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Using Judgments to Understand Decoy Effects in Choice

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Students were presented choice triads from several different domains, with alternatives described along two dimensions. In Experiment 1, the decoy alternative in each set was dominated by only one of the two other alternatives in the set. In Experiment 2, the decoy alternative was dominated by both of the other alternatives in the set. Within different blocks of trials, participants rated (a) overall attractiveness of each alternative, (b) importance of the different dimensions, (c) attractiveness of each attribute value, and (d) the justifiability of each alternative. Significant effects of manipulating the decoy were found for justifiability ratings and value ratings, with these combining to predict effects on attractiveness ratings. Results argued against a weight-change model of decoy effects and supported value-shift and value-added models.

There is overwhelming evidence that evaluations and choices are context dependent (Huber, Payne, & Puto, 1982; Mellers, 1983, 1986; Mellers & Cooke, 1994; Parducci, 1974; Simonson & Tversky, 1992; Wedell, 1991, 1994, 1995, 1996a). The contextual dependency of decision making means that when interviewing job applicants, the interviewer will tend to evaluate each applicant in the context of the previous applicants. Similarly, when buying a car, the consumer's evaluation of subsequent cars will be influenced by the initial set of cars examined. In the first case, the decision to hire a given applicant will be more favorable if the applicant is preceded by a series of unattractive applicants rather than a series of attractive applicants. In the second case, the consumer will likely buy a more fuel efficient vehicle if the cars being evaluated are predominantly economy cars rather than gas guzzlers.

Context effects in judgment have been studied more extensively than context effects in choice. This may be partly due to the coarse nature of choice data leading to a less precise determination of the underlying contextual processes. The research presented here attempts to use multiple judgment tasks to study more precisely the processes that underlie contextual dependencies found in choice tasks. Insofar as the preference judgments reflect the same pattern of effects as previous research on choice, then the relationship of preference judgments to judgments on theoretically relevant dimensions may provide key insights into the contextual processes involved.

For this research, we have chosen to study the effects of different types of decoys on preference. Decoy effects are good examples of the contextual dependency of choice. A decoy is an alternative that is added to a choice set in order to alter the relative attractiveness of the other alternatives in the set. One of the most extensively studied decoys is the asymmetrically dominated (AD) decoy (Huber, Payne, & Puto, 1982). One alternative is said to dominate another when it is clearly superior to it on at least one dimension and is equivalent or superior to it on all other dimensions. An AD decoy is dominated by one alternative in a set but not by the others. Adding an AD decoy to a choice set can dramatically increase the proportion choosing the dominating alternative. For example, in an experiment using three different consumer domains, Wedell (1991) reported an average of 68% choosing alternative *A* when the AD decoy favored *A* but only 27% choosing *A* when the AD decoy favored *B*, a 41% shift. This large shift in choice occurred even though the percentage choosing the decoys averaged only 3%. The sheer magnitude of the AD effect suggests the importance of understanding the processes that underlie it. More generally, this type of context induced preference reversal represents a potential violation of rational choice principles. As such, it is important to determine exactly how and why these effects occur.

In addition to the AD decoy, several other types of decoys have been studied. These different types of decoys are summarized in Fig. 1, which represents the location of alternatives in a two dimensional space. In the diagram, alternative *A* is superior to alternative *B* on dimension 2 but not on dimension 1. The arrow

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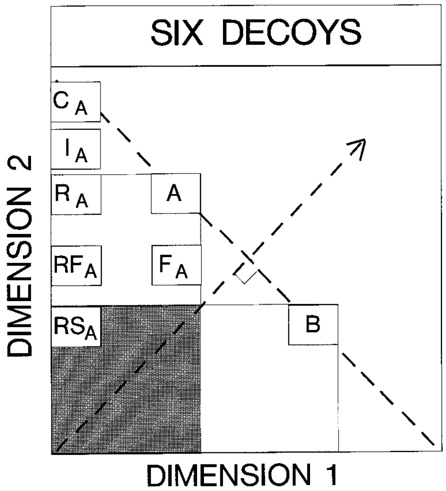

FIG. 1. Locations of six types of decoys studied in the literature (*C*, compromise; *I*, inferior; *R*, range; *F*, frequency; *RF*, range-frequency; and *RS*, range with symmetric dominance). The diagonal arrow represents a preference vector in which dimensions 1 and 2 are equally weighted. Alternatives *A* and *B* are located on an equi-preference contour. Shaded regions correspond to regions of dominance.

represents a preference vector corresponding to equal weighting of the two dimensions. Alternatives *A* and *B* lie on the same preference contour, indicating that in pairwise choice each would be chosen 50% of the time. The shaded regions in Fig. 1 represent classes of alternatives that are dominated by *A*, *B*, or by both *A* and *B*.

The three types of AD decoys shown in Fig. 1 are the range (*R*), frequency (*F*), and range-frequency (*RF*) decoys, first described by Huber *et al.* (1982). The distinctions among these decoys derive from their potential effects in terms of Parducci's (1974) range-frequency theory of judgment, which proposes that the attribute values of stimuli depend on the contextual frequency distribution. The range decoy favoring *A* (R_A) extends the range downward on dimension 1, which is the attribute on which *A* is weakest. The F_A decoy increases the differences in ranks for alternatives *A* and *B* on the dimension on which *A* is strongest. The RF_A decoy combines the dimension 1 location of R_A with the dimension 2 location of F_A to manipulate both range and rank differences.

The remaining decoys shown in Fig. 1 are not asymmetrically dominated. The RS_A decoy extends the range downward on dimension 1 to favor *A* but is symmetrically dominated by *A* and *B*. The I_A or inferior decoy is similar to the R_A decoy, except that its value on dimension 2 has been raised so that it is not strictly dominated by *A*. Even though I_A is not dominated by *A*, it is clearly inferior to *A* and is rarely chosen (Huber & Puto, 1983). Raising the dimension 2 value of the I_A decoy further gives rise to the compromise decoy (C_A). The compromise decoy is chosen significantly more often than the I_A decoy and is assumed to operate by making the targeted alternative (*A*) appear to be a good compromise between extreme alternatives (Huber & Puto, 1983; Simonson & Tversky, 1992).

The focus of the present studies was on those decoys that are dominated by one or both of the other alternatives in the choice set (i.e., R_A, F_A, RF_A, and RS_A). We present the locations of the other decoys in Fig. 1 as a reference for understanding different results reported in the literature. Our approach to determining the psychological processes underlying the AD decoy effects was to have participants make multiple sets of judgments, rather than make a single choice for each set of alternatives. Different judgment tasks were linked to different constructs underlying theoretical models of decoy effects. Insofar as overall judgments of attractiveness reflect the same decoy effects as found in choice, then the pattern of judgment results from the other tasks may clarify the psychological processes that produce decoy effects.

In the next section we present three general models of decoy effects. We then review the literature on decoy effects, as it pertains to the three models. Finally, before proceeding to experimental detail, we describe how we will link judgment tasks to the different models.

THREE MODELS OF DECOY EFFECTS

Wedell (1991) has described three classes of models that have been used to explain decoy effects. Figure 2 presents these models diagramatically as they pertain to AD decoys R_A and F_A. The weight-change model as-

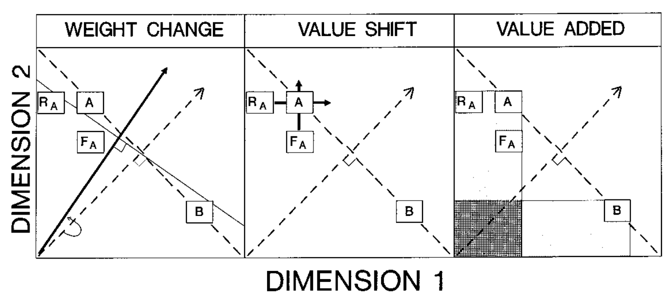

FIG. 2. Illustration of three models of decoy effects. The weight-change model assumes that the range decoy favoring *A* (R_A) and the frequency decoy favoring *A* (F_A) operate by giving greater weight to dimension 2. The value-shift model assumes R_A and F_A change the attractiveness values of *A* on dimensions 1 and 2. The value-added model assumes that the asymmetrical dominance of R_A and F_A adds value to *A* by making it more justifiable.

sumes that adding a decoy changes the relative weighting of the attributes. The value-shift model assumes that weights remain constant, but that the subjective values assigned to each attribute description are shifted by the presence of the decoy. The value-added model assumes that relationships among alternatives, such as the presence or absence of dominance, play a key role in the valuation of alternatives.

Weight-Change Model

The left panel of Fig. 2 illustrates the weight-change model, which assumes that adding a decoy alternative changes the relative weights assigned to the different attributes. This is represented by a change in the direction of the preference vector, the slope of which corresponds to the weight of dimension 2 divided by the weight of dimension 1. The altered weighting scheme places the targeted alternative on a relatively higher preference contour and hence increases its likelihood of being chosen. For the change in weight to favor the targeted alternative, the relative weight must decrease on the targeted alternative's weakest attribute. Thus, *A* is favored when less weight is given to dimension 1 and *B* is favored when less weight is given to dimension 2. For the decoys shown in Fig. 2, the weight-change model argues that relative weight given a dimension decreases when the range is extended (R_A) or increases when the number of different attribute values on that dimension increases (F_A).

Value-Shift Model

The middle panel of Fig. 2 illustrates the value-shift model, which assumes that adding the decoy changes the subjective evaluation of attribute values so that the overall value of the targeted alternative is increased relative to the other alternative. These changes in dimensional value may be explained by Parducci's (1974) range-frequency theory and are illustrated in Fig. 2 by arrows representing the shift in the value of *A* in the presence of R_A or F_A. In applying range-frequency theory to the current problem, the attractiveness value of stimulus *i* on dimension *m* in context *k* (V_{imk}) may be conceived as a weighted average of its corresponding range value (R_{imk}) and its corresponding frequency value (F_{imk}). This may be expressed algebraically as:

$$V_{imk} = zR_{imk} + (1 - z)F_{imk}, \tag{1}$$

where *z* expresses the relative weighting of the range value and varies from 0 to 1.

