding a difference score of zero.

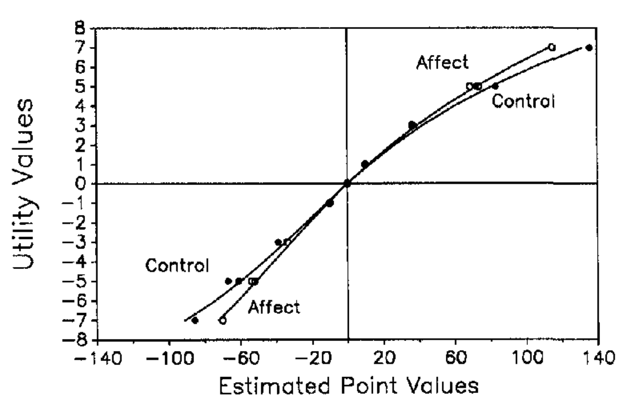

Figure 1. Best-fitting average utility functions for affect and control subject groups.

Results of this analysis revealed that only the level-of-utility main effect was significant, $F(2, 200) = 49.58, p < .001$. Further, as Table 3 shows, all but one of the mean differences were in a direction consistent with loss aversion (a smaller number of points was associated with losses than with the corresponding gains). This indicates that for both groups there was an aversion to losses, and it became more pronounced as the utility level increased. The nonsignificant main effect of affect treatment indicated that this loss aversion or difference in impact between comparable gains and losses was not significantly greater for one group than for the other. For the affect group subsequent *t* tests on the difference scores indicated that the mean difference (loss aversion) scores between +7 and −7 and between +5 and −5 were significantly different from zero; the mean differences were 41.90, $t(49) = 6.50, p < .001$, for +7/−7 and 19.26, $t(49) = 3.23, p < .01$, for +5/−5. The steepness differential at +3/−3 was not significant (mean difference = 3.60), $t(49) < 1$. For the control subjects the same pattern occurred. The mean differences were 53.03, $t(51) = 6.24, p < .001$, for +7/−7; 14.84, $t(51) = 2.90, p < .01$, for +5/−5; and −0.63, $t(51) < 1$, for +3/−3.[5] Thus, we observed loss aversion for both groups, but it was more pronounced at more extreme utilities and was not significantly affected by feeling state. What was affected by posi-

[5] Because of a hardware problem when running the DSS program, the Nova 3 system on several occasions lost data from the last trial. This happened to 3 subjects in the affect group and 5 subjects in the control group. Hence, the degrees of freedom were slightly different in several of the analyses involving Trial 8; we reduced the sample size from 53 to 50 for affect subjects and from 57 to 52 for control subjects on this trial.

tive feelings was the perceived utility of losses, especially large losses: They seemed worse to positive-affect subjects than to controls.

Discussion

Our results are compatible with those of previous research that indicate that persons in whom positive affect has been induced tend to be conservative or self-protective in situations in which meaningful loss is likely. The results suggest that one possible mediator of that observed difference is a change in the perceived negative value or utility of losses, such that the anticipated impact associated with any given loss is greater for a person who is feeling happy than for someone in a more neutral state. This idea is compatible with social learning theory principles of self-regulation (e.g., Bandura, 1973, 1986; Mischel, 1973) and with the results of studies in the social psychological literature suggesting that people who are feeling happy become motivated to maintain their positive states and thus may have more to lose than controls in the same situation (e.g., Isen & Simmonds, 1978; Mischel et al., 1976).

Further, the suggestion from this study that people who are feeling good may be especially sensitive to loss is compatible with that of another recent study that indicated that persons in whom positive affect had been induced reported more thoughts about possible loss on a thought-listing task than did controls, in a high-stakes gambling situation (Isen & Geva, 1987). It is not intuitively evident why happy people should think more about possible loss than do control subjects, but one possibility is that they have more at stake: They stand to lose both the loss itself and their current positive affective state. Another possibility, however, is simply the effect observed in our study, that for whatever reason, a given loss seems more aversive to someone who is feeling happy than to a control subject. Under that circumstance, it is not surprising that a happy person should think more about possible loss than would a control subject. It is important to mention that such effects have been observed only in situations that direct subjects' attention to possible loss. In situations of no danger, positive-affect subjects would be expected to think more about positive outcomes, stimuli, and options.

