Brand Retrieval, Consideration Set Composition, Consumer Choice, and the Pioneering Advantage

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Recent research on the pioneering advantage has shown that consumers often prefer pioneering brands to follower brands. Recent research on consumer choice suggests that information about brands is filtered through a series of sequential cognitive processes. This study attempts to integrate these two separate lines of research by investigating the effects of pioneering on each stage of the multistage decision process. A within-subjects longitudinal experiment was conducted to simulate brand order of entry into a new market. We also developed a sequential logit model to isolate the direct impact of pioneering on each stage of the decision process while controlling for indirect effects of pioneering on previous stages. The results revealed that the pioneering brand (vs. followers) is more likely to be retrieved, considered, and selected. Moreover, the results revealed that consumers are more likely to bypass consideration set formation when the choice decision is simple (vs. complex). Theoretical and practical implications of the results are discussed.

Recent research on the pioneering advantage has shown that the first brand to enter a new market often earns a long-term market share advantage over later entrants. The pioneering advantage has been observed in both consumer and industrial markets and in both growing and saturated markets (Gurumurthy and Urban 1992; Lilien and Yoon 1990; Robinson 1988; Robinson and Fornell 1985; Urban et al. 1986). Moreover, under some circumstances, the effect appears to be robust to switching costs and to moderately suboptimal positioning strategies (Carpenter and Nakamoto 1989; Kardes and Gurumurthy 1992). Nevertheless, pioneering brands are not always successful, and degree of success can vary considerably across situations (Carpenter and Nakamoto 1990).

Though extensive prior research has examined the pervasiveness and robustness of the pioneering advantage, relatively little prior research has examined the psychological mechanisms that contribute to the pioneering advantage. Two notable exceptions are the Carpenter and Nakamoto (1989) and Kardes and Gurumurthy (1992) studies. These studies showed that an anchoring-and-adjustment based preference evolution process (Carpenter and Nakamoto 1989) and an information search and information integration process (Kardes and Gurumurthy 1992) influence the magnitude of the pioneering advantage. We suggest that additional processes are also likely to be involved. The goal of the present research is to investigate the effects of pioneering on consumer decision processes neglected by previous models.

THE PIONEERING ADVANTAGE

Previous research on the pioneering advantage has shown that, when consumer preferences are ambiguous (i.e., when consumers are uncertain about the ideal combination of features for a new product innovation), preferences evolve slowly over time through an anchoring-and-adjustment process (Carpenter and Nakamoto 1989; Hoch and Deighton 1989; Kahneman and Snell 1990). Because consumers are exposed to brands sequentially, and because the first brand has a temporary monopoly (initially, only one brand is available),

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the first brand tends to have a disproportionately large effect on trial and preference. Consequently, (*a*) the ideal combination of features is determined by the combination provided by the pioneering brand, (*b*) the pioneer becomes the prototype for the category, and (*c*) asymmetric feature comparison processes (see Tversky 1977) differentiate the pioneer from followers and lead followers to be perceived as mere "copy cats" (Carpenter and Nakamoto 1989).

The preference evolution model applies primarily when the pioneering brand is a discontinuous innovation because preferences toward discontinuous innovations are likely to be ambiguous (Donnelly and Etzel 1973). Conversely, when the pioneering brand is a continuous (incremental) innovation, preferences are less ambiguous, and prior knowledge provides a useful framework for organizing attribute information about the pioneering brand. This attribute information may be perceived as novel and interesting. Novel and interesting information is attention drawing (Kahneman 1973) and tends to be more memorable (Anderson 1983). Because follower brands share many attributes with the pioneer, attribute information about followers is more likely to be perceived as redundant and less interesting. Redundant and uninteresting information is not attention drawing and is less memorable; and exposure to redundant information can lead to premature cessation of the search process. Because consumers learn more about the pioneer than about followers, and because judgmental extremity and confidence increases as the amount of information available for judgment increases (the set-size effect; Anderson 1981), judgments of the pioneer are more extreme and are held with greater confidence (Kardes and Gurumurthy 1992). That is, sequential information processing leads consumers to learn more about the pioneer than about followers. Judgments based on a large amount (e.g., six attributes) of information having favorable evaluative implications are more favorable and are held with greater confidence than judgments based on a small amount (e.g., three attributes) of information having favorable evaluative implications. Consequently, consumers form more favorable and more confidently held evaluations of the pioneer (vs. followers).

The Carpenter and Nakamoto (1989) and Kardes and Gurumurthy (1992) models both focus on the contribution of multiattribute evaluation processes to the pioneering advantage. However, recent research indicates that brand choice can be influenced without altering brand evaluations (Nedungadi 1990). Specifically, brand retrieval and brand consideration processes can produce effects on brand choice that are independent of the effects of brand evaluation on brand choice. Thus, it becomes important to determine the effects of pioneering on brand retrieval and brand consideration, as well as on brand choice. Brand retrieval and brand consideration processes may contribute to the pioneering advantage in ways that are independent from the multiattribute evaluation processes examined by Carpenter and Nakamoto (1989) and Kardes and Gurumurthy (1992). The aim of the present research is to investigate this issue.

THE CHOICE PROCESS

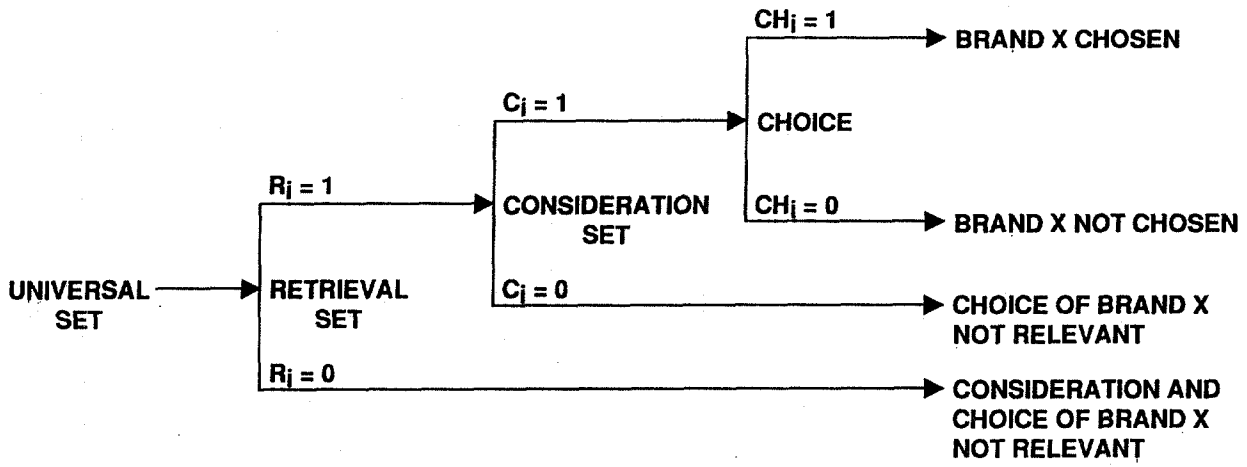
Dynamic models of consumer choice emphasize that choice sets vary across purchase occasions (Hauser and Wernerfelt 1989, 1990; Lehmann and Pan 1991; Nedungadi 1990; Ratneshwar and Shocker 1991; Roberts and Lattin 1991; Shocker et al. 1991; Simonson and Tversky 1992). Much of this variability is due to the complexity of the decision process and the consumer's efforts to reduce this complexity. One way to reduce complexity is to use a two-stage decision model (e.g., Bettman 1979; Gensch 1987; Johnson and Payne 1985; Wright and Barbour 1977) where available alternatives are first screened on the basis of a simple noncompensatory rule (stage 1), and the remaining alternatives are analyzed more carefully using a compensatory rule (stage 2).