The range value of a stimulus describes the proportion of the subjective range lying below that value:

$$R_{imk} = (S_{im} - S_{\min,mk})/(S_{\max,mk} - S_{\min,mk}), \tag{2}$$

where S_{im} is the context invariant scale value of stimuli *i* on dimension *m*, and $S_{\max,mk}$ and $S_{\min,mk}$ represent the subjective maximum and minimum values defining the range on dimension *m*, respectively. Inclusion of an extreme valued decoy such as R_A may lead to a lower value of the subjective minimum and hence increase the range value of *A* on dimension 1. Because *A* is closer to the subjective minimum on dimension 1 than is *B*, its range value will shift more. This type of shift would lead to a reduced difference in subjective values of *A* and *B* on dimension 1, and hence increase the relative attractiveness of *A*.

The frequency value of a stimulus describes the proportion of the contextual values lying below that value on the given dimension,

$$F_{imk} = (\text{rank}_{imk} - 1)/(N_{mk} - 1), \tag{3}$$

where rank_{imk} is the rank of stimulus *i* on dimension *m* in context *k*, 1 is the minimum rank, and N_{mk} is the maximum rank of contextual stimuli on dimension *m*. Inclusion of an intermediate valued decoy, such as F_A, should lead to an increased difference in the frequency values for *A* and *B* on dimension 2, and hence increase the relative attractiveness of *A*. It should be noted that range and frequency values tend to be correlated so that the extremity manipulation of the R_A decoy can also be explained by a change in frequency values.

Value-Added Model

The value-added model assumes that relational properties of the decoy and target add value to the target. For the AD decoy, the presence or absence of dominance relationships may be a key determinant of the value added to the alternative. Thus, because R_A and F_A both lie in the shaded region corresponding to asymmetric dominance by *A*, they both add to the overall value of *A*. More generally, the additional value may stem from an increase in the justifiability of the targeted alternative (Simonson, 1989).

It is important to note that the value-added approach lies outside the general multiattribute utility (MAUT) framework (von Winterfeldt & Edwards, 1986). According to MAUT, choice depends on a comparison of overall attractiveness values for alternatives that result from a weighted additive integration of dimensional values. The value-added model argues that choice is not strictly dependent on weights and dimensional values, but also relies on relational aspects of the choice set not captured by these components. A context-dependent version of this model may be represented algebraically as follows:

$$A_{ik} = \sum_{m} W_{mk}V_{imk} + J_{ik}, \quad (4)$$

where A_{ik} is the overall attractiveness value of alternative i in contextual set k, W_{mk} is the context dependent weighting of dimension m, V_{imk} is the context dependent scale value of alternative i on dimension m, and J_{ik} is the value added to alternative i in context k based on relational properties that increase its justifiability. Equation (4) incorporates all three models described above because dimensional weights (W), dimensional values (V), and an alternative's justifiability (J) are all free to vary with context. The aim of the present experiments was to develop judgment measures of the four components of Eq. (4) (A, W, V, and J) in order to evaluate the plausibility of each model.

EVIDENCE FOR DIFFERENT MODELS

Evidence Related to Shifts in Value

The original Huber *et al.* (1982) study of decoy effects included the *R*, *F*, and *RF* decoys in order to examine the plausibility of a contextual valuation interpretation of AD effects. If dimensional values of alternatives were altered by the inclusion of the decoy in accordance with range-frequency theory (Parducci, 1974), then one would expect significant effects of all three types of decoys. Furthermore, one would expect the largest effects for the *RF* decoy because it adds the effects of *R* and *F* decoys. Also, one would expect that increasing the extremity of the *R* decoy would increase the decoy effect. The results of Huber *et al.* (1982) were not particularly supportive of the value-shift model. Rather than showing the strongest effects, the *RF* decoy showed the weakest effects. Furthermore, increasing the extremity of the *R* decoy did not increase the decoy effect.

Further evidence against the value-shift model was provided by Wedell (1991). In Experiments 2 and 3, Wedell (1991) included the *RS* decoy, which was symmetrically dominated by *A* and *B* but extended the range to favor either *A* or *B*. In both between-subjects and within-subjects manipulations, the *RS* decoy produced no significant effects, whereas the corresponding *R* decoys produced large effects on choice. Wedell (1991) argued that these results were inconsistent with weight-change and value-shift models, but were consistent with the value-added model in which the asymmetric dominance relationship added value to the targeted alternative.

Not all evidence, however, has gone against the value-shift model. Ratneshwar, Shocker, and Stewart (1987) found that when meaningfulness of alternatives was enhanced by adding increased detail to descriptions, the decoy effect was significantly reduced. They argued that the reduction in decoy effects was due to the decreased dependence on the use of context to interpret attribute values when descriptions rendered these more meaningful. However, because the meaningfulness manipulation was confounded with aspects of the display, an alternative interpretation of these results is that the effect may have been due to greater difficulty in detecting dominance relationships within the meaningful display condition.

More direct evidence for value shift was provided in a recent study by Ariely and Wallsten (1995) in which participants filled in missing values in order to make the targeted alternative equally attractive to the nontargeted alternative. The substituted values were consistent with a model in which the presence of the decoy led to overvaluation of key attribute values. However, these results must be viewed with caution. First, it is well known that choice and matching procedures often yield different preference orderings (Tversky, Sattath, & Slovic, 1988), and thus generalizing these effects to choice may be problematic. Second, the test of the model was not particularly sensitive, and thus the results were relatively weak. Third, these results were obtained using the inferior decoy with alternative's described on three attributes so that their generality to the AD decoys described on two attributes is unknown.

Perhaps the strongest evidence for the plausibility of the value-shift model comes from a study which did not employ the typical decoy manipulation. Instead of seeing alternatives in choice sets, Mellers and Cooke (1994) presented each alternative one at a time for judgment on a general attractiveness scale. The contextual manipulation in this study was not the inclusion of a decoy but rather the global context determined by the set of stimuli being judged. Consistent with results for pairwise choice (Simonson & Tversky, 1992), extending the range on an alternative's poorer dimension increased the attractiveness of that alternative. The experiment was set up to distinguish between a value-shift explanation in terms of range-frequency processes and a change in weighting model. The overall pattern of data was consistent with the value-shift model and inconsistent with the weight-change model.

In summary, although the value-shift model provides a plausible explanation of the AD decoy effect, there is not much evidence that directly supports it in the decoy task. The best evidence for a shift in values comes from the Mellers and Cooke (1994) experiment, which used a task that differed in many critical ways from the typical decoy task.

Evidence Related to Changes in Weight

As reviewed above, much of the evidence related to the value-shift model also relates to the weight-change model. Wedell (1991) concluded that the lack of a decoy effect for the *RS* decoy was inconsistent with a weight-change model in which weight depended on range extension. The results from the Mellers and Cooke (1994) experiment were inconsistent with a weight-change model, although the generality from their task to decoy tasks may be questioned. The most positive piece of evidence reported in the literature supporting the weight-change model is given by Ariely and Wallsten (Experiment 2, 1995). They found that adding an inferior decoy significantly altered the relative weight of a targeted dimension, as inferred from direct importance ratings. However, a close examination of the results indicates that these data provide at best mixed support. For 5 of the 15 comparisons of relative weighting they made, the increased weight was in the opposite direction than predicted by the weight-change model. Because attractiveness was not measured in the same experiment, there was no way to determine whether changes in weight corresponded to changes in attractiveness. An alternative explanation of their findings is that the importance ratings increased when the range on a dimension increased, regardless of whether it favored or did not favor the targeted alternative. This interpretation is consistent with a recent set of experiments by Wedell (1996b) in which importance ratings of a dimension increased with increase of the contextual range of that dimension in a pairwise choice task.

A final piece of evidence against the weight-change model derives from process measures taken during the decoy choice task. Wedell (1993) used an information board process tracing paradigm in which participants uncovered information in order to make their decisions. The task was to choose which of three gambles one preferred to play. Looking times at probability information were significantly greater for those who tended to choose the high probability bet, indicating a positive link between looking time and weight. Given this positive relationship, the weight-change model would predict greater looking time at dimension 2 when R_A was present rather than R_B. However, the opposite relationship was found.

In summary, there is little in the way of concrete support for the weighting hypothesis. The strongest evidence to date is from the Ariely and Wallsten (1995) study, but that evidence is mixed. Results from Wedell (1991, 1993) and Mellers and Cooke (1994) appear to be inconsistent with the weight-change model.

Evidence Related to Added Value

Wedell (1991) interpreted his pattern of results as generally supportive of a value-added model in which the dominance of an alternative over another alternative in the set increased its value by increasing the justifiability of choosing that alternative. The strongest evidence for the value-added model comes from work by Simonson (1989). In Experiment 1 of Simonson (1989), students in a classroom setting made choices from a trinary set, with either an *RF* or a *C* decoy in one of two justification conditions. In the low justification condition, students were told that their responses would be totally confidential and that they should not put their names on the questionnaire. In the high justification condition, they were told that their decisions would be evaluated by the class and that they might be asked to justify their decisions. The *RF* and *C* decoy effects were both significantly greater in the high justification condition. In addition, Simonson (Experiment 2, 1989) found that students gave higher justifiability ratings to an alternative when it asymmetrically dominated another alternative in the set. Overall, both measured justifiability and the manipulation of a requirement to justify a choice predicted the occurrence of decoy effects in a manner consistent with the value-added model.

