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Though most observers acknowledge that consumers make inferences among product attributes, the influence of such inferences on product evaluation is much less clear. Study respondents evaluated products for which information on one of two attributes was systematically omitted. A general model is built to estimate the directional effect of inferences on product evaluation. The effect of inferences to a missing attribute is statistically significant and in the expected direction. In one case, the marginal value of the remaining attribute (price) reverses in sign because of an inference. Thus, inferences are theoretically important and a potentially troublesome issue in the modeling and measurement of consumer choice processes.

The Impact of Inferential Beliefs on Product Evaluations

Most studies of preference and choice examine the issue of how product attributes and/or advertisements lead to consumer choice. In using a typical model one assumes that the consumer evaluates a product in terms of its visible (i.e., accessible) attributes, processes this information via one or more rules, and forms a preference or makes a choice. For instance, in a typical multiattribute model exercise, a consumer is asked to evaluate objects on a number of attributes and to provide an overall evaluation of each object. Models are then built which relate the attribute evaluations to preference. In a conjoint measurement study, a consumer is presented with a description of the product in terms of its attributes and asked to evaluate each description. A model is then built reflecting these evaluations. In other situations such as an ASSESSOR study (Silk and Urban 1978), consumers are shown advertisements of a brand and asked to evaluate the brand. Conceptually, in all of these approaches one assumes that the subject is utilizing only the stated or elicited information in arriving at preference or choice. Operationally, in the statistical models which underlie these analyses, any other factors which affect preference are assumed to be random and not systematically related to the stated or elicited information.

An alternative view of consumer processing that does not share these assumptions augments the original model with an inference process whereby the visible attributes serve as cues which the subject uses to make inferences about other product attributes or characteristics. These "inferred" attributes are combined with the visible attributes to arrive at preference or choice. We examine the impact of these inferences on the weight given to the visible attributes.

We became interested in this problem after analyzing the results of a beer choice experiment (McCann et al. 1979). Subjects evaluated 16 profile cards which described a beer in terms of five attributes: price, taste, texture, container, and user image. Analysis was based on linear regression analysis with dummy variables for the levels of the attributes. Figure 1 shows the pattern of part worths for the price attribute.

Although the price curve was expected to be uniformly downward-sloping, an inverted-V relationship was obtained between choice and price level. One explanation is an inference from price to quality. That is, the value of the lowest level of price may have been diminished through either of two inferential mechanisms. First, the low price level may have resulted in a discounting of the other information given on the profiles, such as taste and texture. Second, low price may have evoked negative inferences to dimensions not mentioned, such as status or purity. Whatever the explana-

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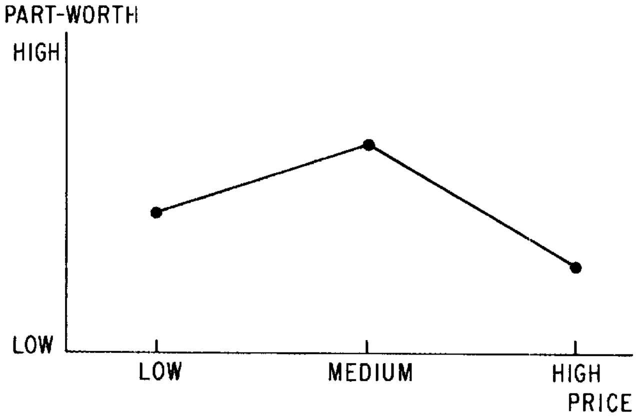
Figure 1
PART WORTH VALUES OF PRICE IN BEER CONJOINT STUDY



tion, a similar counterintuitive result was found by Robinson (1979) who discovered segments with apparent upward-sloping demand curves. Because the analytic models underlying these results did not recognize the possible inference, the derived effect of price may have been distorted.

Though the existence of such inferences may render the measurement of beliefs and values more difficult, these same inferences may simplify or facilitate a communications program designed to change attitudes. A quick pursual of television ads indicates that they are very often focused on one of many possible product attributes. The value of such commercials depends not only on the salience and value of the attribute featured, but also on the inferences made from that claim to other attributes. Thus a knowledge of inferences is important not only in getting information from, but also in giving information to, the ultimate consumer.

The goal of this article is to examine the concept of consumer inferences as they are manifested in a laboratory choice situation. Several questions are addressed. First, are inferences made in such situations? If so, how significant is their impact in judgments of overall preference, and does this impact vary with different kinds of attributes? Finally, if inferences are made and have an impact on preference judgments, what are the implications of this result for theories of cognitive processing and our ability to decompose preference into components for each attribute via common techniques such as conjoint analysis?

In the next section we review past research to illustrate both the potential importance of inferences and the relative lack of empirical findings in the area. Then a formal model is developed that allows one to predict the directions of change if inferences occur. Finally an experiment is described in which inferences are shown to have a statistically significant effect on overall preference judgments.

