Are food choices really habitual?

Integrating habits, variety seeking and compensatory choice in a utility maximizing framework

by

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Abstract

Given the large number of choices that consumers make each day it seems likely that they will often adopt decision strategies that minimize cognitive effort, particularly with low price products (such as most items found in a supermarket). One such strategy may be to simply choose what has been chosen in the past, i.e. to fall into a pattern of habitual choices or decisions. In contrast, there may be preferences for variety in markets for low price, highly differentiated goods. We develop a conceptual and empirical model of habitual choice, and the factors that result in transitions to two strategies other than habitual selection, to wit, utility maximizing choice among available alternatives and a variety seeking strategy. The empirical approach we employ provides a mechanism for the examination of panel data that avoids the state dependence issues present in most applications to these types of data. We apply this framework to the choice of two food products that illustrate the heterogeneity across types of products in decision strategies and routine choice patterns.

Keywords: Food choices, consumer packaged goods, choice modeling, habitual behavior, variety-seeking, panel data, habits

JEL Codes: D12, D03, C25

Introduction

Consumers make countless decisions every day. In the area of food choices alone, consumers are estimated to make over 200 choice decisions per day (Wansink and Sobel 2007). Given the sheer number of decisions involved across the many facets of people's lives, it seems unlikely that individuals allocate substantial cognitive effort and time to each and every one of them every time they need to make a decision. Decisions regarding small budget items like food choices or selections of consumer packaged goods would seem more likely to be relegated to some form of habitual choice behavior. Heiner (1983), for example, has suggested that uncertainty prevents fully maximizing behavior, leading instead to the development of what he terms "behavioral rules." Empirically, Hamermesh (2005) examines temporally routine behavior in households (as opposed to repeated choice of products) and finds that the extent of such behavior is partially explained by household characteristics such as income and education.

In this paper we investigate patterns of choices of consumer packaged goods over time, with a focus on understanding the relative role of habit, variety seeking and optimizing decision making in explaining observed choices. Note that we define habit as a *process* or *strategy* of choosing the same good in consecutive periods, recognizing that optimization or full evaluation may also generate the choice of the same good in several periods. We therefore differentiate the *strategy* of habitual choice versus full evaluation versus variety seeking, from the *observation* of repetitive outcomes. That is, mere observation of repeated choices by a decision maker does not constitute evidence of any particular strategy: habitual or full evaluation decision strategies, as we define them, can both generate repetitive sequences of different lengths depending upon such factors as the number of products in the market, frequency and intensity of promotional activities and personal characteristics (e.g. shopping frequency).

We begin with a descriptive analysis of choice patterns over a set of goods ranging from snack products and beverages to personal hygiene items. This preliminary analysis results in two major findings or stylized facts. First, pure repetition of choices (successive choice across purchase occasions of the same SKU or stock-keeping unit) is *not* the norm. In our examination of 25 consumer packaged goods, the average likelihood of repetition is at most 55%. Second, there is a large amount of heterogeneity in the degree of repetition over the set of goods. Some products (e.g. milk, margarine and butter) exhibit substantial repetitive choice (around 50%), while others (e.g. toothbrushes, deodorants, cereals) do not display such high repetition rates (less than 20%).

These stylized facts regarding choice patterns then lead us to a more detailed examination of conceptual models of choice and empirical scrutiny of two specific consumer goods. We construct a model that separates consumer decision making strategies into three archetypal states: pure variety-seeking, full information evaluation (specifically, utility maximizing, compensatory decision making) and pure habit. We model a form of two-stage decision making: at a higher level, the consumer determines *how to make a decision*, then the consumer decides *which product to purchase* conditional on the strategy. In the first stage consumers decide whether to make a habitual choice, engage in full evaluation of alternatives, or make a pure variety seeking choice. The choice among strategies is partly based on an individual's forecast of the benefits to be accrued by adopting a particular strategy, and partly on potential processing costs and variety seeking premia. The conditional choice of product in the full evaluation mode is determined by utility maximization.