Summary of Evidence

The pattern of effects described above provides the strongest evidence for the value-added model, according to which relational properties among the choice alternatives add value to the targeted alternative. For AD decoys, the relational property appears to be dominance of other alternatives in the set, which increases justifiability of the targeted alternative. For the compromise decoy, the relational value may be related to avoiding extremes (Simonson & Tversky, 1992). In conjunction with the experimental evidence, the focus of the value-added model on the issues important to decision making in a real world context, such as justifiability or accountability of choices, makes it a particularly attractive explanation of the decoy effect. The lack of decoy effects for the *RS* decoys raises problems for both value shift and weight-change models. To date, there is little support for a weight-change explanation, although the recent results of Ariely and Wallsten (1995) are suggestive. Work by Mellers and Cooke (1994) provide the most convincing support for a value-shift model; however, serious differences between the task they used (successive presentation of individual alternatives) and a typical decoy effect task (simultaneous presentation of three alternatives) limits the application of their results to the decoy effect.

Based on the evidence discussed above, we hypothesized that the value-added model of AD decoy effects would receive the greatest support in the present research, and that the weight-change model would receive no support. The proposed research design should provide a strong test of the applicability of the value-shift model to AD decoy effects, and it should also provide a means to determine whether multiple processes may combine to produce AD decoy effects.

JUDGMENT APPROACH TO STUDYING DECOY EFFECTS

In the two experiments presented here, we used judgment tasks that were designed to correspond to the four key components of Eq. (4) (A_{ik}, W_{mk}, V_{imk}, and J_{ik}) in order to test effects predicted by the three models. For each judgment task, participants were presented with sets of three alternatives described on two dimensions and were prompted to make a series of judgments. Although some researchers of decoy effects have used judgment tasks (Ariely & Wallsten, 1995; Simonson, 1989), the present research was unique in that judgments for several tasks were obtained from each participant. The inclusion of multiple judgment tasks allowed us to determine the interrelationships among the different constructs represented by each task.

In the attractiveness judgment task, participants made a judgment of the overall attractiveness of each alternative within the contextual set. These attractiveness judgments were assumed to correspond to the attractiveness parameter (A_{ik}) of Eq. (4) and were used to test for the occurrence of the basic decoy effect. To use attractive judgments in this manner, it is important to demonstrate that these judgments accurately reflect preferences expressed in choice. Prior research (Ariely & Wallsten, 1995; Simonson, 1989) has demonstrated that judgments of attractiveness show the same type of decoy effects as found in choice. One way in which the present research will provide a further test of the correspondence between decoy effects in judgment and choice is by including *RS* decoy conditions in which decoy effects are not expected (Experiment 2). If the attractiveness ratings reflect the same pattern of significant and nonsignificant decoy effects found for choice data (Wedell, 1991), then the validity of using the attractiveness rating task as a substitute for choice will be enhanced.

In the importance judgment task, participants made a judgment of the importance of each of the two attributes for each choice set. These importance judgments were assumed to correspond to the weighting parameter (W_{im}) of Eq. (4) and were used to test for decoy-induced changes in weighting. Prior research (Ariely & Wallsten, 1995) has demonstrated systematic effects of decoys on importance ratings. However, in that research there was no way to validate the use of the importance ratings as a measure of weight or to relate importance ratings directly to attractiveness ratings. In the present study, the validity of the importance ratings can be established by finding a positive correlation between the importance of a dimension and the tendency to assign higher attractiveness values to alternatives with high values on that dimension.

In the value judgment task, participants made judgments of the attractiveness of each attribute value for each alternative in the choice set. These value judgments were assumed to correspond to the dimensional value parameter (V_{imk}) of Eq. (4) and were used to test for decoy-induced changes in dimensional value. These changes, if they occur, can be compared to predictions from Parducci's (1983) range-frequency theory as described in Eqs. (1–3). The value-shift model predicts that the combined value judgments for an alternative will be greater when the decoy targets that alternative.

Finally, in the justifiability judgment task, participants made judgments of how easily one could justify the choice of each alternative in the set. These justifiability ratings were assumed to correspond to the justifiability-based value-added component (J_{ik}) of Eq. (4). The value-added model predicts that justifiability ratings for an alternative will be higher when the decoy targets that alternative.

EXPERIMENT 1

Experiment 1 focused on the *R* and *F* decoys, both of which are asymmetrically dominated and illustrated in Figs. 1 and 2. These two types of decoys allowed us to examine the effects of range extension on weighting of dimensions and to test specific predictions of range-frequency theory (Parducci, 1974). If weight increases with range extension, as found by Wedell (1996b) and consistent with Ariely and Wallsten (Experiment 2, 1995), then the importance ratings for dimension 1 relative to dimension 2 should be greater for the R_A decoy than the R_B decoy. This predicted effect would be contrary to the weight-change model.

The results of Experiment 1 can be analyzed in several ways. First, judgments of the common alternatives (*A* and *B*) can be submitted to a repeated measures analysis of variance (ANOVA) to determine whether the interaction patterns predicted by each model are obtained. By counterbalancing the presentation order of the tasks, we can evaluate whether interaction patterns found for the full set of ratings reflect the patterns found when the task occurs first, so that ratings are not influenced by prior tasks. Second, we can conduct a set of regression analyses to examine interrelationships among the different judgment tasks. These analyses can help to determine whether different judgment tasks predict overlapping or unique variance in the attractiveness judgments. Finally, we can examine the plausibility of using range-frequency theory to explain differences in value judgments by fitting the model to the data.

Method

Participants and Design

Participants were 158 university undergraduates who received course credit for participation. The basic design variables were (a) *Decoy Type* (*R* or *F*), which was manipulated between subjects; (b) *Decoy Target* (*A* or *B*), which was manipulated within subjects but was nested within choice domain (10 sets favoring *A* and 10 favoring *B*); (c) *Choice Domain,* which consisted of sets from 20 different domains and was manipulated within subjects; and (d) *Task Order,* which consisted of four counterbalanced orders in which to perform the task. Subjects were randomly assigned to the between-subjects conditions, and presentation of choice sets was randomized for each participant.

Materials and Apparatus

Twenty choice sets were constructed under each of four different conditions for a total of 80 sets. Each set contained alternatives from a single type of consumer product (e.g., computers, microwaves, etc.) or consumer service (e.g., choosing a restaurant, hiring a mechanic, etc.), and each was made up of two alternatives (*A* and *B*) and either a range decoy (R_A or R_B) or a frequency decoy (F_A or F_B). As illustrated in Fig. 2, *A* always had a higher attractiveness value on Dimension 2 than *B* and *B* had a higher value on dimension 1 than *A*. Values of *A* and *B* were determined by a prior norming study so that in pairwise choice the proportion choosing A over B ranged between 0.30 and 0.70.

R decoys were constructed by using the same value of the targeted alternative on its better dimension and a value on the poorer dimension that was lowered (in attractiveness) by half the distance between *A* and *B* on that dimension. *F* decoys were constructed by using the same value of the targeted alternative on its poorer dimension and a value that was halfway between *A* and *B* on the other dimension. All materials and instructions were presented on IBM PS/2 Model 50Z microcomputers. (The full set of materials is presented in the Appendix.)

Procedures

Participants were told they would encounter several sets of three choice alternatives, but that instead of making choices, they would be making different types of judgments. They were told they would encounter each choice set once in four different blocks of trials, with each block corresponding to a different type of judgment.

Participants were then presented with the trinary choice sets four times each in separate blocks corresponding to the different rating tasks. Each choice set was represented as a 3 × 2 matrix, with the three rows corresponding to the three alternatives and the two columns corresponding to the two dimensions. On a given trial, the arrangement of the alternatives and dimensions on the screen was randomized. Choice options were presented on the screen 3 s prior to presentation of the first rating prompt and the information remained on the screen until all ratings were made. Ratings were made on 9-point scales, with 1 labeled "not at all" followed by the relevant dimension label, "attractive," "justifiable," or "important," and 9 labeled "very" followed by the relevant dimension label.

To avoid confusion about what was being judged, the judgment cue indicating what information to judge was accompanied by blinking the corresponding information. Thus, in judgments of alternatives (attractiveness and justifiability tasks), the alternative labeled *A*, *B*, or *C* would blink when appropriate. In the dimensional importance rating task, the attribute label corresponding to the attribute being rated would blink. Finally, in the value judgment task, the attribute value for the alternative being judged would blink.

Results

Because two of the 20 sets were presented with incorrect values for a subset of participants, these were dropped from all analyses. The results are presented in three sections. The first examines the results of ANOVAs conducted separately for each type of judgment. The next section examines the interrelationships among judgments using regression analyses. The third section evaluates the fit of the range-frequency model to the value rating data.

ANOVAs for Each Task

Mean ratings for each task are presented in separate tables below, segregated by judgment block. The critical tests in each task are captured by interaction terms that compare how evaluations of the alternatives common to all sets (*A* and *B*) differ across contexts. Results from repeated measures ANOVAs conducted on the full set of data are reported, along with the results for each of the four blocks in which the rating task may have occurred.

Attractiveness ratings. Table 1 presents the mean ratings of attractiveness for alternative *A* and *B*, segre-

TABLE 1
Attractiveness Ratings for Alternatives A and B (Experiment 1)

			Alternative A		Alternative B	
Decoy	Block	*N*	Favors A	Favors B	Favors A	Favors B
R	1	22	6.84	6.24	6.11	6.50
R	2	18	7.02	6.59	6.35	6.57
R	3	19	6.80	5.98	5.76	6.49
R	4	20	6.34	6.16	6.09	6.19
R	Mean	79	6.74	6.24	6.08	6.43
F	1	23	7.01	6.33	5.93	6.56
F	2	17	6.70	6.13	5.93	6.56
F	3	19	6.91	6.50	6.49	6.73
F	4	20	6.65	6.23	6.22	6.77
F	Mean	79	6.83	6.30	6.14	6.65

Note. R, range decoy; F, frequency decoy. Block denotes the block in which attractiveness ratings were made.

gated by task order, type of decoy, and favored alternative. The decoy effect should be reflected in a significant Alternative × Favored Alternative interaction in which attractiveness ratings of *A* are greater when the context favors *A* and attractiveness ratings of *B* are greater when the context favors *B*. All the means shown in Table 1 exhibit this pattern.

