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Comparability and Hierarchical Processing in Multialternative Choice

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Abstract
Consumer choice research recently moved beyond brand-based decisions to study the more noncomparable choices consumers often face. Noncomparable choice processing in choices involving multiple products is discussed. In Experiment 1, consumers used attribute-based processing at an abstract level and alternative-based processing at a concrete level to evaluate more noncomparable alternatives independent of choice set size. In Experiment 2, the choices from Experiment 1 were compared with choices within which products varied in comparability. The results suggest that comparability variance within a multialternative choice set facilitates consumers' use of product categories and hierarchical processing to eliminate choice alternatives.

Keywords
consumer choice, multialternative choice, noncomparable choice

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Comparability and Hierarchical Processing in Multialternative Choice

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Consumer choice research recently moved beyond brand-based decisions to study the more noncomparable choices consumers often face. Noncomparable choice processing in choices involving multiple products is discussed. In Experiment 1, consumers used attribute-based processing at an abstract level and alternative-based processing at a concrete level to evaluate more noncomparable alternatives independent of choice set size. In Experiment 2, the choices from Experiment 1 were compared with choices within which products varied in comparability. The results suggest that comparability variance within a multialternative choice set facilitates consumers' use of product categories and hierarchical processing to eliminate choice alternatives.

Studies investigating how consumers evaluate products and make decisions have focused on comparable choice alternatives, typically brands from the same product category. Recently, Johnson (1984) extended the scope of this research to include more noncomparable alternatives or specific alternatives from different product categories. Johnson found that consumers use two types of choice processing when faced with noncomparable product alternatives: alternative-based processing at a concrete level and attribute-based processing at a more abstract level. However, only binary choices were studied, and, as previous research suggests, choice strategies for multiple alternatives may be quite different (Lussier and Olshavsky 1979; Payne 1976). Certain types of processing may become more or less attractive as the number of alternatives increases. For example, finding common, abstract attributes on which to compare multiple noncomparable alternatives may be difficult.

This article extends our knowledge of noncomparable choice processing to multialternative choice situations. Experiment 1 uses choices varying in set size and comparability to test for the existence of the two types of processing found in the Johnson (1984) study of binary choice. Experiment 2 tests a hypothesis regarding the hierarchical nature of choice processing when comparability varies within a multialternative choice set.

COMPARABILITY AND CHOICE

Product comparability, which varies from choice to choice, is the degree to which consumers describe or represent products using the same nonprice attributes (Johnson 1984). Brands within a category are described on many of the same concrete attributes and are comparable. Two toasters may, for example, be compared directly on the number of slots, the width of the slots, and color. More abstract product categories, described on similar abstract or category level attributes, are likewise comparable (Johnson and Fornell 1987). At a general level, toasters and blow dryers may be compared on necessity, practicality, and gift giving. However, specific alternatives from different product categories are more noncomparable. A toaster may be described by its number and width of slots, but a blow dryer may be described by its weight and number of speeds. Noncomparable choices may result from a limited choice set (e.g., when only one alternative is available within each possible category). Or, consumers may decide first or separately which alternatives they prefer within each of two or more categories, and then they may choose between or among the specific category choices.

Johnson (1984) suggests that consumers use two possible strategies to compare more noncomparable alternatives. The first is an alternative-based or across-attribute strategy, such as a linear compensatory, conjunctive, or disjunctive strategy (Bettman 1979), whereby consumers evaluate or consider alternatives holistically or across their descriptive attri-

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butes. Concrete attributes are combined or considered for each alternative, and the resulting overall evaluations are then compared. Previously studied in the context of comparable alternatives, alternative-based strategies can be applied directly to noncomparables. Even the most noncomparable of alternatives can be compared on overall worth or utility using this type of processing.

The second strategy is an attribute-based or within-attribute strategy with abstraction. Using an attribute-based strategy, such as additive difference (Tversky 1969) or elimination by aspects (Tversky 1972), consumers compare alternatives directly on their descriptive attributes. Because noncomparable alternatives are described on different concrete attributes, consumers abstract their representation of the choice alternatives to a level where comparability exists (i.e., where attributes overlap) to make attribute comparisons. The basic tenet here is that more abstract, nonprice attributes describe a wider range of choice alternatives.[1] For example, to choose between a stereo and a television, consumers might first describe the two products on relatively abstract attributes, such as versatility or entertainment, and then directly compare the alternatives on these attributes. The more noncomparable the alternatives, the more abstract the required representation and resulting nonprice comparisons. (Price is one concrete attribute on which even noncomparable alternatives can be directly compared.)

Given these strategies, the level of abstraction of evaluative product attributes should increase as choice comparability decreases, depending on the strategy involved. An alternative-based strategy does not require comparability and may be applied directly to concrete product representations. An attribute-based strategy requires a more abstract, comparable representation when products are noncomparable. Therefore, attribute-based product comparisons should become more abstract, but alternative-based attribute combinations should remain relatively concrete as comparability decreases.

A cost-benefit analysis of these strategies provides a second prediction: alternative-based processing should increase relative to attribute-based processing as choice comparability decreases. In a cost-benefit approach, choice strategies are viewed as varying with respect to the resources required to execute a strategy and the choice strategies' ability to produce an accurate response or to select a preferred alternative (Beach and Mitchell 1978). Strategies that are optimal on the basis of these cost-benefit considerations are chosen (see Johnson 1986; Johnson and Payne 1985; Klein and Bither 1987; Shugan 1980). Consumers bear no incremental processing costs applying alternative-based strategies when moving from comparable to noncomparable choices. Applying attribute-based strategies to noncomparables, however, requires an additional stage of processing, namely the formation of a more abstract, comparable representation. This may be as simple as recalling a more abstract, categorical representation or as effortful as mapping concrete attributes directly into values on more abstract, comparable attributes (Johnson 1986). The result may be a relative increase in the processing costs associated with attribute-based processing and a predicted shift toward alternative-based processing as comparability decreases.

