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Asymmetries in Strength of Preference: A Focus Shift Model of Valence Effects in Difference Judgments

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A descriptive model of strength of preference for options composed of multiple attributes is proposed. This *focus shift model* assumes that people judge strength of preference by weighting the desirable and undesirable features of choice alternatives. Judgments of how much better a superior option is can differ in absolute magnitude from the inverse judgment of how much worse an inferior option is. The "how much better" question is referred to as the positive valence question and the "how much worse" question is referred to as the negative valence question; a positive valence effect occurs when a positive valence question receives a larger rating in absolute magnitude than the corresponding negative valence question. A negative valence effect occurs when the opposite ordering is observed. In Experiments 1–3, statistically reliable positive and negative valence effects were observed at the individual participant level. Analysis in terms of the focus shift model showed that particular configurations of subjective weights were associated with positive and negative valence effects. Experiment 4 showed that the direction of the valence effect was predictable from the intrinsic pleasantness of the stimulus domains. Implications for preferential choice and choice–rejection asymmetries are discussed.

Much research has demonstrated that performance on logically equivalent tasks can differ as a function of how the task is described. A famous example is the preference reversal phenomenon, where people may choose gamble *A* over gamble *Z* but assign a higher selling price to *Z* than to *A* (Lichtenstein & Slovic, 1971, 1973; Lindman, 1971). Pricing of objects may also exhibit similar reversals. The *endowment effect* is the finding that people demand more money to give up an object in their possession than they are willing to pay to obtain it. Kahneman, Knetch, and Thaler (1990) randomly assigned participants to the roles of buyers and sellers and found that a mug was valued at $2.50 by buyers, whereas owners refused to sell the same mug for less than $5.25. Sometimes reaction times exhibit asymmetries. Banks, Clark, and Lucy (1975) presented participants with an abstract picture of two circles, each connected with a line stretching downward to the bottom of the frame. Participants responded to either "Which balloon is higher?" or "Which balloon is lower?" Reaction time was reliably shorter for the "higher" than for the "lower" question. Judgments of similarity provide another example (Tversky, 1977). Tversky's participants rated North Korea as more similar to China than China is to North Korea. Likewise, participants in Holyoak and Gordon's (1983) study rated their friends as more similar to themselves than they were to their friends. These asymmetries challenge psychologists to explain how logically equivalent questions produce differences in cognitive representation or processing.

In this article we report studies of an asymmetric pattern in comparative judgments. One can say that a question has a *positive valence* if it asks how much better a superior object is than an inferior one, and that it has a *negative valence* if it asks how much worse an inferior object is than a superior one. We say that a *positive valence effect* occurs if a positive valence question produces systematically higher ratings of absolute magnitude than a corresponding negative valence question; the converse of this is the definition of a *negative valence effect.* Positive and negative valence effects are the asymmetries that we study in this article.

Positive and negative valence effects are analogous to some of Dunning and Parpal's (1989) findings. Dunning and Parpal asked undergraduates to judge how much more challenging the classes would be at their preferred school (first choice school) than at a less preferred school (second choice school). Other participants were asked to judge how much less challenging the classes would be at the second choice school than at the first choice school. For this question and a variety of analogous questions, Dunning and Parpal found that ratings of "how much more is the first choice than the second choice" were systematically larger in absolute magnitude than ratings of "how much less is the second choice than the first choice." To explain this difference, Dunning and Parpal distinguished two kinds of judgment; mental addition and mental subtraction.

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Mental addition was defined as "assessments in which people must determine whether a causal agent will produce an outcome to a greater degree" (Dunning and Parpal, 1989, p. 5). Mental subtraction was defined by replacing *greater* with *lesser*. The finding that judgments requiring mental addition exceeded judgments requiring mental subtraction was explained by the hypothesis that "people give predominant weight to features contained in the subject of the comparison" (Dunning and Parpal, 1989, p. 6). Thus, in judging how much better (stronger, more challenging, etc.) A is than Z, the participant gives greater weight to the features of A, whereas in judging how much worse (weaker, less challenging, etc.) Z is than A, the participant gives greater weight to the features of Z. According to this hypothesis, these asymmetries in social comparisons occur because the subjective weights of features differ as a function of the judgment that the participant is asked to make.

The phenomena discussed in this article are very similar to the phenomena investigated by Dunning and Parpal (1989), but there are also fundamental differences in how we define the research problem and approach its analysis. The differences are much easier to explain after describing our experimental design and results. We discuss the similarities and differences between our study of valence effects and Dunning and Parpal's (1989) study of mental addition and subtraction after we present our model and experimental results.

We propose a focus shift model to explain valence effects in strength of preference. This model builds upon previous research in several ways. First, the focus shift model distinguishes subsets of desirable and undesirable features of objects, much in the spirit of preference theories that distinguish gains from losses (Kahneman & Tversky, 1979, 1984). It assigns distinctive roles to the desirable and undesirable features of the options in a paired comparison choice. Second, we show that valence effects are associated with changes in the pattern of subjective weights for desirable and undesirable features. This analysis is analogous to the contingent weighting model of preference reversals according to which different preference tasks induce different patterns of weights for probabilities and outcomes (Tversky, Sattath, & Slovic, 1988).

A Focus Shift Model

For simplicity, let us start by considering a choice between a pair of options, option A and option Z. These options can be pairs of gambles, pairs of apartments, pairs of academic courses, and so on. We follow the notational convention of always designating the preferred option as A and the less preferred option as Z. Options A and Z can be represented as sets of desirable and undesirable features. Let us designate the desirable features of option A as A_{good}, the undesirable features of option A as A_{bad}, the desirable features of option Z as Z_{good}, and the undesirable features of option Z as Z_{bad}. These four sets of features are illustrated in Figure 1.

Let D_s denote the superiority rating, that is, the rating of how much better A is than Z. Similarly, let D_i denote the inferiority rating, that is, the rating of how much worse Z is than A. Our focus shift model describes the superiority ratings as

$$D_s = \alpha_s f(A_{\text{good}}) - \beta_s f(A_{\text{bad}}) - [\gamma_s f(Z_{\text{good}}) - \eta_s f(Z_{\text{bad}})], \quad (1)$$

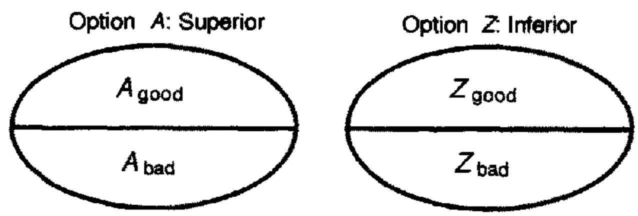

Figure 1. Terminology for feature subsets in the focus shift model.

where α_s and β_s are the weights for the desirable and undesirable features of option A, and γ_s and η_s are the corresponding weights for option Z. The contribution of each feature set to the judgment is represented by $f(\cdot)$. Likewise, the inferiority rating is

$$D_i = \alpha_i f(A_{\text{good}}) - \beta_i f(A_{\text{bad}}) - [\gamma_i f(Z_{\text{good}}) - \eta_i f(Z_{\text{bad}})], \quad (2)$$

where α_i and β_i are the weights for the desirable and undesirable features of option A, and γ_i and η_i are the corresponding weights for option Z. Note that Formulas 1 and 2 assert that the values of the feature sets $f(A_{\text{good}})$, $f(A_{\text{bad}})$, $f(Z_{\text{good}})$, and $f(Z_{\text{bad}})$ are the same for superiority and inferiority judgments. What changes are the weights assigned to these feature sets.

The focus shift model can be viewed as an extension of a feature contrast model of dissimilarity ratings. According to Tversky's (1977) model, the dissimilarity of object A to Z is described by Formula 3:

$$DisSim(A, Z) = \kappa f(A - Z) + \lambda f(Z - A) - \theta f(A \cap Z), \quad (3)$$

where $(A - Z)$, $(Z - A)$, and $(A \cap Z)$ denote the sets of features that are distinctive to A, distinctive to Z, and common to A and Z, respectively; κ, λ, and θ denote subjective weights associated with each subset. One difference between the focus shift model and the feature contrast model is that in the focus shift model, there is no counterpart to the subset $A \cap Z$ (see Figure 1). Although the focus shift model can be generalized to represent subsets of common features, the current version takes only distinctive features into consideration. In the experiments reported below, the stimuli never contain common features in their explicit descriptions, and common features that are implicit in the stimuli do not vary within the experiments (e.g., when the stimuli are descriptions of apartments, different descriptions never have common features and implicit common features of apartments do not vary in the experiment). Because there are no common features in our studies, Formula 3 can be rewritten as

$$DisSim(A, Z) = \kappa f(A) + \lambda f(Z) - \theta f(\phi) = \kappa f(A) + \lambda f(Z),$$

because $A \cap Z = \phi$ and $f(\phi) = 0$, assuming feature additivity.

Another difference between the focus shift model and the feature contrast model is that it divides the sets $(A - Z)$ and $(Z - A)$ into desirable and undesirable features (see Figure 1). Hence, we obtain the following:

$$DisSim(A, Z) = \kappa f(A_{\text{good}} \cup A_{\text{bad}}) + \lambda f(Z_{\text{good}} \cup Z_{\text{bad}})$$

Assuming that $f(\cdot)$ is additive over disjoint unions of feature sets, we obtain

$$DisSim(A, Z) = \kappa f(A_{good}) + \kappa f(A_{bad}) + \lambda f(Z_{good}) + \lambda f(Z_{bad}).$$

We generalize this hypothesis to allow for differential weighting of the desirable and undesirable features, thus,

$$DisSim(A, Z) = \kappa_1 f(A_{good}) + \kappa_2 f(A_{bad}) + \lambda_1 f(Z_{good}) + \lambda_2 f(Z_{bad}). \quad (4)$$

The formal resemblance between Formula 4 and Formulas 1 and 2 should now be clear. We should point out that Formula 4 represents a model of dissimilarity, whereas Formulas 1 and 2 represent models of difference judgment, and there may be substantive differences between dissimilarity and difference judgments. For example, it might be possible to add unique good features to both A and Z in such a manner as to leave the difference constant while increasing the dissimilarity. What we have shown in our derivation, however, is a formal analogy between the feature contrast model and the focus shift model.