For the *R* decoy, the predicted interaction pattern was obtained for the combined set of participants, $F(1,71) = 19.4$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant for those who made attractiveness ratings in blocks 1, 2, or 3, but not for those in block 4. Although there was a significant interaction ($p < .05$) involving task order in the combined analysis, it did not involve the Alternative × Favored Alternative interaction component and so is not particularly relevant.

For the *F* decoy, the predicted interaction pattern was obtained for the combined set of participants, $F(1,71) = 57.8$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant in each of the four blocks. No interactions involving task order were significant in the combined analysis.

The results on attractiveness ratings indicate strong decoy effects for both *R* and *F* decoys. The lack of a significant effect of the *R* decoy in the fourth block does not appear to represent any systematic practice or carryover effect.

Justifiability ratings. Table 2 presents the mean ratings of justifiability for alternative *A* and *B*, segregated by task order, type of decoy, and favored alternative. The value-added model predicts a significant Alternative × Favored Alternative interaction on justifiability ratings that parallels the interaction found for attractiveness ratings. Thus, the justifiability ratings of *A* should be greater when the context favors *A* and justifiability ratings of *B* should be greater when the context favors *B*. Consistent with the value-added model, all the means shown in Table 2 exhibit this pattern.

For the *R* decoy, the predicted interaction pattern was significant for the combined set of participants, $F(1,71) = 22.2$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant for those who made justifiability ratings in blocks 1, 2 or 3, but not for those in block 4 (although it was marginally significant, $p < .10$). There were no significant interactions involving task order in the combined analysis.

For the *F* decoy, the predicted interaction pattern was obtained for the combined set of participants, $F(1,71) = 31.7$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant in blocks 1, 2, 3, but not in block 4 (although it was marginally significant, $p < .06$). No interactions involving task order were significant in the combined analysis.

The results on justifiability ratings are consistent with the value-added model for both *R* and *F* decoys. The lack of a significant effect in the fourth block for both *R* and *F* decoys may reflect some type of fatigue effect or it could simply reflect noise in the data. In both cases the interaction pattern was marginally significant.

Importance ratings. Table 3 presents the mean ratings of importance for dimensions 1 and 2, segregated by task order, type of decoy, and favored alternative. The weight-change model predicts a significant Dimen-

TABLE 2
Justifiability Ratings for Alternatives A and B (Experiment 1)

			Alternative A		Alternative B	
Decoy	Block	*N*	Favors A	Favors B	Favors A	Favors B
R	1	20	6.70	6.56	6.15	6.67
R	2	22	6.95	6.06	6.19	6.66
R	3	18	7.04	6.48	6.37	6.58
R	4	19	6.61	5.95	5.80	6.29
R	Mean	79	6.82	6.26	6.13	6.55
F	1	20	6.87	6.45	5.82	6.45
F	2	23	6.89	6.29	6.14	6.35
F	3	17	6.38	6.06	5.88	6.36
F	4	19	7.00	6.44	6.37	6.55
F	Mean	79	6.80	6.32	6.06	6.42

Note. R, range decoy; F, frequency decoy. Block denotes the block in which justifiability ratings were made.

TABLE 3
Importance Ratings for Dimensions 1 and 2 (Experiment 1)

			Dimension 1		Dimension 2	
Decoy	Block	*N*	Favors A	Favors B	Favors A	Favors B
R	1	19	7.31	7.01	7.04	7.15
R	2	20	7.28	7.21	7.09	7.03
R	3	22	7.44	7.37	7.03	7.32
R	4	18	7.68	7.54	7.08	7.34
R	Mean	79	7.42	7.28	7.06	7.21
F	1	19	7.14	7.27	7.19	7.04
F	2	20	7.09	7.12	6.92	7.08
F	3	23	7.25	7.02	7.13	6.78
F	4	17	7.08	7.42	7.25	7.03
F	Mean	79	7.15	7.19	7.12	6.97

Note. R, range decoy; F, frequency decoy. Block denotes the block in which justifiability ratings were made.

sion × Favored Alternative interaction on importance ratings in which the importance ratings of dimension 2 should be greater when the context favors *A* and importance ratings of dimension 1 should be greater when the context favors *B*. The data of Table 3 do not reflect the pattern predicted by the weight-change model.

For the *R* decoy, the Dimension × Favored Alternative interaction was significant for the combined set of participants, $F(1,71) = 8.2$, $p < .01$, but it was in the opposite direction than predicted by the weight-change model. Planned comparisons (at $p < .05$) indicated that this interaction was significant only for those who made importance ratings in block 3. There were no significant interactions involving task order in the combined analysis.

For the *F* decoy, the Dimension × Favored Alternative interaction was not significant, $F(1,71) = 3.4$, $p > .05$, although it was in the direction predicted by the weight-change model. Planned comparisons (at $p < .05$) indicated that this interaction pattern was significant only in block 4. No interactions involving task order were significant in the combined analysis.

The results on importance ratings were generally unsupportive of the weight-change model. In the overall analysis on the *R* decoy, the dimension that was extended received significantly more weight. This result is consistent with previous results (Ariely & Wallsten, 1995; Wedell, 1996b), but it is inconsistent with the weight-change model of decoy effects. The *F* decoy did not produce a significant Dimension × Favored Alternative interaction, although the pattern of means was in the direction predicted by the weight-change model. This trend may have resulted from carryover effects. Only the fourth block of importance ratings showed a significant interaction. It may be that after having made the other three sets of ratings, participants tended to make their importance ratings more consistent with the previous sets of ratings.

Value ratings. Table 4 presents the mean ratings of attractiveness for each attribute value of each alternative, segregated by task order, type of decoy, and favored alternative. The value-shift model assumes that changes in the overall attractiveness of an alternative result from changes in the attractiveness of specific values. The model predicts a significant Alternative × Favored Alternative interaction in which the combined value ratings of alternative *A* are greater when the context favors *A* and the combined value ratings of alternative *B* are greater when the context favors *B*. Decoy effects on valuation may also be reflected in a significant Dimension × Favored Alternative interaction. This is most clear in the case of the *R* decoy, in which the predicted effect is to increase values on dimension 1 for R_A and increase values on dimension 2 for R_B. The data of Table 4 reflect both of these types of interactions.

TABLE 4
Value Ratings for Each Alternative on Each Dimension (Experiment 1)

				Alternative A		Alternative B	
Decoy	Block	*N*	Dim.	Favors A	Favors B	Favors A	Favors B
R	1	18	1	5.95	5.28	7.56	7.36
			2	7.38	7.64	4.95	5.84
R	2	19	1	5.53	4.68	7.34	7.02
			2	7.27	7.44	4.84	5.55
R	3	20	1	5.90	5.09	7.56	7.18
			2	7.27	7.65	5.11	5.60
R	4	22	1	6.02	5.18	7.74	7.54
			2	7.52	7.80	5.10	5.85
R	Mean	79	1	5.85	5.06	7.56	7.28
			2	7.37	7.64	5.01	5.71
F	1	17	1	5.70	4.87	7.22	7.16
			2	7.40	7.36	4.82	5.61
F	2	19	1	5.81	5.09	7.31	7.28
			2	7.67	7.51	5.01	5.65
F	3	20	1	5.41	4.71	7.43	7.52
			2	7.67	7.76	4.58	5.27
F	4	23	1	5.86	4.70	7.47	7.42
			2	7.67	7.15	5.00	5.43
F	Mean	79	1	5.70	4.83	7.37	7.36
			2	7.61	7.44	4.86	5.48

Note. R, range decoy; F, frequency decoy. Block denotes the block in which justifiability ratings were made.

For the *R* decoy, the combined value ratings of *A* were greater when the decoy favored *A* ($M_A = 6.61$ vs. $M_B = 6.35$) while the reverse was true when the decoy favored *B* ($M_B = 6.29$ vs. $M_B = 6.50$). This predicted Alternative × Favored Alternative interaction was significant for the combined set of participants, $F(1,71) = 38.4$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant for all four blocks of ratings. The predicted Dimension × Favored Alternative interaction was also significant for the combined set of participants, $F(1,71) = 176.1$, $p < .001$, as were the planned comparisons ($p < .05$) for each of the four blocks. There were no significant interactions involving task order in the combined analysis.

For the *F* decoy the combined value ratings of *A* and *B* were similar to that of the *R* decoy ($M_A = 6.66$ vs $M_B = 6.14$ and $M_A = 6.12$ vs $M_B = 6.42$, respectively). Again, this predicted Alternative × Favored Alternative interaction was significant for the combined set of participants, $F(1,71) = 82.4$, $p < .001$. Planned comparisons (at $p < .05$) indicated that this interaction was significant for all four blocks of ratings. The Dimension × Favored Alternative interaction was also significant for the combined set of participants, $F(1,71) = 176.1$, $p < .001$, and it was in the same direction as found for the *R* decoy. Planned comparisons ($p < .05$) of the interaction effect were significant for each of the four blocks. There were no significant interactions involving task order in the combined analysis.

The results on value ratings were generally supportive of the value-shift model. Component ratings shifted with context in a way that would produce a decoy effect on overall attractiveness of the alternatives. These effects were strong and occurred across all presentation blocks.