Shocker et al. (1991) suggest that consumers may use more than two stages to simplify decision making, especially when the purchase decision is extremely complex. They developed a sequential process model involving a series of hierarchical or nested sets of alternatives. The *universal set* refers to all brands that are available in the marketplace. The *retrieval set* consists of the subset of brands in the universal set that the consumer can access from memory. Because consumers may not be exposed to all brands and because consumers may not encode all brands to which they have been exposed, the retrieval set is usually much smaller than the universal set (Alba and Chattopadhyay 1985, 1986). The *consideration set* consists of the subset of brands in the retrieval set that are scrutinized carefully on a particular choice occasion. Because consumers may not consider all brands retrieved (some brands match consumers' immediate goals more closely than others), the consideration set is often smaller than the retrieval set. Finally, one brand is selected from the consideration set.

The sequential multistage process model is summarized in Figure 1. As Figure 1 indicates, consumers retrieve a subset of brands available from the universal set of all existing brands. If a brand is not retrieved, it cannot be considered or chosen. Consequently, a brand that is not retrieved is irrelevant to consideration and choice. If a brand is retrieved, it may or may not enter the consumer's consideration set. If a retrieved brand is not included in the consumer's consideration set, the brand cannot be chosen. Consequently, the brand is irrelevant to choice. Finally, one brand from the set of brands included in the consumer's consideration set is chosen.

FIGURE 1

THE SEQUENTIAL MULTISTAGE PROCESS MODEL



Brand Retrieval

What factors influence brand retrieval? Any variable that influences the encoding of brand-related information into memory—such as attention, comprehension, level of prior knowledge, processing capacity, processing effort, opportunity to process—should also influence brand retrieval (Alba and Chattopadhyay 1985, 1986; Alba and Hutchinson 1987; Meyers-Levy 1989; Nedungadi 1990). Consumers are exposed to brands in many different ways, including advertising, packaging, point-of-purchase displays, word-of-mouth communications, and consumer magazines. Recently encountered and attended to brands are more accessible from memory than brands encountered long ago. Frequently encountered brands are more accessible than infrequently encountered brands. Distinctive brands (e.g., brands that differ from other brands) are more accessible than nondistinctive brands.

How does pioneering influence brand retrieval? When a new brand enters a new market, the brand may be very salient or attention drawing. When only one brand exists in a new market, there are no competing brands to draw attention away from the pioneering brand. Moreover, when only one brand is available, the brand is distinctive because similar brands have not yet entered the market. The pioneering brand is distinctive, and distinctive brands are more accessible from memory. Consequently,

H1: A brand should be more likely to be included in the retrieval set if it was the pioneering brand as opposed to a follower brand.

Brand Consideration

What factors influence brand consideration? Brand retrieval is one factor that exerts a strong influence on brand consideration (Nedungadi 1990). Accessible brands are likely to be retrieved and are also likely to be included in consumers' consideration sets. Because the pioneering brand is more likely to be retrieved, it should also have a greater likelihood of being considered. That is, pioneering should influence brand consideration indirectly by first influencing brand retrieval.

In addition to the indirect effect of pioneering on brand consideration, recent research suggests that pioneering should also produce a direct effect on brand consideration. The evaluation cost model of consideration set formation suggests that pioneering should influence brand consideration even when brand retrieval is controlled by performing consideration set analysis conditional (vs. unconditional) on retrieval (Hauser and Wernerfelt 1990). To briefly summarize the model, evaluation costs are costs involved in deciding whether or not to include a brand in the consideration set (Hauser and Wernerfelt 1990). Evaluation costs include thinking costs (e.g., Alba and Hutchinson 1987; Shugan 1980), search costs (e.g., Alba and Hutchinson 1987; Beatty and Smith 1987), and opportunity costs (e.g., Schmalensee 1982). For a brand to be included in the consideration set, evaluation benefits must exceed evaluation costs (Hauser and Wernerfelt 1990).

Overall, evaluation costs are lower for the pioneering brand than for follower brands. Thinking costs, search costs, and opportunity costs are low, initially, because only one brand is available. However, these evaluation costs increase as more brands enter the market (i.e., information load increases). Hauser and Wernerfelt (1990) maintain that the expected utility of the best brand among considered brands also increases as the number of brands included in the consideration set increases because the optimal brand (i.e., the brand with the greatest expected utility) is more likely to be included in the consideration set if the number of brands

included in the consideration set is large (vs. small). However, the marginal incremental utility of adding an additional brand to the consideration set decreases as consideration set size increases (see Hauser and Wernerfelt 1990, p. 406, eq. 14). That is, the costs (i.e., thinking costs, search costs, and opportunity costs) of evaluating one more brand are more likely to outweigh the benefits of evaluating one more brand as the number of brands already included in the consideration set increases.

H2: A brand should be more likely to be included in the consideration set if it was the pioneering brand as opposed to a follower brand.

Again, it should be noted that brands that are not retrieved cannot be considered and are, therefore, irrelevant to consideration set composition. Hypothesis 2 suggests that, contingent on retrieval, the pioneer should be more likely to be considered. Failure to control for the effects of pioneering on retrieval results in the confounding of retrieval and consideration.

Brand Choice

Because decision costs (the costs involved in selecting one brand from the set of considered brands) are conditional upon evaluation costs (the costs involved in determining whether or not to include a brand in the consideration set), the pioneering brand should be more likely to be chosen simply because it is more likely to be included in the consideration set (Hauser and Wernerfelt 1990). That is, pioneering should influence brand choice indirectly by first influencing brand retrieval and brand consideration.

In addition to the indirect effects of pioneering on brand choice, recent research suggests that pioneering should also produce a direct effect on brand choice. The first brand to enter a market provides a natural starting point for the comparison process, and, consequently, the pioneering brand frequently becomes the standard of comparison by which all follower brands are judged (Carpenter and Nakamoto 1989). The standard of comparison is differentiated from other brands, which are perceived as "copy cats." This leads to a preference advantage for the standard of comparison. Consequently,

H3: A brand should be more likely to be chosen if it was the pioneering brand as opposed to a follower brand.

Consistent with the work of Carpenter and Nakamoto (1989) and Kardes and Gurumurthy (1992), the sequential multistage process model also emphasizes the critical role of sequential brand exposure in fostering the pioneering advantage. Unlike the previous work, however, the multistage process model suggests that brand retrieval and brand consideration processes can contribute to the pioneering advantage in ways that are independent of the contribution of multiattribute evaluation processes.