An increase in alternative-based processing with a decrease in comparability also may result from the abstraction process required to make attribute comparisons; holistic, alternative-based processing of concrete information may be required to form the abstract attribute representations on which attribute-based processing occurs (Johnson 1984, 1986). Finally, a reduction in attribute-based processing may be an artifact of abstraction. Abstraction, by definition, implies a concentration of information (Johnson 1984; Johnson and Fornell 1987). A few abstract attributes capture roughly the same information as a larger number of concrete attributes, resulting in generally more concrete attribute information to combine than abstract attribute information to compare in any given choice. Therefore, as comparability decreases, the number of attribute-based comparisons should decrease relative to attributes combined.

Johnson (1984) reports the results of two experiments that support these two main predictions. Subjects were presented with binary alternatives at different levels of comparability and were asked to make choices or to project how a third party would choose. Verbal protocols and eye movements were collected to infer the type of processing. Subjects used more abstract product attributes to make relative comparisons and continued to rely on alternative-based processing of concrete information as comparability decreased. Alternative-based processing also increased relative to attribute-based processing as comparability decreased. Again, only binary choices were studied in this initial investigation of noncomparable choice.

In a slightly different vein, Bettman and Sujan (1987) explored how the ready availability of a decision criteria affects expert and novice consumers' judgments of comparable and noncomparable products. They presented subjects with either two comparable or two noncomparable products, instructed the subjects to form impressions of each of the two alternatives, and then recorded the subjects' evaluations

[1]Abstractness, in this context, is defined as the inverse of how directly an attribute denotes particular objects or events. Concreteness-abstractness is equated in this regard with the specificity-generality of terms and the subordination-superordination of categories (Johnson 1984; Johnson and Fornell 1987; Paivio 1971; Rosch 1975, 1977; Rosch et al. 1976).

and cognitive responses. Prior to the impression formation task, some subjects were primed for a decision criterion. Bettman and Sujan's no criterion subjects (i.e., those who were not primed) are comparable to the subjects in the Johnson study. The no criterion subjects that were classified as experts evoked more concrete attributes for the comparable alternatives and more abstract attributes for the noncomparable alternatives, which is consistent with the Johnson (1984) results. Those classified as novices, however, evoked predominantly abstract thoughts for both comparables and noncomparables. (Knowledge had no effect on attribute abstraction in the Johnson study). The different results for the novices can be explained by the products used in the two studies. Bettman and Sujan used relatively sophisticated products (35mm cameras and computers), but Johnson used products for which most consumers were likely to have at least some degree of knowledge (e.g., bicycles, televisions). The tasks and methods also were quite different in the two studies.

Hypotheses

An important, unstudied aspect of noncomparable choice concerns the decisions that consumers face involving multiple noncomparable alternatives. Consumers, for example, may choose to attend a particular movie, play, or sporting event, or may choose among a radio, a blow dryer, and a coffee maker. How does the number of alternatives affect the processing of noncomparable choice sets? Stated differently, how do consumers choose among more than two specific alternatives from more than one product category?

Experiment 1 uses choices varying in set size and comparability to examine the generalizability of Johnson's (1984) results to multiple alternatives. Two hypotheses are tested. Hypothesis 1 predicts the change in processing that Johnson (1984) found characteristic of binary choices. Using attribute-based processing, the attributes on which consumers directly compare products should become more abstract as comparability decreases. Using alternative-based processing, the attributes that consumers combine or consider when evaluating particular alternatives should remain relatively concrete as comparability decreases. Therefore, a decrease in comparability should differentially affect the abstractness of attribute-based comparisons and alternative-based combinations.

H1: Attribute-based product comparisons become more abstract and alternative-based attribute combinations remain relatively concrete as comparability decreases.

Johnson (1984) also predicted and found a tradeoff toward alternative-based processing relative to attribute-based processing as comparability decreased. Due to the additional resources required to use attribute-based processing and/or the nature of abstraction, alternative-based attribute combinations should increase relative to attribute-based product comparisons as comparability decreases.

H2: Alternative-based attribute combinations increase relative to attribute-based product comparisons as comparability decreases.

The hypotheses, simply stated, predict that consumers continue to make attribute-based comparisons by forming more abstract representations while gradually shifting to alternative-based processing as comparability decreases. These hypotheses correspond to Johnson's (1984) Hypotheses 1a and 1b.

A single study was conducted incorporating two partially overlapping experimental designs. For simplicity, the subset of the study designed to test Hypotheses 1 and 2 is described as Experiment 1, and the subset designed to test Hypothesis 3 (developed in a later section) is described as Experiment 2. Details regarding the procedure and instructions for subjects in the study are described in the Experiment 1 section.

EXPERIMENT 1

The subjects in the study were asked to make choices among actual products in a laboratory setting. The products' prices were held relatively constant to keep consumers from considering only the more expensive products. Small consumer durables ranging in value from $15 to $20 were used, and the average retail value of the products was $18. Previous research indicates that relatively inexpensive durables of this sort are purchased typically on the basis of one store visit and with shorter planning periods than major durables, which is consistent with the experimental procedure (see Hansen 1972, pp. 335–337 for a review).