Regression Analyses

Separate and combined regressions were conducted examining how changes in attractiveness ratings across contexts were predicted by corresponding changes in justifiability, importance, and value ratings. To do so, interaction contrast scores reflecting decoy effects were computed for each participant on each judgment task. The interaction contrast scores were computed for attractiveness, justifiability, importance, and value ratings, respectively, as follows:

$$\text{ADIFF} = \text{A}_{\text{AA}} - \text{A}_{\text{BA}} + \text{A}_{\text{BB}} - \text{A}_{\text{AB}},$$

$$\text{JDIFF} = \text{J}_{\text{AA}} - \text{J}_{\text{BA}} + \text{J}_{\text{BB}} - \text{J}_{\text{AB}},$$

$$\text{WDIFF} = \text{W}_{\text{2A}} - \text{W}_{\text{1A}} + \text{W}_{\text{1B}} - \text{W}_{\text{2B}},$$

$$\text{VDIFF} = \text{V}_{\text{A1A}} + \text{V}_{\text{A2A}} - \text{V}_{\text{B1A}} - \text{V}_{\text{B1A}} + \text{V}_{\text{B1B}} + \text{V}_{\text{B2B}} - \text{V}_{\text{A1B}} - \text{V}_{\text{A2B}}.$$

TABLE 5

Regression Coefficients from Models Predicting Differences in Attractiveness Ratings from Differences in Justifiability, Value, and Importance Ratings (Experiment 1)

Predictor variable	Decoy type	Regression model: Single	Regression model: Multiple
VDIFF	F	.357	.288
	R	.472	.145
JDIFF	F	.318	.231
	R	.757	.688
WDIFF	F	.251	—
	R	−.011	—

Note. VDIFF, JDIFF, and WDIFF are context-sensitive difference scores on value, justifiability, and weight. R, range decoy; F, frequency decoy. The multiple regression model included VDIFF and JDIFF; WDIFF was not included because it was not statistically significant.

The notation used above is derived from Eq. (4). For example, J_{AB} reflects the justifiability rating of alternative *A* in a context favoring *B*, or V_{B1A} is the value rating of alternative *B* on dimension 1 when the context favors *A*. The interaction scores are calculated so that positive correlations between ADIFF scores and any of the other difference scores represent relationships predicted by the corresponding model. Negative correlations are then relationships in the opposite direction.

Table 5 presents coefficients from simple regression models for each predictor variable as well coefficients from the multiple regression model that included only variables uniquely predicting significant proportions of variance in the criterion variable. In the simple regression analyses, context based attractiveness differences were predicted by corresponding differences in both justifiability ratings and value ratings for both *R* and *F* decoys. Only the *F* decoy produced a significant relationship between ADIFF and WDIFF scores consistent with the weight-change model.

Simple regression analyses do not allow one to determine the unique relationships between variables. In order to do so, multiple regression equations were built by first including all three predictors and then eliminating variables whose unique contribution was not significant ($p < .05$). For both *R* and *F* decoys, the resulting equation included only JDIFF and VDIFF scores, excluding the WDIFF scores. The coefficients for these two-variable models are shown in Table 5. Although it is difficult to compare the magnitude of regression coefficients in such models, it is interesting to note that the JDIFF coefficient is much larger than the VDIFF coefficient for the *R* decoy, but it is somewhat smaller for the *F* decoy. These results provide further support for the value-shift and value-added models, but do not support the weight-change model.

The null results for the importance ratings in both regression and ANOVA analyses raises a possible alternative interpretation that these ratings had nothing to do with weights assigned to attributes. If importance ratings did not correspond to weights, then tests on these ratings did not constitute a test of the weight-change model. The validity of the importance ratings as a measure of weight can be partially established by examining the relationship between how differences in the importance ratings of dimension 1 versus 2 correspond to differences in the attractiveness of *A* versus *B*. The predicted relationship is that the tendency to rate dimension 2 higher in importance than dimension 1 should correspond to the tendency to rate *A* higher in attractiveness than *B*, because *A* is superior on dimension 2. Correlations of these difference scores were run on the 18 domains included in the analysis, with all but one of the correlations significant ($p < .05$, two-tailed test). All correlations were in the predicted direction and the mean of the correlations was $r = .37$. These correlations then provide some validation of the assertion that differences in importance ratings correspond to differences in weight. Thus, failure to find contextual differences in importance ratings or finding differences in the opposite direction than predicted by the weight-change model is problematic for that model.

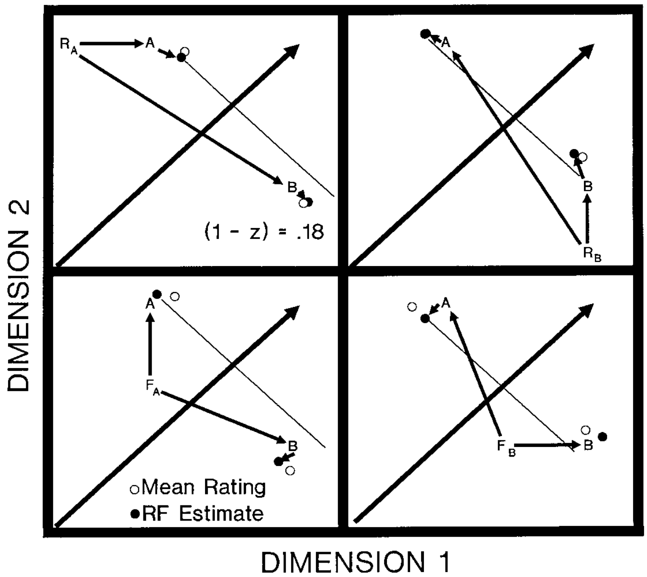

FIG. 3. Comparison of the range-frequency estimates generated from Equation 5 (solid circles) and mean attribute value ratings of alternatives *A* and *B* (open circles). The arrows from the decoy alternatives (R_A, R_B, F_A, F_B) onto alternatives *A* and *B* and through to the estimated points illustrates the value shifts resulting from the range-frequency processes. The diagonal arrow represents and equal weight preference vector. The preference contour (solid line) for the estimated position of alternative *A* is given in each panel as an illustration of the relative shift in preferences for *A* and *B*.

Fit of the Range-Frequency Model

Strong and systematic effects of decoy were found for the value ratings, with these differences across context predicting contextual differences in attractiveness. To what extent can these decoy effects on valuation be explained by Parducci's (1983) range-frequency model? To investigate this question, we fit a constrained version of the range-frequency model to the data. Because allowing range values to vary with decoy resulted in too many free parameters, we held range values constant across decoys. Although the *R* decoy may be conceived as operating by altering the subjective range, it may also operate through corresponding changes in frequency values. The value of the weighting parameter, *z*, was held constant across dimensions and decoys. We assumed that range values for common stimuli were a linear function of their mean ratings across contexts. Finally, following Parducci (1983), we assumed the matching scale assumption in which subjective judgments on a 0–1 scale were converted to mean ratings by multiplying by the range of category values and adding the minimum category value. Thus, the equation we fit to the data is given below:

$$V_{imk} = 1 + 8[z(a + b\overline{V}_{im}) + (1 - z)F_{imk}]. \quad (5)$$

Note that all differences between contexts are captured by the inferred value of the frequency weighting parameter, $(1 - z)$, which weights the differences in frequency values calculated a priori. The model of Eq. (5) was fit to the data using an iterated nonlinear regression procedure with a least squares loss function. The resulting fits were exactly the same as those derived from a multiple regression of value ratings on mean ratings and frequency values, except that the parameterization of Eq. (5) yielded range values and an interpretable value of *z*.

The fit of a context independent model with the range weighting fixed at $z = 1$ yielded R^2 of .935. Freeing the weighting parameter significantly incremented the fit of the model, $R^2 = .986$. The inferred value of the weighting parameter was $z = .82$, which is comparable to values typically found with familiar stimuli (Wedell, 1994). A comparison of range-frequency model predictions to actual mean ratings is illustrated in Fig. 3. The model does an excellent job in predicting how values shift for the *R* decoys and a reasonable job predicting how values shift for the *F* decoys. A preference vector representing equal weight of dimensions 1 and 2 is drawn in each panel of Fig. 3, along with a preference contour describing the attractiveness value of the range-frequency estimate of the value of alternative *A*. As shown, the predicted preference contour for *A* is higher than that for *B* when the decoy favors *A*, but the reverse is true when the decoy favors *B*. Thus, the value-shift model based on range-frequency processes clearly predicted a decoy effect in choice and provided a reasonable account of the judgment data.

Discussion

Experiment 1 results provide support for value-shift and value-added models of the AD effect, but they provide no support for a weight-change model. Indeed, results from the *R* decoy conditions contradicted the weight-change predictions. Instead of greater importance being assigned to the dimension that favored the targeted alternative, significantly greater importance was given to the other dimension. This result suggests that increasing the range of values on a dimension increases the weight of that dimension, which is consistent with results from pairwise judgment (Wedell, 1996b). The lack of support for the weight-change model is consistent with previous work in the choice domain (Wedell, 1991, 1993). Although these results may seem inconsistent with conclusions reached by Ariely and Wallsten (1995), they are consistent with the results they reported for their Experiment 2, in which participants assigned greater importance to the dimension with an extended range.

The results of Experiment 1 argue strongly for two processes underlying AD decoy effects. First, both value ratings and justifiability ratings showed decoy effects consistent with corresponding value-added and value-shift models. Second, both variables remained significant when combined in a multiple regression equation predicting attractiveness ratings. Third, justifiability ratings were consistent with previous results (Simonson, 1989). Fourth, the value ratings were consistent with predictions from Parducci's (1983) range-frequency theory. Taken together, these results provide considerable support for both value-added and value-shift processes operating in AD decoy effects.