One superficial difference between Formula 4 and Formulas 1 and 2 is that the weights for $f(A_{bad})$ and $f(Z_{bad})$ are $+\kappa_2$ and $+\lambda_2$ in Formula 4 whereas they are $-\beta_s$ and $-\eta_s$, and $-\beta_i$ and $-\eta_i$ in Formulas 1 and 2 respectively. This is not a fundamental difference because one has a choice between allowing $f(A_{bad})$ and $f(Z_{bad})$ to be negative, in which case the weights that multiply them should be positive, or else one can require that $f(A_{bad})$ and $f(Z_{bad})$ should be positive, in which case the weights that multiply them should be negative. We have chosen the latter representation, but either would be satisfactory.

The focus shift model analyzes valence effects as follows. By definition, a valence effect occurs when $D_s - D_i \neq 0$. Therefore, by Formulas 1 and 2, a positive valence effect ($D_s > D_i$) occurs whenever

$$(\alpha_s - \alpha_i)f(A_{good}) - (\beta_s - \beta_i)f(A_{bad}) > (\gamma_s - \gamma_i)f(Z_{good}) - (\eta_s - \eta_i)f(Z_{bad}). \quad (5)$$

Conversely, a negative valence ($D_s < D_i$) occurs whenever

$$(\alpha_s - \alpha_i)f(A_{good}) - (\beta_s - \beta_i)f(A_{bad}) < (\gamma_s - \gamma_i)f(Z_{good}) - (\eta_s - \eta_i)f(Z_{bad}). \quad (6)$$

Formulas 5 and 6 suggest a variety of configurations of subjective weights by which positive and negative valence effects could occur. For example, assuming that $f(A_{good}) > f(Z_{good})$ and $f(A_{bad}) < f(Z_{bad})$, a positive valence effect should occur if α_s is much greater than α_i, β_s is much smaller than β_i, and γ_s and η_s are roughly equal to γ_i and h_i, respectively. Clearly, there are many different patterns of weights that would produce positive or negative valence effects. Later, we show that positive and negative valence effects are associated with specific patterns of weights, and that other patterns that are capable of producing valence effects are not observed in actual judgments. For the moment, we note that Formulas 5 and 6 attribute the valence effects to patterns of weight changes (focus shifts) that would produce either $D_s > D_i$ or $D_s < D_i$. The essence of the focus shift model is that people focus on desirable and undesirable attributes differently, depending on the valence of the question, thereby producing systematic effects of question valence on strength of preference. A major purpose of this article was to determine empirically the pattern of focus shifts under different conditions.

It is interesting to note that the occurrence of a focus shift is plausible on the basis of the compatibility principle of Tversky, et al. (1988), but that the compatibility principle does not predict the direction of valence effects.

> According to [the compatibility principle], the weight of any input component is enhanced by its compatibility with the output. The rationale for this principle is that the characteristics of the task and the response scale prime the most compatible features of the stimulus. (Tversky et al., 1988, p. 376)

Applying this principle to the superiority and inferiority judgments, we would expect the "how much better" question to place greater emphasis on the desirable features of the superior option ($\alpha_s > \alpha_i$), because "how much better" is more compatible with the desirable features of the superior option than the "how much worse" question. Similarly, we would expect the "how much worse" question to place greater emphasis on the undesirable features in the inferior option ($\eta_s < \eta_i$), because "how much worse" is more compatible with the undesirable features of the inferior option than the "how much better" question.

We regard this pattern, $\alpha_s > \alpha_i$ and $\eta_s < \eta_i$, as the pattern of focus shifts predicted by the compatibility principle. It is not hard to see that these relations, $\alpha_s > \alpha_i$ and $\eta_s < \eta_i$, are not sufficient by themselves to predict the direction of valence effects. Depending on the values of β_s, β_i, γ_s, γ_i and $f(A_{good})$, $f(A_{bad})$ $f(Z_{good})$, and $f(Z_{bad})$, either positive or negative valence effects could occur. Thus, the compatibility principle does not predict whether positive or negative valence effects would occur but it does constrain the pattern of focus shifts that could produce either type of valence effect. We show in the experiments reported here that the pattern of focus shifts predicted by the compatibility principle does not generally occur.

Finally, we remark that the results we are about to report are correlational in nature. We show that specific patterns of weight shifts are associated with the positive or negative valence effects, but we cannot prove that the weight shifts cause the valence effects to occur. The difficulty is that we cannot manipulate weight shifts to observe the effects on valence, nor can we manipulate valence effects to observe their effects on regression weights. The value of our analysis lies in determining which patterns of weights are associated with valence effects out of the much larger variety of possible patterns that could produce such effects.

The next section introduces an experiment that allows us to estimate α, β, γ, and η for positive and negative valence questions. Our goal in Experiment 1 was to discover which patterns of subjective weighting lead to positive and negative valence effects.

Experiment 1

We chose gambles as a benchmark stimulus domain for a test of our model because of its central role in the literature of preferential choice (for a review, see Slovic, Lichtenstein, & Fischhoff, 1988). Table 1 shows an example of a stimulus pair used in Experiment 1. Choice situations were depicted as a choice between two six-outcome gambles, options A and Z. Participants were instructed to imagine that they could choose one of the options, then receive the reward based on a roll of a die. In every stimulus presentation, option A was preferable to Z because A gave greater payoffs or smaller losses for every face of the die. The dependent variables were participants' ratings of how much better A was than Z, and ratings of how much worse Z was than A. We planned to use multiple regression to investigate how the subjective weighting of each feature subset would change depending on the valence of the question.

Method

Stimuli. We chose two levels of A_{good} and two levels of A_{bad}, leading to four different A options. Likewise, we chose two levels of Z_{good} and two levels of Z_{bad}, leading to four different Z options. The stimuli consisted of all combinations of A and Z options, thereby creating a $2 \times 2 \times 2 \times 2$ design. The stimulus levels were chosen such that A was always superior to Z for every face of the die.

Material. Stimuli were presented in booklets. Each booklet consisted of four practice stimuli, followed by the 16 pairs of options. The booklets were prepared in two different random orders that were used for different groups of participants.

Procedure. Participants were required to take part in two sessions. Half of the participants gave superiority ratings in the first session and inferiority ratings in the second. The remaining participants gave the ratings in the opposite order. At the beginning of the first session, participants were informed that the gambles were hypothetical and that no actual monetary transaction would occur. They were then instructed on how to make ratings of degree of superiority or inferiority by placing marks on a line labeled "No Difference" at one end and either "Absolutely Better" or "Absolutely Worse" at the other end. After rating four practice stimuli, participants were presented with 16 pairs of options. For each pair, each participant was asked to state his or her preference and then give a rating for one of two questions: either "How much better is the option that you chose than the option that you did not choose?" or "How much worse is the option that you did not choose than the option that you chose?"

The participants received either 16 positive or 16 negative valence questions in a first block of trials, then performed a filler task. They then received a second block of 16 questions with the same valence as the first block. At the second experimental session, they received 16 questions of the opposite valence to that of the first session, followed by a filler task, followed by a second block of 16 questions of the opposite valence to that of the first session. Stimuli were presented in one of two random orders. We do not discuss the ordering further because analyses indicated no order effect. The participants' responses (marks on a response line) were converted to a 14-point rating scale by measuring the position of the mark (0 equals no difference and 13 equals the greatest difference). Note that this scoring procedure converted the response to the absolute magnitude of the difference rating in the sense that 13 was the maximum difference for both the superiority rating and the inferiority rating.

Participants. Participants were 32 University of Washington undergraduates who took part in the experiment for partial fulfillment of course requirements in an introductory psychology course.

Table 1
A Pair of Choice Options Used in Experiment 1

Number on die	Option A	Option Z
Die shows 1	Win \$35	Win \$5
Die shows 2	Win \$40	Win \$15
Die shows 3	Win \$55	Win \$20
Die shows 4	Lose \$5	Lose \$55
Die shows 5	Lose \$15	Lose \$65
Die shows 6	Lose \$20	Lose \$80

Results and Discussion

In Experiments 1–3, we discarded data from participants who responded in the following ways. First, the response scale was labeled with verbal categories, namely, "No difference," "Moderately Better [or Worse]," and "Absolutely Better [or Worse]." Some participants circled these verbal categories instead of marking the response scale. Second, some participants' responses were limited to only three positions on the response scale. Two participants in Experiment 1 could be described by one of these aberrant patterns of response, and their data were discarded. In addition, we checked whether any participants paradoxically preferred option Z to option A, but this preference never occurred in Experiment 1.

Thus, the effective sample size in Experiment 1 was 30 participants. The following analyses use as data the mean ratings across Blocks 1 and 2 within each participant and stimulus pair. Consequently, the data for each participant consisted of 16 superiority and 16 inferiority ratings, each datum actually being the mean of two ratings.

Analysis of stimulus pairs. Table 2 shows the mean superiority and inferiority ratings and paired t-tests for each stimulus pair. There were 12 positive valence effects, of which 1 was significant. There were 3 negative valence effects; none of them were significant. There was one case of indifference. Thus, the majority of valence effects were positive.

Valence effects at the individual participant level. We calculated paired t tests within each participant's data, contrasting superiority with inferiority ratings. Mean valence effects were positive for 17 participants, 13 of which were significant at the .05 level. Mean valence effects were negative for 13 participants, of which 10 were significant at the .05 level. Thus, both positive and negative valence effects were observed at the individual participant level.

Modeling superiority and inferiority ratings. For each participant, we performed separate multiple regressions for superiority and inferiority ratings. In these regressions, the values of $f(A_{good})$, $f(A_{bad})$, $f(Z_{good})$, and $f(Z_{bad})$ were set equal to the mean gains and mean losses for the A and Z options, respectively. For example, for the choice shown in Table 1, $f(A_{good}) = (35 + 40 + 55)/3$, $f(A_{bad}) = (5 + 15 + 20)/3$, $f(Z_{good}) = (5 + 15 + 20)/3$, and $f(Z_{bad}) = (55 + 65 + 80)/3$. The values of $f(A_{good})$, $f(A_{bad})$, $f(Z_{good})$, and $f(Z_{bad})$ then served as the predictor variables in our regression analyses. The regression for the superiority ratings yielded estimates of α_s, β_s, γ_s, and η_s, and the regression for the inferiority ratings yielded estimates of α_i, β_i, γ_i, and η_i.