It should be emphasized, however, that consumers are unlikely to form consideration sets across all situations (Shocker et al. 1991). Of course, when consumers fail to form consideration sets, consideration set processes cannot contribute to the pioneering advantage. Hence, it is important to determine when consumers are likely versus unlikely to form consideration sets.

Shocker et al. (1991) suggest that decision complexity may be one important moderator of the likelihood of consideration set formation. Decision complexity is determined by the number of available alternatives (e.g., number of brands retrieved) and by the amount of attribute information available for each alternative (Johnson and Payne 1985; Olshavsky 1979; Payne 1976). If a large number of brands are relevant for choice (e.g., if a large number of brands are retrieved), consumers may attempt to simplify decision making by eliminating alternatives and by performing a more effortful compensatory analysis on the few remaining alternatives (Bettman 1979; Gensch 1987; Johnson and Payne 1985; Shocker et al. 1991; Wright and Barbour 1977). By contrast, if a small number of brands are relevant for choice (e.g., if a small number of brands are retrieved), eliminating alternatives is unnecessary. Instead, consumers may be more likely to perform a compensatory analysis of all relevant brands. Hence,

H4: Consumers should be likely to form consideration sets when decision complexity is high (e.g., when a large number of brands are retrieved). By contrast, consumers should be less likely to form consideration sets when decision complexity is low (e.g., when a small number of brands are retrieved).

MODELING THE MULTISTAGE DECISION PROCESS—THE SEQUENTIAL LOGIT MODEL

Structure of the Data and Definitions

Figure 1 presents the multistage decision process as a sequential "tree" structure, where consumers form a *retrieval set* from a *universal set* of brands, reduce the retrieval set to a *consideration set* and then *choose* one brand. The resulting data from this framework will consist of information on a sample of size N from the population of interest. For every individual i, $i = 1, 2, \ldots, N$, the following will be observed: (1) whether or not the events of interest (retrieval, consideration, and choice of a focal brand) occurred and (2) the vectors, $\mathbf{X}_{ri}$, $\mathbf{X}_{ci}$ and $\mathbf{X}_{chi}$, of independent variables that are hypothesized to affect retrieval, consideration, and choice, respectively.

Let R_i, C_i, and CH_i denote, respectively, whether or not the ith individual retrieved, considered, and chose

the focal brand and be defined as follows: $R_i = 1$ if the focal brand was retrieved, 0 otherwise; $C_i = 1$ if the focal brand was considered, 0 otherwise; $CH_i = 1$ if the focal brand was chosen, 0 otherwise. It is important to note that the issue of consideration is relevant only if $R_i = 1$. Thus, if the ith individual did not retrieve the focal brand ($R_i = 0$), the issue of consideration is irrelevant. Consequently, retrieval serves as a selection mechanism by identifying (selecting) the set of individuals for whom consideration is even relevant, rather than as a causal variable. Further, the issue of choice is relevant only if the focal brand was considered ($C_i = 1$). If, however, the focal brand was not retrieved ($R_i = 0$) or retrieved but not considered ($R_i = 1$, $C_i = 0$) the issue of choice is irrelevant. Here again the consideration stage serves as a selection mechanism for the choice stage.

The Estimation Model—Likelihood Specification

Given the above data structure, the objective is to derive the likelihood function for a model that (*a*) treats choice as relevant only for those who considered the focal brand, (*b*) treats consideration as relevant only for those who retrieved the focal brand, and (*c*) is able to isolate the effects of any single variable on each of the three stages of the process, thus yielding *direct and unique* effects of pioneering on each stage of the decision process.

The Appendix provides a detailed derivation for the following expression of the log-likelihood for the sample:

$$\begin{aligned} L^* = \Sigma_i \{ & R_i C_i CH_i \ln [F_1 F_2 F_3] \\ & + R_i C_i (1 - CH_i) \ln [F_1 F_2 (1 - F_3)] \\ & + R_i (1 - C_i) \ln [F_1 (1 - F_2)] \\ & + (1 - R_i) \ln [1 - F_1] \}, \end{aligned} \tag{1}$$

where F_1, F_2, and F_3 are defined in the Appendix. Algebraic expansion of Equation 1 results in the following expression for the log-likelihood function:

$$\begin{aligned} L^* = \Sigma_i \{ & [R_i \ln (F_1) + (1 - R_i) \ln (1 - F_1)] \\ & + [R_i C_i \ln (F_2) + R_i (1 - C_i) \ln (1 - F_2)] \\ & + [R_i C_i CH_i \ln (F_3) \\ & + R_i C_i (1 - CH_i) \ln (1 - F_3)] \}, \end{aligned} \tag{2}$$

which in turn can be presented as a sum of three terms as follows:

$$\begin{aligned} L^* = & \Sigma_i [R_i \ln (F_1) + (1 - R_i) \ln (1 - F_1)] \\ & + \Sigma_{i|R_i=1} [C_i \ln (F_2) + (1 - C_i) \ln (1 - F_2)] \\ & + \Sigma_{i|C_i=1} [CH_i \ln (F_3) \\ & \quad + (1 - CH_i) \ln (1 - F_3)]. \end{aligned} \tag{3}$$

Equation 3 presents the final form of the log-likelihood function for the analysis of the sequential decision process. Noting from Equations A6–A8 that F_1, F_2, and F_3 model the retrieval, consideration, and choice stages, respectively, the following issues emerge from the structure of Equation 3.

1. Starting from a conceptual description of the sequential decision process, the log-likelihood for the model has been derived to be the sum of three terms each of which resembles a single-stage log-likelihood function (see Eq. A4).

2. The first summation term deals with the retrieval stage and considers all the respondents (indexed by i). However, the second summation term, dealing with consideration, considers only those respondents for whom $R_i = 1$, thereby holding retrieval constant. Similarly, the third summation term, dealing with choice, considers only those respondents for whom C_i (and, of course, R_i) = 1, thereby holding consideration and retrieval constant. Therefore, the overall likelihood function explicitly controls for retrieval while modeling consideration and explicitly controls for consideration while modeling choice. Consequently, the estimates for the impact of independent variables at each stage will be unconfounded with their effects on earlier stages.

Maximizing L^* using standard maximization techniques will yield estimates for: (*a*) β_{0r}, β_{0c}, and β_{0ch}, the intercept terms in the retrieval, consideration, and choice stages, respectively, and (*b*) vectors β_r, β_c, and β_{ch}, the impact of the hypothesized variables ($\mathbf{X}_{ri}$, $\mathbf{X}_{ci}$, and $\mathbf{X}_{chi}$) on the retrieval, consideration, and choice stages, respectively. Interpretation of the estimates is similar to the standard logit analysis. For instance, a significant positive coefficient in β_r implies that the corresponding independent variable is associated with an increase in the likelihood of the focal brand being retrieved. As in standard logit analyses, we test the significance of a set of k independent variables with a likelihood-ratio (LR) test. The LR test is analogous to the F-test in the analysis of variance or multiple regression and involves computing an LR statistic. First, the model is estimated with and without constraining the impact of the set of k independent variables to zero. Then, denoting the corresponding log-likelihood values by L_1 and L_2, the statistic is computed as $2(L_2 - L_1)$ and is chi-square distributed with k degrees of freedom (Greene 1990).