THE IMPORTANCE OF INFERENCES

Many theorists have postulated an effect of inferences among attributes contributing to overall evaluations Both Brunswik (1956) and Fishbein and Ajzen (1975) assume that intertrait correlations have an effect on evaluations. With the exception of source effects (Heider 1958) which relate more to the attributes of the sender than to those of the object, there appear to have been more calls to do research than completed works (e.g., Lutz and Swasy 1980; Olson 1977), particularly among researchers in marketing. Perhaps the research was done but the effects were small and inhibited publication, reflecting truth in the statement by Slovic and MacPhillamy (1974) that "information that has to be held in memory, inferred or transformed in any but the simplest ways, will be discarded" (p. 193).

A few direct tests have been done. Lutz (1975a,b) and Olson and Dover (1978) showed that a communication on one variable had "second-order" effects on the beliefs about other variables. However, the design of the experiments made it impossible to determine whether this inference affected overall evaluation or vice versa. Wyer (1974) tested a variety of inference models, generally finding some evidence that inferences affect overall evaluations. The effects, however, were not large.

Though many have posited the influence of inferential beliefs on product evaluations, too little empirical work has been done. One area in which inferences are important is the validation of models of cognitive algebra. These models depend on the assumption that inferential beliefs have minimal impact on overall evaluations.

Inferences and Cognitive Algebra

A cognitive algebra represents a consumer decision as a mathematical relationship (Anderson 1971). Bettman, Capon, and Lutz (1975) tested quantitative forms of information integration and showed that various rules are used by different consumers for the same problem. Troutman and Shanteau (1976), using the functional measurement approach developed by Anderson (1971), argue that new information can best be accounted for by an averaging process rather than adding. However, as pointed out by Cohen, Miniard, and Dickson (1980) and Fishbein and Ajzen (1975 p. 232), with this test one assumes that inferences across attribute levels do not occur. For example, consider two attributes, such as comfort and luxury in an automobile, with a high ecological correlation. If luxury is left out of a product description and its level is inferred from the level of comfort, the marginal effect on preference of one unit of comfort may increase. In other words, comfort gets some of the value of inferred luxury. Anderson's (1971) test of averaging is confounded with an alternative explanation of inferences across ecologically correlated attributes. The exact theoretical relationships are worked out in the analytic sections of this article.

Inferences and Importance Weights

A second area in which inferences could be troublesome is the measurement of importance weights. Importance weights provide an assessment of the relative value of one attribute over others in a consumer decision process. It is useful to distinguish ways to derive such measures. Direct measures are those whereby respondents evaluate the direct importance or value of an attribute. Derived or decompositional measures are those whereby respondents evaluate alternatives that are defined on two or more attributes. A quantitative analysis (e.g., regression) is performed to derive the weights implied by those judgments. These decompositional models can be further divided into two-at-a-time (Johnson 1974) and profile judgments, whereby alternatives are defined on many attributes (Green and Srinivasan 1978). Both the meaning and the stability of such measures of attribute importance—whether directly measured from judgments on attributes singly or derived from judgments on two or more attributes—depend on whether consumers make inferences to the other attributes *not defined*. Consider first direct measures. The importance of, say, comfort in an automobile may be elevated because luxury is often associated with comfort. Weitz and Wright (1979) speculate that such an inferential mechanism may be part of the reason for direct weights being more multidimensional than derived weights. Gardner and Edwards (1975) note that ecological correlations distort multiattribute utility estimation and suggest that research be carried out. To date, however, their suggestion has not been followed.

Derived weights entail similar problems. Inferences may distort results through three mechanisms: (1) attentional shifts, (2) discounting of unlikely combinations, and (3) revision of weights. Attentional shifts occur when two ecologically correlated attributes allow the simplifying consumer to ignore one of the attributes while focusing on the other. If an individual simplifies a profile evaluation task by limiting the number of attributes considered, a rational elimination strategy is to ignore those attributes that are predictable (in society if not in the orthogonal array) from a knowledge of the other attributes in the set. Thus the inference process may be relevant in determining the attention paid to various attributes. A second mechanism through which distortion could occur is the discounting of attributes whose levels conflict with prior ecological expectations. Thus, if a car is described as simultaneously uncomfortable and luxurious, a consumer may effectively downgrade it by discounting both variables. Finally, inferences to variables left out of a profile task may distort the valuation of an attribute. That is, a salient attribute left out may be inferred on the basis of those still in and, as a result, could modify their marginal values.