EXPERIMENT 2

Whereas Experiment 1 focused on effects of AD decoys, Experiment 2 focused on the effects of a symmetrically dominated decoy that extend the range on one dimension (*RS* decoy). Wedell (1991) used the *RS* decoy to test between value-shift and value-added models. He reasoned that if range-frequency valuation processes were operating, then the range extension of the *RS* decoy should still produce a decoy effect even though the decoy was not asymmetrically dominated. Contrary to the value-shift model predictions, Wedell (1991) replicated several times the lack of significant decoy effects on choice for the *RS* decoy. In another experiment (Wedell, 1993), the *RS* decoy has been shown to produce a small significant effect favoring the non-favored alternative. This result can be explained by looking at the nature of the *RS* decoy illustrated in Fig. 1. Although RS_A is dominated by both *A* and *B*, it shares a value only with *B*. Wedell (1991) speculated that the shared value may make the dominance of *B* over RS_A more salient and thus tend to favor *B* instead of *A*.

How can we reconcile the results of Experiment 1, which supported both value-shift and value-added models, with results of the *RS* decoy in choice (Wedell, 1991, 1993), which have not supported the value-shift model? One possibility is that single stimulus judgments do not predict choice behavior, and so the judgment results of Experiment 1 may not generalize to the choice situation. This interpretation would be supported if attractiveness ratings for *RS* decoys do not show the same results as the corresponding choice data. Thus, one important function of Experiment 2 is to determine whether attractiveness ratings for the *RS* decoy mimic the choice data results and produce no significant decoy effect. Insofar as they do, then the validity of generalizing from the judgment to the choice situation is enhanced.

If results from attractiveness ratings in Experiment 2 correspond to choice results for the *RS* decoy, then the results from justifiability and value ratings may help determine how value-shift and value-added processes operate for the *RS* decoy. One possibility is that the processes tend to cancel out. Assuming the dominance of the RS_A decoy by *B* is more apparent than its dominance by *A*, decoy effects on justifiability ratings should show the opposite interaction pattern as found in Experiment 1. The opposing effects of value-added and value-shift processes may then cancel out to produce no decoy effects on attractiveness. This explanation can also account for the opposite effects of the *RS* decoy on choice found by Wedell (1993).

Method

Experiment 2 sampled another 77 students from the same population as Experiment 1. The design and procedure were identical to that of Experiment 1, except that only one type of decoy, the *RS* decoy, was used. Participants made four sets of judgments of the same 20 choice sets, but with the RS_A or RS_B decoy constituting the third alternative in the set. The *RS* decoys were created by using the same range-extended value from the *R* decoy of Experiment 1, but changing the other attribute value so that it matched the value of the non-

TABLE 6

Attractiveness Ratings for Alternatives A and B (Experiment 2)

			Alternative A		Alternative B	
Decoy	Block	*N*	Favors A	Favors B	Favors A	Favors B
RS	1	19	7.03	6.92	6.34	6.67
RS	2	19	6.22	6.62	6.25	5.98
RS	3	20	7.09	6.98	6.84	6.76
RS	4	19	6.71	6.67	6.71	6.76
RS	Mean	77	6.76	6.80	6.54	6.54

Note. RS, range symmetric decoy. Block denotes the block in which attractiveness ratings were made.

favored alternative as shown in Fig. 1. (See the Appendix for the actual stimuli.)

Results

Attractiveness Ratings

The mean ratings of attractiveness for alternatives *A* and *B* across decoy conditions are shown in Table 6. These results can be compared to corresponding results for *R* and *F* decoys shown in Table 1. Unlike the asymmetrical decoy results, the *RS* decoy produced little change in the mean ratings of *A* and *B*.

A repeated measures ANOVA was conducted on the attractiveness ratings of *A* and *B* for the full set of participants. The Alternative × Favored Alternative interaction, which was significant and quite large in Experiment 1, was not significant for the *RS* decoy, $F(1,69) = 0.07$, $p > .10$. The lack of an interaction for attractiveness ratings is consistent with the lack of *RS* decoy effects on choice (Wedell, 1991). A significant three way interaction of task order, alternative, and targeted alternative was found, $F(1,69) = 3.60$, $p < .05$. Planned tests of the two way interaction for each block of ratings revealed no significant effects for blocks 1, 3, and 4, but a significant interaction was found for block 2, $F(1,17) = 14.33$, $p = .001$. In block 2, the attractiveness of *A* was greater when *B* was favored while the attractiveness of *B* was greater when *A* was favored. Although this interaction was in the opposite direction from that found in Experiment 1 using *R* and *F* decoys, it was in line with previous results (Wedell, 1993) that reported a small but significant increase in choice of the non-favored alternative using the *RS* decoy. Thus, despite the interaction with task order, the results across the four blocks were consistent with previous choice data using the *RS* decoys.

Justifiability Ratings

The mean ratings of justifiability for alternatives *A* and *B* across decoy conditions are shown in Table 7. These results can be compared to corresponding results for *R* and *F* decoys shown in Table 2. The *RS* decoy had the opposite effect on mean ratings of justifiability than found for *R* and *F* decoys. The justifiability of *A* was greater when the *RS* decoy favored *B*, and similarly the justifiability of *B* was greater when the *RS* decoy favored *A*. These results are consistent with the idea that shared attribute values makes dominance more salience and hence increases justifiability.

A repeated measures ANOVA was conducted on the justifiability ratings of *A* and *B* for the full set of participants. The Alternative × Favored Alternative interaction was significant, $F(1,69) = 8.9$, $p < .05$, but it was in the opposite direction than found in Experiment 1. A significant three way interaction of task order, alternative, and targeted alternative was also found, $F(1,69) = 2.89$, $p < .05$. Planned tests of the two-way interaction for each block of ratings revealed a significant effect (at $p < .05$) for block 3, and a marginal effect (at $p < .07$) for block 4. Both effects were in the opposite direction than found in Experiment 1. Thus, the nature of the three way interaction was that across blocks there were either no significant effects of the *RS* decoy on justifiability or the nontargeted alternative was favored.

Importance Ratings

The mean ratings of importance for dimension 1 and 2 across decoy conditions are shown in Table 8. These results can be compared to corresponding results for the *R* decoy shown in Table 3. The results for importance ratings of the *RS* decoy replicate those for the *R* decoy, with greater importance assigned to the dimension for which the range was extended. Like the Experiment 1 results, this pattern does not support a weight-change model of decoy effects.

A repeated-measures ANOVA was conducted on the

TABLE 7

Justifiability Ratings for Alternatives A and B (Experiment 2)

			Alternative A		Alternative B	
Decoy	Block	*N*	Favors A	Favors B	Favors A	Favors B
RS	1	19	6.96	7.08	6.68	6.52
RS	2	19	6.90	6.75	6.35	6.35
RS	3	19	6.18	6.48	6.34	6.02
RS	4	20	6.61	6.84	6.74	6.65
RS	Mean	77	6.66	6.79	6.53	6.39

Note. RS, range symmetric decoy. Block denotes the block in which attractiveness ratings were made.

TABLE 8

Importance Ratings for Dimensions 1 and 2 (Experiment 2)

			Dimension 1		Dimension 2	
Decoy	Block	N	Favors A	Favors B	Favors A	Favors B
RS	1	20	7.19	7.09	7.15	7.48
RS	2	19	7.12	7.03	7.03	7.28
RS	3	19	7.43	7.33	7.34	7.35
RS	4	19	7.02	6.90	6.77	6.92
RS	Mean	77	7.19	7.08	7.07	7.26

Note. RS, range symmetric decoy. Block denotes the block in which attractiveness ratings were made.

importance ratings of dimensions 1 and 2 for the full set of participants. The Dimension × Favored Alternative interaction was significant, $F(1,69) = 7.0$, $p < .05$, and it was in the same direction found for the *R* decoy in Experiment 1. No significant interactions involving task order were found. Planned tests of the interaction for each block of ratings revealed no significant effects in the individual blocks, although block 2 was marginally significant (at $p < .06$).

Value Ratings

The mean ratings of each attribute value for alternatives *A* and *B* across decoy conditions are shown in Table 9. These results can be compared to corresponding results for *R* and *F* decoys shown in Table 4. Overall effects of the *RS* decoy on mean value ratings were in the same direction as found for *R* and *F* decoys, although the *RS* effects were greatly reduced. Consistent with a value-shift model, the combined value ratings of *A* were slightly greater when the *RS* decoy favored *A* ($M_A = 6.58$ vs $M_B = 6.50$), and similarly the combined value ratings of *B* were slightly greater when the *RS* decoy favored *B* ($M_A = 6.32$ vs $M_B = 6.42$). Also, the combined mean ratings for dimension 1 were greater when the decoy favored *A* ($M_1 = 6.55$ vs $M_2 = 6.41$) while the combined mean ratings for dimension 2 were greater when the decoy favored *B* ($M_1 = 6.34$ vs $M_2 = 6.57$).

A repeated-measures ANOVA was conducted on the attribute value ratings of *A* and *B* for the full set of participants. The Alternative × Favored Alternative interaction was significant, $F(1,69) = 5.4$, $p < .05$ as was the Dimension × Favored Alternative interaction, $F(1,69) = 26.6$, $p < .01$. There were no significant interactions involving task order. Planned tests of the Alternative × Favored Alternative interaction for each block of ratings revealed significant effects (at $p < .05$) for blocks 2, 3, and 4. The Dimension × Favored Alternative interaction was significant for all four blocks.

Regression Analyses

Separate and combined regressions were conducted examining how changes in attractiveness ratings across contexts were predicted by corresponding changes in justifiability, importance, and value ratings. Interaction contrast scores reflecting decoy effects were computed in the same way as described in Experiment 1. The results most closely parallel those found for the *R* decoy in Experiment 1. Simple regression models predicting ADIFF scores showed significant relationships with JDIFF scores ($r = .47$) and VDIFF scores ($r = .47$), but not with WDIFF ($r = -.03$). The multiple regression equation was built by first including all three predictors and then eliminating variables whose unique contribution were not significant ($p < .05$). This resulted in the inclusion of only JDIFF and VDIFF scores, with standardized regression weights of .40 for each. These results provide further support for the value-shift and value-added models, but do not support the weight-change model (Table 10).

