The Relationship Between Prior Brand Knowledge and Information Acquisition Order

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The relationship between prior knowledge and information search to the selection of information at the brand-attribute level is examined. The focus is on both the content and the certainty associated with prior beliefs about the attribute values of various brands. We find that information is acquired earlier with respect to prior beliefs that are more uncertain and less favorable. In addition, we find earlier acquisition of information on brands with high prior attractiveness in a choice but not in a ranking task. A dynamic analysis of information acquisition incorporating the effect of prior knowledge and newly acquired knowledge on search priorities is developed.

Often consumer decision making involves both the retrieval of brand information from memory and the acquisition of additional knowledge about brands from the external environment. The purpose of this article is to examine how prior brand knowledge affects the acquisition order of additional brand information. More specifically, we investigate the effects of prior beliefs about brands at the level of brand-attribute values, and the certainty associated with those beliefs, on the priority of search for additional brand-attribute information. This investigation is conducted in the context of two decision tasks—choosing the best alternative and ranking all of the alternatives.

The present study builds upon two major research traditions. First, there is the work on the value of information (Nelson 1970; Stigler 1961). This work assumes that (1) consumers form expectations about the value of additional information, (2) these expectations guide decisions about search, and (3) the search for information should be continued only if the expected gain in utility associated with the additional information is greater than the expected cost of search. The sequence of information acquisition in terms of value of that information has also been examined (Hagerty and Aaker 1984; Meyer 1982; Ratchford 1985; Weitzman 1979). The crucial assumption here is that the most valued units of information are collected first, followed by less valued ones, and so on. Much of this work has focused on the selection of alternatives to be examined (e.g., Meyer 1982). Recently, Hagerty and Aaker (1984) developed a normative model of information search extending the value of information concept to the level of individual items of information about brand-attribute values. We further develop the value of information concept as it applies to observed search at the brand-attribute level.

Second, there is the extensive literature on consumer information processing in decisions (Bettman 1979, 1986). This research is primarily concerned with understanding the strategies that consumers use to make judgments and choices. Of particular relevance is that stream of work that examines decision strategies through the monitoring of information acquisition behavior (Bettman and Jacoby 1976). That research has conceptualized the consumer decision problem in terms of search through a brand-by-attribute matrix (Bettman 1979). A cell of the matrix represents a value for a particular brand on a particular attribute. The consumer is not given these brand-attribute values but must explicitly search for them in an information board. While much has been learned from such studies, generally the role of prior knowledge has not been explicitly consid-

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ered. The present study extends that research tradition by explicitly investigating how search is affected by prior beliefs about the values of the brand-attribute matrix.

COMPONENTS OF PRIOR BELIEFS INFLUENCING ACQUISITION ORDER

The Figure presents components of a consumer's knowledge that are likely to influence the priority of accessing information. Previous research has focused on the marginal impacts on search of brand or attribute characteristics. The present study shifts this focus to the consumer's prior beliefs about the individual brand-attribute values reflected in the elements of the Figure. Russo and Johnson (1980) argue that much of the knowledge relevant to brand choice is stored in memory in terms of these brand-attribute values. In addition to the content of knowledge, e.g., that a brand has an expected high level of reliability, a consumer is also likely to have a degree of confidence in this knowledge. That is, for some beliefs the consumer will be quite certain about this knowledge. For other beliefs the consumer will be quite uncertain. The prior beliefs and the degree of certainty about the individual beliefs are denoted by B_{ik}s and C_{ik}s, respectively, in the Figure. As noted, these two components of prior knowledge are the focus of the present study. However, prior work on search behavior suggests that two additional components of prior knowledge are likely to influence information acquisition priorities (Meyer 1982; Tigert 1966). These two components represent more aggregate levels of knowledge. They are (1) prior brand attractiveness, denoted A_i, and (2) prior beliefs about overall attribute importance, denoted W_k in the Figure.

The effects of these four components of prior knowledge on information acquisition can be derived from a simple model relating information acquisition priority to prior beliefs. This model derives from Hagerty and Aaker's (1984) model, which is an extension of Raiffa and Schlaifer's (1961) classic analysis of the selection of information that best guides choice. Since our focus is descriptive, mathematical detail is left to an appendix. The model is helpful, however, as it permits precision in specifying the relationships among variables, which supplements the discussion below.

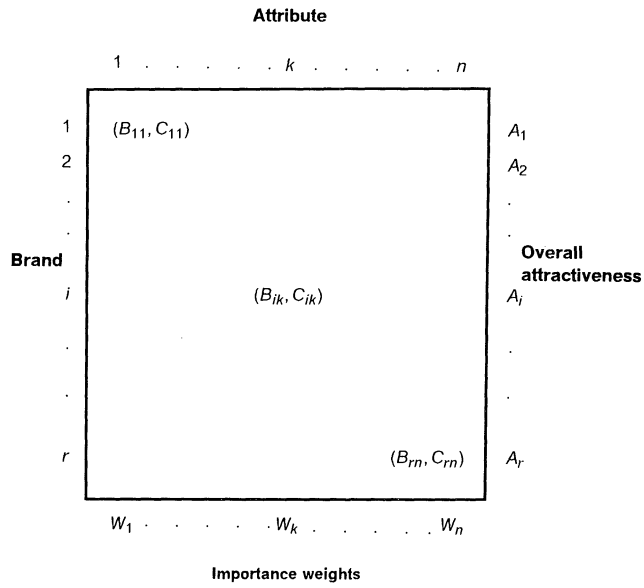
We now turn to a more detailed discussion of the effects of C_{ik} (prior certainty associated with attribute k of brand i), B_{ik} (prior evaluation of brand i on attribute k), A_i (brand attractiveness), and W_k (attribute importance).

Prior Certainty

In general, one would expect that the more certain a consumer is about the value of a particular brand on a particular attribute, the lower the priority of search for additional information. Both Meyer (1982) and Ratchford (1985) propose that brands associated with low

FIGURE

THE COMPONENTS OF BRAND BELIEFS THAT INFLUENCE ACQUISITION PRIORITY



initial certainty will be looked at first. Hagerty and Aaker (1984) make a related prediction in terms of variance about brand-attribute values (B_{ik}s). If a decrease in certainty corresponds to an increase in prior variance, then information units with less certainty, other aspects held constant, provide a greater expected value of information. This leads to the prediction that lower certainty about a brand-attribute value will lead to earlier acquisition of additional information about that value.