Design and Stimulus Selection

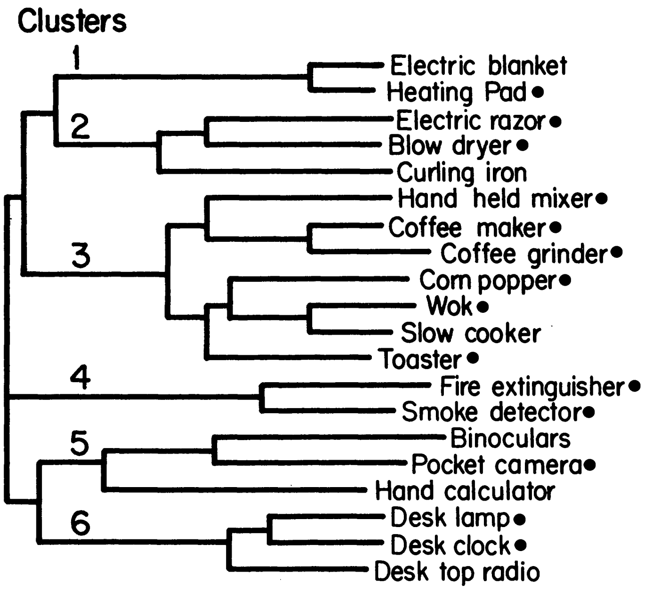
The independent variables manipulated in Experiment 1 included the comparability of the alternatives in the choice set and the number of alternatives involved. To test the hypotheses, alternatives were classified as either comparable, moderately noncomparable, or more noncomparable (Johnson 1984). A convenience sample of 11 consumers rated similarities among a set of 20 possible small consumer durables to obtain the higher level classifications. Identical clusters of similar alternatives were found using an additive tree (ADDTREE; see Sattath and Tversky 1977) and multidimensional scaling (MINISSA; see Roskam and Lingoes 1970) procedure. Alternatives from the same categories are considered comparable, alternatives from different categories within the same cluster of categories are considered moderately noncomparable, and alternatives from different categories and different clusters are considered more noncomparable.

Three levels of choice set size were used, $n = 2$, 4, and 6. Therefore, the ADDTREE and MDS solutions had to have at least six approximately equally different clusters with at least six different categories in one of the clusters. The scaling solutions were successful at meeting this constraint, and stimulus sets were operationalized by selecting products from the six distinct clusters. Figure A shows the ADDTREE solution for the original 20 products (Kruskal's stress = 0.042) with the category clusters labeled from one to six. According to this scheme, for example, two coffee makers are considered comparable, a coffee maker and a toaster are moderately noncomparable, and a coffee maker and a pocket camera are more noncomparable. In support of this operationalization, the average intercluster distance in the ADDTREE solution for these product categories was 2.5 times the average intracluster distance. The MDS analysis suggests five significant dimensions and the five dimensional solution (Kruskal's stress = 0.043) resulted in an average intercluster distance nearly four times the average intracluster distance for the test stimuli.

Certain practical constraints, such as the availability and price of brands in each product category, also were encountered. Given these constraints and the six cluster solution, specific choices were operationalized

FIGURE A

ADDTREE SOLUTION FOR GENERATING CHOICE ALTERNATIVES



NOTE: ● = categories used in the study.

that (1) represented the three levels of comparability and the three choice set sizes, (2) were as globally valuable as possible, and (3) contained products priced as equally as possible. Although specific products were used, by necessity, in more than one choice, no individual product brand was presented more than twice to minimize learning and familiarity during the course of the experiment. All told, products were selected from 14 of the original 20 categories for inclusion in Experiments 1 and 2 (see Figure A). The specific choice sets for Experiment 1 included: (1) two coffee makers (comparable); (2) a corn popper and a toaster (moderately noncomparable); (3) a smoke detector and a heating pad (more noncomparable); (4) four toasters (comparable); (5) a corn popper, a mixer, a wok, and a coffee maker (moderately noncomparable); (6) a coffee grinder, an electric razor, a heating pad, and a camera (more noncomparable); (7) six smoke detectors (comparable); (8) a toaster, a mixer, a corn popper, a coffee grinder, a wok, and a coffee maker (moderately noncomparable); and (9) a corn popper, a desk lamp, a fire extinguisher, an electric razor, a heating pad, and a pocket camera (more noncomparable).

The use of actual products and the constraints that this entailed necessitated a potential confound in the designs of Experiments 1 and 2. Products and categories did not appear equally often across the experimental conditions. In Experiment 1, for example, the size and comparability manipulations may be compromised as some products and some categories appeared only in certain conditions. However, the potential product and category confounds did not appear to undermine the manipulations in either experiment or to affect greatly the type of processing.

Procedure

Subjects were run individually through the study. Subjects first read and signed a consent form and rated their knowledge within each product category using Johnson's (1984) knowledge scale. The subjects were then presented one at a time with the various choice sets. Each choice set was arranged randomly on a table in front of the subjects. Subjects were instructed to "choose the one product among those available in each group that you want the most." Before making their choices, subjects were also told that "after you have made all of the choices, you will then be able to keep one of the products from among your earlier choices as compensation for participating in the study."[2] Stimulus sets were hidden from the sub-

[2]In hindsight, it is ambiguous as to whether the subjects understood if they or the experimenter would be choosing the product for final compensation. If subjects knew that they would be making the choice, then Experiments 1 and 2 may have had incentive problems. Subjects may have compared products to preferred choices from previous choice sets, thus mitigating the experimental manip-

jects until each choice was made. Seventeen choice sets (the nine described above for Experiment 1 plus an additional eight for Experiment 2) were presented in random order to every other subject and in reverse order to the remaining subjects.

Concurrent verbal protocols (Ericsson and Simon 1980) were used to obtain information regarding the subjects' decision processing. Subjects were instructed to think aloud while making their decisions and their responses were tape recorded. A pretest suggested that subjects had very little difficulty adapting to the protocol procedure; therefore, to limit the number of times subjects were exposed to particular products, no warm-up task was used in the experiment. Throughout the study, subjects who were quiet for several seconds were prompted with "What are you thinking?" The subjects were also videotaped while they made their decisions. The video recordings were used to identify products being evaluated that were unidentifiable from the audio recordings and to back up the audio recordings.

Thirty-one subjects were recruited for the study (25 females and six males). The subjects represented a convenience sample of nonstudents that included staff members at a large, Midwestern university. These subjects ranged in age from 24 to 55 and represented a variety of educational backgrounds. One subject failed to perform the task as instructed and was dropped from the study. This resulted in 30 usable subjects' protocols involving 24 female and six male subjects.