METHOD

Overview

In the main experiment, subjects were exposed to brand names for 18 hypothetical, good-tasting, low-calorie chocolate bars. Following Kardes and Gurumurthy (1992), brand order of entry into this new market was simulated by presenting brand names sequentially over a two-week period. The pioneering brand was intro-

duced in session 1. One week later, brand names for six followers were presented. One week after session 2, brand names for 11 additional followers were presented. One week after session 3, brand retrieval, brand consideration, and brand choice were assessed.

Pretests

Pretests were conducted to facilitate the construction of a list of novel and provocative brand names for a new chocolate bar. Novel brand names were used in the main experiment to control for familiarity and prior knowledge effects on consideration sets and choice. In the first pretest, 48 undergraduates were asked to generate as many different new brand names as possible that met the following criteria: the name must be brief, easy to pronounce, and dissimilar to the brand names of existing chocolate bars. Seventy-eight brand names were generated.

In the second pretest, an independent sample of 48 undergraduates were asked to evaluate the 78 brand names generated in the first pretest. Of these 78 brand names, 21 were preferred by two or more subjects. One of the final 21 brand names was eliminated because it was too similar to an existing brand name in a different product category, and two were eliminated because they were single-syllable names (most of the names in the final list were two-syllable names). The following 18 brand names were used in the main experiment: Indulge, Topnut, Delight, Escape, Always, Crimson, E. Z. Eat, Fifth Street, Go For It, Indeed, Just 4 U, Munchy, Rapper, Sassy, Tasty, Timely, Try Me, and Ultimate.

The most preferred brand name, Indulge, was endorsed by 10 of the 48 pretest subjects. To provide a conservative test of the hypotheses, this name was not used to represent the pioneering brand in the main experiment. The following two-syllable brand names were randomly selected to represent the pioneering brand: Topnut (preferred by two pretest subjects), Delight (preferred by four pretest subjects), and Escape (preferred by five pretest subjects). Two-syllable brand names were used for the focal brands. Fourteen of the 18 brand names in the final list were two-syllable brand names.

The Main Experiment

An independent sample of 115 MBA students (55 males, 60 females, ages ranged from 22 to 44 with a median age of 31) participated in the main experiment. Subjects were told that the purpose of the "Product Name Survey" was to assess their reactions to brand names for good-tasting, low-calorie chocolate bars. They were also told that manufacturers' names would not be revealed.

Session 1. In session 1, subjects were told that "one firm has recently developed a new type of candy bar. The R&D Department of this firm has labored intensively for many years and has finally developed a formula for a good-tasting, low-calorie chocolate. Taste tests have shown that consumers are unable to tell the difference between this new chocolate and regular chocolate." They were also told that we were interested in their personal reactions to one possible brand name for this product.

Subjects received a booklet containing one brand name and several questions about their reactions toward this name. The main experiment was run in three different classes, and each class was assigned randomly to one of three pioneering brand conditions (Topnut, $n = 35$; Delight, $n = 40$; Escape, $n = 37$). Three subjects failed to complete all measures for the focal brands and were excluded from the analysis.

No information other than the brand name was provided. To bolster the cover story, subjects were asked to indicate brand name attitudes on a scale ranging from 0 (extremely bad) to 10 (extremely good). They were also asked to assess the likelihood that the product possesses a number of different attributes (i.e., milk chocolate taste, white chocolate taste, dark chocolate taste, nuts, caramel filling, cream filling) on scales ranging from 0 (not at all likely) to 10 (extremely likely). Finally, subjects were asked to indicate brand attitudes on a scale from 0 (extremely bad) to 10 (extremely good).

Session 2. One week later, subjects received an unexpected second booklet with the instructions: "Earlier you participated in a survey about reactions to a name for a new type of good-tasting, low-calorie chocolate bar. The firm that developed this candy bar and several competing firms are now developing many different varieties of candy bars using this new type of chocolate. You will be asked to read several different possible names for these candy bars and to indicate your reactions to these names." Brand name attitudes, brand attitudes, and attribute ratings were assessed.

The booklet contained brand names for six followers (E. Z. Eat, Always, Crimson, Fifth Street, Tasty, Go For It). These names were presented in one of two different random orders (the above order or Fifth Street, Tasty, Always, Go For It, E. Z. Eat, Crimson). Again, no information other than brand names was provided. Subjects were randomly assigned to each order condition. Subjects were asked to complete the same scales used in session 1 for each brand presented in session 2.

Session 3. One week following session 2, subjects received an unexpected third booklet containing brand names for 11 additional followers. The instructions were the same as those used in session 2, and the 11 brand names were presented in one of two different random orders. Subjects were randomly assigned to each order condition. Two of the 11 brand names were focal brand names. That is, subjects who received Topnut in session 1 received Delight and Escape in session 3. Subjects who received Delight in session 1 received Topnut and

Escape in session 3. Subjects who received Escape in session 1 received Topnut and Delight in session 3. The effects of pioneering were assessed by comparing subjects' responses to each focal brand name when it served as the pioneering brand as opposed to a follower brand (i.e., first vs. not first). Hence, within each focal brand condition, the focal brand served either as a pioneer or as a follower, and brand name was held constant. This procedure was employed to control for brand name association effects (Meyers-Levy 1989).

Again, no information other than brand names was provided. Subjects were asked to complete the same scales used in sessions 1 and 2 for each brand name presented in session 3.

Session 4. One week following session 3, subjects received an unexpected fourth booklet containing the main dependent measures. No brand names were mentioned in this booklet. The first page of the booklet was blank except for instructions to "list the names of the chocolate bars that you would be interested in trying. List as many or as few names as you wish."

The number of brands listed (consideration set size) and the brand names listed (consideration set composition) were recorded. Subjects were also asked to choose one most preferred brand. Finally, subjects were asked to list as many brand names as they could recall that were not included in their consideration sets. To test the possibility that measuring consideration set composition first may have produced cues that could facilitate subsequent retrieval, we examined the relationship between number of brands considered and number of brands subsequently retrieved. No relationship was found ($b = 0.083$, $p > .20$). Therefore, measuring consideration set composition first did not produce cues that facilitated subsequent retrieval.

ESTIMATION AND RESULTS

Direct Effects of Pioneering on Brand Retrieval, Consideration, and Choice

The proportion of subjects retrieving, considering, and choosing each focal brand as a function of the pioneering manipulation is presented in Table 1. Note that consideration is contingent on retrieval and choice is contingent on consideration. Thus, the proportions in Table 1 reflect the direct effects of pioneering on each stage while holding previous stages constant and controlling for the effects of pioneering on previous stages. Observe in Table 1, for example, that Topnut was retrieved by 65.7 percent (23 out of 35) of the subjects when it served as the pioneer as opposed to 26.7 percent (20 out of 75) when it served as the follower. In turn, Topnut was considered by 100 percent (all 23) of the subjects when it served as the pioneer as opposed to 85 percent (17 out of 20) when it served as the follower. Finally, while 56.5 percent (13 of the 23) of the subjects who considered Topnut when it served as the pioneer chose Topnut, only 23.5 percent (4 out of 17) of the subjects who considered Topnut when it served as a follower chose Topnut. Similar patterns emerge for Delight and Escape. Thus, each of the focal brands is more likely to be retrieved, considered, and chosen when it is first versus not first.