Prior Evaluation

There has been substantial evidence that pieces of information acquisition. Thus, an interesting question (e.g., below average) than if they are favorable (see Kanouse 1984; Wright 1974). In the areas of person and concept evaluation, subjects pay more attention to and give more weight to unfavorable or negative information over favorable information of the same magnitude (Fiske 1980). In the context of risky choice, Kahneman and Tversky (1979) have proposed the related idea that losses loom larger than equivalent gains.

Despite finding negativity effects in a number of domains, we were unable to find consumer research linking negativity or unfavorableness of prior beliefs with the likelihood of accessing more information about those beliefs. Further, a negativity effect does not follow directly from the Hagerty and Aaker (1984) model of information acquisition. Thus, an interesting question arises as to the generality of the negativity effect. Based on evidence of a negativity effect in evaluating persons, concepts, and gambles, we hypothesize that items of

brand information with more negative priors will be accessed earlier than those with more positive priors.

Prior certainty (C_{ik}) and evaluation (B_{ik}) are at the brand-attribute level. We now consider prior knowledge at a more aggregate level.

Brand Attractiveness

It is expected that higher prior brand attractiveness will lead to earlier acquisitions. This prediction is based on the idea that brands should be searched if they have a reasonable chance of being chosen; such brands tend to be brands that have high initial attractiveness.

There is empirical evidence supporting the strategy of focusing on highly attractive alternatives (Meyer 1982). Other researchers focusing on contexts with low brand knowledge report evidence of phased decision processes (e.g., Bettman and Park 1980; Payne 1976). In the first phase, alternatives are eliminated quickly on the basis of one or two inferior values. The second stage is selective, focusing on alternatives with high attractiveness. When consumers have sufficient brand knowledge, this prior knowledge may provide the criteria for the initial elimination phase. Consumers would then focus attention immediately on brands forming the "evoked set" (Howard and Sheth 1969). The evoked or considered set would be heavily populated by brands perceived to be most attractive prior to search.

Attribute Importance

There is substantial evidence suggesting that the order of information acquisition about an attribute is highly correlated with its subjective importance (Holbrook, Velez, and Tabouret 1982; Sheluga, Jaccard, and Jacoby 1979; Tigert 1966). Based on this finding, search order has often been used for measuring attribute importance (e.g., Heeler, Okechuku, and Reid 1979; Jaccard, Brinberg, and Ackerman 1986). This is consistent with a prediction derived from the Hagerty and Aaker model that an increase in the weight of an attribute (W_k) will lead to earlier acquisitions. However, given the existing evidence regarding the positive effect of attribute importance on acquisition priority, we do not consider this to be a hypothesis. Instead, attribute importance is used in the analysis below as a covariate only.

Ranking vs. Choice

Most work on information search and preferences has involved a choice type of response. However, decision makers in general, and consumers in particular, are sometimes asked to express preferences using other response modes, e.g., rating or ranking. These response modes are different from choice primarily in that decision makers are asked to provide explicit evaluation of all options in a set, rather than focus on the best. Prior behavioral research has indicated that choice and other response modes do not always elicit the same preference order (Einhorn and Hogarth 1981; Payne 1982).

It may be that different response modes for preferences elicit different cognitive processing. This suggests that the effects of prior beliefs on information search leading to a preference decision might differ contingent on response mode. Thus, in addition to a choice task, this study also examines the effect of prior knowledge in a ranking task. Ranking is a procedure often used by marketing researchers to collect preference information on all alternatives in a set (e.g., Chapman and Staelin 1982; Green and Srinivasan 1978). Examination of the similarities and differences between the two response modes in terms of the effects of prior knowledge on search should contribute to our understanding of this very important contingency in decision research (Payne 1982).

The difference between choice and ranking is expressed in a revision of the Hagerty and Aaker normative model as detailed in the Appendix. While there is no agreed-upon objective function to assess the value of information that achieves a more precise rank order (cf. Chapman and Staelin 1982; Luce and Suppes 1965), one way to do so is to assume that the purpose of a rank order is to prepare one for a choice among each pair of brands within the choice set. Given that each pair is equally weighted, then the expected value of collecting information about a brand can be approximated by the sum of the expected values of collecting it with respect to all pairs of brands that include that brand.

With respect to certainty (C_{ik}) and attribute importance (W_k) this assumption leads to the same predictions for the ranking task as for choice. With respect to brand attractiveness, however, it is no longer possible to predict its effect on acquisition priority. Intuitively, this reflects the fact that in ranking, subjects are asked to pay as much attention to the lower ranked alternatives as the higher ranked ones. Finally, with respect to prior evaluation (B_{ik}), for the same reasons as in choice, it is predicted that pieces of information associated with more negative prior beliefs will have a higher priority during search.

To summarize the central theme, the acquisition of additional information by consumers when making a decision is expected to be guided by the information the consumer already has about the brands and the degree of certainty felt about that information. Of course, each relationship between prior knowledge and information acquisition priority hypothesized above will be conditional on the levels of other components. For example, lower levels of certainty and negative brand-attribute beliefs are expected to result in earlier accessing of such information. However, low certainty and negative beliefs are also associated with less attractive brands, which are hypothesized to be accessed later.

HYPOTHESES

Our hypotheses regarding the relationships between components of prior knowledge and the priorities during information search through a brand-by-attribute

matrix are summarized below. Hypotheses 1 and 2 deal with the effects of prior knowledge at the brand-attribute level. Although often discussed, little prior research has directly tested the relationships between prior knowledge and search behavior at the brand-attribute level. Hypothesis 3 deals with the effect of prior knowledge at the aggregate knowledge level of overall brand attractiveness.

H1: The lower the certainty about the value of a brand on an attribute, the higher the priority of information acquisition about the value of the brand on that attribute.

H2: The more negative the prior evaluation of a brand's value on an attribute, the higher the priority of acquiring additional information about that piece of information.