Table 2
Observed Valence Effects per Stimulus Item in Experiment 1

Stimulus pair	Superiority	Inferiority	t	Stimulus pair	Superiority	Inferiority	t
1	9.02	8.20	1.54	9	9.92	9.53	0.69
2	9.82	9.54	0.72	10	10.55	10.58	−0.10
3	8.46	7.78	1.42	11	9.44	9.18	0.57
4	9.17	9.53	−1.02	12	9.65	8.92	1.74
5	8.14	7.49	1.17	13	9.34	7.60	4.66**
6	8.78	8.92	−0.41	14	9.57	9.12	0.68
7	7.82	7.40	0.90	15	8.77	8.08	1.57
8	8.29	7.79	1.15	16	9.10	9.10	0.00

Note. $N = 30$.
**$p < .01$.

The following analysis assumes that the response function is close to linear, given that the features in the stimuli lie fairly close to each other. Regression analyses are a heuristic tool for determining the impact of sets of variables as a function of the valence of the question. We do not regard multiple correlation coefficients as the main criterion for evaluating the focus shift model, for it is well known that false models can correlate highly with data (Birnbaum, 1973, 1974; Shanteau, 1977). Rather, we are attempting to use regression coefficients to detect qualitative effects of the valence of questions on the weighting of feature subsets. This strategy is similar to that of Slovic and Lichtenstein (1968).

The left panel of Figure 2 shows notched boxplots (McGill, Tukey, & Larsen, 1978) of the squared multiple correlation coefficient (R^2) for superiority and inferiority ratings in Experiment 1. The "whiskers" extend to the least and greatest observations that are not outliers. The top and bottom ends of oblique lines (notches) indicate upper and lower limits of 95% confidence intervals for the median. The top and bottom ends of the box represent the interquartile range, and the horizontal line within the box denotes the median. The first notched boxplot displays the distribution for the 30 individual participant regressions on the superiority ratings, and the second notched boxplot displays the corresponding regressions on the inferiority ratings. The quartiles were .65 and .82 for superiority ratings, and .61 and .74 for the inferiority ratings; the respective medians were .74 and .65. In general, the regressions explained a large proportion of the variance. For all 23 participants with significant valence effects, the direction of the effects was consistent between actual and predicted ratings.

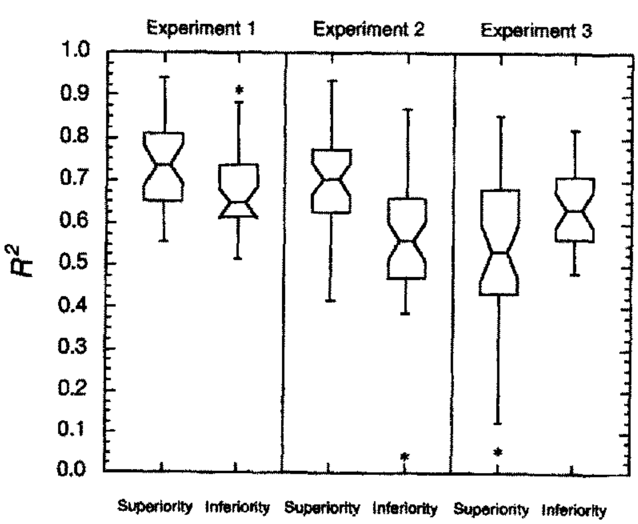

Figure 2. Notched boxplots of squared multiple correlations for model fitting in Experiments 1–3. Asterisks represent outliers.

For each participant, we estimated the difference in parameter estimates, $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$. The top panel of Figure 3 shows notched boxplots of the estimated parameter differences for the 13 participants whose valence effects were significantly positive. The differences were positive for α and η, whereas the differences of β and γ distributed around zero. These plots indicate that subjective weights associated with A_{good} and Z_{bad} were greater in the superiority judgments. Formula 5 shows that emphasis on A_{good} in superiority judgments (increase in $\alpha_s - \alpha_i$) should increase the positive valence effects by highlighting how good option A is. Similarly, the emphasis on Z_{bad} in superiority judgment (increase in $\eta_s - \eta_i$) should also increase the positive valence effects by highlighting how bad option Z is.

The bottom panel of Figure 3 shows notched boxplots of the estimated parameter differences for the 10 participants whose valence effects were significantly negative. The pattern is a mirror image of the top panel of Figure 3 reflected around zero. This trend can be understood as the inverse pattern to the case of positive valence effects. The emphasis on A_{good} and Z_{bad} in the inferiority judgments enhanced the negative valence effects by highlighting how much worse option Z was relative to A. Table 3 shows the mean and median values for $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$ over the 30 participants. Comparing these values to Figure 3, it is clear that the mean and median values are much closer to zero than the typical weight differences of individual participants. Thus, there were roughly equal numbers of positive and negative valence effects among the individual participants, corresponding to equal numbers of U-shaped and inverted U-shaped plots of the weight differences; therefore the central tendencies over the entire sample were close to zero. The notched boxplots of $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$ over the entire sample show medians that were close to zero, and boxes and whiskers that were much wider at α and η than at β and γ. We did not display the notched boxplots over the entire sample because it is less informative than Figure 3.

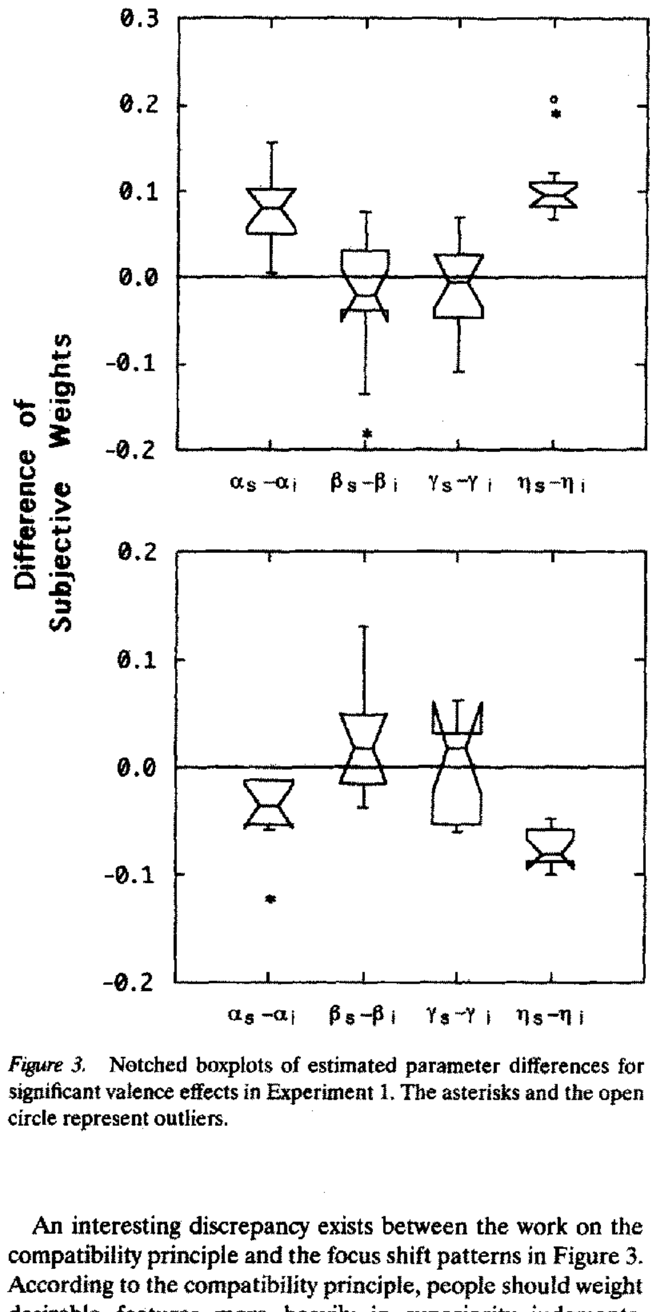

Figure 3. Notched boxplots of estimated parameter differences for significant valence effects in Experiment 1. The asterisks and the open circle represent outliers.

An interesting discrepancy exists between the work on the compatibility principle and the focus shift patterns in Figure 3. According to the compatibility principle, people should weight desirable features more heavily in superiority judgments, whereas they should weight undesirable features more heavily in inferiority judgments. In contrast to this idea, Figure 3 shows that participants with significantly positive valence effects had subjective weights that were heavier for α_s and η_s, and that participants with significantly negative valence effects had subjective weights that were heavier for η_i and α_i. Neither subset of participants displayed the pattern that would be predicted by the compatibility hypothesis, namely $\alpha_s > \alpha_i$ and $\eta_s < \eta_i$.

In Experiments 2 and 3, we attempt to replicate the findings in Experiment 1 in semantically richer domains of options. We chose descriptions of apartments and college courses as domains in which participants have more direct experiences than they do with gambles.

Experiment 2

We presented descriptions of hypothetical apartments as choice options in Experiment 2. Descriptions of hypothetical apartments were constructed by combining sets of desirable and undesirable features. The features in Experiment 2 were screened in a pilot experiment by participants who did not take part in any other experiments reported here. The features that passed the screening were ones that participants unanimously regarded as desirable or unanimously regarded as undesirable. Appendix A shows the apartment descriptions used in Experiment 2.

In constructing the stimuli, it was crucial to make sure that participants would unanimously prefer option *A* to option *Z*. The reason is that the focus shift model assigns different weights to the features in the preferred option and less preferred option. If some participants preferred *A* to *Z* in the first choice and others had the opposite preference, and if some other participants preferred *A* to *Z* in the second choice and others had the opposite preference in the second choice, and so forth, then the preferred and less preferred options would be different from participant to participant and item to item. Thus, it would become impossible to compare data fittings of different participants. Therefore, we tried to construct stimuli such that the *A* option would be unanimously preferred to the *Z* option. To achieve this purpose, apartment *A* was always given a larger number of desirable features (either three or four) and fewer undesirable features (either one or two), whereas apartment *Z* was always given a larger number of undesirable features (either three or four) and fewer desirable features (either one or two).