TABLE 1

PROBABILITY OF INCLUDING A BRAND IN EACH STAGE OF DECISION PROCESS BY ENTRY CONDITION

Focal brand and condition	Stage in the decision process: Retrieval, *R*	Consideration, *C* (given *R*)	Choice, *CH* (given *C*)
Topnut:[a]			
Pioneer ($n = 35$)	.657	1.000	.565
Follower ($n = 75$)	.267	.850	.235
Delight:[b]			
Pioneer ($n = 40$)	.650	.923	.667
Follower ($n = 73$)	.191	.571	.375
Escape:[c]			
Pioneer ($n = 37$)	.702	.961	.680
Follower ($n = 77$)	.103	.625	.200
Indulge:			
Follower ($n = 114$)	.184	.667	.357

[a]Topnut is more likely to be retrieved when it is first (.657) vs. not first (.267); Topnut is more likely to be considered (given retrieval) when it is first (1.000) vs. not first (.850); Topnut is more likely to be chosen (given consideration) when it is first (.565) vs. not first (.235).

[b]Delight exhibited similar patterns, at each stage, as those observed for Topnut.

[c]Escape exhibited similar patterns, at each stage, as those observed for Topnut and Delight.

Table 1 also presents the proportion of subjects retrieving, considering, and choosing Indulge, the brand that was preferred most in the pretest. The results for Indulge provide a useful reference point for comparing the performance of the pioneer to the performance of another strong brand. Consistent with the pretest results, Indulge outperformed all 14 nonfocal brands on each stage of the decision process. Moreover, as Table 1 indicates, Indulge performed similarly to the focal brands when they served as followers in the retrieval ($z = 0.067$, NS), consideration ($z = 0.38$, NS), and choice ($z = -0.61$, NS) stages. By contrast, even though the pretest results indicate that Indulge was the most preferred brand, the pioneering brand outperformed Indulge in the retrieval ($z = 7.39$, $p < .0001$), consideration ($z = 3.89$, $p < .0001$), and choice ($z = 1.97$, $p < .05$) stages. Regardless of which focal brand served as the pioneer, the pioneer outperformed Indulge at each stage of the decision process.

Results from the Sequential Logit Model Estimation

Table 2 presents the results from the estimation of the sequential logit model from Equation 3. A likelihood-ratio test reveals that the independent variables

TABLE 2

ESTIMATION RESULTS FOR SEQUENTIAL LOGIT MODEL

Independent variables (IVs)	Stage in the decision process		
	Retrieval	Consideration[a]	Choice[b]
Constant	−5.769***	−4.888*	−.603
Pioneer	3.065***	4.025**	1.279*
Brand name	.062	.524*	−.181
Brand attitude	.181*	.107	.344**
NUMRET	.614***	−.530*	.102
NUMC[c]	. . .	1.283**	−.653*
Topnut[d]	.681	3.874*	−.358
Delight[d]	.181	−.663	.464
Log-likelihood under no effect of IVs for this stage	−300.135	−239.895	−233.810
Log-likelihood under no effect of IVs for the entire process	. . .	−332.930	. . .
Overall log-likelihood	. . .	−220.455	. . .

NOTE.—Entries are regression estimates.
[a]Consideration contingent on retrieval.
[b]Choice contingent on consideration.
[c]Note that consideration set size (NUMC) is not relevant for retrieval.
[d]Dummy variables for brands using Escape as the base.
*$p < .05$.
**$p < .01$.
***$p < .0001$.

collectively explain a significant portion of the variance in the retrieval-consideration-choice process structure presented in Figure 1 ($\chi^2 = 224.95$, $df = 20$, $p < .0001$). Findings for each stage follow.

Retrieval Stage. A likelihood-ratio test suggests that the hypothesized independent variables capture a significant portion of the variance in the pattern of retrieval ($\chi^2 = 159.36$, $df = 6$, $p < .0001$).

Observe in Table 2 that a brand is *more* likely to be retrieved when it serves as a pioneer as opposed to being a follower ($b = 3.065$, $p < .0001$). This result was observed regardless of which focal brand served as the pioneer. Thus, Hypothesis 1 is supported. In addition, brand attitude has a significant positive effect on the likelihood of retrieval ($b = 0.181$, $p < .05$). Thus, subjects who had a more favorable attitude toward a focal brand were more likely to retrieve the brand. Finally, the likelihood of the focal brand being among the retrieved brands is higher when more brands are retrieved ($b = 0.614$, $p < .0001$).

Consideration Stage. As discussed in the model development section, the sequential logit model framework in Equation 3 models consideration of a brand while explicitly controlling for retrieval. A likelihood-ratio test suggests that the hypothesized independent variables explain a significant portion of the variance in pattern of consideration ($\chi^2 = 38.88$, $df = 7$, $p < .0001$).

As Table 2 indicates, regardless of which focal brand served as the pioneer, a brand is *more* likely to be considered if it served as a pioneer as opposed to being a follower ($b = 4.025$, $p < .01$). Hence, Hypothesis 2 is supported. While brand attitude did not appear to significantly affect consideration, brand name has a significant positive effect on the likelihood of consideration ($b = 0.524$, $p < .05$). Thus, subjects who liked the name of the focal brand more, were more likely to consider the focal brand. In addition, effects of retrieval and consideration set sizes are observed. Specifically, as more brands were retrieved, the likelihood of the focal brand being considered decreased ($b = -0.530$, $p < .05$), and as more brands were considered, the likelihood of the focal brand being considered increased ($b = 1.283$, $p < .01$). Finally, Topnut was more likely to be considered than Escape ($b = 3.874$, $p < .05$).

Choice Stage. A likelihood-ratio test reveals that the hypothesized independent variables capture a significant portion of the variance in pattern of choice ($\chi^2 = 26.71$, $df = 7$, $p < .0001$).

Support for Hypothesis 3 emerges from the finding that a brand is *more* likely to be chosen if it serves as a pioneer as opposed to being a follower ($b = 1.279$, $p < .05$). Again, this result was observed regardless of which focal brand served as the pioneer and while explicitly controlling for consideration. In addition, brand attitude has a significant positive effect on the likelihood of choice ($b = 0.344$, $p < .01$). Thus, subjects who had a more favorable brand attitude were more likely to choose the focal brand. Finally, as more brands were considered, the likelihood of the focal brand being chosen decreased ($b = -0.653$, $p < .05$).

Predictive Performance. While the likelihood-ratio tests provide evidence for the descriptive performance of the model structure, it is also important to assess the

predictive ability of the model. Consequently, using estimates from the sequential logit model, a discriminant (classification) exercise was performed and the proportion of correct predictions in each stage noted. The results of the predictive exercise are presented in Table 3. Observe that the proportions of correct classifications in the retrieval, consideration, and choice stages are 83 percent, 89.7 percent, and 73.5 percent. Further, in every stage, the proportion of correct classification exceeds both the proportional chance criterion (C_{pro}) and the maximum chance criterion (C_{max})—two benchmarks advocated by Morrison (1969) to assess predictive performance in such classification exercises. These findings provide support for the predictive power of the model specification.