H3: In a choice task, the greater the prior overall attractiveness of a brand, the higher the priority of information acquisition about that brand.

Testing these hypotheses requires us to record subjects' prior beliefs and to examine their subsequent information acquisition behavior. We next describe an information search task that is specially designed to encourage subjects to consider carefully each acquisition of an item of information at the brand-attribute level.

METHOD

Subjects

The subjects were 58 first-year MBA students. They were each paid $5 for participating. Subjects were assigned randomly to one of the two response mode conditions, choice or ranking, with 29 subjects in each condition.

Materials

The product category, brand names, and product attributes were selected so that subjects would be likely to have some prior knowledge and beliefs about them but would also need additional information to make an accurate choice or ranking.

The product category used was a typewriter/printer. It was a new kind of typewriter with a display and a memory, which could also be used as a printer for a personal computer. This product class had several characteristics that made it suitable for this study. First, it was a relevant product for the subjects, all of whom had recently completed a course on using personal computers. Second, subjects had varying prior knowledge about the product category and brand names but little personal experience with the specific product-brands being evaluated. This was expected to result in more heterogeneous prior evaluations and certainty levels.

TABLE 1

INFORMATION MATRIX:
BRAND-ATTRIBUTE VALUES EXPOSED

	Brand					
Attribute	JC Penney	Sony	Radio Shack	IBM	XX	YY
Quality of print	1	1	1	2	1	0
Ease of use	0	2	−1	−1	1	0
Number of compatible PC brands	−1	1	0	2	0	1
Reliability	1	1	1	3	1	0
Availability of accessories/supplies	2	−1	2	2	−1	0
Price	$382	$415	$335	$595	$299	$275

Four well-known brand names—JC Penney, Sony, Radio Shack, and IBM—were used. The use of familiar brand names was one way in which the present study extends prior work by Hagerty and Aaker (1984). In addition to brands with recognizable names, two brands called "XX" and "YY" were presented as new brands in the market. This design ensured that there were at least two brands about which all subjects were uncertain. The range of brands, therefore, represents a common situation in which the consumer is familiar to varying degrees with some of the available brands but quite unfamiliar with others.

The attributes, brands, and the content of the accessed information for our study are displayed in Table 1. The information available for acquisition was described as being based on a recent survey by an independent research firm. The values of the attributes had a possible range of −3 to +3, except for price, for which actual dollar amounts were provided. The values chosen were derived from a previous survey, using a different sample, in which students were asked to indicate their expectations regarding the values of the brands on the different attributes. The mean "expected" values were chosen in order to reduce the likelihood of reactive effects from very novel or unexpected information.

Procedure

The experiment was conducted in the behavioral laboratory of a business school. Each subject was in a separate room, equipped with a personal computer.

The study had several parts. First, subjects were introduced to the experiment. Next, prior attributes' search importance, and prior beliefs and certainty about the assessed brands were measured. This was followed by the actual information acquisition and choice/ranking task. Subjects were then debriefed and paid. Details on each part of the procedure are given next.

Introductory Section. The first section introduced the task. Subjects were seated in front of a PC, which was used throughout the task. They received a brief description of the product and were shown a photograph of it. They were told that there are 12 brands of typewriter/printer on the market, including two new brands that were recently introduced, and were given the names of the 10 familiar brands.

Prior Search Importance: W_k. Next, six attributes were defined, and subjects were asked to suppose that a choice was required among all 12 brands on the market (at that stage, they did not know that only a subset of six of the brands would be considered in later tasks). They were then shown the six attributes and asked which attribute they would select, assuming that they had to base their decision on information regarding the brand values on just one of the six attributes. Then, if they could get information about a second attribute, they were asked which attribute they would select, and so on through the six attributes. This procedure provides our ordinal measure of attribute search importance, W_k. Other researchers have used search priority as a measure of attribute importance (see review in Holbrook et al. 1982; Jaccard et al. 1986). Obviously, this measure of attribute search is somewhat limited. The measure is likely to reflect the general uncertainty regarding the values of all 12 brands on the market on these attributes, as well as relative attribute importance. However, given the focus of this study on search, we viewed it as an adequate measure. In our analysis, as explained below, this measure is used as a covariate in ways that provide a conservative test of our major hypotheses regarding the effects of prior knowledge at the specific brand-attribute level.

Prior Evaluation and Associated Certainty: B_{ik}, C_{ik}. The third section was designed to measure the prior evaluations of the familiar brands' attributes and their associated certainty levels. This was one of the most crucial tasks in terms of our main hypotheses. To measure the prior evaluation, a seven-point scale was used, anchored +3 (e.g., most reliable), 0 (average), and −3 (e.g., least reliable). Prior beliefs about price were also taken on the same seven-point scale for reasons of consistency, with +3 corresponding to the least expensive and −3 to the most expensive brand on the market. After a rating was entered, a second scale appeared on the screen, and the subject indicated the degree of certainty with the rating just given. A five-point scale, used by Katz (1944) and Antil (1983), was employed, with "very uncertain" (1) and "very certain" (5) as anchors.

Information Acquisition Task. The construct of primary interest in the present study was the value of information, using the priority or order of information acquisition as the indicator of that value. The information acquisition procedure used was a modification of the information board task used by numerous researchers (e.g., Jacoby, Chestnut, and Fisher 1978; Moore and Lehmann 1980). Under the commonly used information acquisition procedure, acquisition costs are low and availability of information is guaranteed. Consequently, order of acquisition might partially reflect exploratory behavior and routinized search heuristics (Arch, Bettman, and Kakkar 1978). An obvious way that could have been used to simulate search cost was to deduct from the subject's fee a certain amount for each acquisition. This would have a direct impact on the amount of search but unfortunately would have been somewhat ambiguous with respect to the order of acquisition. That is, if there is a charge per acquisition, one might limit oneself to a specific number of acquisitions, but the order of those acquisitions within that set might reflect ease of processing considerations rather than the direct informational value of each acquisition.