In the domain of gains positive-affect subjects showed only a slight tendency toward the increased subjective utility of gains that would be associated with relatively greater risk-seeking behavior. Such a change in the subjective utility of gains might have been expected, although the change would not be in the right direction to provide the basis of an alternative interpretation of the behavior of positive-affect subjects considering a meaningful loss, because increased risk-seeking behavior has sometimes been observed among positive-affect subjects in situations of low possibility of loss or hypothetical risk (e.g., Isen & Patrick, 1983). Our results were in the right direction to be consistent with that finding (i.e., a smaller number of points to achieve the same value), but the effect was not strong and even the tendency seemed to be present only for large utility values. This suggests that perhaps examining the effects of positive affect on gains of higher value might be of interest; it may also be that positive-affect subjects might respond more markedly to other types of positive gains. In any case, the results suggest that, at least for the situation tested here, the impact of affect on utility of losses is stronger than on utility of gains. This implies that people who are feeling happy may be especially sensitive to loss and avoidant of loss under circumstances that call attention to the possibility of loss.

There are at least two factors—perceived utility and subjective probability—that play a role in determining risky choice. For this reason, the fact that we found no significant effect of affect on utility estimates when considering gains does not necessarily mean that greater risk-prone behavior could not have been observed among affect subjects even with the range and type of stimuli used in this study, as has been found under some circumstances (e.g., Isen & Patrick, 1983). What it does suggest is that if greater risk-prone behavior were to be observed in affect subjects, it might be more likely attributable to an effect of feelings on subjective probability than on perceived utility. In fact, effects of positive feelings on the estimation of subjective probability of gains have been observed (Nygren & Isen, 1985). In contrast, we have observed only a borderline effect on perceived utility for one (relatively large) gain, and these two sets of findings suggest that any effect of feelings on preference in the domain of gains may be more likely attributable to their effect on probability estimation. Consequently, it may be that one will observe relatively risk-prone behavior as a function of affect only when probability is free to vary. That probability was not free to vary in our study may be the reason that we did not find positive affect to be associated with estimates that would be compatible with relatively greater risk-seeking behavior.

This observation, together with the results obtained on the losses end of the curve, suggests that the processes of utility estimation and subjective weighting of probabilities may each be affected by feeling states but that one process may be more implicated in consideration of gains and the other more central in consideration of possible losses. Persons who are in a positive affective state and are considering the positive outcomes in risky situations may focus, for decision making, on the probability of winning; the impact of affect on consideration of these outcomes may be most evident on probability estimation or weighting. When making decisions under uncertainty, these individuals may place less importance on the actual value of a positive outcome and more importance on the likelihood of occurrence. On the other hand, when considering possible losses, these persons may focus on how the loss will feel (its subjective utility) rather than on its likelihood; the deciding factor in people's behavior with regard to losses may be the impact of the affective state on utility estimation. Finally, even though our results suggest an impact of affect on perceived negative utility of losses, it remains possible that subjective probability of losses is also affected, in a direction with the opposite behavioral implication (lowered), by positive feeling state (e.g., Johnson & Tversky, 1983; Nygren & Isen, 1985).

One possible way to account for the influence of positive affect on the perceived utility of losses that might be suggested in the context of prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981) is that positive affect represents a positive change in the reference point. This hypothesis would suggest that people who are feeling happy evaluate gambles similarly to the way in which those who have already won something evaluate them. This would cause their reference point to shift to the right along the abscissa of the utility function in

Figure 1 (the credit point axis). Because the utility function tends to be steeper for losses than for gains, if the only difference between the two groups were a shift in reference point in the direction of gains for the positive-affect group, then the utility curve for that group would be expected to be shallower than that of the control group for both gains and losses. Neither of these predictions was supported, and thus a simple shift in reference point cannot account for our results.

In summary, our results, together with those reported elsewhere (e.g., Isen & Geva, 1987; Isen & Patrick, 1983; Johnson & Tversky, 1983; Nygren & Isen, 1985), contribute to the development of a more complete understanding of the complex role that positive affect plays in decision making under risk or uncertainty. These findings suggest that people who are feeling happy may accurately be characterized as cautious optimists: They report higher probability estimates for gains and lower probability estimates for losses (both of which reflect optimism), yet their behavior when allowed to gamble reflects caution or risk aversion. The results of this study suggest a mechanism underlying that complex state of affairs. Persons who are feeling happy are more sensitive to loss (i.e., the negative utilities of losses are greater for them), but at the same time their utilities for gains do not appear to be affected as much. In other words, possible gains do not seem much more appealing to persons who are happy, but possible losses seem more aversive. Literally, then, to a person who is in a positive affective state it may be that taking a chance is just not worth the risk.

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