As in Experiment 1, we expected to observe positive valence effects when superiority and inferiority ratings were averaged across participants. At the same time, we expected that significantly positive and negative valence effects would occur at the individual participant level, and that these effects would be associated with differences in subjective weights for A_{good} and Z_{bad}.

Model Fitting and Parameter Estimation in Experiments 2 and 3

Unlike the gamble stimuli, the features of the apartments were qualitative features without preexisting scale values (e.g.,

Table 3
Mean and Median Values for the Estimates of the Differences of Subjective Weights

Subjective weights	$\alpha_s - \alpha_i$	$\beta_s - \beta_i$	$\gamma_s - \gamma_i$	$\eta_s - \eta_i$
Gambles				
M	0.01	0.08	−0.10	0.01
Mdn	0.01	0.09	−0.09	0.01
Apartments				
M	−0.33	−0.85	−0.28	−0.63
Mdn	−0.30	−0.27	−0.39	−0.53
Courses				
M	−0.34	0.18	0.30	−1.49
Mdn	−0.73	0.18	0.59	−1.54

the subjective worths of "clean and spacious" versus "has a nice view" were not known a priori). Therefore, it was necessary to revise the coding scheme by which we created the predictor variables for the regression models. To understand this coding scheme, it will be simplest if we describe it in terms of the specific features for the apartment stimuli (see Appendix A). The apartment descriptions in the option A column were all constructed from 10 features, 7 of which were desirable and 3 of which were undesirable. The apartment descriptions in the option Z column were all constructed from 10 features, 3 of which were desirable and 7 of which were undesirable. Note that there were no features in common to options A and Z. A specific choice between an option A and an option Z was created by selecting a subset of features for the A options and another subset of features for the Z options. In our regression model, each feature for A or Z corresponded to a separate predictor variable that could take on one of two values—one if the feature was present in the stimulus, and zero if the feature was absent from the stimulus.

Before computing the regressions, we further reduced the number of predictor variables by eliminating variables that were highly correlated with other predictor variables. Whereas logically there were 10 variables associated with the A option and 10 associated with the Z option, we reduced the analysis to 6 predictors for the A option and 5 for the Z option. By omitting all but 1 of any set of highly correlated variables, the correlations among the remaining predictor variables were reduced. The correlations among the predictor variables were not completely eliminated, but the data analysis below was designed to take the remaining correlations into account.

With this coding, the models described by Formulas 1 and 2 take on the forms

$$D_s = \alpha_{1s}f(A_{good_1}) + \alpha_{2s}f(A_{good_2}) + \alpha_{3s}f(A_{good_3}) + \alpha_{4s}f(A_{good_4}) + \cdots + \eta_{3s}f(Z_{bad_3}), \quad (7)$$

and

$$D_i = \alpha_{1i}f(A_{good_1}) + \alpha_{2i}f(A_{good_2}) + \alpha_{3i}f(A_{good_3}) + \alpha_{4i}f(A_{good_4}) + \cdots + \eta_{3i}f(Z_{bad_3}). \quad (8)$$

These formulas contain four A_{good} variables, two A_{bad} variables, two A_{good} variables, and three Z_{bad} variables. The value of $f(\cdot)$ is either zero or one depending on whether the feature in question is present or absent.

Because the regression analyses for Experiments 2 and 3 were based on correlated predictor variables, we calculated the mean of the regression weights for each of the subsets to produce a summary measure of the regression weights for a particular feature component. For example, we estimated α_s as $(\alpha_{1s} + \alpha_{2s} + \alpha_{3s} + \alpha_{4s})/4$ and made similar estimations for β_s, γ_s, and η_s, and α_i, β_i, γ_i, and η_i. It should be noted that each regression weight, α_{1s}, α_{2s}, α_{3s}, and α_{4s}, is the square root of the sums of squares uniquely explained by the corresponding predictor variable, $f(A_{good_1})$, $f(A_{good_2})$, $f(A_{good_3})$, and $f(A_{good_4})$, divided by the sums of squares of the predictor variable. Although the model suffers from multicollinearity, each weight estimate is a function of the sums of squares that are uniquely explained by a feature. The mean weight estimates for feature subsets obtained in this way are analogous to the weight estimates in Experiment 1 in that both measure the unique contribution of feature subsets to the variance in superiority or inferiority ratings.

We should point out that the presence of multicollinearity among the predictor variables is less problematic in the present regression analysis than in more typical uses of regression analysis. Typically, multicollinearity among predictors creates difficulties of interpretation when one is trying to compare regression models with different, possibly overlapping sets of predictor variables (Cohen & Cohen, 1983). In the present analysis, we are primarily interested in comparing a regression analysis of superiority judgments to a regression analysis of inferiority judgments. In each such comparison, the two regression analyses have exactly the same predictor variables because the stimuli were exactly the same in the tasks of rating superiority and inferiority. Therefore, the effects of multicollinearity were constant across the two regressions. Hence, if the regression analyses reveal differences in weights associated with a particular feature subset (e.g., A_{good}), these differences can only be attributed to question valence because the correlational structure of the predictor variables was constant across the regressions that are being compared.

Except for the methods for calculating mean feature weight, the rest of the data analysis procedure was the same as in Experiment 1.

Method

Stimuli and material. There were two levels of A_{good}, two levels of A_{bad}, two levels of Z_{good}, and two levels of Z_{bad}. Hence, there were 16 stimulus pairs. Consult Appendix A for the stimuli. As in Experiment 1, the stimulus pairs were presented in a booklet.

Procedure. The experimental procedure was the same as in Experiment 1. The only difference was in the coding of the responses. There were a few trials in which apartment Z was preferred over apartment A. In these cases, the rating was assigned a negative value. Hence, the response scale was a 27-point scale ranging from −13 (*apartment Z is absolutely better*) to 13 (*apartment A is absolutely better*).

Participants. Participants were 41 University of Washington undergraduates who participated in the experiment for partial fulfillment of course requirements in an introductory psychology course. Four participants failed to follow instructions and their data were discarded.

Results and Discussion

Analysis of stimulus pairs. Table 4 shows mean difference ratings and a paired t-test statistic for each stimulus pair. There were 11 positive valence effects, of which 2 reached significance. There were 5 negative valence effects, including 1 significant negative effect. As in Experiment 1, the majority of valence effects were positive.

Valence effects at the individual participant level. We calculated paired t tests that compared superiority to inferiority ratings within each participant's data. Mean valence effects were positive for 19 participants, of which 9 were significant at the .05 level. Mean valence effects were negative for 18

Table 4
Observed Valence Effects per Stimulus Item in Experiment 2

Stimulus pair	Superiority	Inferiority	*t*	Stimulus pair	Superiority	Inferiority	*t*
1	9.33	8.17	2.99**	9	9.15	7.91	2.26*
2	9.92	9.03	1.76	10	8.99	8.54	0.97
3	7.50	6.47	1.90	11	8.57	8.46	0.26
4	9.29	8.98	0.79	12	8.47	8.28	0.51
5	7.99	8.58	−1.06	13	7.98	7.32	1.13
6	8.53	8.54	0.15	14	8.35	8.51	−0.40
7	6.36	6.22	0.42	15	6.44	6.82	−0.53
8	8.49	8.61	−0.30	16	7.36	8.79	−3.72**

Note. $N = 37$.
*$p < .05$. **$p < .01$.

participants, of which 12 were significant at the .05 level. Again, both positive and negative valence effects were observed at the individual participants' level.

Modeling superiority and inferiority ratings. We fitted Formulas 7 and 8 within superiority and inferiority ratings, respectively, from each participant, and also within the mean ratings averaged across participants. The method of estimating the average regression weight for A_{good}, A_{bad}, Z_{good}, and Z_{bad} was previously described. We calculated the mean predicted valence effect from the fitted regression models for each participant. The mean predicted valence effects were in the same direction as the observed valence effects for all 21 participants with significant valence effects.

The middle section of Figure 2 shows notched boxplots of R^2 for superiority and inferiority ratings in Experiment 2. The first notched boxplot displays the distribution for the 37 individual participant regressions on the superiority ratings, and the second notched boxplot displays the corresponding regressions on the inferiority ratings. The quartiles were .62 and .77 for superiority ratings and .46 and .66 for the inferiority ratings; the respective medians were .70 and .56. In general, the regressions explained a moderate to large proportion of the variance.

Table 3 shows the mean and median values of $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$. Figure 4 shows notched boxplots of the differences in average regression weights, that is, plots of the estimates of $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$, where α_s, α_i, β_s, β_i, γ_s, γ_i, η_s, and η_i are average regression weights as previously described. The top panel of Figure 4 is restricted to participants with significantly positive valence effects, and the bottom panel is restricted to the participants with significantly negative valence effects. As in the gambles stimuli, the notched boxplot over the entire sample (not shown) has medians that are close to zero and greatest variance at α and η. Figure 4 shows that participants with positive valence effects typically weight A_{good} and Z_{bad} more heavily in the positive valence question ($\alpha_s - \alpha_i > 0$ and $\eta_s - \eta_i > 0$), whereas participants with negative valence effects typically weight A_{good} and Z_{bad} more heavily in the negative valence question ($\alpha_s - \alpha_i < 0$ and $\eta_s - \eta_i < 0$). In combination with Formulas 5 and 6, these results show that significant valence effects were associated with specific configurations of subjective weights.

Experiment 3

In Experiment 3, we used the descriptions of hypothetical college courses that appear in Appendix B. Each feature was selected by the same screening procedure as in Experiment 2. The desirable and undesirable features in the course stimuli were placed in a one-to-one correspondence with the desirable and undesirable features used in Experiment 2. Thus, the stimuli and experimental design in Experiment 3 were isomorphic to the stimuli and the experimental design in Experiment 2.