These mechanisms appear to be recognized implicitly by persons designing conjoint studies. Green and Srinivasan (1978), in their review of conjoint analysis, speculate that the two-factor-at-a time method will be better than a full profile approach (many attributes) "if the environmental correlation between the factors is small" (p. 108). They also advocate grouping variables that are highly correlated to avoid strong discounting and simplification effects. Thus they acknowledge the importance of knowing the inferential structure among attributes in order to design valid and stable conjoint analyses.

The effect of deleting an attribute on the derived importance weights was tested by Yates, Jagacinski, and Farber (1978). Respondents were asked to evaluate a large number of candidates for admission to college on the basis of four attributes. For a subset of these alternatives (50 of 125), one attribute was missing. The derived importance weights were very similar whether taken from the full or partially described set, thus reinforcing the finding that such derived weights are relatively robust to the choice of attributes. However, the attributes were chosen "to be intuitively independent, in the ecological and value senses of the term" (p. 245). Thus, instead of testing inferences, the investigators chose the attributes to minimize such effects. It is significant, however, that the choice of independent attributes was intuitive rather than empirical, so that the assumption of independence was tentative.

In summary, there appear to be two streams of research concerned with the effect of inferences among attributes on overall evaluations. One stream acknowledges the existence of inferences but has had some difficulty measuring or predicting the magnitude of their effects. The second stream (represented by researchers who test algebraic representations of information integration and measure attribute importance weights) views inferences among attributes as a nuisance best avoided by judicious choice of attributes.

Our study differs from both traditions in that (1) the hypothesized effect of inferences is made explicit and a system is developed to estimate the direction and magnitude of that effect, (2) attributes are deliberately chosen with high ecological correlations, (3) the inference structure is explicitly measured, and (4) the degree of inferencing among attributes is experimentally manipulated.

FORMAL DEVELOPMENT

In this section we present a mathematical theory for predicting the effect of inferences on preferences in a context where information about an attribute is missing, i.e., not visible or stated in the product description. A very simple model is made of this situation which allows one to test the directional effect of inferences. Focus is primarily on the *marginal* value of an attribute, that is, the rate of change in overall evaluation as a function of change in the attribute. This measure of the marginal effect of an attribute allows the analysis to be very general with respect to the form of the preference function and the inference structure. Generalization to multiple attributes or discrete variables is straightforward.

First define the general preference function and its partials. W represents the function evaluated if information is provided on both alternatives, and V represents the function if one attribute is dropped.

$W(X_1, X_2)$ = value of item given level X_1 on attribute 1 and X_2 on attribute 2.
$\partial W/\partial X_1$ = marginal value of attribute 1 if information is provided on both attributes.
$V(X_1)$ = value of an item if *no* information is provided on attribute 2.
dV/dX_1 = marginal value of attribute 1 if *no* information is given on attribute 2.

We then can show that the preference function, $W(X_1, X_2)$, and the rule specifying what happens when a variable is dropped determine the change in the marginal value of the remaining attribute. A general model is developed which predicts the impact for any continuous preference function. The two most popular processing rules, adding and averaging, are examined to determine whether they successfully account for inferences.

Impact of Inferences

A reasonable assumption is that an inference is made to the omitted attribute so that the omitted attribute is replaced by its expected value, $E(X_2/X_1)$. Given this assumption and any preference function with a differentiable form, one can predict the change in the marginal value due to omitting a variable. Consider the following function.

(1) $$W = f(X_1, X_2),$$

which if X_2 is dropped becomes

(2) $$V = f(X_1, E(X_2/X_1)).$$

Taking partials and manipulating, we have

(3) $$dV/dX_1 = \partial W/\partial X_1 + \partial W/\partial X_2 \cdot dX_2/dX_1,$$

or

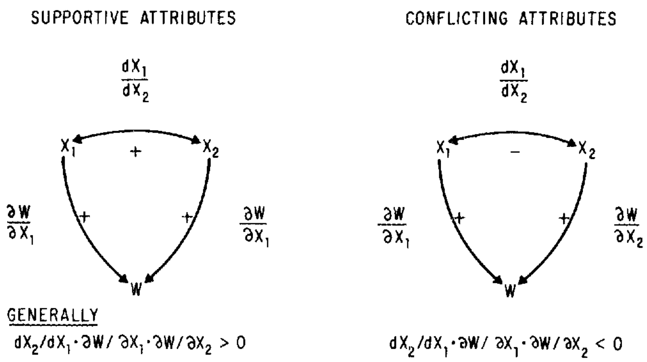
marginal value of X_1 alone	=	marginal worth of X_1 given X_2 present	+	marginal worth of X_2 given X_1 omitted	·	marginal change in X_2 given X_1.

Consistent with intuitions, the effect of inferences on the marginal value of an attribute in the two conditions thus depends on the sign of the inference function relating the two attributes. It is useful to distinguish between two kinds of inference structure that separate these two cases. The most common structure is *supportive* attributes, where dX_2/dX_1 has the same sign as dW/dX. The other is *conflicting* attributes, where dX_2/dX_1 has the opposite sign. This distinction is diagrammed in Figure 2.