Protocol Coding

The protocols were transcribed and coded for two types of information to test the research hypotheses. The first was the set of attributes used in making each decision. Coders were instructed to code only attributes that subjects explicitly mentioned or used to describe or to evaluate the choice alternatives. Attributes of products not involved in the choice at hand, such as those mentioned by subjects during their recollection of previously or presently owned products, were explicitly excluded from the codes. The second type of information coded was how each attribute was processed. Each attribute was coded as being either the basis of an attribute-based comparison (i.e., whether the subject directly compared two or more products on a single attribute), as part of an alternative-based combination (i.e., whether the subject combined or sequentially considered two or more attributes for an alternative), or as a stand-alone description of a product or product group. The product or products involved in the comparisons, combinations, and descriptions were recorded. Because actual products were used, the subjects often handled, pointed to, or gestured toward the products they were considering at any one time. Subjects frequently did not verbally identify products by name; they instead used phrases such as "This one has a nice finish" or "This one makes more than that one." Constant reference was made to the videotapes to identify these products. Coders were instructed to consult the videotapes whenever they could not identify the object or objects of a consumer's verbal evaluation from the verbal protocol. (A copy of the coding scheme is available from the author.)

Three judges naive to the research hypotheses independently coded 510 combined Experiment 1 and Experiment 2 choice protocols. Following Johnson (1984), coding reliabilities were calculated for both types of information coded. The conditional probability of a product attribute coded by one judge being coded by a second judge ranged from a low of 0.54 to a high of 0.79 (average probability of 0.69). The coding of attribute use was consistent for 75, 71, and 77 percent of the attributes coded in common by judges 1 and 2, judges 1 and 3, and judges 2 and 3, respectively. The corresponding Cohen's Kappa measures of classification reliability (see Bishop, Fienberg, and Holland 1975, p. 395) were 0.58, 0.53, and 0.57, respectively (all significant at $p < 0.001$). A two out of three rule was adopted to extract information from the judges' codings to form a common code and to test the research hypotheses.[3] Only attributes coded by at least two of the three judges were considered. Comparisons or combinations involving these attributes were considered if at least two judges agreed. If only two judges coded an attribute and they disagreed about how it was used, the attribute was assumed only to describe the product.

Dependent Variables

The first dependent variable of interest was how individual attributes were processed. Using the common code, attributes were classified as being the basis of an attribute comparison or as part of an alternative-based combination. (Attributes not classified as comparisons or combinations were ignored.) The sec-

ulations. However, a review of the first ten subjects' protocols reveals that these comparisons were rare. Only five such comparisons were found, involving only 2.9 percent of the 170 choice protocols examined. Overall, the ambiguity in the instructions does not appear problematic.

[3]The coding reliabilities reported here are lower than those reported in the Johnson (1984) study. The author and one of the judges conducted a thorough review of the protocols and the codings to investigate why the reliabilities are lower. A major reason was that individual judges often missed or ignored some attributes and process information that, according to the objective coding instructions, should have been coded. In almost all cases, if legitimate processing information was present in the protocols, it was recognized by two out of the three judges, which led to the adoption of the two out of three rule.

TABLE

EXPERIMENT 1 ANALYSIS OF VARIANCE RESULTS

	Hypothesis 1: attribute abstraction				Hypothesis 2: type of processing (comparisons minus combinations)			
Source	*df*	Mean square	*F*	Probability	*df*	Mean square	*F*	Probability
Between subjects:								
Subjects	29	5.655	1.73	.011	29	6.895	2.78	.000
Within subjects:								
Type of operation	1	36.898	11.31	.001	–	–	–	–
Comparability	2	131.676	40.35	.000	2	37.737	13.19	.000
Choice set size	2	1.250	0.38	.682	2	1.171	0.47	.625
Type of operation × comparability	2	74.364	22.79	.000	–	–	–	–
Type of operation × choice set size	2	0.581	0.18	.837	–	–	–	–
Comparability × choice set size	4	16.978	5.19	.000	4	3.170	1.28	.280
Type of operation × comparability × choice set size	4	3.656	1.12	.346	–	–	–	–

ond critical dependent variable was the concreteness-abstractness of the processed attributes. Following Johnson (1984) and Johnson and Fornell (1987), attribute concreteness-abstractness was operationalized by having separate, independent judges rate the different attributes elicited by subjects in the study ($n = 203$). A convenience sample of 30 adult, nonstudent judges rated the attributes on an 11-point scale from zero (very concrete) to 10 (very abstract). Five judges were dropped due to consistent, nonsignificant correlations between their ratings and those of any other judge. The ratings were averaged across the remaining 25 judges to produce concreteness-abstractness measures, which were consistent with those used in Johnson (1984) and in Johnson and Fornell (1987). The concreteness-abstractness measures of the 29 common attributes used in all three studies had an average correlation of 0.93, and the correlations ranged from 0.90 to 0.95.

Each subject's average knowledge of the alternatives in each choice set was calculated and included in the initial versions of all of the analysis models reported hereafter. Knowledge had no significant or near significant effects on the dependent variables in Experiment 1 or Experiment 2; thus, it was excluded from all the models and results reported.

Effects of Comparability on the Abstractness of Attributes Used

Hypothesis 1 predicts a significant type of processing by comparability interaction effect on attribute abstraction: attribute-based comparisons should become more abstract and alternative-based combinations should remain relatively concrete as comparability decreases. Hypothesis 1 was tested using a repeated measures analysis of variance model. The dependent variable of interest was the level of abstraction of the processed attributes ($n = 573$). The independent variables included the type of operation (two levels: comparison or combination), the comparability of the choice set (three levels), choice set size (three levels), the interactions involving these factors, and a subjects factor (30 levels).

The Table shows the results. Attribute concreteness-abstractness varied significantly with type of operation, comparability, and subjects. The important result is the significant type of processing by comparability interaction depicted in Figure B ($F = 22.79$, $p < 0.001$). As comparability decreased, the abstractness of the comparisons increased relative to the abstractness of the combinations, supporting Hypothesis 1. The abstractness of the comparisons averaged 4.26, 7.48, and 7.43, respectively, for the comparable, moderately noncomparable, and more noncomparable alternatives. The corresponding averages for attributes combined were 4.29, 5.04, and 5.13.