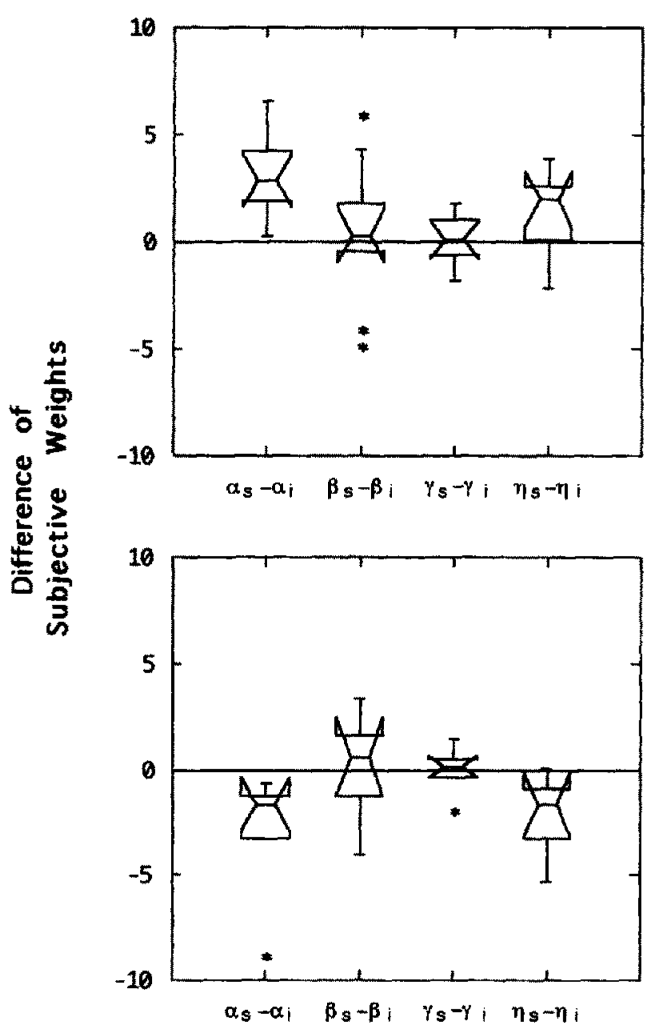

Figure 4. Notched boxplots of estimated parameter differences for significant valence effects in Experiment 2. Asterisks indicate outliers.

Method

Stimuli, material, and procedure. We used the same set of materials as in Experiment 2, except that the features and cover story pertained to hypothetical college courses. Consult Appendix B for these features. The experimental procedure was the same as in Experiment 2. Because the stimuli and experimental design were isomorphic in Experiments 2 and 3, the method of data analysis was also identical.

Participants. Participants were 34 University of Washington undergraduates who took part in the experiment for partial fulfillment of requirements in an introductory psychology course. Two participants failed to follow instructions and their data were discarded.

Results and Discussion

Analysis of stimulus pairs. Table 5 shows mean difference ratings and a paired *t*-test statistic for each stimulus pair. There were nine positive valence effects, of which two reached significance. There were seven negative valence effects, none of which was significant. As in Experiments 1 and 2, the majority of valence effects were positive, but not overwhelmingly so.

Valence effects at the individual participant level. We calculated paired *t* tests that compared superiority to inferiority ratings within each participant's data. Mean valence effects were positive for 17 participants, of which 10 were significant at the .05 level. Mean valence effects were negative for 15 participants, of which 6 were significant at the .05 level. Thus, both positive and negative valence effects were observed at the individual participant level.

Modeling superiority and inferiority ratings. We fitted Equations 7 and 8 and the average regression weights for A_{good}, A_{bad}, Z_{good}, and Z_{bad} by the procedure described in the analysis of the results from Experiment 2.

The right section of Figure 2 shows notched boxplots of R^2 for superiority and inferiority ratings in Experiment 3. The first notched boxplot displays the distribution for the 32 individual participant regressions on the superiority ratings, and the second notched boxplot displays the corresponding regressions on the inferiority ratings. The quartiles were .43 and .69 for superiority ratings and .56 and .71 for the inferiority ratings; the respective medians were .53 and .63. Again, the regressions explained a moderate to large proportion of the variance.

As in Experiment 2, the mean predicted valence effects were in the same direction as the observed valence effects for the 16 participants with significant valence effects. Table 3 shows the mean and median values of $\alpha_s - \alpha_i$, $\beta_s - \beta_i$, $\gamma_s - \gamma_i$, and $\eta_s - \eta_i$. Figure 5 shows notched boxplots of the differences in mean regression weights. The top panel of Figure 5 is restricted to the participants with significantly positive valence

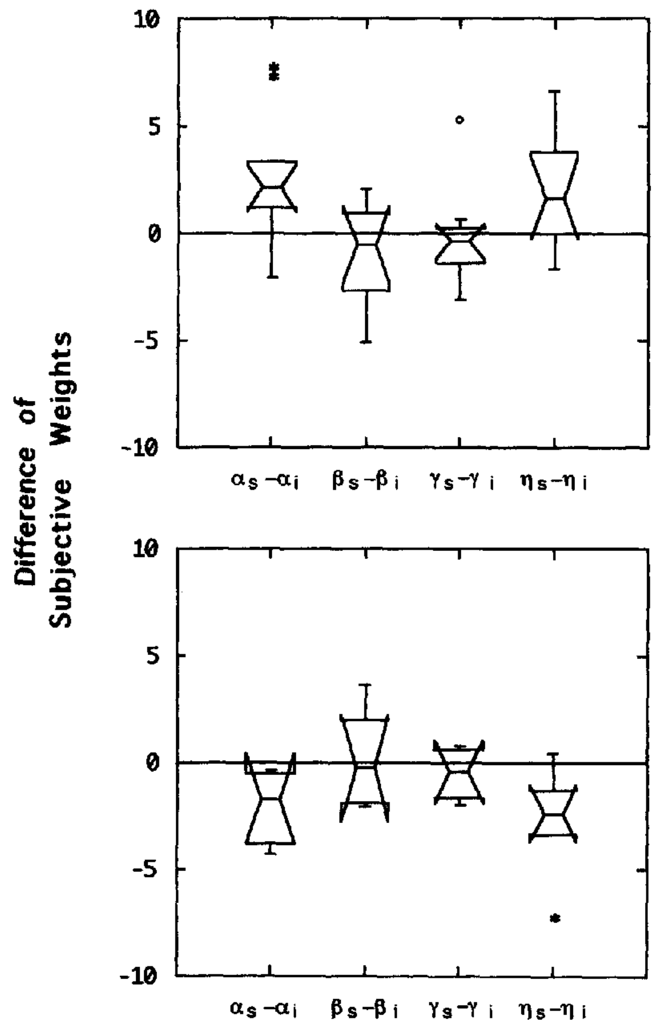

Figure 5. Notched boxplots of estimated parameter differences for significant valence effects in Experiment 3. Asterisks and the open circle indicate outliers.

Table 5
Observed Valence Effects per Stimulus Item in Experiment 3

Stimulus pair	Superiority	Inferiority	*t*	Stimulus pair	Superiority	Inferiority	*t*
1	7.22	7.52	−0.43	9	6.92	5.14	2.66*
2	7.97	7.25	1.06	10	6.84	6.73	0.15
3	6.42	5.44	1.47	11	6.67	7.39	−0.98
4	5.42	5.42	−0.09	12	7.84	8.19	−0.51
5	6.23	6.73	−0.86	13	3.68	4.92	−1.52
6	6.92	6.73	0.20	14	7.55	6.44	1.63
7	4.30	2.80	2.16*	15	4.44	6.04	−1.06
8	6.70	6.16	0.73	16	6.67	6.26	0.46

Note. $N = 32$.
*$p < .05$.

effects, and the bottom panel is restricted to the participants with significantly negative valence effects. The notched boxplot over the entire sample (not shown) has medians that are close to zero (See Table 3), and greatest variance at α and η. As was found in Experiment 2, the patterns in Figure 5 parallel the patterns in Figures 3 and 4. We discuss the similarity in pattern below, when we compare Experiments 1, 2, and 3.

The Pattern of Focus Shift in Experiments 1, 2, and 3

We are now in a position to compare the pattern of focus shift across the three experiments. The notched boxplots shown in Figures 3–5 are all based on the regression weights of the individual participants. The most striking feature of these notched boxplots is the U-shaped pattern for the participants with significantly positive valence effects (the top panels of Figures 3–5) and the inverted U-shaped pattern for the participants with significantly negative valence effects (the bottom panels of Figures 3–5). Furthermore, in all plots, the differences in average β and γ weights (A_{bad} and Z_{good}, respectively) were close to zero, whereas the differences in α and η weights were substantially different from zero.

Looking back at Formulas 5 and 6, it is clearly possible for positive or negative valence effects to result from a variety of parameter configurations. However, our results show that positive and negative valence effects were associated with specific patterns of changes in the subjective weights. Positive valence effects were associated with a decrease in the weight given to A_{good} and Z_{bad} as the question valence shifted from positive to negative. Negative valence effects showed exactly the opposite pattern: The weight given to A_{good} and Z_{bad} increased as the question valence shifted from positive to negative. As noted in the discussion of Experiment 1, the pattern found in Figures 3–5 is inconsistent with the compatibility principle. The "how much better" question would appear to be more compatible with the emphasis on feature sets of the superior option, A_{good} and A_{bad}, or with the desirable feature sets, A_{good} and Z_{good}. Conversely, the "how much worse" question would appear to be more compatible with emphasis on the feature sets of the inferior option, Z_{good} and Z_{bad}, or with the undesirable feature sets, A_{bad} and Z_{bad}. In contrast, participants with positive valence effects emphasized A_{good} and Z_{bad} in response to the "how much better" question, and participants with negative valence effects emphasized A_{good} and Z_{bad} in response to the "how much worse" question.