Supportive vs. Conflicting Attributes

A supportive attribute pair is one in which the direct effect of an attribute has the same direction as the in-

Figure 2
INFERENCE STRUCTURES RESULTING IN DIFFERENT PREDICTIONS IF A SALIENT ATTRIBUTE IS OMITTED



ferred effect *through* the other member of the pair. For example, if a car is comfortable, one could infer that it is also luxurious, and thus the marginal value of comfort is increased. In contrast, for conflicting attributes, the value of one attribute through the other has the opposite sign of its value directly. An example is miles per gallon and acceleration in an automobile; inferring decreased acceleration from increased mileage could lower the marginal impact of stated mileage. Thus, with conflicting attributes, the value of the original attribute is decreased by an inference to the other attribute.

More generally, one may reverse score any attribute by multiplying its scoring by minus one and redefining it as its opposite. The effect of such a transformation is to change any two adjacent signs in Figure 2. The product of the three signs, however, will remain unchanged. Therefore, a supportive pair is one for which the product of dX_2/dX_1, $\partial W/\partial X_1$, and $\partial W/\partial X_2$ is positive and a conflicting pair is one for which that product is negative. Under this general rule, acceleration and miles per gallon would be conflicting even if acceleration were reverse scored.

Effect of Omitted Attributes as Predicted by Adding and Averaging Processing Rules

The concepts of supportive and conflicting attributes are valuable in separating any effect due to inferences from any effect due to the underlying processing rules. Two such processing rules, adding and averaging, are examined to determine what they predict if an attribute is omitted in the absence of any inferences. We show that a change in value caused by deleting a supportive attribute could be due either to an averaging processing rule or to an inference. With conflicting attributes, however, the effect of inferences is in a different direction from that generated by either processing rule. Thus a test of inferences must be made with respect to conflicting attributes to rule out a conflicting interpretation based on a particular underlying processing rule.

The Additive Model

In a strict additive model one assumes attribute independence. Overall evaluation can then be decomposed as the additive sum of two terms:

$$W_1(X_1, X_2) = U_1(X_1) + U_2(X_2). \tag{4}$$

Assuming independence if X_2 is dropped, we have

$$V_1(X_1) = U_1(X_1) + K, \tag{5}$$

where K is any constant. Taking partials of the above expressions yields

$$\partial W_1/\partial X_1 = dV_1/dX_1$$

Thus, a strict additivity rule predicts no change in the marginal value of an attribute when information on a correlated attribute is dropped.

The Averaging Model

In the averaging model one assumes that the value function is a convex combination of independent evaluations of each attribute:

$$W_2(X_1, X_2) = \alpha_1 \acute{U}_1(X_1) + \alpha_2 \acute{U}_2(X_2), \tag{6}$$

where

$$\alpha_1 + \alpha_2 = 1 \text{ and } \alpha_1, \alpha_2 \geq 0 \tag{7}$$

Under the averaging model, if one attribute is omitted the weight for the remaining attribute should go to unity, or

$$V_2(X_1) = \acute{U}_1(X_1) + K. \tag{8}$$

Thus under averaging the weight given to an attribute increases as one deletes competing attributes Again, taking partials and manipulating, we have

$$\partial W_2/\partial X_1 = \alpha_1\, dV_2/dX_1. \tag{9}$$

Because α is constrained between zero and unity, the effect of omitting an attribute under averaging is to increase the absolute value of the marginal value of the remaining attribute.

A PROPOSED TEST OF INFERENCES

For conflicting attributes, the adding, averaging, and inferencing models result in different predictions. Specifically, adding predicts no change, averaging predicts an increase, and inferencing predicts a decrease in the marginal value of the attribute remaining after one is deleted. This fact allows a relatively uncontaminated test of the effect of inferences.

The effect of inferences can be estimated by taking a pair of conflicting attributes and measuring the marginal value of one with information on the other present ($\partial W/\partial X$), then comparing that to its value alone (dV/dX). Designing the attributes to be conflicting allows a rather direct interpretation of such an experiment. If dropping a conflicting attribute decreases the marginal value of the remaining attribute, inferring must have occurred. If the marginal value increases, averaging is the only explanation. If there is no change across the two conditions, adding is a consistent explanation. A complete test would require a large number of pairs of attributes that differ with respect to their ecological correlations (dX_2/dX_1). We examine one critical case of a conflicting pair, in which inferences are simple to make and very strong.