A separate analysis involving only the product comparisons reveals a significant main effect for comparability on the level of abstraction of comparisons, $F = 89.63$, $p < 0.001$. (The subjects factor was again significant, $F = 2.35$, $p < 0.001$, but the set size main effect and the set size by comparability interaction were not significant.) A Newman-Keuls test for differences in means reveals a significant difference ($p < 0.05$) between the comparable and moderately noncomparable alternatives and between the comparable and more noncomparable alternatives, but not between the moderately and more noncomparable alternatives. Showing only a difference between the comparable and the two noncomparable conditions may suggest that the subjects simply made comparisons on overall evaluations rather than on abstract attributes as comparability decreased. However, a qualitative inspection of the abstract comparisons involving the noncomparable product alternatives supports

FIGURE B

ATTRIBUTE ABSTRACTION BY COMPARABILITY AND TYPE OF PROCESSING

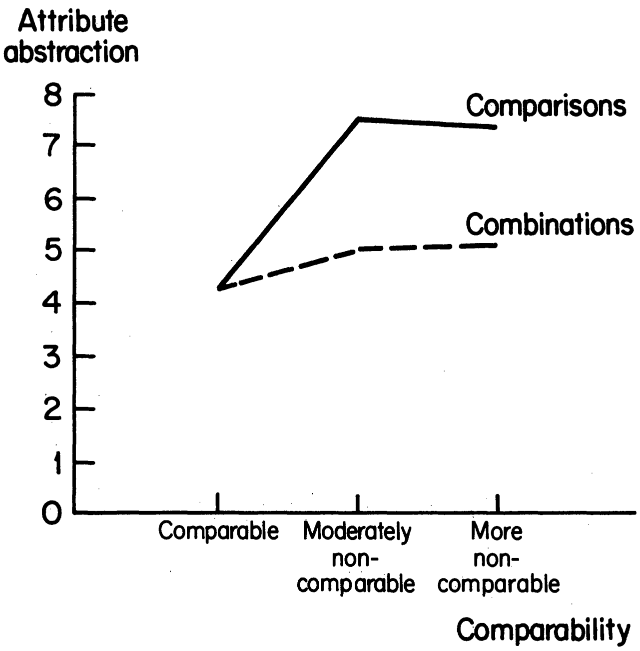
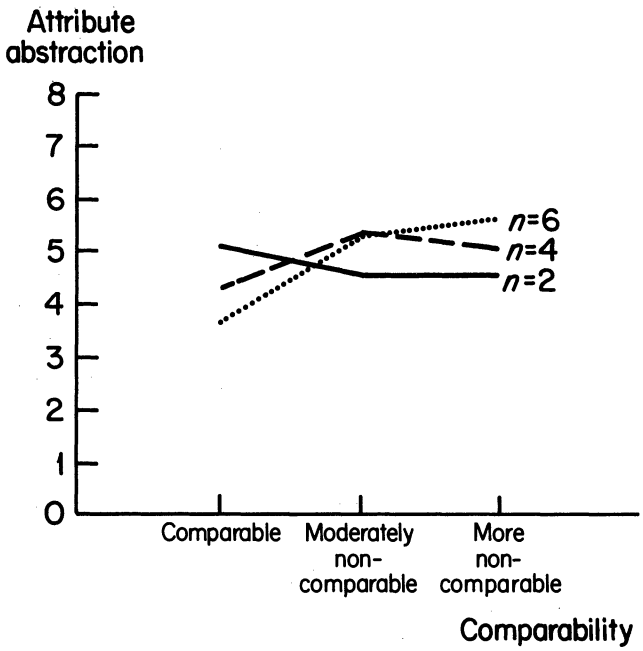


FIGURE C

ABSTRACTNESS OF ATTRIBUTE COMBINATIONS BY COMPARABILITY AND CHOICE SET SIZE



the prominent use of abstract attributes rather than overall evaluations. The most common comparisons for the comparable choice alternatives (frequencies in parentheses) were on "size" (13), "coffee making capacity" (12), "brand name" (9), and "number of features/accessories" (7); and the most common comparisons for the combined moderately and more noncomparable choices were on "usefulness" (22), "necessity" (9), "use as a gift" (5), and "frequency of use" (4).

The observed small increase in the abstractness of attribute combinations from the comparable to noncomparable choices was not predicted. A separate analysis, involving only the combinations, reveals that this difference was significant, $F = 3.80, p < 0.05$. (The subjects factor was again significant, $F = 1.91, p < 0.01$, but set size was not.) However, a significant interaction involving set size and comparability drove the effect ($F = 4.59, p < 0.01$). Figure C depicts this interaction (which itself drove the overall interaction between set size and comparability on attribute abstractness in the Table). Combinations became more abstract as comparability decreased only when multiple alternatives were involved; the most abstract alternative-based processing occurred when consumers faced a larger number of noncomparable alternatives. (The abstractness of combinations did not vary significantly with comparability for $n = 2$.) The significance of this result is discussed in the final section of this article.

Effects of Comparability and Number of Alternatives on Attribute-Based Versus Alternative-Based Processing

Hypothesis 2 predicts an increase in alternative-based combinations relative to attribute-based comparisons as comparability decreases. Three separate repeated measures analysis of variance models were used to test for differences in each of three dependent variables: the number of comparisons made during a choice, the number of combinations made, and the difference in the incidence of these two types of processing (the number of comparisons minus the number of combinations per choice per subject). The independent variables included a subjects factor (30 levels), comparability (three levels), choice set size (three levels), and a set size by comparability interaction term.