Our empirical approach avoids the difficulties associated with the use of lagged endogenous variables to model habits and allows us to concentrate on the factors underlying participation in the higher-level decision states. Furthermore, as discussed below, our approach avoids issues associated with state dependence as preference parameters are stable over time but decision strategies are assumed to change.

A number of implications arise from our findings. First, they provide insights for consumer behavior characterization. Most consumer demand analysis is conducted using static, optimizing, full information (i.e. fully evaluative) models. Our empirical analysis incorporates temporal aspects of choice but uses a decision strategy framework in which consumers can choose to simply repeat the previous type purchased in order to minimize cognitive effort (habitual behavior), to randomly choose another product than the one last chosen (pure variety-seeking, but with minimum effort), or to conduct a comprehensive re-assessment of all products based on attributes and prices (full evaluation). Thus, the joint selection of strategy and product frames the overarching utility maximization problem. We also illustrate the heterogeneity of patterns of decision strategies over time that can arise from the structure of our model using simulations.

Finally, we show that the proposed approach of modeling potentially habitual decisions as arising from a selection of decision strategy, followed by product choice conditional on this strategy, provides a strong alternative explanation to habit formation based on the phenomenon of state dependence (Heckman 1981). In the literature, state dependence implies that current product utility is impacted by prior choices, leading to an association of additional utility with previously experienced products. In a sense, this is justified from the perspective that consumers learn what they like through experience, and this affects their current behavior over and above the utility generated from product attributes and marketing activity. State dependence implies, therefore, that product utilities evolve over time based on past choice behavior in a way unique to each purchaser, even with the maintained hypothesis of constant tastes for attributes and price.

The remainder of the paper continues as follows. First we review some of the relevant literature. We follow with a description of repeated product choice behavior over a range of consumer packaged goods – stylized facts on repeat purchase behavior. These findings illustrate the heterogeneity in repeated choices over goods. We then develop the conceptual framework in which choice is influenced by attributes and prices as well as decisions states characterized as evaluative, habitual and variety-seeking. We outline the factors affecting the selection of decisions states. In the penultimate section of the paper we report the results of our detailed empirical analysis of product choice and decision states. We conclude with a discussion of the implications of our findings.

Literature Review

The traditional stochastic full information, utility maximizing model of consumer choice (e.g. McFadden 1981) could generate a number of choice patterns depending on the information facing the consumers and the degree to which product availability, attributes, and prices, as well as promotional activities (advertising, in-store displays, placement in weekly supermarket inserts), vary over time. If attributes, prices and promotional activities are constant over time, and consumers are fully informed about these attributes, then one can expect repetition of choice of the same product as a result of individual utility maximization.

Alternately, a changing environment and/or learning may generate choices that vary widely over the range of available products.

On the other hand, consumers may be engaged in routine or habitual choice and repeated choices of the same product may arise because of a simplification heuristic or a cognitive cost minimization strategy. In terms of product choice in categories involving consumer packaged goods, the consumer behavior literature suggests that individuals transition through a pattern of search among goods until a suitable good is found, and then repeatedly purchase this same alternative over time; at some point, however, exogenous shocks may lead to a break from this routine, with a return to search behavior (Howard and Sheth 1971). Alternate models suggest that consumers make decisions regarding choices from certain categories without conscious consideration of the options (Wansink and Sobel 2007).

If consumers are cognitive misers, it is unlikely that they will always invest significant effort into the evaluation or comparison of alternatives. Thus the use of simplifying decision strategies (Heiner 1983), e.g. a strategy to purchase the same product as the last good purchased, seems a likely course for consumer goods which comprise a small part of the budget and are frequently purchased. Over a period of time, then, it seems to us that a record of purchases made by cognitive misers should show patterns of repeated choices arising from a habitual decision strategy. Hamermesh (2005) constructs a somewhat different rationale for routine in his analysis of temporal patterns of production/consumption. He suggests that there are preferences for variety. However, routine is "productive" because it reduces planning costs and thus creating variety is relatively costly. This can be interpreted, however, as non-routine purchases involving some elevated cognitive cost.