TABLE 3

INDICES OF PREDICTIVE PERFORMANCE OF SEQUENTIAL LOGIT MODEL

	Stage in the decision process		
Predictive index	Retrieval	Consideration	Choice
False positive (%)	18.75	8.33	27.12
False negative (%)	16.18	33.33	25.58
Proportion correct (%)	83.09	89.74	73.53
Comparative benchmarks:			
Proportional chance criterion, C_{pro} (%)	54.67	77.65	50.17
Maximum chance criterion, C_{max} (%)	65.28	87.20	52.94

Indirect Effects of Pioneering on Brand Retrieval, Consideration, and Choice

The above analyses have explicitly controlled for retrieval while analyzing consideration and have explicitly controlled for consideration while analyzing choice. Consequently, the effects of pioneering on consideration and choice is not confounded with its effects on earlier stages. In this section, we illustrate, using Topnut as an example, the nature of the confounds in the impact of pioneering on each stage if the analysis fails to control for previous stages. At the consideration stage, we would conclude that Topnut was considered by 65.7 percent (23 out of 35) of *all* subjects when it served as a pioneer versus only 22.7 percent (17 out of 75) of *all* subjects when it served as a follower. This yields an "effect size" of 0.43 (=0.657 − 0.227) due to pioneering. However, this value confounds the effect of pioneering on consideration with its impact on retrieval. Observe in Table 1 that the true "effect size" due to pioneering while explicitly controlling for retrieval is 0.15 (=1.00 − 0.85). Thus, for Topnut, failure to control for retrieval at the consideration stage leads to a significant *overestimation* of the impact of pioneering.

At the choice stage, if consideration is not held constant, we would conclude that Topnut was chosen by 37 percent (13 out of 35) of all subjects when it served as the pioneer versus 5.3 percent (4 out of 75) when it served as a follower. Compare the implied (and confounded) "effect size" of 0.316 (=0.37 − 0.053) due to pioneering with its unconfounded value (see Table 1) of 0.33 (=0.565 − 0.235). Thus, for Topnut, failure to control for consideration at the choice stage leads to an *underestimation* of the impact of pioneering. Similar results emerge for Delight and Escape. Neglecting the effects of pioneering on previous stages results in the confounding of direct and indirect effects and leads to erroneous theoretical conclusions.

When Are Consideration Sets Likely to Be Used?

Hypothesis 4 proposed that consumers should be likely to form consideration sets to simplify relatively complex choice decisions. By contrast, consumers should be likely to bypass consideration set formation when choice decisions are relatively simple (e.g., when the number of retrieved brands [NUMRET] is small). When NUMRET is small, the consideration set size and, therefore, its composition are likely to resemble the retrieved set size and composition. Thus, the consumer is unlikely to simplify the decision process by reducing the retrieval set to a consideration set and *then* making a choice. Consequently, when NUMRET is small the consideration stage will be bypassed.

To test Hypothesis 4, a median split was performed on the basis of NUMRET to obtain LOW and HIGH subsamples.[1] The characteristics of the two subsamples are as follows:

	LOW NUMRET Subsample	*HIGH NUMRET Subsample*
Range of NUMRET	1–3	4–8
Mean (SD) *NUMRET*	1.53 (1.17)	5.18 (1.11)
n	53	59

[1]Hypothesis 4 proposes that consumers should be more likely to form consideration sets when a large number of brands are retrieved as opposed to when a small number of brands are retrieved. Thus, Hypothesis 4 suggests that the underlying *structure* of the decision process is *qualitatively* different in each of the two regimes—one specified by a large number of brands retrieved and the other specified by a small number of brands retrieved. A median split was judged as an appropriate mechanism of deriving the two regimes. In general, however, we recognize that the boundary between the two regimes is not necessarily well specified and could be individual specific. In order to implement such an individual level distinction, however, we need a measure of the number of stages in the decision process, at the individual level. Using concurrent verbal protocols might be one way to get at the number of stages in the decision process at the individual level. Such regime-related structural differences have been examined as "switching regressions" in the econometrics literature (see Maddala 1983). However, the underlying processes examined in the switching regressions literature involve only single linear regression models and not *multistage* decision models. Deriving switching-regression-type models in the context of multistage decision models is beyond the scope of this paper and promises to be an interesting challenge.

TABLE 4

ESTIMATION RESULTS FOR SEQUENTIAL LOGIT MODEL (LOW NUMRET SUBSAMPLE; $N = 53$)

Independent variables (IVs)	Stage in the decision process		
	Retrieval	Consideration[a]	Choice[b]
Constant	−3.828***	−2.867	.527
Pioneer	1.509**	1.482	2.763*
Brand name	.058	.296	−.238
Brand attitude	.202	.525	.395
NUMC[c]	. . .	−1.022	−2.311*
Topnut[d]	.697	3.256	1.991
Delight[d]	.207	1.866	1.408
Log-likelihood under no effect of IVs for this stage	−102.400	−97.919	−99.572
Log-likelihood under no effect of IVs for the entire process	. . .	−113.367	. . .
Overall log-likelihood	. . .	−93.262	. . .

NOTE.—Entries are regression estimates.
[a]Consideration contingent on retrieval.
[b]Choice contingent on consideration.
[c]Note that consideration set size (NUMC) is not relevant for retrieval.
[d]Dummy variables for brands using Escape as the base.
*$p < .05$.
**$p < .01$.
***$p < .0001$.

TABLE 5

ESTIMATION RESULTS FOR SEQUENTIAL LOGIT MODEL (HIGH NUMRET SUBSAMPLE; $N = 59$)

Independent variables (IVs)	Stage in the decision process		
	Retrieval	Consideration[a]	Choice[b]
Constant	−2.383**	−8.485*	−2.032
Pioneer	4.544***	5.954**	1.611*
Brand name	.016	.616	−.151
Brand attitude	.137	−.092	.388**
NUMC[c]	. . .	1.751**	−.195
Topnut[d]	.594	4.292	−1.022
Delight[d]	.354	−1.625	.351
Log-likelihood under no effect of IVs for this stage	−174.681	−142.689	−134.867
Log-likelihood under no effect of IVs for the entire process	. . .	−205.661	. . .
Overall log-likelihood	. . .	−123.288	. . .

NOTE.—Entries are regression estimates.
[a]Consideration contingent on retrieval.
[b]Choice contingent on consideration.
[c]Note that consideration set size (NUMC) is not relevant for retrieval.
[d]Dummy variables for brands using Escape as the base.
*$p < .05$.
**$p < .01$.
***$p < .0001$.

Subsequently, the three-stage model was estimated for each subsample. Following are the findings from the results presented in Tables 4 and 5.