Methodological Issues in Experiments 1, 2, and 3

In fitting regression models to the data from Experiments 1, 2, and 3, we assumed that ratings were a linear function of the predictor variables (mean gains and losses in Experiment 1, or feature codes in Experiments 2 and 3). It is possible, however, that the ratings were only an ordinal measure of strength of preference and that the ratings would have to be transformed nonlinearly to perform a valid regression analysis. We checked for this possibility by repeating our analysis after taking a logarithmic transformation of the rating data. The results showed a similar pattern at the group and individual levels, but the proportion of explained variance was lower. Therefore, we reported the results from untransformed data. To avoid the assumption of a linear response function, it is necessary to axiomatize the focus shift model and to test the axiomatization. We have not attempted this type of analysis in Experiments 1–3.

An alternative account of valence effects could be based on the hypothesis that strength of preference remains the same in response to positive and negative valence questions, but that there exist two different response functions, one for superiority judgments and another for inferiority judgments. We would mention, however, that Yamagishi (1994) gathered superiority and inferiority judgments using stimuli similar to those in Experiment 3. His analysis showed that the rank order of subjective differences was systematically different in response to positive and negative valence questions. This finding shows that differences in response to positive and negative valence questions cannot be explained by a nonlinear but monotonic transformation of response function. We have not presented this kind of analysis here because it digresses from the main issues of this article.

Experiment 4

Although in Experiments 1–3, valence effects at the group level were generally positive, it was also clear that a substantial number of participants produced systematic negative valence effects. Under what conditions are negative valence effects likely to be prevalent? Are there domains that naturally tend to produce positive valence effects and other domains that naturally lead to negative valence effects? To answer these questions, let us first consider the relationship between our concepts of positive and negative valence questions and Dunning and Parpal's (1989) concepts of additive and subtractive frames.

For Dunning and Parpal (1989), mental addition is associated with the question of whether an outcome would produce more of an attribute, and this question is orthogonal to the issue of whether the attribute is desirable or undesirable. Statements a and b in Table 6 are paraphrases of mental addition examples in Dunning and Parpal. Both questions ask how much more of an attribute would be present in a given circumstance. Statements c and d in Table 6 are paraphrases of

Table 6
Conceptual Contrast Between Mental Addition / Subtraction and Valence Effects

Positive valence	Negative valence
Mental addition	
a How much more likely is it that you will be accepted at your first choice job given that you go to Cornell?	b How much more likely would you be to be rejected at your first choice job if you had gone to another school?
a′ How much better is the preferred option?	b′ How much worse is the less preferred option?
Mental subtraction	
c How much less likely is it that you will be rejected at your first choice job given that you go to Cornell?	d How much less likely would it have been that you would be accepted at your first choice job given that you went to another school?
c′ How much less bad is the preferred option?	d′ How much less good is the less preferred option?

mental subtraction examples taken from Dunning and Parpal. Both questions ask how much less of an attribute would be present in a given circumstance. In our terminology, however, statements a and c are positive valence questions because they ask how much greater is the more desirable outcome, and statements b and d are negative valence questions because they ask how much less is the less desirable outcome.

Now consider statements a′ and b′, the positive and negative valence questions used in our experiments. In Dunning and Parpal's (1989) terminology, both statements involve mental addition because statement a′ asks how much more goodness and statement b′ asks how much more badness are present in the superior and inferior options, respectively. Statements c′ and d′ are the mental subtraction counterparts of statements a′ and b′. As one can see, statement c′ suggests that both options are bad, and asks how much less bad is the preferred option. Statement d′ suggests that both options are good and asks how much less good is the preferred option. In addition, statements c′ and d′ are odd questions in that the corresponding statements a′ and b′ would generally be preferred as the way to ask the logically equivalent questions. We did not use mentally subtractive statements in our experiments because they are conceptually awkward and would have carried presuppositions that we did not want to introduce into our stimuli.

Dunning and Parpal (1989) conjectured that mental addition always exceeds mental subtraction, or in terms of observable relations, that ratings of how much more of an attribute would be present should exceed ratings of how much less of an attribute would be present. The question we ask, however, is orthogonal to this prediction, namely, do positive and negative valence questions interact with the domain when both questions require mental addition? An examination of Dunning and Parpal's results suggests the following generalization: When the attribute in question was itself desirable, a positive valence effect was observed, and when the attribute in question was itself undesirable, a negative valence effect was observed. For example, Dunning and Parpal (Table 5) found that the mean rating of statement a (17.2) exceeded the mean rating of statement b (13.9), thus exhibiting a positive valence effect for the likelihood of being accepted at the first-choice job. The mean rating of statement c (10.0) was slightly less than the mean rating of statement d (10.6), thus exhibiting a negative valence effect for the likelihood of being rejected at the first-choice job. Examination of other examples in Dunning and Parpal also suggests a pattern of positive valence effects when the attribute in question was desirable and negative valence effects when the attribute in question was undesirable. We should mention that in some of Dunning and Parpal's questions it is difficult to determine whether participants would regard the attribute as desirable or undesirable; for example, is the attribute of "pressure" a desirable or an undesirable attribute in the question "How much more pressure would you feel in classes at Cornell?"

Experiment 4 was designed to provide a direct test of the hypothesis that positive valence effects will be observed when the options are drawn from a domain that is predominantly desirable, and that negative valence effects will be observed when the options are drawn from a domain that is predominantly undesirable. In Experiment 4, we selected domains that undergraduates would generally regard as either clearly desirable or clearly undesirable, and tested for valence effects within these domains.

Method

Material. A questionnaire was handed out to each participant. The first part of the questionnaire explained the judgments of "better" and "worse." The participants then made two choices between two pairs of practice stimuli. In each choice, the participant indicated which option was preferred, rated how much better was the superior option, and rated how much worse was the inferior option. Following the practice items, participants were presented with the actual experimental stimuli, consisting of pairs of options that were drawn from clearly desirable or clearly undesirable domains. The intrinsically pleasant domains were the following: being allowed to participate in special university seminars (hereafter, Seminar), foreign travels (Travel), parties (Party), and high-quality vacations (Vacation). The intrinsically unpleasant domains were the following: choosing between life-threatening cancer treatments (Cancer Treatment), choosing between different illnesses (we administered two choices between pairs of illnesses, Illness Pair 1 and Illness Pair 2), choosing a way to kill time in a deserted place (Killtime), and choosing between different residences in an unsafe neighborhood (BadArea). The descriptions of choice options appear in Appendix C.

Participants. Participants were 712 University of Washington undergraduates who were enrolled in introductory psychology courses. Fifty-three participants were assigned to the Seminar group, 160 to Vacation, 159 to Party, 55 to Travel, 47 to Illness Pair 1, 44 to Illness Pair 2, 44 to Killtime, 47 to BadArea, and 103 to Cancer Treatment.

Procedure. Data were gathered in a large group setting in which many different questionnaire studies were administered. The materials pertaining to the present experiment were randomly assigned to a sample of participants along with materials for other studies on other topics. Our questionnaire consisted of two practice items followed by a single test problem. The practice items were two choices among monetary gambles. After making each choice, the participant was asked to judge "How much better was the preferred gamble?" and "How much worse was the less preferred gamble?" The order in which these latter questions were asked was counterbalanced. After responding to the practice items, the participant received one of the task problems in Appendix C. The participant stated their preference for one of the two options in the problem and then provided superiority and inferiority ratings on a 16-point scale that ranged from 0 (*no difference*) to 15 (*maximum difference*). The exact wording of the questions for superiority and inferiority ratings was the same as in Experiments 1–3. The order of superiority and inferiority judgments was counterbalanced across participants.

Results and Discussion

Unlike in Experiments 1–3, we did not know a priori in this experiment whether option A or Z would be preferred. In fact, some participants did prefer option A, and other participants did prefer option Z. Nevertheless, the direction of the valence effect was consistent regardless of choice. For instance, in Vacation, 134 participants chose A, whereas 26 chose Z. Both the former and the latter groups of participants showed significantly positive valence effects, $t(133) = 12.08$, $p < .01$, and $t(25) = 4.13, p < .01$, respectively. The preference for A or Z, as well as the interaction between the preference and the magnitude of the valence effect, failed to reach significance, $F(1, 157) = 2.14$ and 1.61, respectively. Because the Vacation pair exhibited a significant main effect of valence and no interaction effect, it makes sense to report these results simply as a significant positive valence effect without distinguishing between the two types of preferences, for A and for Z. Similar findings were observed for all other choice pairs; hence, we report the valence effects collapsing over the preference for A or Z.

Figure 6 shows notched boxplots of $D_s - D_i$ for all individual participants. As predicted, the vast majority of values for $D_s - D_i$ were greater than zero for stimuli sampled from intrinsically pleasant domains and less than zero for stimuli sampled from intrinsically unpleasant domains. Table 7 shows the mean superiority and inferiority ratings, as well as paired t-test statistics. In every case, positive valence effects were evident in the pleasant domains, and negative valence effects were evident in the unpleasant domains. The t-value column shows that all but one of the effects were significant by two-tailed, paired t-tests. Although the negative valence effect in Killtime just failed to reach significance, the valence effect was negative, as predicted. These results support the hypothesis that positive valence effects are found when the domain is regarded as intrinsically pleasant and negative valence effects are found when the domain is regarded as intrinsically unpleasant.

General Discussion

The findings of Experiments 1–4 demonstrate unequivocally that valence effects occur in judgments of superiority and inferiority. This finding is inconsistent with traditional psychophysical theories of subjective difference, according to which psychological differences are quantified by a single invariant scale $\psi(\cdot)$ (Garner, 1954; Torgerson, 1961). In other words, if x and y are any pair of stimuli (e.g., two tones differing only in intensity); $\psi(x) - \psi(y)$ is the hypothesized psychological measure of subjective difference. What the valence effect shows is that for complex, multiattribute stimuli, the strength of preference cannot be represented by a single scale $\psi(\cdot)$. Rather, the value assigned to a stimulus (gamble, apartment, academic course, etc.) depends on the valence of the question (i.e., how much better is the superior option or how much worse is the inferior option). Of course, traditional psychophysics was primarily concerned with the measurement of subjective magnitude for simple sensory stimuli like pure tones varying in intensity, monochromatic lights varying in intensity, weights varying in mass, and so forth. The valence effects found in the present experiments make use of stimulus domains that are different from the traditional domains of sensory continua. Therefore, our findings do not directly conflict with traditional theories of psychological difference.