As a counterpoint to this notion, it may be that if consumers are motivated by a need, or preference, for variety (Hamermesh 2005, Gronau and Hamermesh 2008), the pattern of purchases will be characterized by selections away from a current brand or type. The opposite of pure habit, e.g., selection of anything but what was chosen last, may therefore appear in choice patterns. Consumers may recognize that the "costs" associated with the choice of a brand or product that they do not enjoy is relatively small, since a different product can be chosen with little impact on the budget or on subsequent satisfaction with consumption. If products are purchased frequently (e.g. yogurt) then the new product will replace the old one in a relatively short period of time. A pattern of wide-ranging choices may thus arise which would correspond to an outcome expected from variety-seeking or search for a new favorite product.

We expect that different types of food products or consumer packaged goods will generate different mixtures of the alternative strategy states. Furthermore, literature on routine decisions and repetitive choice suggests that demographic characteristics influence the degree of repetition or variety-seeking (Verplanken et al. 2005; Weiss 2010). As mentioned above, Hamermesh (2005) provides similar insights for time use variety and routines. This literature suggests that separating choice behavior into two stages – first "how" to choose and then "what to choose" – may provide an avenue for representing movements between low effort habitual choice, fully evaluative choice, and variety seeking.

Our approach of separating the consumer's decision process into two stages has been employed in other contexts. Ching et al (2009) construct a two stage "price consideration" model of choice. In their model consumers first decide whether they will consider purchasing a product in a category or not. Only if they consider the category will they investigate prices and other attributes. The first stage decision is affected by the inventory of the good, demographic factors, and signals like advertisements. This model outperforms standard models like the conditional logit model or a model that includes state dependence (lagged choice as an explanatory variable). This model, however, is based on a structure of decision time periods and includes “no purchase” decisions. The key insight in Ching et al is that consumers may use heuristics to screen whether or not to investigate a product category in detail. We share with the Ching et al model the notion that consumers are cognitive misers and will reduce their cognitive burden by simplifying the decision process. However, other than this similarity and the fact that Ching et al is a two stage model, our approaches are quite different.

A number of other two stage models have been employed in the literature, often to approximate choice set formation. Gilbride and Allenby (2004) for example construct a model in which consumers first screen alternatives and then choose based on the smaller set. Ding et al (2009) provide a review of such practices and list a large number of papers using this approach to choice set formation. In contrast our two stages correspond to “how to choose” (strategy), then “what to choose,” holding the choice set fixed. Note, however, that the habit strategy renders the choice set issue moot, opening an interesting avenue for future research on choice set formation.

Most conceptual and empirical models of repetitive behaviors, routine choices or habits employ intertemporal models that include the potential for habits or variety-seeking (e.g. Chintagunta 1993; Swait et al. 2004, Siddhartha et al. 2004; Arnade et al. 2008). These models are not usually formulated to explain the choice of habitual decision making as a “strategy;”

rather, they attempt to incorporate intertemporal utility effects into empirical models of disaggregate choice. An alternative formulation is to specify deviations from habit as being costly (because of increased costs of evaluation or efficiencies associated with routines), but also potentially allowing for utility arising from variety itself (Hamermesh 2005). This second perspective suggests that variety and habit may provide utility directly, relative to full evaluation, regardless of the choices of products made. It also suggests that a "higher level" of utility maximization is employed in evaluating whether a habitual or variety seeking strategy is chosen.

In another strand of the literature there is evidence that consumers (and decision makers in general) employ dual-process mechanisms (Kahneman and Frederick 2002). Type 1 processing is based on simple heuristics or rules influenced by the choice environment and past behavior or choice. Such processing is also typically characterized as rapid and nearly unconscious (Evans 2003). Type 2 processing takes longer and may involve more careful evaluation of objects and outcomes. Purely habitual choice is more closely aligned with Type 1 processing, as are other processes involving little evaluation – e.g., random choice from a subset of goods (i.e. random choice from a choice set), or choosing anything except what was chosen last time (perhaps to satisfy an inherent need for variety). Type 2 processing, on the other hand, is more likely to be associated with more complex decision modes, such as fully informed optimization over the available goods. The conceptual model we develop below is based on this notion of switching between strategies or decision-making styles.