EXPERIMENTAL PROCEDURE

The experiment involved beers described in terms of two attributes The sample consisted of 36 adults who indicated they consumed at least one six-pack of beer per month. Respondents were interviewed in their homes and asked to indicate their likelihood of purchasing 24 beer profile descriptions. These profiles were defined on two dimensions: price per six-pack and the percentage of brands the beer defeated in a blind taste test Likelihood of purchasing was measured on an 11-point scale anchored at "extremely unlikely" and "extremely likely" to purchase the beer. A sample question is given in Figure 3

The stimuli were defined on five levels of price per six-pack ($1.50, $1.75, $2.00, $2.25, $2.50). The meaning of these prices was reinforced by verbal cues (least expensive, less expensive than average, average, more expensive than average, most expensive) which reflected the common range of beer prices at the time of the study. Taste was defined on five levels, each giv-

Figure 3
SAMPLE INSTRUCTIONS AND STIMULUS USED IN STUDY

PREFERENCE SURVEY

Instructions You are asked to evaluate 24 beers. Sometimes you'll be told how much a six-pack of the beer costs, other times you will be told something about how the beer tastes, other times both are available The taste information comes from a blind taste test, in which people compared the tastes of different beers

Evaluate each description On the scale indicate the likelihood that you would purchase this beer—taking into consideration what you know about its price and taste [a]

	PRICE	*TASTE RATING*
		In a blind taste test people rated it
Beer #1	Is average in price A six-pack costs $2 00	Better-tasting than 50% of all beers tested

How likely is it that you would purchase this beer?

Extremely Unlikely										Extremely Likely
0	1	2	3	4	5	6	7	8	9	10
				X						

[a] For the inference-prompted group this last paragraph was replaced with

"Where one of the ratings, either price or quality, is missing, please fill in your best guess of the value of the missing rating based on the other Then give your likelihood of purchasing the beer ing the percentage of brands defeated in the blind taste test (10%, 30%, 50%, 70%, 90%). As shown in Figure 4, the stimuli formed a balanced lattice. Fourteen concepts (the 13 given plus one replication) were defined on both attributes, whereas for 10 concepts information on one attribute was available.

To manipulate the degree of inferencing, two questionnaires were assigned randomly to respondents. The inference-prompted questionnaire had a task identical to that of the unprompted condition except the 18 subjects were asked to fill in their best guess as to the value of the missing attributes before indicating their likelihood of each purchase.

Thus the experiment resulted in three distinct kinds of data. First, the 14 stimuli in an orthogonal array on both price and taste were used to calculate the marginal value ($\partial W/\partial X$) of each when jointly present. Second, for 10 items an attribute was omitted, thus providing an estimate of the single-attribute value function (dV/dX). Finally, by examining the relation between the inferred and the given attributes, we could determine the sign of the inference function (dX_2/dX_1).

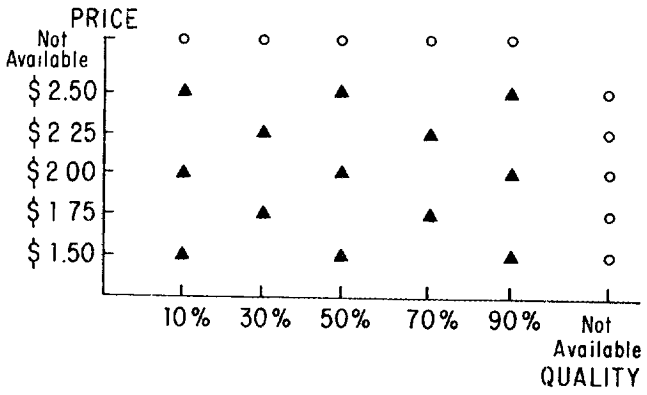
ANALYSIS

The analysis consisted of relating the likelihood of purchasing to price and/or quality in the three conditions: (1) both attributes together, (2) one omitted, and (3) inference-prompted. The original dependent variable was the arcsin transformation on the likelihood to purchase. Because these results were not substantially different from the results on the raw likelihoods, the more easily understood raw values are reported here. The findings can be divided into those concerning the two-attribute preference function ($\partial W/\partial X$), the single-attribute functions (dV/dX), and the inference functions (dX_2/dX_1).

The two-attribute preference function was estimated by using a multiple regression on the 540 observations

Figure 4

DESCRIPTION OF 13 DUAL- (▲) AND 10 SINGLE-ATTRIBUTE (o) CONCEPTS



formed by pooling 15 judgments involving both price and quality for each of the 36 respondents. The equation was:

$$(10) \quad L = .4P - .0015P^2 + 1.6T - .0068T^2 - 35.6$$

where:

L = likelihood of purchase $0 \le L \le 100\%$,
P = price/six-pack in pennies $150¢ \le p < 250¢$, and
T = percentile rating in taste test $10\% \le T \le 90\%$.