In contrast, the procedure we used was designed to focus attention on each acquisition by increasing its opportunity cost. Subjects first gave either a choice or rank order response, depending on their experimental cell. The subjects in the choice cell were just asked to indicate their most preferred alternative. The subjects in the rank order cell were asked to provide a complete preference ordering of all of the six alternatives in terms of overall attractiveness. They were then told that they could acquire one information unit each round, and that information would be displayed throughout the task. After each round subjects were given the opportunity to change their choice/rank order. However, at the end of each round a random number generator determined whether any more information acquisitions would be permitted. Thus each item of information acquired might be the last one, a fact reinforced by the suspense generated by the random number process. If the number was "13" (out of 15 possible numbers), the procedure stopped, and the most recent choice/ranking was the final one. The sequence of generated numbers was actually predetermined, with "13" appearing after 22 acquisitions. Subjects could stop at any time by notifying the experimenter. However, the procedure created a feeling that the subject was privileged to collect information on each successive round and appeared to discourage early stopping. In fact, none of the 58 subjects stopped before the 22nd round.

Interviews with subjects at the end of the task revealed high involvement with the task. Some indicated that they would have acquired a few additional pieces of information if they could, others said that they had sufficient information, and a few subjects in the choice task indicated that they had made their final choice earlier but were curious about additional ratings. None of the subjects interviewed guessed the purpose of the study.

Method of Analysis

Independent Variables. Three of the four independent variables, attribute importance (W_k), prior eval-

uation (B_{ik}), and certainty (C_{ik}), were measured directly from subjects in the survey, as described earlier. Brand attractiveness (A_i) was not measured directly but was derived from the other independent variables. Several attractiveness measures were tried and tested by their correspondence to subjects' choices/rank orders of the brands in terms of overall attractiveness prior to acquiring any information. The derived measure that best predicted the prior rank orders/choices was constructed as follows. For an individual, each brand's attribute received a score that equaled the product of its prior evaluation, the certainty level associated with that evaluation, and its attribute importance. The overall brand attractiveness measure was then the sum of each brand's scores for each of its six attributes, normalized to sum to one for each subject. Intuitively, this measure assumes that brand attractiveness can be determined based on the prior evaluation of that brand's attribute values and the certainty associated with the beliefs, weighted by the attributes' importance weights. This measure successfully predicted the prior most attractive brand for 76 percent of the subjects in the choice task. In the ranking task, the average number of violations (i.e., the number of switches out of 15 possible needed to get a perfect fit across the six rankings) was slightly above one, with only two out of 29 subjects having more than two violations. Several other forms of the attractiveness model were tested, such as one that does not include the certainty component, but they were less predictive of the prior rank orders/choices. Generally, though, the results reported later are not sensitive to the particular attractiveness measure used or to the scaling assumptions of the component measures. For example, in the ranking task, if the prior rank orders provided by the subjects are used instead of the derived attractiveness measure, the results are practically identical.

The fact that the measure of attractiveness that includes the certainty component performed best suggests that subjects' confidence in their prior evaluations of a brand's attributes reflects their assessment of that brand's attractiveness. Indeed, prior research (Antil 1983; Katz 1944; Suchman 1950) suggests that the relationship between attitude and confidence resembles a U- or J-shape. That is, those with more extreme attitudes tend to be more intense and confident in their attitude position than those with neutral or indifferent attitudes. Thus, even though some other attempts to increase the predictive ability of multiattribute attitude models by adding a certainty component were not successful (e.g., Bennett and Harrell 1975), including certainty did improve the predictive ability of the attractiveness model in the present study.

Generating attractiveness scores for the unfamiliar brands (XX, YY) was also somewhat problematic, since priors were not requested of those brands. The certainty level assigned was set at the lowest level of 1 (very uncertain) on a five-point scale, since, by design, very little was known about these brands. With respect to the prior evaluations of these brands' attributes, the determination of an appropriate value was more difficult. Meyer (1981) showed that evaluations of unfamiliar alternatives are formed by assigning discounted (below neutral) average values to the unknown attributes. The average prior evaluation on the six attributes of the familiar brands ranged between -0.6 and $+1$. A sensitivity analysis was performed using 0, -1, and -2 as values for the prior evaluation of the unfamiliar brands. None of the findings reported later changes substantially due to using any of these values. However, a rating of -1 was used because it was consistent with the discounted average values of the familiar brands, and it resulted in the best fit between derived brand attractiveness (described earlier) and subjects' initial choices/rankings in terms of overall attractiveness.

A Logit Model of Information Choice. To analyze the determinants of acquisition priority we use a logistic choice model that models selection of the items of information from those remaining to be accessed. In this model, each information acquisition is seen as a selection of one from the set of remaining items of information, S. The utility of an information item giving the value of brand i on attribute k (U_{ik}) is assumed to be a linear function of the prior attractiveness of the brand (A_i), the importance of the attribute (W_k), the prior certainty about the brand-attribute pair (C_{ik}), and its prior evaluation (B_{ik}). That is,

$$U_{ik} = a_0 + a_1A_i + a_2W_k + a_3C_{ik} + a_4B_{ik}. \quad (1)$$

Following the standard multiple logistic model, the probability of choosing any item of information from those left in the set (S) is simply

$$P(x_{ik}|S) = expU_{ik}/\sum_{i'k'\epsilon S} expU_{i'k'}. \quad (2)$$

This logistic model is estimated using a routine that iteratively finds the maximum likelihood solution to Equation 2 given the parameters. In addition, the routine provides asymptotic estimates of parameter variances based on the inverse of the second derivative of the likelihood ratio relative to the parameters. Since each subject selected 22 items of information, there are 22 choices to be modeled for each. The first choice is one alternative out of 36 (six brands $\times$ six attributes). The second is one out of 35, and so on, until the 22nd choice, which is one out of 15. The 22 choices of the 29 respondents in each task are then stacked together and pooled, resulting in $22 \times 29 = 638$ information item choices to arrive at shared coefficients of the independent variables.