By modeling habits and variety seeking we are effectively constructing a dynamic consumer choice model. Models of dynamic choice have long espoused that decisions of the type being examined here can exhibit what is termed state dependence (Heckman 1981), wherein current utility for an alternative is dependent upon past choices. While many forms of representing this phenomenon are possible and have been examined in several literatures, in its most basic form the representation of state dependence is accomplished by the inclusion of lagged choices (directly or in exponentially smoothed functions) and/or attributes in the utility function (e.g. Heckman 1981; Guadagni and Little 1983; Keane 1997, Lee 1997; Swait et al. 2004). These lagged choices essentially modify current utility by boosting the attractiveness of previously chosen alternatives, in effect creating a repetition premium. In formulations with a single-period lag this premium can be large but somewhat contained by the shortness of the lag period, but if multi-period lags (e.g. distributed lags, cumulative shares, smoothed loyalty measures) are used this premium can grow larger and larger, and arguably, eventually insurmountable by other (say, attribute-based) sources of utility after a certain point in the decision sequence. To address this effect some approaches used in the literature dampen the effects of these lags (e.g. Guagdani and Little (1983)); however it is not uncommon that the lag effect dominates the choice dynamics.

Given this background on models that attempt to incorporate habits, variety seeking and strategies, we now turn to an investigation of stylized facts on consumer packaged goods choice and then present our conceptual model.

Stylized Facts on Repetitive Choice in Consumer Packaged Goods

We begin our investigation by examining the degree to which consumers repeat immediately prior choice decisions at the SKU (stock-keeping unit) level. We use scanner panel data for the United States sourced from Information Resources, Inc., to examine purchases over time. These data are described in Bronnenberg et al. (2008).[i] We employ five years of data corresponding to the period January 1, 2001 through December 25, 2005.

Figure 1 presents the average percent of repeated choices between two sequential purchase occasions, over a large number of households and a wide range of consumer packaged goods. Clearly there is significant variation in the degree of repetition over these goods. For some goods repetition is relatively high, with approximately half of the purchase occasions involving repeated SKU selection. Surprisingly perhaps, for many other products that one might *a priori* believe would have high incidence of repeated selections, there is relatively little repetition on average. Personal care products, for example, reflect relatively little repetition, as do cereals and shampoos.

--- Figure 1 about here ---

This heterogeneity in repeated SKU purchase raises questions about the possible causes associated with this behavior. Or to turn the issue around, what gives rise to the need for more frequent, more rational and more cognitively intensive decision making in certain of these product categories? Economics has suggested that rule development is an optimal response to choice environment complexity (e.g. Heiner 1983, Hamermesh 2005). On the other hand, the consumer behavior (CB) literature has suggested that repeated consumption of the same product can lead to feelings of monotony, boredom and satiation (Menon and Kahn 1995). Gronau and Hamermesh (2008) outline the potential economic welfare enhancing aspects of variety. The inner desire to maintain an optimal stimulation level (OSL) has been shown in the CB literature to be a self-generated source for wanting change (McAlister and Pessemier 1982). In addition, exogenous stimuli (e.g. novelty, environmental change and complexity, uncertainty, conflict, advertising, word-of-mouth, group affiliations – Howard and Sheth 1969, McAlister and Pessemier 1982) also contribute to the consumer's desire to not simply repeat a past behavior. This desire for change activates some form and intensity of variety-seeking behavior, which covers a plethora of decision strategies ranging from the cognitively simple (e.g. random choice of anything except the prior choice) to the cognitively complex (e.g. full information, utility maximizing choice).

Since these data reflect choices at a household level, it is plausible that household characteristics might affect the repeated buying of the same SKU on sequential purchase occasions, as well as the converse. For example, in certain product categories (e.g. those that have a variation in flavors – yogurts, salty snacks, frozen pizzas) the multiplicity of needs within a household might lead to the purchase of varieties of SKUs. The consumer behavior literature (see the informative review in McAlister and Pessemier 1982; also Verplanken et al. 2005) has identified a number of socio-demographics which are associated with repeated buying: e.g., higher income and/or education are often associated with higher need for variety, larger households (particularly with children) tend to repeat less, buyer age is correlated with greater repetition, television watching can lead to a greater variety in shopping outcomes, and so forth.