Discussion

The overall lack of an effect of the *RS* decoy on the attractiveness ratings is an important finding because it provides further evidence that these judgments reflect the same effects found in choice. The null result cannot be dismissed for lack of power. The range manipulation for *R* and *RS* decoys was of the same magnitude, the number of participants in the respective conditions was approximately the same, and yet the large

TABLE 9

Value Ratings for Each Alternative on Each Dimension (Experiment 2)

				Alternative A		Alternative B	
Decoy	Block	N	Dim.	Favors A	Favors B	Favors A	Favors B
RS	1	19	1	5.29	5.08	6.70	6.37
			2	6.74	7.12	5.03	5.10
RS	2	20	1	5.94	5.59	7.44	7.38
			2	7.56	7.63	5.35	5.71
RS	3	19	1	5.78	5.44	7.65	7.67
			2	7.58	7.67	5.35	5.66
RS	4	19	1	5.94	5.50	7.68	7.73
			2	7.78	7.93	5.35	5.73
RS	Mean	77	1	5.74	5.41	7.37	7.29
			2	7.42	7.59	5.27	5.55

Note. RS, range symmetric. Block denotes the block in which justifiability ratings were made.

TABLE 10

Regression Coefficients from Models Predicting Differences in Attractiveness Ratings from Differences in Justifiability, Value, and Importance Ratings (Experiment 2)

Predictor variable	Decoy type	Regression model	
		Single	Multiple
VDIFF	RS	.475	.404
JDIFF	RS	.474	.404
WDIFF	RS	.029	—

Note. VDIFF, JDIFF, and WDIFF are context-sensitive difference scores on value, justifiability, and weight. RS, range symmetrical decoy. The multiple regression model included VDIFF and JDIFF; WDIFF was not included because it was not statistically significant.

effect interaction effect found for the *R* decoy ($F > 19$) was virtually eliminated for the *RS* decoy ($F < 1$).

This conclusion must be tempered by the finding of a higher-order interaction involving task order. For only one of the four blocks of ratings was a significant decoy effect found, and that effect favored the nontargeted alternative. Wedell (1991) found no significant effect of the *RS* decoys on choice, although he noted the direction of the effect favored the nontargeted alternative. Wedell (1993) found that the *RS* decoy led to a small but significant effect that favored the nontargeted alternative in choice. The interaction with task order reflected the fact that in one block the attraction effect significantly favored the nontargeted alternative and in the other three blocks there was no significant effect. These results are in line with previous research.

Experiment 2 aids in the understanding of decoy effects in demonstrating that the null effects of the *RS* decoy may be conceived as resulting from value-shift and value-added processes operating in opposite directions. The results demonstrated that the nontargeted alternative (which shared a common value with the decoy) was significantly more justifiable, but that the combined dimensional value ratings were significantly higher for the targeted alternative. These processes then combined for a nonsignificant effect of the *RS* decoy on attractiveness. The multiple regression analysis replicated Experiment 1 results in showing significant contributions of both justifiability differences and value differences in predicting attractiveness differences. These results provided further support for the two process interpretation.

Experiment 2 also replicated results from Experiment 1 that cast strong doubt on a weight-change interpretation of AD decoy effects. Like the *R* decoys of Experiment 1, extending the range on a dimension resulted in higher importance ratings for that dimension. Simple and multiple regression analyses relating attractiveness differences to importance differences provided no support for a role of weight in decoy effects.

The pattern of data from Experiments 1 and 2 argues against a halo effect interpretation of the different task ratings. A halo interpretation would propose that ratings of value and justifiability simply reflected carryover effects from overall evaluations of attractiveness. One argument against this interpretation is that in Experiment 1 the three-way interaction of task order, alternative, and favored alternative was not significant in any of the eight analyses conducted. Thus, the same pattern of results held regardless of block. Although this three-way interaction was significant in two of the four analyses conducted in Experiment 2, the results from the *RS* decoys may be said to provide even stronger evidence against a halo interpretation. This is because the effects for attractiveness ratings, justifiability ratings, and dimensional ratings did not coincide. Attractiveness ratings showed no overall effect of decoy, value ratings showed an effect in which the targeted alternative was favored, and justifiability ratings showed the opposite pattern of effects. This pattern cannot be interpreted as a halo effect.

Effects of Local Versus Global Contexts

In considering context effects, it is useful to distinguish between local and global contexts. The global context includes stimuli presented over the entire series of relevant trials and is cumulative in nature. The local context is a limited subset of the global context, possibly corresponding to the stimuli simultaneously presented on a given trial. Contextual processes operating on the local context may not always correspond to those operating on the global context. For example, Wedell, Parducci, and Geiselman (1987) demonstrated that when pairs of photographs of faces were presented for judgment on a physical attractiveness scale, there was a contrast effect of the global context (the full set of faces) but an assimilation effect of the local context (the simultaneously presented other face).

Decoy effects are clear examples of local context effects. Wedell (1991) demonstrated this convincingly in an experiment in which participants chose between triads of gambles. Because decoy was manipulated within subjects, the global context was held constant while the local context varied from trial to trial. The strong decoy effects observed on choice were then due to changes in local context.

Range-frequency theory (Parducci, 1974) was developed as a theory of global contrast effects. Experiments by Mellers and Cooke (1994) found support for a version of the value-shift model based on range-frequency theory operating on attractiveness judgments when context was manipulated globally. Results of the present experiments provided support for similar processes operating at the local level.

In addition to these value-shift processes, local context appears to be involved in value-added processes such as the increased justifiability of an alternative due to its asymmetric dominance of a decoy. Recent work by Wedell (1996b) suggests that the asymmetric dominance of alternatives in the global rather than local context does not enhance the attractiveness of an alternative. In that work, alternatives were presented in pairs. Consistent with a value-shift model, extending the range of variation of the previous pairs on an alternative's poorer attribute increased the proportion choosing that alternative. However, this effect did not depend on whether previous alternatives were asymmetrically dominated by the targeted alternative. Further research is needed to determine the similarities and differences found in global and local contextual processes.

Generality of Contextual Valuation Processes

The results from Experiments 1 and 2 supported the applicability of the value-shift model to decoy effects and thus provided additional evidence that contextual valuation may occur at an early stage of processing. If context effects occurred only at a response selection stage, then cognitive operations that build upon implicit scale values would typically not show context effects. The present results are consistent with the hypothesis that for many cognitive operations, context dependent implicit scale values are generated and operated upon.

Evidence for the generation of context-dependent implicit scale values has been generated in a variety of tasks. Mellers (1983, 1986) found evidence that equity judgments are based on a comparison of range-frequency transformed merit ratings and salaries. The Mellers and Cooke (1994) experiments cited earlier provided evidence that values on different attributes are contextually scaled before being combined into attractiveness judgments. Wedell (1994) found evidence that at least a subset of participants contextually evaluated adjectives before combining them together to form an overall impression. Sailor and Pineda (1993) found that reaction time data for comparative judgments was consistent with context dependent implicit scaling. In their study, reaction time to indicate which of a pair of objects was larger increased when the contextual manipulation increased the subjective differences between the objects. Wedell (1995) found evidence for both a stimulus based (implicit scaling) process and a response based process operating on comparative judgments. Risky, Parducci, and Beauchamp (1979) found evidence consistent with pleasantness judgments being determined by an ideal point process operating on contextually altered stimulus values.

Cognitive operations, however, do not always build on context dependent values. For example, Mellers and Birnbaum (1983) found that participants judging the performance of an individual based on pairs of tests scores did not appear to contextually value scores before combining them. Mellers and Birnbaum (1982) also showed that judgments of the differences in darkness of pairs of dot patterns were based on context independent scale values. Wedell (1996a) recently replicated this finding, but demonstrated conditions under which these judgments became context dependent. In particular, if a short delay was introduced between members of the pair being judged, then dissimilarity ratings reflected differences in context-dependent implicit scale values. Wedell (1996b) also found that prior single stimulus ratings of the stimuli resulted in subsequent dissimilarity ratings being based on context dependent scale values. Finally, Mellers and Birnbaum (1982) demonstrated that cross modality difference comparisons tended to be based on context dependent scale values. These combined results suggest that although there are circumstances when context dependent valuation can be bypassed, there is a broad range of circumstances in which context dependent values will be used in cognitive operations that combine or compare values. In particular, context dependent valuation is most likely to occur when (a) stimulus values are not directly comparable, (b) stimuli must be held in memory for later comparison or integration, or (c) evaluations must be constructed at the time of judgment rather than retrieved from memory.

Generality of Decoy Effects

Decoy effects have proven to be very robust phenomena. They occur for simple numerical stimuli such as gambles as well as for complex consumer-based choices. They have also been shown to occur in both between-subjects and within-subject designs, for both familiar and unfamiliar sets of alternatives, and also in settings in which participants are expected to justify their decisions to others.

The present research speaks to two additional aspects of generality. First, these experiments demonstrate that similar types of decoy effects occur in both choice and judgment. Thus, one cannot simply avoid these contextual effects by switching from a choice to a judgment task. From a management perspective, one may expect similar contextual dependencies may occur in performance appraisals, interviews, and other evaluation tasks that may involve choice, judgment, or both. Second, the evidence for a dual process explanation of AD decoy effects provides an explanation for the robustness of these effects. For example, individuals who may not be sensitive to issues of justifiability or dominance in a particular setting may still show decoy effects based on the value-shift mechanism. Similarly, those who are resistant to contextual effects on valuation because of their greater familiarity with the attributes, may nevertheless show decoy effects through the value-added processing route.