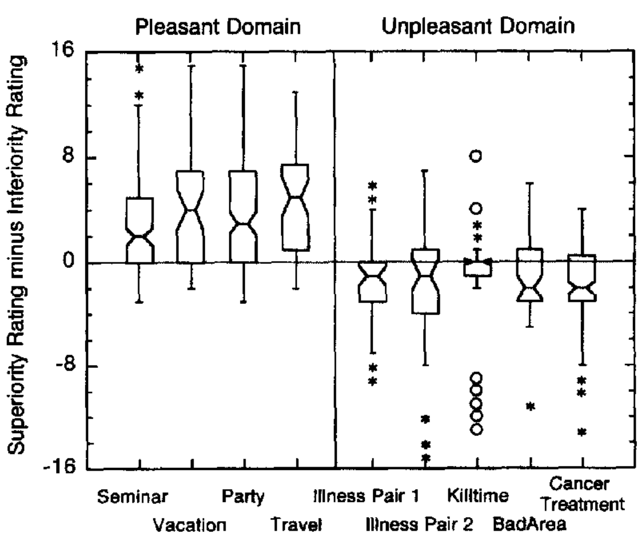

Figure 6. $D_s - D_i$ for each participant in Experiment 4. Asterisks and open circles represent outliers.

Table 7
Mean Superiority Ratings, Inferiority Ratings, and t Values in Experiment 4

Stimulus pair	Superiority	Inferiority	t	*df*
Seminar	8.77	4.71	7.19**	52
Vacation	10.48	7.42	10.29**	159
Party	11.13	7.30	12.71**	158
Travel	9.94	5.48	8.78**	54
Illness Pair 1	8.23	9.15	−2.23*	46
Illness Pair 2	9.32	10.59	−2.12*	43
Killtime	6.14	7.16	−1.76	43
BadArea	7.36	8.30	−2.70*	46
Cancer Treatment	9.33	10.60	−5.10**	102

Note. $N = 712$.
$^*p < .05$. $^{**}p < .01$.

The focus shift model helps us to determine the pattern of changes in the subjective weights that are associated with positive and negative valence effects. Although Formulas 5 and 6 imply that valence effects could be produced by a variety of weight configurations, the empirical results, especially those represented in Figures 3–5, show that valence effects are actually associated with specific patterns of weight shifts. Positive valence effects are associated with a U-shaped plot of the changes in the regression weights, and negative valence effects are associated with an inverted U-shaped plot. What this means is that for both positive and negative valence effect participants, the focus on the A_{bad} and Z_{good} components did not shift much between the positive and negative valence questions. The main difference between positive and negative valence participants occurred in the shift in focus on the A_{good} and Z_{bad} components. For the positive valence participants, the weights for A_{good} and Z_{bad} were greater in the superiority judgment, whereas for the negative valence participants, these weights were greater in the inferiority judgment.

The finding of the U- and inverted-U-shaped patterns in the results for participants with positive and negative valence effects, respectively, is at least somewhat inconsistent with Tversky et al.'s (1988) compatibility principle. The question of how much better a superior option is would seem to be compatible with either the features of the superior option, that is, A_{good} and A_{bad}, or with the desirable features of both options, that is, A_{good} and Z_{good}. Under either interpretation of compatibility, one would predict that $\alpha_s > \alpha_i$ and $\eta_s < \eta_i$. In contrast to this prediction, the positive valence questions were associated with greater emphasis on A_{good} and Z_{bad} in the positive valence participants and reduced emphasis on A_{good} and Z_{bad} in the negative valence participants. In other words, participants with significantly positive valence effects typically had $\alpha_s > \alpha_i$ and $\eta_s > \eta_i$, and participants with significantly negative valence effects typically had $\alpha_s < \alpha_i$ and $\eta_s < \eta_i$.

Thus, the patterns for the positive and negative valence effects appear inconsistent with the compatibility principle.

Why did some participants have systematic positive valence effects and other participants have systematic negative valence effects? In terms of the focus shift model, why was the shift in weight U-shaped for some participants and inverted-U-shaped for other participants? Although we cannot yet characterize the difference between these two types of participants, Experiment 4 provided an interesting clue for understanding the difference. Experiment 4 gave us a clear indication that positive valence effects are associated with domains of desirable outcomes and negative valence effects are associated with domains of undesirable outcomes. In Experiments 1–3, the stimulus domains could not be categorized a priori as desirable or undesirable. We speculate, however, that participants who produced positive valence effects viewed the stimuli in these experiments as generally desirable, whereas others who produced negative valence effects viewed these stimuli as generally undesirable. Taken together, the results from Experiment 4 and our speculation suggest that the principle of compatibility may operate between the attitude towards the particular domain and the valence of the question, rather than between the specific feature components of choice alternatives and the valence of the question. In other words, the "how much better" question is more compatible with a domain that is perceived as generally desirable, and the "how much worse" question is more compatible with a domain that is perceived as generally undesirable, and it is this correspondence that is associated with positive and negative valence effects. Further work is required to resolve these issues.

The judgment phenomena and theoretical analysis that were discussed here are closely related to several other research problems in the theory of preference. Before we discuss relations between the focus shift model and these problems, we should first point out that the focus shift model pertains to strength of preference, whereas the work we are about to discuss pertains to preferential choice. In other words, our work pertains to judgments of how strongly one prefers one option over another, whereas much of the related work pertains to the choice of a preferred option or rejection of a less preferred option from an offered set. Because of this difference in domain, we can only speak of plausible connections between our work and work in preferential choice. In the absence of a bridging theory that encompasses both domains, one cannot derive tight predictions from the focus shift model that either conflict with or support models of preferential choice. Here, we discuss phenomena and theories that are related to the focus shift model, but we remark from the outset that our remarks are based primarily on plausible relations rather than a well-developed theory that encompasses both strength of preference and preferential choice.

Shafir (1993) discovered an asymmetry in choice and rejection that is strongly analogous to our work, both in empirical findings and in underlying cognitive mechanisms. To describe this asymmetry, suppose that B and Y are multiattribute options, with B being a mixture of highly desirable and highly undesirable features and Y being a mixture of somewhat desirable and somewhat undesirable features. Shafir found that for appropriately chosen stimuli, participants would both choose B when offered B and Y and reject B when asked to eliminate one of the options, B or Y. Evidently, this pattern is paradoxical, for the choice of B out of the set $\{B, Y\}$ is logically equivalent to the rejection of Y out of the same set. Shafir explained this pattern of choice–rejection in terms of a feature decomposition that is much like the one we have adopted in the focus shift model together with a shift in the weights assigned to feature components. Invoking the compatibility principle, Shafir predicted that the desirable features of the options would be more heavily weighted in choice and the undesirable features would be more heavily weighted in rejection. Therefore, he predicted that the highly desirable features of B would lead to its choice in the choice task, and the highly undesirable features of B would lead to its elimination in the rejection task.

Houston, Sherman, and Baker (1989) proposed that effects of presentation order on preferential choice could be modeled by differential weighting of the features of the choice options. Specifically, suppose that choice options are presented sequentially, with the first option, C, to be treated as the subject of the comparison, and the second option, X, to be treated as the target of the comparison. Houston et al. hypothesized that the unique features of the subject receive greater weight than the unique features of the target. Therefore, if the unique features of both the subject and the target are desirable, this task should produce a preference for C over X. If the unique features of both the subject and the target are undesirable, this task should produce a preference for X over C. These predictions were supported in experiments in a variety of stimulus domains.

The focus shift model has much in common with theoretical analyses proposed by Shafir (1993) and Houston et al. (1989). All three analyses assume a decomposition of options into common and distinctive features, and cross-cutting this decomposition is a distinction between desirable and undesirable features. Furthermore, all three analyses propose that the weights assigned to different subsets of features are influenced by the specific judgmental task. In all of the analyses, the observed pattern of preference behavior is derived from a hypothesized pattern of weights as applied to the feature components of stimuli. Clearly, this line of theory construction has its roots in Tversky's (1977) contrast model of similarity and Kahneman & Tversky's (1979) prospect theory. The contrast model emphasized that the similarity between objects might be a function of the common and distinctive features of the objects, and the transfer of this representation hypothesis to preferential choice is straightforward. Prospect theory emphasized the important distinction between gains and losses in preference under risk. The distinction in the focus shift model and in Shafir (1993) and Houston et al. (1989) between the desirable and undesirable features of objects is highly analogous to gains and losses in monetary risks.

Finally, we note that the contrast between judgments of "how much better" and "how much worse" is rather analogous to the judgments that were previously investigated under the rubric of the semantic congruity effect (Banks et al. 1975).[11] Recall that Banks et al. presented participants with an abstract drawing of a pair of circles located at different heights that

[11] This analogy was pointed out to us by Thomas Wallsten (personal communication, November, 1990), as well as by anonymous reviewers.

were connected to the bottom of the picture frame by a straight bar. The correct reaction time was reliably shorter when the question asked "Which balloon is higher?" than "Which balloon is lower?" When the picture was inverted, the correct reaction time was shorter to the question "Which yo-yo is lower?" than to "Which yo-yo is higher?". Thus, "Which is higher?" elicited a shorter reaction time in an intrinsically high domain, and "Which is lower?" elicited a shorter reaction time in an intrinsically low domain. Although it is clear that these phenomena are analogous to the findings in Experiment 4, it is not clear whether the processes producing these phenomena are similar. In particular, models for the semantic congruity effect are intended to predict the conditions under which a judgment of greater or lesser will be faster, whereas the focus shift model attempts to specify the condition under which similar judgments will be rated as larger or smaller. We leave it for further investigation to determine whether these phenomena are produced by similar cognitive representations or processes.

Whether there can be a larger unifying theory that explains the various phenomena discussed here is an open question. One approach to explaining these phenomena might attempt to account for the effects of preference task and stimulus presentation on the relative weight assigned to components of the stimuli. It has been proposed that preferential choice, pricing of options, decisions to reject, and the valence of strength-of-preference judgments all affect the relative weight of feature components (Shafir, 1993; Slovic, Griffin, & Tversky, 1990; Tversky et al., 1988). Other theorists have proposed that changes in the task affect the actual process of information integration as opposed to the weights assigned to feature components (Mellers, Ordóñez, & Birnbaum, 1992). What one seeks are general psychological principles like the compatibility principle and an information processing mechanism that jointly predict the diverse effects of task and stimulus structure.