Low NUMRET Subsample. Note from Table 4 that a likelihood-ratio test reveals that overall the independent variables explain a significant portion of the variance in the retrieval-consideration-choice process structure ($\chi^2 = 40.21$, $df = 17$, $p < .0001$). However, while likelihood-ratio tests suggest that the hypothesized independent variables explain significant variation in retrieval ($\chi^2 = 18.276$, $df = 5$, $p < .01$) and choice ($\chi^2 = 12.62$, $df = 6$, $p < .05$), the hypothesized variables do not have an impact on consideration ($\chi^2 = 9.314$, $df = 6$, $p = .16$). In addition, none of the independent variables seem to have an impact on the consideration stage and thus do not improve the fit. Further, the predicted probability of considering a focal brand, given retrieval, was found to be .984. Thus, in cases of small retrieval sets, the most parsimonious specification of the process involves only two stages—a retrieval stage followed by a choice stage.

In addition, (1) pioneer brands are more likely to be retrieved and chosen, and (2) the likelihood of the focal brand being chosen decreases as the consideration set size increases.

High NUMRET Subsample. Observe in Table 5 that a likelihood-ratio test reveals that overall the independent variables explain a significant portion of the variance in the retrieval-consideration-choice process structure ($\chi^2 = 164.746$, $df = 17$, $p < .0001$). Further, the independent variables explain significant variation at each stage of the process ($\chi^2 = 102.786$, $df = 5$, $p < .0001$; $\chi^2 = 38.802$, $df = 6$, $p < .0001$; and $\chi^2 = 23.158$, $df = 6$, $p < .01$ at the retrieval, consideration, and choice stages, respectively). Thus, all three stages are important in the specification of the process. Consequently, in cases when the retrieval set is large, a simplification procedure seems to be operating, where the consumer reduces the complexity of the decision process by utilizing a consideration set which then forms the set of relevant brands for making a choice.

In addition, (1) pioneering brands are more likely to be retrieved, considered, and chosen, (2) the likelihood of the focal brand being included in the consideration set increases as the consideration set size increases, and (3) unlike in the Low NUMRET case, brand attitude has a significant effect and serves to increase the likelihood of the focal brand being chosen. Thus, in cases where the retrieval set is large and the consideration set has more than a few brands, a brand-related variable serves to isolate the most preferred and, therefore, the chosen brand.

Additional evidence for the role of NUMRET in the number of stages emerges from an examination of the likelihood of consideration as a function of NUMRET treated continuously. From the results of the estimation of the sequential logit model presented in Table 2, we

computed the mean likelihood of consideration as a function of NUMRET. The results indicate that, as NUMRET increases, the likelihood of considering a focal brand decreases. For instance, when two brands are retrieved, the predicted likelihood of considering a focal brand is 0.989. Thus, in such conditions, if the focal brand is retrieved, it will most likely be considered and the consideration stage is redundant. When five brands are retrieved, the mean likelihood is 0.90. Finally, when eight brands are retrieved the mean likelihood of consideration is 0.79. In such conditions, the consideration stage clearly serves as a filtering mechanism and is therefore a necessary stage in the decision process. Considered together, these findings provide consistent support for Hypothesis 4. Moreover, the impact of pioneering was significant in all relevant stages of the decision process.

DISCUSSION

The present study attempted to integrate recent research on the pioneering advantage and consumer choice by mapping the effects of pioneering on each stage of the decision process. We also developed and tested a sequential logit model for analyzing consumer choice. The model is useful for isolating the effects of an independent variable on each stage of the consumer decision process. To illustrate the model, we conducted a within-subjects longitudinal experiment designed to simulate brand order of entry into a new market. Hypothetical brands and a hypothetical market were used to control for prior knowledge effects. The results revealed that when three stages are involved in the decision process—brand retrieval, brand consideration, and brand choice—the pioneering brand outperforms followers at each of the three relevant stages. Similarly, when only two stages are involved in the decision process—brand retrieval and brand choice—the pioneering brand outperforms followers at each of the two relevant stages.

The sequential logit model is also useful for determining the number of stages involved in the decision process. In our study, three stages were used when decision complexity was high, and two stages were used when decision complexity was low. Theoretically, it is possible for decision complexity to be higher or lower than the levels employed in the present study. When decision complexity is extremely high, consumers may use more than three stages (Shocker et al. 1991). Conversely, when decision complexity is extremely low, consumers may use only a single stage (brand selection). The sequential logit model should prove to be useful for addressing this issue empirically.

Prior research on psychological processes that contribute to the pioneering advantage has focused on brand evaluation processes (Carpenter and Nakomoto 1989; Kardes and Gurumurthy 1992). However, recent research has shown that brand choice can be influenced without altering brand evaluations (Nedungadi 1990). Consistent with Nedungadi's analysis, the results of the present study indicate that brand retrieval and brand consideration produce effects on brand choice that are independent of the effects of brand attitude on brand choice. Moreover, the pioneering brand outperformed followers in each stage of the decision process. The pioneer was more likely to be retrieved, considered, and chosen even when indirect effects were controlled. Together, the effects of pioneering on brand retrieval, brand consideration, and brand choice produce a remarkably robust pioneering advantage.

In our view, it is not surprising that many processes appear to contribute to the pioneering advantage. Most robust phenomena are multiply mediated. Preference evolution (Carpenter and Nakamoto 1989), information integration (Kardes and Gurumurthy 1992), brand accessibility (Nedungadi 1990), and evaluation-cost trade-off (Hauser and Wernerfelt 1990) processes all play an important role in the pioneering advantage. Pioneering brands serve as standards of comparison (Carpenter and Nakamoto 1989), are evaluated extremely and confidently (Kardes and Gurumurthy 1992), are likely to be retrieved from memory, and are likely to be included in consumers' consideration sets. Consequently, pioneering brands often dominate later entrants. Recent research shows that it is possible for followers to overcome the pioneering advantage, but this is not easy (Carpenter and Nakamoto 1990).

One limitation of the present study is that subjects were exposed to a series of hypothetical brands presented sequentially over a relatively brief time frame (three weeks) to simulate brand order of entry into a new market. Like all simulation studies, several features of this study were designed to map onto features present in natural settings. However, a perfect mapping is not possible. Hence, future research should examine the extent to which the results of the present investigation generalize to nonhypothetical brand names, longer time frames, nonhypothetical markets, and other product categories.

The present research attempted to integrate a psychological approach toward understanding pioneering and choice with a cognitive economics approach. Initially, the two approaches appear to be inconsistent. For example, the evaluation cost model emphasizes a complex cognitive economic analysis of the benefits and costs of including a brand in the consideration set. In contrast, psychological research shows that relatively effortless consumer judgment and decision-making processes are commonly observed (for reviews, see Alba, Hutchinson, and Lynch 1990; Bettman, Johnson, and Payne 1990; Cohen and Chakravarti 1990).

How can this apparent inconsistency be resolved? Cognitive economic models focus on the pattern of responses produced by a judgmental process, whereas procedural models focus on the judgmental process itself. For example, Lopes (1987) has shown that the re-

lationship between averaging as an algebraic phenomenon (Anderson 1981) and averaging as a procedural phenomenon lies in the directional nature of the anchoring-and-adjustment process (Hoch and Deighton 1989; Kahneman and Snell 1990). Quantitatively, there may be no simple relationship between algebraic and procedural rules. Qualitatively, cognitive operations that produce responses lying between old responses and new information are averaging procedures.