The R^2 for equation 10 was .54, and all of the terms were statistically significant ($p \le .05$). Several versions of the function were tried to test for possible interactions. First a dummy indicator term was created to test whether the two groups, with and without inference prompting, had different values on the two-attribute preference ratings. None of the four terms formed by multiplying this dummy indicator and the variables in equation 10 were significant ($p \ge .10$). This result indicates that the groups may be pooled for the purpose of estimating an aggregate preference function. Additionally two tests were made to determine the existence of an interaction between the levels of stated price and taste quality. In the first test, a bilinear interaction term, $P \cdot T$, typically used in functional measurement (Anderson 1971) was not significant ($p > .10$). The second test was an attempt to ascertain whether respondents discounted profiles that had inconsistent or unbelievable levels of price and taste quality. That is, respondents examining a profile that has, say, high taste but low price may have seen the combination as improbable and therefore risky. If such a phenomenon were operant, the coefficient of terms representing deviation from expectations should be statistically significant. These terms were $(P - E(P/T))^2$ and $(T - E(T/P))^2$, where the expected values came from the average value of the other attribute determined in the attribute-omitted condition. The coefficients of these terms were not significant ($p > .10$), and thus we can conclude that discounting due to improbable attribute combinations was not severe, if it occurred at all.

The preceding tests mean that equation 10 is adequate for the two-attribute preference function. Notice that though there are no interactions across variables or experimental groups, both variables are quadratic in form, indicating that the marginal value of an attribute depends on its level. In the present case, the form of these quadratic terms indicates that both improved taste quality and price reduction show diminishing returns. The lack of cross-terms in equation 10 means that the marginal value of price and taste quality can be expressed as a function of these attributes individually. This feature affords an easy visual comparison of the predicted marginal values in the three experimental conditions.

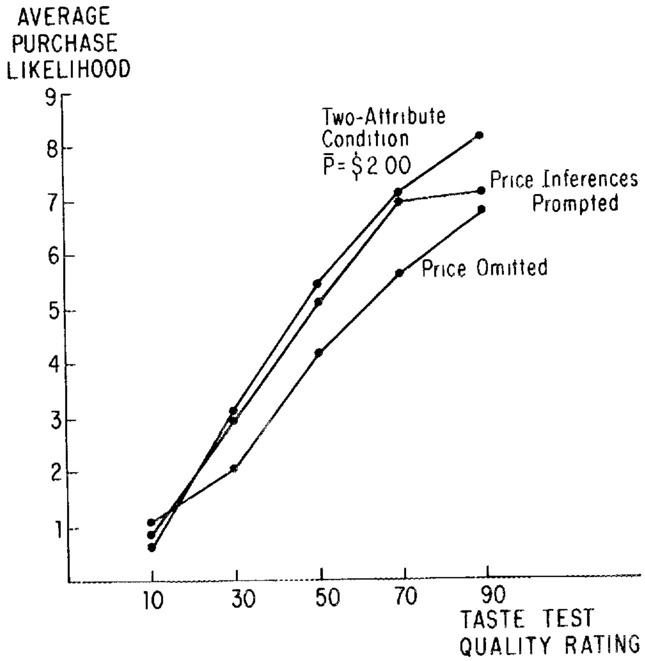
Given the two-attribute function, the predicted change in the single-attribute functions depends on the sign of the inference function. That sign was operationalized by the correlations of price and taste quality at the individ-

Figure 5
EFFECT OF OMITTING PRICE ON THE MARGINAL VALUE OF QUALITY RATINGS

Statistical Tests

	Change in mean	*Change in trend*
Two attributes vs omitted	***	**
Two attributes vs inferences prompted	NS	**
Inferences prompted vs omitted	***	NS

** $P < .05$
*** $P < .01$



ual level. These correlations were positive (average $r = .81$) for *all* 18 respondents; thus, despite the orthogonal information in the study, a strong correlation between price and quality emerged. This result combined with the signs of the derivatives of two-attribute preference function in the relevant range confirms that the attributes of price and taste quality are conflicting as designed. The prediction is that if inferences are taking place, the marginal values of each attribute alone should be attenuated relative to the condition in which the other attribute is present. We first consider the effect of price inferences on the evaluation of taste quality ratings and then consider the effect of taste quality inferences on price statements.

Effect of Omitting Price on the Marginal Value of Taste Quality

Figure 5 depicts the value of purchase likelihood as a function of stated taste quality in the three experimental conditions. The top line represents the two-attribute preference function (equation 10) at the average level of price ($P = \$2.00$). Parallel curves would reflect different effects of taste quality at different price levels. The next two lines represent the average value of taste quality given that price was left out and the inference-prompted conditions, respectively. Statistical differences in the curves were estimated by subtracting the purchase likelihoods at each level of taste quality. A test of whether the average values of these differences are greater than zero is a test of the mean value of the curves. The slope of a regression of these differences against taste quality provides a test of relative derivatives.