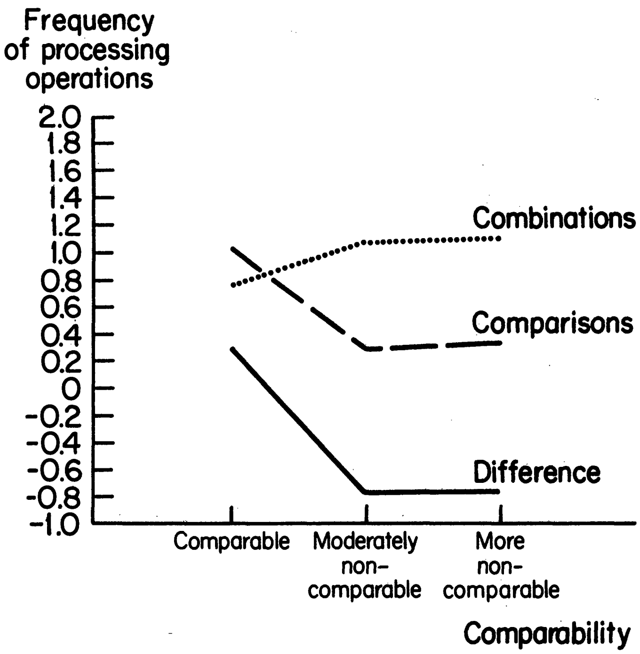
Of primary interest in testing Hypothesis 2 is the relative amount of each type of processing occurring in the choices. Therefore, the Table presents the model results using the $n = 270$ difference measures (Comparisons-Combinations) as the dependent variable. Moving from comparable to noncomparable choice alternatives resulted in a significant decrease in comparisons minus combinations, indicating more alternative-based processing relative to attribute-based processing and thus supporting Hypothesis 2. The mean differences were 0.267, −0.789, and −0.767 for the comparable, moderately noncomparable, and more noncomparable alternatives, respectively ($F = 13.19$, $p < 0.001$). A Newman-Keuls contrast of the factor level means reveals that the dependent variable differed significantly ($p < 0.05$) between the comparable and noncomparable alternatives, but not between the moderately noncomparable and more noncomparable alternatives. This pattern of results is consistent with those reported under Hypothesis 1.

Neither set size nor a set size by comparability interaction affected the type of processing. A reexamination of the common code reveals that the subjects overtly considered most of the available products as set size increased (averaging 1.65, 3.08, and 4.09 products considered for the n = 2, 4, and 6 choices, respectively), thus supporting a set size manipulation. Set size had little effect on the relative use of attribute- versus alternative-based processing.

The average frequencies of comparisons, combinations, and their difference as a function of comparability, presented in Figure D, provide additional insight. The number of comparisons occurring in each choice decreased significantly from the comparable to the noncomparable alternatives (average comparisons equaled 1.02, 0.28, and 0.33 for comparable, moderately noncomparable, and more noncomparable alternatives, respectively; $F = 37.46$, $p < 0.001$). The number of combinations increased directionally but not significantly with decreases in comparability (average combinations equaled 0.76, 1.07, and 1.10 for the comparable, moderately noncomparable, and more noncomparable alternatives, respectively; $F = 1.85$, $p = 0.16$). Although the largest change occurs for the (comparisons-combinations) difference variable, suggesting that combinations and comparisons contribute to the overall effect, comparisons contribute disproportionately to the effect. The set size and set size by comparability interaction effects for comparisons and combinations were not significant when analyzed separately.

FIGURE D

FREQUENCY OF PROCESSING BY COMPARABILITY AND TYPE



Summary of Experiment 1 Results

The main result of Experiment 1 is that subjects use more abstract attributes to directly compare products and relatively concrete attributes to holistically or individually evaluate products as choice comparability decreases. Additionally, attribute-based comparisons decrease relative to alternative-based combinations as comparability decreases. Going from two to four to six noncomparable alternatives generally does not affect choice processing. These results support the generalizability of Johnson's (1984) predictions to multiple alternatives.

COMPARABILITY VARIANCE AND HIERARCHICAL PROCESSING

Although comparability is well-defined in the case of binary alternatives, an interesting problem arises when conceptualizing many multialternative choices. Comparability in a binary choice is the degree of overlap in the descriptive attributes of the two alternatives. When a choice involves more than two alternatives, each alternative in the group has some level of comparability with each other alternative, and the level of comparability may or may not be equal across pairs. Multialternative choice sets differ in the degree to which alternatives in the set are, on average, comparable or noncomparable and in the degree to which the comparability among the member pairs of the set is the same or different for all possible pairs. Comparability variance within the stimulus sets in Experiment 1 purposefully was constrained; only alternatives from the same general level of comparability or similarity were included in any one choice set.

In this section of the article, the interesting situation that occurs when alternatives within a choice set vary in comparability is explored. (Binary choices, by definition, have zero comparability variance.) Consider consumers who choose among a coffee maker and two toasters. Because the two toasters are much more comparable than either toaster is with the coffee maker, the group as a whole has a higher comparability variance than do the choices in Experiment 1.

This comparability or similarity variance may systematically affect choice processing. The higher the comparability variance of the products in any given choice, the more transparent the products' natural categorical relationships become, and consumers may take advantage of these relationships when evaluating the alternatives. Rather than evaluating each alternative separately or eliminating particular alternatives on the basis of concrete or abstract attributes, consumers may process alternatives hierarchically, i.e., they may group alternatives into their natural categories to eliminate alternatives and to simplify choice processing. Using Hauser's (1986) terminology, transparent categorical relationships allow consumers to process alternatives in a top-down or hierarchical fashion rather than to process each alternative individually in a bottom-up fashion.

In the previous example, consumers initially decide between the coffee maker and the two toasters. If consumers choose the coffee maker, the choice is over. If they select the toasters, they then must choose between the toasters. However, when choice sets are more equally comparable or noncomparable, or equally different, consumers may not group alternatives into any particular categories or compare them in any particular order. Stated differently, less structure is imposed on choices involving products with lower comparability variance.