The Value-Added Model

Equation (4) incorporates a value-added component into choice along with traditional weighted summation of value components. One appealing feature of the value-added model is that it can be used to incorporate relational information into the choice process. Typically, MAUT models do not incorporate relational information. However, in pairwise choice, Thurstone's (1927) choice model can account for dominance relationships by inclusion of correlated error. A problem with Thurstone's approach is that it does not generalize to choice situations using more than two alternatives. Tversky's (1972) elimination by aspects model can be applied to these situations and is also sensitive to dominance relations so that a dominated alternative is virtually never chosen. However, the model does not predict the AD decoy effects. By including an added component that is linked to relationships among the alternatives, Equation (4) provides an explicit way of representing added values such as justifiability.

There is growing evidence that choice must include factors beyond isolated weights and values. Simonson (1989) demonstrated with *AD* decoys that the value added component of "choice justification" was higher for the targeted alternative than for the other alternatives. Likewise, he also showed that a second value added component, "evaluation apprehension," was reduced for the targeted alternative with *AD* and *C* decoys. Influences of perceived regret associated with a choice may also constitute a value that is added to the choice process (Simonson, 1992). More generally, Tetlock and his colleagues (Tetlock, 1985; Tetlock & Boettger, 1989) have argued that choices occur within social settings and thus anticipated social attributions may be important determinants of choice, especially when perceived accountability for a choice is high. Further investigation is needed to better understand the different types of relational values that may play a role in choice. The gathering of multiple judgment measures used in the present experiments may prove a helpful way to determine the different facets of what types of values are added in the choice process.

APPENDIX

Choice Sets Used In Judgment Task

Domain/Attribute	A	B	R_A	R_B	F_A	F_B	RS_A	RS_B
1. Computers								
Processing Speed (MH)	40	66	27	66	40	53	27	40
Size of hard drive (in MB)	420	300	420	240	360	300	300	240
2. Restaurants								
Price of meal for two ($)	44	36	48	36	44	40	48	44
Wait to be served (minutes)	20	34	20	41	27	34	34	41
3. Plane tickets								
Cost of ticket ($)	400	330	435	330	400	365	435	400
Length of layover (minutes)	60	150	60	195	105	150	150	195
4. Mechanics								
Warranty length (days)	30	30	15	60	30	45	15	30
Experience (years)	14	7	14	4	11	7	7	4
5. CD players								
Price ($)	250	175	288	175	250	213	288	250
Number of disks	10	4	10	1	7	4	4	1
6. Apartments								
Rent ($)	200	140	230	140	200	170	230	200
Distance (minutes)	10	20	10	25	15	20	20	25
7. Cars								
Miles per gallon	22	35	16	35	22	3	15	22
Number of safety features	10	5	10	3	8	5	5	3

APPENDIX—*Continued*

Domain/Attribute	A	B	R_A	R_B	F_A	F_B	RS_A	RS_B
8. Boats								
Number of passengers	4	20	1	20	4	12	1	4
Speed (knots per hour)	30	10	30	5	20	10	10	5
9. Job offers								
Number of days of sick leave	6	10	4	10	6	8	4	6
Number of paid holidays	16	12	16	10	14	12	12	10
10. Houses								
Price (thousands of $)	75.0	40.0	92.5	40.0	75.0	57.5	92.5	75.0
Square footage	1500	1100	1500	900	1300	1100	1100	900
11. Electric keyboards								
Tone quality (1–100)	75	85	70	85	75	80	70	75
Number of features	15	10	15	8	13	10	10	8
12. Mini-LCD TVs								
Price ($)	195	100	218	100	195	123	218	195
Percent distortion	2	4	2	5	3	4	4	5
13. Preschools								
Children per classroom	12	8	14	8	12	10	10	12
Teacher's experience (years)	12	5	12	2	9	5	5	2
14. Microwaves								
Warranty (months)	8	14	5	14	8	11	5	8
Cooking power (Watts)	1600	900	1600	550	1250	900	900	550
15. Parking spaces								
Price per month ($)	50	25	62	25	50	37	62	50
Distance from work (blocks)	3	6	3	7.5	4.5	6	6	7.5
16. Video cameras								
Weight (pounds)	7.0	4.0	8.5	4.0	7.0	5.5	8.5	7.0
Number of features	14	8	14	5	11	8	9	5
17. Beer (24 packs)								
Price ($)	10.00	8.50	10.75	8.50	10.00	7.75	10.75	10.00
Quality (1 to 100)	60	50	60	45	55	50	50	45
18. Cars								
Ride quality (1 to 100)	65	80	57	80	65	72	57	65
Miles per gallon	30	24	30	21	27	24	24	21
19. Restaurants								
Distance from home (minutes)	45	15	60	15	45	30	60	45
Quality (1 to 5 stars)	4	3	4	2	3.5	3	3	2
20. TV sets (19 inch)								
Percent distortion	3.5	2.5	4.0	2.5	3.5	3.0	4.0	3.5
Average life span (years)	4	3	4	2	3.5	3	3	2

REFERENCES

Ariely, D., & Wallsten, T. S. (1995). Seeking subjective dominance in multidimensional space: An explanation of the asymmetric dominance effect. *Organizational Behavior and Human Decision Processes*, 63, 223–232.

Huber, J., & Puto, C. (1983). Market boundaries and product choice: Illustrating attraction and substitution effects. *Journal of Consumer Research*, 10, 31–44.

Huber, J., Payne, J. W., & Puto, C. (1982). Adding asymmetrically dominated alternatives: Violations of regularity and the similarity hypothesis. *Journal of Consumer Research*, 9, 90–98.

Mellers, B. A. (1986). "Fair" allocations of salaries and taxes. *Journal of Experimental Psychology and Human Perception and Performance*, 12, 80–91.

Mellers, B. A. (1983). Equity judgment: A revision of Aristotelian views. *Journal of Experimental Psychology: General*, 111, 242–270.

Mellers, B. A., & Birnbaum, M. H. (1983). Contextual effects in social judgment. *Journal of Experimental Social Psychology*, 19, 157–171.

Mellers, B. A., & Birnbaum, M. H. (1982). Loci of contextual effects in judgment. *Journal of Experimental Psychology Human Perception and Performance*, 8, 582–601.

Mellers, B. A., & Cooke, A. D. J. (1994). Trade-offs depend on attribute range. *Journal of Experimental Psychology Human Perception and Performance*, 20, 1055–1067.

Parducci, A. (1974). Contextual effects: A range-frequency analysis. In E. C. Carterette & M. P. Friedman (Eds.), *Handbook of perception* (Vol. 2). New York: Academic Press.

Parducci, A. (1983). Category ratings and the relational character of judgment. In H.-G. Geissler & V. Sarris (Eds.), *Modern trends in* *perception* (pp. 89–105). Berlin: VEB Deutscher Verlag der Wissenschaften.

Ratneshwar, S., Shocker, A. D., & Stewart, D. W. (1987). Toward understanding the attraction effect: The implications of product stimulus meaningfulness and familiarity. *Journal of Consumer Research*, 13, 520–533.

Riskey, D. R., Parducci, A., & Beauchamp, G. K. (1979). Effects of context in judgments of sweetness and pleasantness. *Perception and Psychophysics*, 26, 171–176.

Sailor, K. M., & Pineda, K. M. (1993). Evidence for implicit scaling in comparative judgment. *Memory and Cognition*, 21, 431–439.

Simonson, I. (1989). Choice based on reasons: The case of attraction and compromise effects. *Journal of Consumer Research*, 16, 158–174.

Simonson, I. (1992). The influence of anticipating regret and responsibility on purchase decisions. *Journal of Consumer Research*, 19, 105–118.

Simonson, I., & Tversky, A. (1992). Choice in context: Tradeoff Contrast and Extremeness Aversion. *Journal of Marketing Research*, 29, 281–295.

Thurstone, L. L. (1927). A law of comparative judgment. *Psychological Review*, 34, 273–286.

Tetlock, P. E. (1985). Accountability: The neglected social context of judgment and choice. In B. Straw & L. Cummings (Eds.), *Research in organizational behavior* (Vol. 1, pp. 297–332). Greenwich, CT: JAI Press.

Tetlock, P. E., & Boettger, R. (1989). Accountability: A social magnifier of the dilution effect. *Journal of Personality and Social Psychology*, 57, 388–398.

Received: April 4, 1996

Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review*, 79, 281–299.

Tversky, A., Sattath, S., & Slovic, P. (1988). Contingent weighting in judgment and choice. *Psychological Review*, 95, 371–384.

von Winterfeldt, D., & Edwards, W. (1986). *Decision analysis and behavioral research*. New York: Cambridge Univ. Press.

Wedell, D. H. (1991). Distinguishing among models of contextually induced preference reversals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 767–778.

Wedell, D. H. (1993). *Effects of different types of decoys on choice.* Paper presented at the 34th Annual Meeting of the Psychonomic Society, Washington, DC.

Wedell, D. H. (1994). Contextual contrast in evaluative: Test of pre- versus post-integration models of contrast. *Journal of Personality and Social Psychology*, 66, 1007–1019.

Wedell, D. H. (1995). Contrast effects in paired comparisons: Evidence for both stimulus and response based processes. *Journal of Experimental Psychology: Human Perception and Performance*, 21, 1158–1173.

Wedell, D. H. (1996a). A constructive-associative model of the contextual dependence of unidimensional similarity. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 634–661.

Wedell, D. H. (1996b). *Testing models of tradeoff contrast in pairwise choice.* Submitted for publication.

Wedell, D. H., Parducci, A., & Geiselman, R. E. (1987). A formal analysis of ratings of physical attractiveness: Successive contrast and simultaneous assimilation. *Journal of Experimental Social Psychology*, 23, 230–249.