Both conditions in which price was omitted yielded significantly ($p \leq .05$) less steep curves than when price was explicitly given. This result is consistent with the inference hypothesis and contradicts the predictions of the adding or averaging formulations.

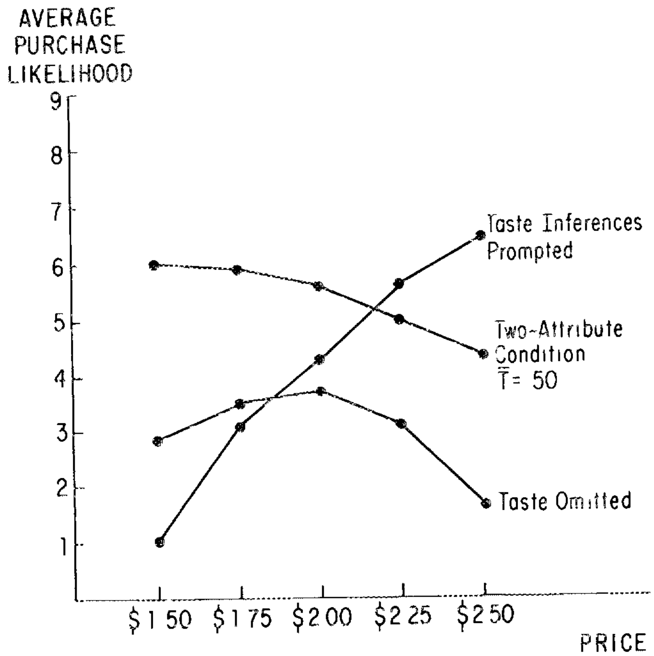
Notice also that in the price-omitted condition, where inferences were not prompted, the mean purchase likelihood dropped. This result was not anticipated, but is reasonable given the greater risk or annoyance of purchasing a beer about which less is known. This effect

Figure 6
EFFECT OF OMITTING TASTE TEST INFORMATION ON THE MARGINAL VALUE OF PRICE

Statistical Tests

	Change in mean	*Change in trend*
Two attributes vs omitted	***	NS
Two attributes vs inferences prompted	***	***
Inferences prompted vs omitted	***	***

*** $P < .001$



is even stronger for the judgments in which taste quality ratings are left out and is discussed more fully in the next section.

Effect of Omitting Taste Quality on the Marginal Value of Price

Figure 6 depicts the effect of price on purchase likelihoods with various manipulations of taste quality. The highest line, with an appropriate downward slope, gives the effect of price derived from the two-attribute preference function evaluated at the average level of taste quality (T = 50%). Omitting quality information resulted in a large mean decrement in purchase likelihood, and a significant increase in the curvature ($p < 0.05$). There are two ways to account for this curvature. First there may be an interaction between inferences and the level of an attribute. The increased curvature could have occurred if inferences were made from the low price levels to low taste quality levels, but not from high prices to high taste quality levels. Such a mechanism might imply a kind of "inferential pessimism" whereby an inference to more negative information is more likely to be made. Alternatively, the curvature may be due to a normal price mechanism where, in the absence of taste quality data, one is simply more likely to purchase a $2.00 per six-pack beer than any other. In any event, the *average* slopes across the two conditions were not significantly different. Though this finding appears consistent with the additive model, the curvature found renders these results globally inconsistent with *any* of the models.

A very different result occurred in the inference-prompted condition. The marginal value of price shifted from negative to strongly positive. To show that this result is predicted by the inference model, consider the following adaptation of equation 3.

$$dV/dP = \frac{\partial W}{\partial P} + \frac{\partial W}{\partial T} \cdot \frac{dT}{dP} \tag{11}$$

The marginal worth of price given both attributes was negative in the range ($\partial W/\partial P$). However, both the marginal worth of taste quality ($\partial W/\partial T$) and the inference (dT/dP) function were positive. Further, the marginal value of taste quality was on average three times greater than that of price. Thus the second term in equation 11 far overpowered the first term and made the marginal value of the price positive.

Notice also that the mean level of the inference-prompted condition was significantly lower than that of the two-attribute condition. However, at very high price levels the prompted inference to high quality resulted in purchase likelihoods above those in the two-attribute condition set at the average taste level ($\bar{T}$ = .50). Thus the difference between the inference-prompted and the two-attribute conditions can be accounted for by (1) a moderate discounting due to not having been given all of the information and (2) a strong inference effect following equation 11.

Summary

It is useful to summarize the results that are consistent across the price and taste quality manipulations. First, even unprompted, inferences influenced the marginal value of an attribute and the effect was in the predicted direction. Omitting price diminished the marginal value of taste quality as predicted by the inferring model, whereas omitting taste information had an interactive effect on the marginal value of price, increasing it at lower levels and decreasing it at higher levels with no overall linear difference.