We suggest that Lopes's (1987) analysis can be extended to other types of quantitative models and other types of procedural models. For example, in the present case, the overall pattern of responses across consumers may conform to Hauser and Wernerfelt's (1990) economic model. However, for an individual consumer, the threshold for including a brand in the consideration set may be produced by a relatively effortless intuitive process (Bowers et al. 1990). Quantitative models are mathematically parsimonious, but this parsimony suggests a degree of judgmental homogeneity that may not exist in nature (Lopes 1987). Procedural models can account for judgmental heterogeneity but neglect quantitative regularities in data (Lopes 1987). Both types of models are needed to provide a clearer understanding of consumer judgment and decision making.

Integrating experimental psychological and econometric approaches is extremely useful. In the present study, we conducted a simulation experiment that provided rich psychological-process-level data and performed an econometric analysis of this data. This integrative approach enabled us to develop a procedural model of some specific psychological mechanisms underlying consumer choice and a quantitative model that captures global mathematical regularities relevant to consumer choice. We hope that this investigation will stimulate additional integrative research that will lead to a deeper understanding of judgmental processes and outcomes.

APPENDIX

In this section we derive the likelihood function for the multistage sequential decision process presented in Figure 1. Because the three dependent variables are discrete in nature, the logit model framework serves as an appropriate framework for analysis (Greene 1990).

Logit Model Underpinnings

Consider that for every individual i, $i = 1, 2, \ldots, N$, we observe a discrete variable Y_i. Only two outcome conditions are possible:

$$\textit{Outcome 1: } Y_i = 1.$$

$$\textit{Outcome 2: } Y_i = 0.$$

Let $\mathbf{X}_i$ represent the vector of independent variables for the ith individual that are hypothesized to be related to the pattern of Y_i. The logit model uses as its estimation basis the following equations:

$$\text{Prob. of outcome 1} = \text{Prob}\,[Y_i = 1] = L(\beta_0 + \mathbf{X}_i'\beta), \tag{A1}$$

$$\text{Prob. of outcome 2} = \text{Prob}\,[Y_i = 0] = 1 - L(\beta_0 + \mathbf{X}_i'\beta), \tag{A2}$$

$$L(\theta) = \exp(\theta)/[1 + \exp(\theta)]. \tag{A3}$$

$L(.)$ denotes the cumulative density function of the logistic distribution, β_0 represents the intercept term, and β is a vector of parameters that reflect the impact of $\mathbf{X}_i$ on the likelihood of observing one or the other value of Y_i. The log-likelihood function for the sample then uses the following structure:

$$L^* = \Sigma_i \{Y_i \ln [\text{Prob. of outcome 1}] + (1 - Y_i) \ln [\text{Prob. of outcome 2}]\}.$$

Using Equations A1 and A2 we can then write the log-likelihood for a single-stage logit model as:

$$L^* = \Sigma_i \{Y_i \ln [L(\beta_0 + \mathbf{X}_i'\beta)] + (1 - Y_i) \ln [1 - L(\beta_0 + \mathbf{X}_i'\beta)]\}. \tag{A4}$$

Likelihood for the Sequential Logit Model

In the context of the multistage sequential process in Figure 1, we have three discrete dependent variables—retrieval, consideration, and choice. As displayed in Figure 1, only four outcome conditions are possible. Using terms defined in the text, these conditions can be expressed as follows.

Outcome 1: $R_i = 1$, $C_i = 1$, $CH_i = 1$.

Outcome 2: $R_i = 1$, $C_i = 1$, $CH_i = 0$.

Outcome 3: $R_i = 1$, $C_i = 0$, choice not relevant.

Outcome 4: $R_i = 0$, consideration and choice not relevant.

The log-likelihood for the sequential logit model will thus have the following form:

$$L^* = \Sigma_i \{R_i C_i CH_i \ln [\text{Prob. of outcome 1}] + R_i C_i (1 - CH_i) \ln [\text{Prob. of outcome 2}] + R_i (1 - C_i) \ln [\text{Prob. of outcome 3}] + (1 - R_i) \ln [\text{Prob. of outcome 4}]\}, \tag{A5}$$

where

Prob. of outcome 1 = Prob $[R_i = 1, C_i = 1, CH_i = 1]$,

Prob. of outcome 2 = Prob $[R_i = 1, C_i = 1, CH_i = 0]$,

Prob. of outcome 3 = Prob $[R_i = 1, C_i = 0]$,

Prob. of outcome 4 = Prob $[R_i = 0]$.

To derive the explicit form of L^* we first need to derive explicit expressions for each of the above four probabilities.
Let

$$F_1 = L(\beta_{0r} + \mathbf{X}'_{ri}\beta_r), \quad \textbf{(A6)}$$

$$F_2 = L(\beta_{0c} + \mathbf{X}'_{ci}\beta_c), \quad \textbf{(A7)}$$

$$F_3 = L(\beta_{0ch} + \mathbf{X}'_{chi}\beta_{ch}), \quad \textbf{(A8)}$$

where (1) the form of $L(.)$ is given in Equation A3, (2) $\mathbf{X}_{ri}$, $\mathbf{X}_{ci}$, and $\mathbf{X}_{chi}$ are as defined in the text, (3) β_{0r}, β_{0c}, and β_{0ch} denote the intercept terms in the retrieval, consideration, and choice stages, and (4) β_r, β_c, and β_{ch} are vectors denoting the impact of the hypothesized variables ($\mathbf{X}_{ri}$, $\mathbf{X}_{ci}$, and $\mathbf{X}_{chi}$) on the retrieval, consideration, and choice stages, respectively.

Because the decision process is sequential in nature we can (Maddala 1983), using the form of Equations A1, A2, and A6–A8, write the following expressions for the probability of observing each of the four outcomes:

Prob. of outcome 1

$$= \text{Prob}\,[R_i = 1]\ \text{Prob}\,[C_i = 1]\ \text{Prob}\,[CH_i = 1] \quad \textbf{(A9)}$$

$$= F_1F_2F_3,$$

Prob. of outcome 2

$$= \text{Prob}\,[R_i = 1]\ \text{Prob}\,[C_i = 1]\ \text{Prob}\,[CH_i = 0] \quad \textbf{(A10)}$$

$$= F_1F_2(1 - F_3),$$

Prob. of outcome 3

$$= \text{Prob}\,[R_i = 1]\ \text{Prob}\,[C_i = 0] \quad \textbf{(A11)}$$

$$= F_1(1 - F_2),$$

Prob. of outcome 4

$$= \text{Prob}\,[R_i = 0] \quad \textbf{(A12)}$$

$$= 1 - F_1.$$

Substituting from Equations A9–A12 for each of the four probabilities in Equation A5, L^* can be specified in terms of population parameters as

$$\begin{aligned} L^* = \Sigma_i \{ & R_iC_iCH_i \ln [F_1F_2F_3] \\ & + R_iC_i(1 - CH_i) \ln [F_1F_2(1 - F_3)] \\ & + R_i(1 - C_i) \ln [F_1(1 - F_2)] \\ & + (1 - R_i) \ln [1 - F_1]\}. \end{aligned} \quad \textbf{(A13)}$$

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