According to researchers, consumers often organize and process consumption alternatives hierarchically (Bettman 1970, 1979; Hauser 1986; Howard 1977). As Simon (1969) argues, a hierarchical approach to problem solving and choice is an extremely efficient way of handling a large number of alternatives. For example, Ranyard (1987), using gambles as stimuli and verbal protocols for analysis, recently found that subjects use similarity-based object groupings to eliminate risky choice alternatives. (For other examples, see Tversky 1972 and Tversky and Sattath 1979.)

Hypothesis 3 stems from the propensity for comparability variance and transparent categorical relationships to drive the choice process. The higher the comparability variance of product choice alternatives, the more salient or transparent the hierarchical relationships among the alternatives and the more likely the hierarchical relationships may be used to eliminate alternatives.

> **H3:** The hierarchical elimination of products as part of a group increases with the variability in comparability among the alternatives within a choice set.

The null hypothesis is that hierarchical elimination, or lack thereof, is equally likely across choice sets. Independent of product comparability variance, consumers may not utilize category membership to process the alternatives and may proceed in a bottom-up fashion. An alternative argument in favor of the null hypothesis is that a consumer's predisposition to view the world hierarchically results in hierarchical or top-down processing whenever multiple alternatives are involved.

EXPERIMENT 2

Stimuli and Design

For Experiment 2, a representative sample of high variance choices was constructed and presented to subjects along with the relatively low variance choices in Experiment 1. These high and low variance choices then were compared for their incidence of hierarchical product eliminations to test Hypothesis 3. The high variance choices were constructed by combining pairs of alternatives that were comparable at more than one of the three levels of comparability used in Experiment 1. Although there are a number of possible high variance choices, they each represent one of four types of combinations. Combination type 1 involves mixing comparable and moderately noncomparable pairs, combination type 2 involves mixing comparable and more noncomparable pairs, combination type 3 involves mixing moderately and more noncomparable pairs, and combination type 4 involves mixing comparable, moderately noncomparable, and more noncomparable pairs.

For $n = 4$ and $n = 6$ choices, a choice representing each of these combination types was operationalized. The specific high variance choice sets included: (1) two desk clocks and two desk lamps (combination type 1, $n = 4$); (2) three desk clocks and three desk lamps (combination type 1, $n = 6$); (3) two cameras and two fire extinguishers (combination type 2, $n = 4$); (4) three toasters and three blow dryers (combination type 2, $n = 6$); (5) a desk clock, a desk lamp, a smoke detector, and a fire extinguisher (combination type 3, $n = 4$); (6) an electric razor, a blow dryer, a mixer, a toaster, a desk clock, and a desk lamp (combination type 3, $n = 6$); (7) two woks, a mixer, and a desk clock (combination type 4, $n = 4$); (8) two toasters, two mixers, and two desk clocks (combination type 4, $n = 6$). Again, all of these choices were derived using the comparability classifications described in Experiment 1 and captured in Figure A under the practical constraints of product availability and a limited product inventory.

Protocol Coding

All 510 choice protocols were coded for the existence of hierarchical processing. The same three judges from Experiment 1 developed trees to describe the sequential elimination of the alternatives in each choice for each subject. The trees indicated points at which products were eliminated (either overtly eliminated or explicitly considered and then ignored) and whether a single product or a group of products was involved. Only products that were mentioned either individually or as part of a group were included in the hierarchies. A hierarchical elimination then was defined as the simultaneous elimination of two or more choice alternatives as part of a single group or category. A review of the coding results revealed that rarely did any of the judges' trees contain more than one instance of hierarchical elimination within any one protocol. Moreover, when a hierarchical elimination did exist, the judges agreed on the products involved. As a result, a simple dichotomous dependent variable, the existence or nonexistence of the hierarchical elimination of products as part of a group or category, was adopted.

Coding reliability was calculated with respect to this dichotomous dependent variable. The judges agreed on the existence or nonexistence of hierarchical elimination in 89, 89, and 87 percent of the choices for judges 1 and 2, 1 and 3, and 2 and 3, respectively. Cohen's Kappa measure of reliability for these three pairs of judges was 0.68, 0.70, and 0.65 (all significant at $p < 0.001$). Using the same two out of three coding rule used in Experiment 1, a choice was considered hierarchical if at least two of the three coders' trees revealed the elimination of two or more alternatives as part of a group. Otherwise, the choice was classified as nonhierarchical.

Analyses and Results

In Hypothesis 3, we predicted that the hierarchical elimination of products as part of a group increases with the variability in comparability among the alternatives within a choice set. This hypothesis was tested by comparing the 240 high variance choices (i.e., combination types 1 through 4 for $n = 4$ and $n = 6$ for each subject) with the 180 multialternative low variance choices from Experiment 1 (i.e., the comparable, moderately noncomparable, and more noncomparable choices for $n = 4$ and $n = 6$). Recall that by definition all $n = 2$ choices have zero comparability variance. A log-linear (logit) model (using weighted least squares to predict minimum chi-square estimates; Grizzle, Starmer, and Koch 1969) was used to determine if the likelihood of hierarchical elimination changed significantly as the independent variables, particularly the comparability variance within a choice set, changed. The independent variables included a subjects factor (30 levels), comparability variance (two levels), choice set size (two levels), a comparability variance by set size interaction term, and a random choice set variable nested within comparability variance.

The results support Hypothesis 3. The likelihood of hierarchical elimination increased significantly (chi-square = 6.54; $p < 0.01$) from the low to the high comparability variance conditions. Only six of the 180 low variance choice cases, or 3 percent, contained hierarchical eliminations. In contrast, 112 of the 240 high variance cases, or 47 percent, contained hierarchical eliminations. The remaining independent variables did not significantly affect the likelihood of hierarchical processing.