Second, in the inference-prompted condition, overall likelihoods followed a pattern consistent with equation 3. Inferences to an important variable (taste quality) had large effects on the marginal value and even allowed it to change sign. Inferences to a relatively unimportant variable (price) had less effect but did change the slope in a way predicted by the inferring hypothesis.

Finally, the expressed purchase likelihood was significantly lower for an alternative with an omitted attribute than for the alternative with that attribute at its mean level. It was as though a discounted mean was substituted for the missing information. This effect was particularly strong when the more important attribute, taste quality, was deleted and ironically seemed to be lessened when inferences were forced.

DISCUSSION

The preceding theoretical and experimental analyses lead to the following conclusions.

Omitting an attribute decreased mean purchase likelihood. Omitting an attribute significantly reduced the average rating level in relation to the mean in the two-attribute condition, as though respondents assigned a discounted mean value to the missing attribute. Quite rationally, this effect appears to be positively related to the importance of the attribute dropped; deleting quality had a much greater effect than deleting price. This discounting was somewhat ameliorated when inferences were prompted; the loss due to not being told enough information is lessened by being asked to infer the missing value.

Discounting of alternatives with missing information has been found in two other studies. Yates, Jagacinski, and Farber (1978) found that the candidates for college admissions with missing information had a lower evaluation than identical candidates with average levels of attributes replacing those missing. Meyer (1981) found the same result with respect to evaluations of potential restaurants.

Graesser, Robertson, and Anderson (1981) studied the extent to which inferences are perceived to be as true as explicit statements. Subjects read a short story and then recalled the story in a session which involved "why, how, when, and where" type questions. Those questions tended to generate a number of inferences, along with recall of passages from the story. In one of the experiments, the subjects rated the truths of both inferences and explicitly stated information. The truth ratings were found to be lower for the inferences than for the stated information (although the inferences were generally rated as "probably true"). This finding suggests that discounting of inferred attributes may be due to the lower believability of such attributes.

These findings lead to the speculation that a communication advantage could be gained by providing information on a brand that competitors are unwilling or unable to give. Particularly if the information is important and does not lead to information overload, its mere presence could give a brand a competitive advantage over those lacking such information.

Even without prompting, inferences had a significant positive impact on marginal values. Deleting price brought about a statistically significant lessening in the marginal value of quality, and deleting the quality information had a mixed effect on the marginal value of price. Although neither effect was very large with respect to the adding versus averaging controversy, these results are strong enough to suggest a modification of future tests. Certainly, rather than choosing attributes that *appear* to be uncorrelated, one should measure the ecological correlation among the attributes and use them as moderator variables.

The implications of the results for conjoint analysis are equivocal. In a negative sense, the instability of the price part worth in the face of the presence or absence of quality information is disturbing. The relevant instability, however, only related to the curvature; the average values remained unchanged. Further, the change in slopes due to unprompted inferences appears very small, particularly in contrast to the large effects found in the prompted condition. Thus, inferences *per se* appear not to be a major force in changing the values of an attribute as other attributes are added. More research is needed to determine what caused the relatively minor distortions found in the unprompted condition

When prompted, inferences can have a very strong effect. The strong effect of prompted inference is a very important finding. We emphasize that the differences found are unlikely to represent a sampling fluke. Apart from the high statistical significance of our results, an earlier, unpublished study by the authors on 18 students produced virtually identical results with respect to the reversal in sign due to prompting.

The distortion in marginal values can be expected to be strong if three conditions are met. First, the two attributes must have a strong ecological correlation. Second, the attribute dropped must be very important so that the inference to its value itself has weight. Finally, the context must be such that an inference is made. The last condition was met in our study by requiring respondents to infer the value of the missing attribute Given the magnitude of the effect of this prompting, the crucial research goal is to determine those conditions under which similar inferences occur without prompting. Apparently, the effect is rather small in the evaluation of a series of product profiles, but is less likely to be so in the evaluation of a single item. Alternatively, suppose an ad makes the inference explicit as part of the copy. The apparently inconsistent results in the research on the price-quality relationship (see Olson 1974 for a review) may well be due in part to situational factors that prompt inferences in some conditions but not others. Given the strong potential effects of an inference from price to quality found here, a few subjects actively inferring could distort the results of an aggregate analysis (Robinson 1979) Thus a theory is needed to explain when individual and task differences prompt inferences among attributes.

Our findings suggest that an impact of inferential beliefs on product evaluations can occur and can be very significant, depending on the degree of prompting. Thus, what is ultimately needed to understand the phenomenon is a theory and empirical work detailing the contexts in which such inferences occur

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