The literature and these stylized facts raise a number of questions about consumer choice and the simple sequential repetition of purchases of the same product. Is the degree of repetition a function of the characteristics of the good or of the category of the good? For example, in some categories there may not be many SKUs or brands, *ceteris paribus* making repeat purchase more likely. The degree of repetition may depend on other characteristics of the category – firms may be changing the composition of the category by introducing new

SKUs, consumers' need for variety may be higher in some product categories than in others, etc. What is the relative importance of intrinsic versus extrinsic stimuli in explaining sequential purchase repetition and variety-seeking? How much more important is the role of marketing activity in inducing changed behavior in categories with high versus low rates of repetition? We attempt to integrate these observations into a coherent modeling framework in the next section, to address such questions.

Conceptual Model

Consider a consumer who must periodically purchase a consumer packaged good. On a given purchase occasion, the consumer can choose between three archetypal strategies: (a) pure habit (choosing exactly the same SKU as on the previous purchase occasion), (b) pure variety-seeking (choosing at random anything other than the product SKU previously purchased) or (c) full evaluation (utility maximization from the set of all SKUs available). The first two "strategies" do not involve evaluation of attributes and prices and are simple in cognitive burden. The full evaluation option requires effort but in return yields the utility maximizing choice. Both the habit strategy and the full evaluation strategy can yield the choice of the same good – thus both can appear to result in choices being repeated on temporally contiguous shopping trips. In our conceptual framework consumers are assumed to choose between "strategies," then conditional on the outcome of this process, they either make a habitual choice, a pure variety-seeking choice, or fully evaluate the set of options to make their final selection. We describe below the strategy selection stage as resulting from a type of utility maximization process, but this process is geared to provide insight about whether the consumer chooses a simple or complex cognitive process to reach his or her purchase decision.

This allows us to separate the utility of the process (i.e., habitual or variety seeking behavior) from the utility of the good, and to separate repetitive choice into pure habit or fully evaluative decision making.

Let U_E be the utility associated with the full evaluation of the options available. We assume that household h faces a fixed choice set (C_h) of available options, j=1,…,J. In the full evaluation mode the consumer's utility is assumed to take on a random utility form, where U_j is the overall utility from alternative j, arising from the additive combination of a systematic utility V_j and a random component ε_j, thusly: $U_j = V_j + \varepsilon_j$. The systematic utility contains information on attributes and prices that is observable by the researcher, while ε_j contains other components of utility unavailable to the researcher but known to the consumer. Assuming a Type I extreme value distribution for ε_j generates the conditional logit model (Ben-Akiva and Lerman 1985; McFadden 1981). The expected value of the maximum utility from this set of options can therefore be summarized as $ln \sum_{j \in C_h} e^{V_j}$ (Ben-Akiva and Lerman 1985). This expression, commonly referred to as the "logsum" or "inclusive value," gives the expected *maximum* utility from the set of options in full evaluation mode – it is essentially a representation of the evaluation of all options and choice of the most preferred alternative. We argue that the benefit of pursuing the full evaluation strategy is a function of the expected maximum utility; however, for the consumer to make an assessment of this benefit they would actually have to perform the full evaluation. Therefore, as cognitive misers, we propose that in the selection of decision strategy consumers forecast this expectation by the simple mechanism of assuming that the current expectation is identical to the expectation of the maximum utility from their *prior* supermarket visit. Note that in the product categories of interest here, this forecasting mechanism is a reasonable one to use: specific products change infrequently in terms of attributes, though prices can vary within a (usually) limited range; change is more likely to come through the addition or removal of products, events that are quite complex to forecast. Given that full evaluation likely consumes cognitive resources, we thus assume that the utility of the full evaluation strategy takes the form

$$U_E(I_{t-1} - \theta), \quad (1)$$

where $I_{t-1} = ln \sum_{j \in C_{h,t-1}} e^{V_j}$ is the prior visit's (i.e. the (t-1)st) expectation of maximum utility, $C_{h,t-1}$ is the set of alternatives available during the prior visit. θ represents the net effect of the cognitive processing costs of undertaking full evaluation and the utility of knowing that the "best" option is chosen and the market has been fully evaluated. Other quantities are as previously defined.