RESULTS

Factors Influencing Acquisition Priority

The results of the pooled logit analysis for the separate choice and ranking tasks regarding the effects of the

TABLE 2

COEFFICIENTS FOR THE POOLED LOGIT MODELS PREDICTING ACQUISITION PRIORITY FOR CHOICE AND RANKING TASKS[a]

Variable	Response mode: Choice[b]	Response mode: Ranking[c]
Prior certainty (C_{ik})	−.62[d]	−.61[d]
	(.19)	(.18)
Prior evaluation (B_{ik})	−.21[e]	−.48[d]
	(.16)	(.15)
Prior brand attractiveness (A_i)	1.34[d]	−.01
	(.15)	(.16)
Attribute importance (W_k)	2.31[d]	3.00[d]
	(.14)	(.15)

[a] Standard errors in parentheses.
[b] Chi-square test of model (4 df) = 360.2.
[c] Chi-square test of model (4 df) = 489.2.
[d] $p < 0.05$.
[e] $p < 0.10$.

components of prior knowledge on acquisition priorities are reported in Table 2. All of the hypotheses were supported. Each of these results is discussed below. Then, additional analyses are reported in which prior knowledge includes not only the effect of knowledge that existed prior to starting the task, but also the impact of knowledge acquired during the task.

Prior Brand-Attribute Certainty. Prior certainty about the values of brand-attributes had a statistically significant negative coefficient in both the choice ($p < 0.001$) and ranking ($p < 0.001$) tasks. The negative coefficient indicates that lower certainty led to higher priority during information acquisition. This provides strong statistical support for H1. However, to better understand this effect, it is useful to examine cell means.

Table 3, combining the results for the choice and ranking tasks, illustrates the result with respect to both the probability that the unit of information was accessed at all in the first 22 acquisitions (since, as indicated earlier, only 22 out of 36 available items of information were acquired), and the average acquisition priority. As might be expected, there was a relationship between prior attractiveness, and prior evaluations and prior certainty. People were, in general, more certain about the brands they found more attractive (as measured by the subjects' prior rankings/choices of the brands or by the derived attractiveness measure). Therefore, in order to show the effect of prior certainty in a table form, it is necessary to control, at least partially, for brand attractiveness.

Table 3 illustrates that for both high and low brand attractiveness, units of information associated with low certainty are more likely to be acquired at all and tend to have higher average acquisition priorities than those associated with high certainty.

Prior Brand-Attribute Evaluation. Prior brand-attribute evaluation had a statistically significant negative coefficient in the ranking task ($t = -3.2, p < 0.001$) and a marginally statistically significant coefficient ($t = -1.31, p < 0.10$) in the choice task. The negative coefficient for this term indicates that units of information with less favorable prior evaluations tend to be acquired earlier than those with less favorable evaluations.

TABLE 3

EFFECT OF CERTAINTY ON ACQUISITION PRIORITY (HOLDING BRAND ATTRACTIVENESS CONSTANT) POOLING ACROSS TASKS[a]

Prior brand attractiveness	Prior certainty	N	Acquisition probability	Mean acquisition priority[b]
High	High (3, 4, 5)	899	0.63[c]	18.19[c]
			(0.02)	(0.33)
High	Low (1, 2)	145	0.71[c]	19.84[c]
			(0.04)	(0.81)
Low	High (3, 4, 5)	338	0.53[c]	15.51[c]
			(0.03)	(0.54)
Low	Low (1, 2)	706	0.60[c]	17.67[c]
			(0.02)	(0.38)

[a] Standard errors in parentheses.
[b] Acquisition priority = 36 − acquisition order. Items of information that were not acquired at all were assigned an expected priority value of 7, i.e., (36 − 22)/2). This was done to preserve the information contained in the fact that an item of information was not one of the first 22 acquired.
[c] Differences between high and low prior certainty are significant at the $p < 0.05$ level.

Table 4, combining the results for the choice and ranking tasks, illustrates this effect. Because of the correlation between brand-attribute prior evaluation and the brand's attractiveness (similar to the above case regarding certainty), attractiveness plays the role of a covariate, allowing estimation of the net effect of prior evaluation on acquisition order. As Table 4 illustrates, less favorable prior evaluations tend to have higher acquisition priority and are more likely to be among the 22 items of information that were acquired. Table 4 also suggests that this effect is much stronger for brands of low attractiveness.

Prior Brand Attractiveness. Prior brand attractiveness was hypothesized to result in higher priority during information acquisition in the choice task. In the choice task the effect of prior brand attractiveness was strongly statistically significant ($t = 8.93, p < 0.001$). In contrast, for the ranking task, the effect of prior brand attractiveness was nonsignificant ($t = -0.06$). An examination of the first acquisitions in the choice and rank order conditions reinforces the above analysis. In choice, 21 out of 29 subjects acquired the first piece of information about their initially most attractive brand, while only six out of 29 did so in ranking.

A closer examination of the data, however, reveals that there is a curvilinear relationship between brand attractiveness and acquisition priority in the ranking task but not in the choice task. A quadratic attractiveness term entered into the logit model of the ranking task results in a significant coefficient ($t = -4.61$, p

TABLE 4

EFFECT OF PRIOR EVALUATION ON ACQUISITION PRIORITY (HOLDING BRAND ATTRACTIVENESS CONSTANT) POOLING ACROSS TASKS[a]

Prior brand attractiveness	Prior evaluation	N	Acquisition probability	Mean acquisition priority[b]
High	Positive or zero	796	0.63 (0.02)	18.22 (0.35)
High	Negative	248	0.66 (0.03)	19.05 (0.64)
Low	Positive or zero	217	0.47[c] (0.03)	14.12[c] (0.58)
Low	Negative	827	0.61[c] (0.02)	17.69[c] (0.35)

[a] Standard errors in parentheses.

[b] Acquisition priority = 36 − acquisition order. Items of information that were not acquired at all were assigned an expected priority value of 7, i.e., (36 − 22)/2). This was done to preserve the information contained in the fact that an item of information was not one of the first 22 acquired.

[c] Differences between high and low prior evaluation are significant at the $p < 0.05$ level.

< 0.001). In the choice task, on the other hand, the coefficient of quadratic attractiveness is not statistically significant ($t = 0.25$). This finding suggests that in the ranking task, alternatives of mid-level attractiveness tend to have a higher priority during search. This interaction makes sense because in a rank order task the probability of changing any rank order is greatest if one gets information on alternatives whose attractiveness is close to that of a large number of other alternatives.