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Appendix A

Apartment Descriptions Used in Experiment 2

Option A Apartments

The building is new and well maintained.
The room is clean and spacious.
The residents in the apartment are friendly.
The parking costs extra $25 per month.

The building is new and well maintained.
The room is clean and spacious.
The residents in the apartment are friendly.
The apartment is distant from shopping areas.
The kitchen does not have a refrigerator.

The landlord is honest and friendly.
The apartment is 4 blocks from the University.
There are no bugs and mice in the apartment.
The rent is $220 per month.
The parking costs extra $25 per month.

The landlord is honest and friendly.
The apartment is 4 blocks from the University.
There are no bugs and mice in the apartment.
The rent is $220 per month.
The apartment is distant from shopping areas.
The kitchen does not have a refrigerator.

Option Z Apartments

The room has a nice view.
The apartment has a convenient access to shopping areas.
The apartment is 18 blocks from the University.
The residents in the apartment are unfriendly.
The kitchen does not have a refrigerator.
The traffic around the apartment is always noisy.

The room has a nice view.
The apartment has a convenient access to shopping areas.
The building is old and poorly maintained.
Four residents have to share a bathroom.
The landlord is unfriendly.

The kitchen has a microwave oven.
The apartment is 18 blocks from the University.
The residents in the apartment are unfriendly.
The kitchen does not have a refrigerator.
The traffic around the apartment is always noisy.

The kitchen has a microwave oven.
The building is old and poorly maintained.
Four residents have to share a bathroom.
The landlord is unfriendly.

Appendix B

Course Descriptions Used in Experiment 3

Option A Courses

The professor is friendly.
The TA understands students' difficulties.
The TA is helpful.
Four hours of work are required daily.

The professor is friendly.
The TA understands students' difficulties.
The TA is helpful.
Three essays are required weekly.
The lectures are disorganized.

The TA is knowledgeable.
The professor is serious about students' progress.
Student evaluations of the course are usually excellent.
The textbook is simple and informative.
Four hours of work are required daily.

The TA is knowledgeable.
The professor is serious about students' progress.
Student evaluations of the course are usually excellent.
The textbook is simple and informative.
Three essays are required weekly.
The lectures are disorganized.

Option Z Courses

The class has relaxed atmosphere.
Reading load is light.
The textbook has lots of irrelevant information.
The TA does not understand students' difficulties.
The professor is unfriendly.
The required textbook costs $120.

The class has relaxed atmosphere.
Reading load is light.
The professor does not care about students' progress.
The TA is ignorant about course contents.
Student evaluations of the course are usually poor.

The lecture is well organized.
The textbook has lots of irrelevant information.
The TA does not understand students' difficulties.
The professor is unfriendly.
The required textbook costs $120.

The lectures are well organized.
The professor does not care about students' progress.
The TA is ignorant about course contents.
Student evaluations of the course are usually poor.

(*Appendix C follows on next page*)

Appendix C

Stimuli in Experiment 4

Seminar

Suppose that you have the chance to take one of two seminars which are being offered on a special, experimental basis to a select group of undergraduates. You are given the choice between the following two seminars.

Course A

The content is directly related to your interests.
Experienced people have told you that taking this course will look good on your record.
The typical student in this seminar is a serious student who has high career aspirations.
The meeting time for this seminar is very convenient for your schedule.

Course Z

Taught by a Nobel laureate who is known to be a friendly person.
Students who have taken this seminar have told you that it was one of the best educational experiences that they ever had.
A good friend of yours will be taking this seminar.
The meeting time for this seminar is reasonably convenient for your schedule.

Vacation[C1]

Suppose that you are going to purchase a vacation travel. Your travel agency recommends Option A and Option Z. They are almost identical to each other, except for the differences listed below.

Option A

Good Hiking Available
Plenty of Good Party Spots
Beautiful Scenery
Good Restaurants
Attractive Beach

Option Z

Good Museums
Lots of Outdoor Sports

Party

Suppose that you are about to go to a social gathering. Because you need some spare time to work, you can allow yourself to go to one party. Your friends told you that each party would have the following atmosphere:

Party A

Nice Food
Exciting People
Fun Games
Live Music

Party Z

Good Pool Table
Good Selection of Pops/Beverage

Travel

Suppose that you have won an all-expense-paid foreign travel for two as a prize in a contest. According to the rules of the contest, you can choose to take your travel in either Country A or Country Z, as described below. To which country would you rather go?

Country A

The national cuisine is excellent, and it suits your taste.
The country has many great art museums containing priceless masterpieces by world-renowned artists.
The main city of the country is famous for a sophisticated night life.
You will be able to visit places where historically important events took place.

Country Z

The culture is exotic and very colorful.
The culture is very different from American and European culture.
There are opportunities to hike in wild environments where many varieties of unusual animals can be seen.
The cost of living is low, and you will be able to buy inexpensive, high-quality items that are hard to find in the U.S.
There are several spectacularly beautiful ocean beaches that will be accessible to you.

Illness Pair 1[C2]

The following descriptions are taken from a study of the quality of life for older patients with different kinds of health problems. We would like you read these scenarios, and evaluate how difficult life would be if you had to experience these combinations of symptoms.

Condition A

I am able to work. Over the past year I have noticed a feeling of tiredness and I have lost 20 pounds in weight. I have little energy and I am unable to keep up with my usual routine. I have made an effort to walk to work but I have let the house and hobbies "slide." I am sleeping poorly. I am maintaining my present weight.

Condition Z

I have been tired and weak and unable to work. I have lost 15 pounds in weight. I walk slowly and travel outside the house is difficult. Much of the day I am alone, lying down in my bedroom. Social contact with my friends is reduced.

Illness Pair 2[C2]

The following descriptions are taken from a study of the quality of life for older patients with different kinds of health problems. We would like you read these scenarios, and evaluate how difficult life would be if you had to experience these combinations of symptoms.

[C1] The features used in the Vacation scenario were taken from "The influence of unique features and direction of comparison on preferences," by D. A. Houston, S. J. Sherman, and S. M. Baker, 1989, *Journal of Experimental Social Psychology, 25,* p. 125. Copyright 1989 by Academic Press. Adapted with permission.

[C2] The descriptions of symptoms in Illness Pairs 1 and 2 were taken "Measurement of values for states of health with linear analog scales," by H. J. Sutherland, V. Dunn, and N. F. Boyd, 1983, *Medical Decision Making, 3,* p. 479. Copyright 1983 by Hanley & Belfus. Reprinted with permission.

Condition A

I am unable to work. I am tired and sleep poorly due to discomfort in my back and arm. I am worried about my health and finances. I am able to drive my car and I make an effort to walk about my neighborhood.

Condition Z

I live alone and am confined to my home. During the past six months I have lost 35 pounds in weight. I am only able to eat small amount of food at present and I vomit occasionally. I am tired and weak and walk with the aid of a walker. I require assistance to get into and out of the bathtub. Social contact with my friends and family is infrequent.

Killtime

Suppose that you are traveling across the country by airplane. Because of an airlines strike, you get stranded in an airport at 2:00 a.m. You are told that you will simply have to wait for a minimum of six hours (perhaps longer). Furthermore, because it is 2:00 a.m., none of the usual airport restaurants or newsstands are open. You have to decide what to do with the next six hours at this unfamiliar airport.

Option A

Try to get some sleep on a couch.
If you can't sleep, try to study a textbook that you have with you.
If you can't sleep, try to write a letter to a friend.

Option Z

Look for a newspaper that someone has thrown away, and read the newspaper.
Walk around the airport looking in the windows of shops.
Talk to other travelers who are stranded along with you.

BadArea

Suppose that, after graduation, you are offered an excellent job with a company that has its main offices in a very bad section of a large city. Because the job is so well suited to your career plans, you decide to take it. When you look for an apartment, however, you discover that the only feasible places to live are in two different neighborhoods, both of which have drawbacks. The following describes problems that you have with either neighborhood.

Neighborhood A

Homeless people are often encountered in this neighborhood.
It is hard to find adequate housing. Although many apartments are safe and reasonably clean, they are often too small, overheated, and dark.It is not uncommon to see garbage and other litter scattered across the sidewalk.
You are within walking distance of your work, but you have been warned to avoid certain parts of the neighborhood at night.

Neighborhood Z

The people who live in this neighborhood seem unfriendly, and appear to be hostile to your social and political views.
Typical housing is satisfactory, but lacking in personality.
The streets of this neighborhood are reasonably safe, but unattractive.
Other than convenience stores and gas stations, there are few retail stores of any interest.
Travel to work from this neighborhood is a tedious 45 minute drive during rush hour. The bus takes one hour.

Cancer Treatment[C3]

Imagine that you are developing lung cancer. Two kinds of treatments, namely surgery or radiation therapy, are available.

Option A: Surgery

Surgery for lung cancer involves an operation on the lungs. Most patients are in the hospital for two or three weeks and have some pain around their incisions; they spend a month or so recuperating at home. After that, they generally feel fine. Of 100 people having surgery, 10 will die through the surgery, 32 will have died at the end of the first year, and 66 will have died at the end of 5 years.

Option Z: Radiation Therapy

Radiation therapy for lung cancer involves the use of radiation to kill the tumor and requires coming to the hospital about four times a week for six weeks. Each treatment takes a few minutes and during the treatment, patients lie on a table as if they were having an X-ray. During the course of the treatment, some patients develop nausea and vomiting, but by the end of the six weeks they also generally feel fine. Of 100 people having radiation therapy, none will die through the treatment, 23 will have died at the end of the first year, and 78 will have died at the end of 5 years.

[C3] The description of the options in the Cancer Treatment scenario was excerpted from information published in the *New England Journal of Medicine,* B. J. McNeil, S. G. Pauker, H. C. Sox, and A. Tversky, "On the elicitation of preferences for alternative therapies," *New England Journal of Medicine,* 306, p. 1260, 1982.

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