The "utility" of pure habitual decision making is assumed to simply generate the utility of the product previously chosen, or simply

$$U_H(V_{t-1}). \quad (2)$$

Relative to the expression in equation (1), the utility of the habitual strategy does not include a processing cost because its use requires low cognitive effort, nor does it consider any additional utility for optimal choice or full evaluation.

An alternative to full evaluation or habit is to seek variety or change. A number of representations could be developed for such behavior. One representation is to reflect the utility of variety as a desire for diversity of product choice within the set of available products. Higher utility from higher diversity can be modeled using a measure of entropy or a Shannon diversity index and it can be assumed that the consumer searches over products over time so as to increase entropy or diversity. Maximizing entropy or diversity is achieved when products have equal chance of being chosen. However, this is a fairly complex and cognitively challenging process requiring memory over product consumption. A simplifying heuristic which can approximate this strategy is to choose randomly from all products except the one consumed in the previous period. This strategy provides a sharp contrast to the habit heuristic by employing the consumer's purchase history, albeit only a single period, and by producing a diversity of consumption outcomes which satisfies the notion of the search for variety. In fact, such random search can be considered a very inexpensive search strategy since eventually all options will be evaluated if this strategy dominates. It is myopic in that search is not fully planned (as in Erdem and Keane, 1996) but that seems reasonable for consumer packaged goods. It also is differentiated from full evaluation due to the very parsimonious use of information, needing only the prior choice to be operationalized. Essentially this strategy can be characterized by "I'll try something different from my last purchase" which will eventually lead to maximum entropy or diversity.

Therefore, we model the utility (benefit) of adopting pure variety-seeking as the expected product utility to be derived from the set of options given by the products other than the one chosen in the previous visit. We assume that this process, also a type of simplifying heuristic, is based on choice at random. This is accomplished by assuming that all elements of the choice set C_h have equal utility – denoted as $\widetilde{W}$. This means that the "logsum" expression can be replaced by an expression reflecting constant utility for all alternatives but the last one chosen, plus a constant reflecting the net effect between a "variety premium" and the disutility of knowing that the random choice may generate an undesirable outcome:

$$U_{VS}\left(ln\sum_{j\in C_{h-(t-1)}} e^{\widetilde{W}} \ + \gamma\right) = U_{VS}(\tau + \gamma) \qquad . \qquad (3)$$

C_{h-p} is the choice set of household h *without* the option chosen in the previous period (indicated by the subscript [h-(t-1)]). Since the utilities $\widetilde{W}$ are assumed to be constant for all alternatives, the logsum collapses to a constant – which we denote as τ. Finally, we add a parameter (γ) to reflect the net effect of a variety premium and a risk of generating a poor outcome. Note that this strategy is cognitively "simple" because all alternatives being considered are viewed as having equal utility (i.e. are equally attractive from the variety-seeking perspective) and only knowledge of the previously chosen product is required. In this case our conceptual framework generates two additive constants; thus, we will only be able to identify one overall term that captures the net utility of variety seeking relative to the other decision strategies. Equation 3 is an operational way to specify pure variety seeking – choosing at random from all options except the last one chosen. We do not suggest that consumers actually think that all attributes are equal, rather they are effectively ignoring attribute information and choosing at random. Other, more sophisticated, variety seeking strategies could be postulated including ones that aggregated over brands rather than SKUs, or that involved informed search. However, this representation is at the most fundamental level (SKU) and is most consistent with the notion of consumers minimizing processing resources.