Finally, consistent with previous findings (e.g., Tigert 1966), search importance had a strong positive effect on acquisition priority in both choice and ranking. Given that our measure of attribute importance is really a measure of search importance, it is hardly surprising that it strongly predicted behavioral search. A more appropriate measure might be one formed from conjoint analysis. However, we do not believe the results would appreciably change with other measures for two reasons. First, the results we derived occur if importance is left out of the equation. Second, and more important, to the extent that our current measure of subjective search importance already contains information on other aspects of prior beliefs that impact search, it should suppress the impact of these variables in our model of search at the brand-attribute level. Thus, finding significant effects while controlling for general attribute search importance strengthens our confidence in our conclusions.

A Dynamic Analysis of Acquisition Priority

The focus of discussion, so far, has been on the influence of knowledge that existed prior to starting the information acquisition task. However, given the task, this assumption is clearly an oversimplification. In particular, information acquired early can be expected to alter the value of subsequent information, in at least two ways. First, any acquired piece of information might influence the overall perceived attractiveness of the brands. This, according to Hypothesis 3, is expected to influence the priority of acquiring additional information about these brands in the choice task. Second, different decision rules that consumers use imply sequential information acquisition by brand or by attribute (Bettman 1979; Payne 1976). The additive value and satisficing strategies, for example, are characterized by brand-based search. On the other hand, strategies like elimination-by-aspects (Tversky 1972) and lexicographic choice rules are characterized by attribute-based search (Bettman 1979). Much process research concerned with decision strategies has used this distinction between brand versus attribute-based processing. This evaluation strategy-based sequential dependence suggests that the acquisition of an item of information about a particular brand-attribute increases the likelihood that the next acquisition will be on the same brand or attribute. An advantage of the logit analysis that we use is that it permits information acquired in earlier acquisitions to serve as input to later ones. This expanded framework permits the modeling of both updated attractiveness and the tendency to process information within brand or within attribute.

Several ways to define the updated brand attractiveness scores were tried. The one that produced the best fit assumes that the new information is totally absorbed into the attractiveness model (i.e., prior evaluation of a brand-attribute is replaced with its provided value) and the new certainty of this information is a 5, the highest point on the certainty scale.

In order to incorporate the effect of decision strategies on acquisition priorities, two additional variables—"same brand" and "same attribute"—were added to the model as independent variables. At each acquisition, all remaining entries received a value of 1 on the "same brand" and "same attribute" variables if the previous acquisition was on the same brand or same attribute, respectively; entries received a score of 0 on the "same brand"/"same attribute" variables otherwise.

Table 5 presents the results of the pooled logit analysis for the expanded analyses. In columns 2 and 3, the model includes prior certainty, prior evaluation, updated brand attractiveness, and attribute importance. In columns 4 and 5 the "same brand" and "same attribute" variables are added to the model.

A comparison of the coefficients in Table 2 and Table 5 indicates that most coefficients remain remarkably stable under all three models. However, the coefficient for brand attractiveness in column 2 of Table 5 is much greater than the coefficient for prior attractiveness in column 2 of Table 2. Furthermore, replacing prior attractiveness with updated attractiveness increases the Chi-square value associated with the model for the choice task from 360.2 to 390.6. This means that the discovery of unexpected good (bad) information about an alternative strongly increases (decreases) the likeli-

TABLE 5

COEFFICIENTS OF THE DYNAMIC LOGIT MODELS OF ACQUISITION PRIORITY[a]

Variable	Updated attractiveness model		Dynamic model	
	Choice[b]	Ranking[c]	Choice[d]	Ranking[e]
Prior certainty (C_{ik})	−.44[f]	−.59[f]	−.45[f]	−.68[f]
	(.16)	(.16)	(.18)	(.17)
Prior evaluation (B_{ik})	−.24[g]	−.47[f]	−.24[g]	−.40[f]
	(.15)	(.15)	(.16)	(.15)
Updated brand attractiveness (UA_i)	1.73[f]	−.07	1.73[f]	−.05
	(.17)	(.17)	(.17)	(.17)
Same brand (SB_{ik})	—	—	1.87[f]	1.03[f]
			(.16)	(.19)
Same attribute (SA_{ik})	—	—	2.27[f]	2.91[f]
			(.15)	(.15)
Attribute importance (W_k)	2.32[f]	3.00[f]	2.16[f]	2.38[f]
	(.14)	(.15)	(.14)	(.16)

[a] Standard errors in parentheses.
[b] Chi-square test of model (4 df) = 390.6.
[c] Chi-square test of model (4 df) = 489.4.
[d] Chi-square test of model (6 df) = 658.0.
[e] Chi-square test of model (6 df) = 872.8.
[f] $p < 0.05$.
[g] $p < 0.10$.

hood that more information will be sought about that alternative. Notice, however, that in the ranking task, consistent with our previous result, neither prior brand attractiveness nor updated attractiveness are statistically significant.

Inclusion of the decision strategy variables—"same brand" and "same attribute"—in the dynamic model of column 4 had a dramatic effect on the explanatory power of the model for both the ranking and the choice task, almost doubling the χ^2 measure of fit. The coefficients of the two models indicate that the effect of the "same attribute" variable is greater and the effect of the "same brand" variable is weaker in the ranking compared to the choice task. As discussed earlier, in the choice task there appears to be a tendency to focus attention on the more favorable brands in the evoked set, thus limiting attribute-based processing to those alternatives. In a rank-order task, by contrast, the need to make multiple comparisons among alternatives may have made subjects more likely to examine all brands on an attribute.

Indeed, as can be seen in the following tabulation,

Task	Proportion of transitions: By attribute	By brand	Neither	N
Choice	.35	.25	.40	609
Ranking	.53	.12	.35	609

the average proportion of sequential acquisitions using the same attribute (by-attribute acquisitions) is 53 percent for ranking and 35 percent for choice, a strongly significant difference. It is of interest to note the relatively large percentage of transitions between items of information that are neither by brand nor by attribute. Previous studies of decision making using information search methodologies (e.g., Payne 1976) have not found such large percentages. The relatively large percentage of this type of transition found in the present study likely reflects the motivation of subjects to be more selective in their acquisitions using their prior knowledge about the familiar brands. That is, the experimental procedure used in this study appeared to have encouraged subjects to consider carefully each acquisition rather than acquire information more systematically by attribute or by brand. Nonetheless, the positive coefficients for the "same brand" and "same attribute" variables do indicate that search was to some extent controlled by higher level evaluation strategies like elimination-by-aspects or additive value.