A second analysis was conducted using the individual choice sets and subjects as the independent variables to see if any particular choices were driving the support for Hypothesis 3. (The null hypothesis is that each of the individual choice sets is equally likely to produce hierarchical elimination.) The three most significant individual choices that induced hierarchical processing were all in the high variance category. The choice set that included two woks, a mixer, and a desk clock was most significant (chi-square = 4.24; $p < 0.05$), the set containing two pocket cameras and two fire extinguishers was next most significant (chi-square = 3.63; $p < 0.10$), and the only other choice set approaching individual level significance included three desk clocks and three desk lamps (chi-square = 2.57; $p < 0.11$).

Interestingly, all three of these high variance choices contained two or more members of the same basic-level product category (e.g., cameras, fire extinguishers, and so on). These categories, which are analogous to the basic-level categories studied in psychology (Johnson and Fornell 1987), are characterized by their particularly high category inclusiveness or similarity (Rosch 1975; Rosch et al. 1976). As a result, the high variance choice sets that contained members of the same basic-level categories (i.e., combination types 1, 2, and 4) should exhibit greater comparability variance and thus should result in greater hierarchical processing than the high variance choices that contained only members of the same superordinate-level categories (i.e., combination type 3).

A third logit model provides a more systematic test of this prediction. Using the high variance choices as a base, the independent variables included set size (two levels), combination type (four levels), subjects, and a size by combination type interaction. Combination types 1 through 4 differed significantly in their likelihood of hierarchical elimination, chi-square = 8.90, $p < 0.05$. (No other effects were significant.) A contrast of the likelihoods across combination types reveals that, as predicted, combination types 1, 2, and 4 were all more likely to produce hierarchical elimination than was combination type 3 ($p < 0.05$). (The likelihood for combination type 4 was significantly higher than for combination type 2, and combination types 1 and 2 and 1 and 4 were not significantly different.)

Finally, simple contrasts were made between the low and high variance choices on the other available process measures. Type of processing (i.e., comparisons-combinations) and the number of individual combinations did not differ significantly. The number of comparisons from the low to high variance choices did increase (0.57 versus 0.79; $F = 5.14$, p

< 0.05), which is not surprising. The greater the comparability variance of a multialternative choice set, the wider the range of concrete to abstract attributes on which the products can be compared directly. The level of abstraction of these attribute-based comparisons did not differ. Finally, alternative-based combinations were more abstract for the low than for the high comparability variance choices (4.96 versus 4.28; $F = 8.74$, $p < 0.01$). This difference reflects the relatively abstract combinations observed for the multialternative, noncomparable choices in Experiment 1.

Summary of Experiment 2 Results

The main result of Experiment 2 is that increasing the comparability variance of choice alternatives increases the likelihood that subjects eliminate products in a hierarchical or top-down fashion. This hierarchical processing is prominent particularly when alternatives can be grouped and eliminated as members of the same basic-level category.

DISCUSSION

This research demonstrates the importance of attribute concreteness-abstractness as a predictable dimension of consumer choice processing. Consumers used attribute-based processing on relatively abstract attributes and alternative-based processing on relatively concrete attributes to compare noncomparable alternatives, which replicates the Johnson (1984) results. Unlike the earlier study, however, the processing in this study involved multiple alternatives and actual products, which adds convergent and external validity to the Johnson (1984) results. At the same time, the fact that processing was insensitive to the size of the comparable and noncomparable choice sets is inconsistent with an earlier prediction (Johnson 1986).

The concept of comparability variance was introduced and shown to have a predictable effect on choice processing. Consumers appear to simplify multialternative choices by hierarchically eliminating products on the basis of basic-level category membership. This hierarchical processing is functionally similar to the use of elimination rules found in previous studies of multialternative choice (Lussier and Olshavsky 1979; Payne 1976).

Although using actual products as opposed to product descriptions to study choice processing adds external validity, limitations arise. As observed here, consumers may not verbally or overtly evaluate all of the alternatives in a choice set. Verbal protocols should continue to be a very valuable source of process information, but they should be used in conjunction with other sources when actual products are involved.

Perceptual Versus Cost Benefit Explanations

Decision researchers use perceptual and cost-benefit arguments to predict and to explain strategy selection and choice processing (Payne 1982). Interestingly, certain unexpected results observed here are consistent with a perceptual view, yet are more difficult to reconcile from a cost-benefit standpoint.

Recall that the consumers in Experiment 1 combined increasingly abstract attributes as set size increased and comparability decreased (see Figure C). One plausible explanation of this unexpected result is that increasing the size of the noncomparable choice sets increased the salience or availability of abstract attributes relative to concrete attributes. A growing number of studies (Bettman and Sujan 1987; Johnson 1984; Johnson and Fornell 1987; Sujan 1985) support the idea that products are associated with attributes ranging from the concrete to the abstract. Therefore, abstract and concrete attributes should be "activated" (Anderson 1983) when consumers consider any particular product. Because noncomparable alternatives overlap more on abstract than concrete attributes, increasing the number of alternatives in a noncomparable choice set should increase the activation level and resulting salience of common, abstract attributes relative to distinct, concrete attributes. This perceptual argument explains the observed interaction between choice set size and comparability on the abstractness of alternative-based combinations.

In Experiment 2, we observed consumers using a predominantly perceptual cue, basic-level category membership, to hierarchically eliminate products. Superordinate category membership did not have the same effect. The relatively high perceptual similarity or inclusiveness of basic-level categories provides a straightforward explanation of the results. The difference in the perceived similarity of products within and across basic-level categories is simply much greater than the difference in similarity of products within and across superordinate-level categories.

To be consistent with a cost-benefit argument, differences in perceived similarity must reflect subsequent differences in product utility. In other words, the difference in the variance of the utility of products within and across basic-level categories must be greater than the difference in utility variance of products within and across superordinate-level categories. Although such a close relationship between similarity and utility is possible, it is not at all obvious. A perceptual view offers a much more straightforward and parsimonious explanation of the hierarchical processing observed here. However, it is important to note that neither Experiment 1 nor Experiment 2 was designed to differentiate between perceptual and cost-benefit views of choice processing.

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