In sum, the dynamic model of information acquisition greatly increased the explanatory power of the model by allowing incorporation of the effect of early acquisitions on later ones.

Sensitivity of the Results

As already noted, the pooled logit results were generally not sensitive to the way the components of the models were measured. Specifically, different forms of the brand attractiveness measure were tried, and the results reported above are not sensitive to the particular measure used. A related concern is with the relatively low metric quality of the independent variables. Some of our models involved assumed ratio quality data when only weak interval scales were strictly justified. However, we tried a number of additive constants and the results were remarkably insensitive to the constant used. Further, while our measure of brand attractiveness is derived from other measures, our results also do not change in the ranking task if the subjects' direct rankings of attractiveness are substituted for the weighted-additive model used.

The results are also not sensitive to the method of analysis used. In all cases, prior certainty (C_{ik}) and prior evaluation (B_{ik}) had the expected effects on information acquisition behavior. However, it is important to note that all of the analyses reported thus far were pooled across subjects. Such a pooling procedure is standard in logit analyses (e.g., Guadagni and Little 1983). An advantage of the pooled analysis, compared to a within-subject analysis, is that with more observations the estimates of the coefficients tend to be more stable. In spite of these problems, it is worthwhile to note that we ran within-subject logit models, and the patterns of the average coefficients were very similar to the pooled ones given in Tables 2 and 5.

Finally, in addition to the logit analyses, the results were also analyzed using regression, both within subject and across subjects, with the rank order of acquisition of each item of information as the dependent variable. This assumed that the rank orders of acquisitions associated with the brand-attribute entries approximate

an interval measure of acquisition priority. It is again gratifying that the estimated coefficients of the prior knowledge components derived from these regression runs were very similar to those derived from the logit analysis.

DISCUSSION

In his recent review of consumer psychology, Bettman notes that "one of the major developments in research on consumer decision processes is the realization that memory and decision processes interact" (1986, p. 263). Research showing that prior beliefs impact on consumers' information search strategies in estimating covariation relationships is provided by Roedder John, Scott, and Bettman (1986). The present study demonstrates substantial prior knowledge effects on consumers' search for information in a choice or a ranking task. The focus of the study is on how various aspects of prior knowledge about brands influence the priority of acquisition of additional product information at the level of brand-attribute values.

Much knowledge relevant to brand decisions appears stored at the brand-attribute level (Russo and Johnson 1980). Both the contents of prior beliefs about brand-attribute values and the degree of certainty regarding those beliefs are shown to impact on the order in which new information was acquired about brands. Specifically, the results indicate that lower certainty leads to earlier acquisition of information and that units of information with less favorable prior evaluations tend to be accessed earlier than those with more positive evaluations. Both of the findings are important examples of the interactions of prior knowledge at the brand-attribute level on consumer information search.

The finding that consumer search depends on the identity of both the brand and the attribute has strong implications for those formulating communications strategies. In particular, an attribute that is generally quite important may not be so for a particular brand. For example, the attribute "reliability" was on average acquired later for the IBM brand than for any other brand, reflecting greater certainty and favorability in prior beliefs about IBM's reliability. This suggests that a communications campaign based on IBM's reliability might not be as successful as one based on, say, ease of use. Thus, general measures of attribute importance might lead to a communications campaign focused on the wrong attribute.

While the focus of this study has been on prior beliefs at the brand-attribute level, the role of prior beliefs about the overall attractiveness of brands and the overall search importance of attributes on the order in which new information is acquired was also examined. As noted earlier, the measures of attractiveness and prior search importance of attributes were limited in several ways. Nonetheless, the results for prior attractiveness indicate an interesting interaction with the nature of the decision task—choice or ranking. Specifically, information about the most attractive brands was acquired earlier when making a choice. On the other hand, the earlier acquisitions of information were for the moderately attractive brands in the ranking task.

These results further illustrate that information processing is contingent on the response mode (Payne 1982). For consumer researchers it suggests that the commonly used ranking or rating tasks may be inappropriate for predicting choices. If so, then a choice-based conjoint as defined by Louviere and Woodworth (1983) may be more effective at predicting choice than the more traditional forms of conjoint analysis based on rankings.

The importance of prior knowledge in guiding the acquisition of new knowledge was also supported by the impact of updating brand attractiveness on predicting acquisition priority. In the choice task, including an updated attractiveness term in our model of acquisition priority added significantly to the overall fit of the model.

With respect to attribute importance, the findings of this research raise questions about the validity of using search order for measuring attribute importance (Heeler et al. 1979; Jaccard et al. 1986). They suggest that the order of search reflects, in addition to attribute importance, consumers' prior knowledge about the attributes and the considered brands. Specifically, search order will tend to overestimate the importance of attributes associated with less favorable and more uncertain priors.

Overall our results add to the small but growing body of evidence that prior knowledge can affect the type of information processing carried out in making a decision. We found, for example, that consumers will use their prior knowledge to ease their processing task in choice by focusing initially on the most attractive brands and only later sampling information about less attractive alternatives. Since most consumer choices occur in situations where some data are available in the choice environment and some are in memory (Bettman 1986), much more research on the interaction of prior knowledge and consumer search and decision processes seems warranted.

In addition to the empirical findings reported, this article also describes two methodological innovations. First, a modification of the standard information acquisition paradigm is introduced that served to motivate the careful selection of the next item of information to be searched. Second, the logit analysis that included both updated attractiveness measures and attribute and brand dummy variables illustrates how consumer information processing may be examined from a more dynamic perspective than has typically been the case.

Finally, this study has two obvious limitations that suggest directions for further research. First, except for the contrast between choice and ranking, an experimentally manipulated variable, the results are primarily correlational in nature. Additional studies are needed that would more directly manipulate prior knowledge,

perhaps through forced exposure to advertisements or various kinds of training. Second, the use of numerical attribute scales in this experiment, like many other consumer decision experiments, raises issues of external validity. While information in the marketplace is sometimes expressed in simple scales and in an alternative by attribute form, that is not typically the case. A very useful extension of the current work would be to try to replicate the results using a less structured search task.

APPENDIX

Derivation and Specification of a Model of Information Search

This appendix describes a model of the expected value of accessing information on attribute k of alternative i (X_{ik}). The model assumes that search is a function of the mean of the prior belief (B_{ik}), its certainty (C_{ik}), the prior attractiveness of the brand (A_i), and the importance of the attribute (W_k). The model is derived from Hagerty and Aaker's (1984) model, which is itself an extension of Raiffa and Schlaifer's (1961) analysis of information selection.

We first restate two assumptions of the Hagerty and Aaker (1984) model and apply them to the current problem. We then derive the signs of the first derivatives of the model. Finally, we modify the model to approximate the case in which the task is to rank order the alternatives.

Assumptions

The prior belief regarding the level of alternative i on attribute k has mean B_{ik} and variance σ^2_{ik}. Furthermore, zero covariances between attributes or alternatives are assumed. The value of an alternative i on attribute k is given by:

$$X_{ik} = B_{ik} + \epsilon_{ik} \quad \textbf{(1)}$$

where the ϵ_{ik}s are $iidN(0, \sigma^2_{ik})$.

It is assumed that a decision maker ranks all brands in terms of prior attractiveness (A_1 = top rated, A_2 = second, and so on) and chooses the alternative with the highest current expected value (A_1). The prior attractiveness of each brand is the sum of the expected values of its attributes multiplied by the weight of each attribute:

$$A_i = \sum_k W_k B_{ik}. \quad \textbf{(2)}$$

To derive the expected value of getting perfect information on item X_{ik}, Hagerty and Aaker (1984, Equation 7) show that the expected value of knowing the true value of X_{ik} is:

$$EVPI(X_{ik}) = \sigma_{pik} G(\delta_i/\sigma_{pik}) \quad \textbf{(3)}$$

where

$$\delta_i = \begin{cases} A_1 - A_i, & \text{if } i \text{ does not have the top value if } i \neq 1 \\ A_1 - A_2, & \text{if } i \text{ is the current top value if } i = 1. \end{cases} \quad \textbf{(4)}$$

σ_{pik} is the expected reduction in variance due to getting perfect information on the value of X_{ik}. This is, in the present case:

$$\sigma^2_{pik} = W^2_k \sigma^2_{ik}. \quad \textbf{(5)}$$

Finally, $G(\cdot)$ is the unit normal loss integral. It reflects the probability that accessing unit X_{ik} will change the top rated alternative.

Substituting Equations 4 and 5 into Equation 3 and assuming that the certainty ratings approximate the inverse of the subjective standard deviations ($C_{ik} = 1/\sigma_{ik}$) gives:

$$EVPI(X_{ik}) = \begin{cases} (W_k/C_{ik})G[C_{ik}(A_1 - A_i)/W_k] & \text{if } i \neq 1 \\ (W_k/C_{ik})G[C_{ik}(A_1 - A_2)/W_k] & \text{if } i = 1. \end{cases} \quad \textbf{(6)}$$

The Signs of Derivatives of *EVPI*

The signs of derivatives of *EVPI* with respect to C_{ik}, A_i, and W_k can be derived from Equation 6. Since $G(\cdot)$ is always a decreasing function (see Raiffa and Schlaifer 1961, p. 356), and the two terms in Equation 6 are always positive, then it is easy to show that $d(EVPI)/d(W_k) > 0$, $d(EVPI)/d(C_{ik}) < 0$, and $d(EVPI)/d(Ai) > 0$ if $i \neq 1$.

For the brand with the highest current attractiveness ($i = 1$), the situation is more complex. Clearly, an increase in the prior attractiveness of the top brand while keeping the others constant reduces the value of collecting information on the top brand, since there is less chance that the information will lead to a change in the alternative chosen. However, increasing A_1 also decreases the value of accessing information on any other brand since the top brand is a component in the value of collecting information about any lesser brand. Thus, $d(EVPI)/d(A_i) < 0$ if $i = 1$, but the optimal selection of a piece of information does not change since the top alternative improves relative to the sample. In sum, increasing A_i will increase or keep constant the likelihood of accessing information about brand i relative to the other brands.

Deriving $EVPI(X_{ik})$ for the Rank Order Task

The expected value of acquiring information about alternative i in a rank order task is assumed to be the simple sum of the expected values for any pair of alternatives that include i. This explicitly assumes that covariances among pairs of objects are negligible. Thus, the probability of changing the rank order between one pair of alternatives is assumed to be independent of a

likelihood of changing rank orders between other pairs. The expression for each pair comes directly from Equation 6:

$$PAIR_{ij}\ EVPI(X_{ik}) = \begin{cases} (W_k/C_{ik})G[C_{ik}(A_j - A_i)/W_k] & \text{if } A_j > A_i \\ (W_k/C_{ik})G[C_{ik}(A_i - A_j)/W_k] & \text{if } A_i > A_j \end{cases} \quad (7)$$

or, generally,

$$PAIR_{ij}\ EVPI(X_{ik}) = (W_k/C_{ik})G[C_{ik}|A_i - A_j|/W_k]. \quad (8)$$

Assuming that

$$RANK\ EVPI(X_{ik}) = \sum_j PAIR_{ij}\ EVPI(X_{ik}) \quad (9)$$

then

$$RANK\ EVPI(X_{ik}) = (W_k/C_{ik}) \sum_j G[C_{ik}|A_i - A_j|/W_k]. \quad (10)$$

Clearly the direction of the first derivatives of certainty (C_{ik}) and attribute importance (W_k) for such a function will be the same as in the above case of choice. With respect to A_i, brands closest in terms of attractiveness to other brands, which would tend to be those brands with middle attractiveness, will be associated with the highest *EVPI*. This prediction, however, is not mathematically precise. Thus, we have no hypothesis regarding the effect of brand attractiveness in the ranking task.

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