The consumer chooses the decision strategy to employ based on the maximum of {U_E, U_H, U_{VS}}, subject to income and cognitive processing constraints. Conditional on the strategy, the consumer then proceeds to make a product choice using strategy-specific mechanisms. This can be viewed as a decision tree in which U_H and U_{Vs} correspond to Type 1 processing strategies (simple, almost reflexive), while U_E is the full information, compensatory, utility maximization strategy (Type 2 processing). Figure 2 depicts how this decision tree can be used to characterize a sequence of household choices. Framed in terms of the probability of strategy selection, and adding error components to the attractiveness/utility of adopting each strategy option, the probability of making a habitual choice at the t^{th} purchase occasion is therefore

$$Prob(H) = Prob(V_{t-1} + \varepsilon_H \geq max\{ I_{t-1} - \theta + \varepsilon_E , \tau + \gamma + \varepsilon_{VS} \}) \quad . \tag{4}$$

Alternately the decision strategy selection probability can be expressed in terms of the "improvement" over habitual choice:

$$Prob(H) = Prob(\varepsilon_H \geq max\{ (I_{t-1} - V_{t-1}) - \theta + \varepsilon_E , (\tau + \gamma - V_{t-1}) + \varepsilon_{VS} \}). \tag{5}$$

The probabilities of variety-seeking and evaluation are similarly constructed. The representation in equation (5) is the basic model we estimate. The utility of the habitual process is normalized to zero by subtracting the utility of the previously chosen product in the evaluation and variety seeking functions. The parameters that remain reflect the net decision strategy utility of full evaluation and the net decision strategy utility of variety seeking. The parameters of the utilities of the attributes of the alternatives are included in the conditional indirect utility functions V_j and become elements of the decision strategy selection through previous choice utilities. The decision strategy parameters and product attribute parameters are estimated jointly.

Different stochastic assumptions can be made concerning the ε's in (5). In our empirical work we estimate two models of increasing generality. In Model 1 we assume that the ε's are independent and identically distributed (IID) Type I Extreme value (Gumbel) distributed across decision strategies. In addition, we assume that these stochastic quantities are orthogonal to the stochastic product utilities in the full evaluation decision mode, which are also taken to be

IID Gumbel distributed with scale factor μ_E. These assumptions result in a model that implies independence across choice occasions for any consumer. They also ignore unobserved heterogeneity. To relax these assumptions to a certain degree, in Model 2 we adopt a more general model that includes stochastic brand level effects, described subsequently in more detail. This second formulation relaxes the Independence of Irrelevant Alternatives (IIA) assumption that arises from the IID error distributions, as well as that of independence across choice occasions. It also allows us to examine the influence of brand on choice and decision strategy and implicitly the question of aggregation across SKUs.

--- Figure 2 about here ---

An important question in the type of analysis that we conduct is "at what level of aggregation does the habit or variety seeking occur?" Are habit and variety formed at the individual product (SKU) level, or at the brand level? Our initial operational hypothesis is that these effects occur at the SKU level, i.e., habit results in the selection of the same SKU in two consecutive purchase occasions. We adopt this approach for two reasons: a) consumers purchase SKUs; and b) the literature on aggregation in scanner panel data suggests that maintaining the most disaggregate level possible is most likely to provide correct inferences (Andrews and Currim 2005). However, in a second formulation of the model, we include stochastic brand level heterogeneity effects to assess the impact of model specification on our results. This allows for correlation of the unobservables of SKUs within a brand and adds a type of nesting of the brands within the product utility function. This also allows us to test for the significance of brand level effects by comparing this second model to our basic model. In addition, in this more flexible version of the model we include an estimate of the initial prior utility as a random parameter to help account for the issue of initial conditions in dynamic models.

The choice between strategies has been framed above as depending only on the arguments of the systematic utilities (V_j) and decision strategy specific parameters. However, the decision to choose one strategy over another can also depend on external shocks to the choice environment. For example, an advertising signal may affect the variety premium or the Type 2 processing costs, generating a switch from habitual choice to evaluation or variety-seeking. Similarly, the amount of time between purchases (inter-purchase time) may increase the attractiveness of a deviation from habitual because of an increase in the desire for variety, changes in market information or changes in household composition. Inter-purchase time may also reflect inventory effects on strategy selection. Choice environment factors, such as the complexity of the market or the "spread" of individual price or attribute levels may also affect the choice between strategies. Finally, differences in household characteristics may result in the selection of different strategies. In the empirical analysis we examine several of these factors.

In the model we have outlined above, we present an alternative explanation to dynamic choices that does not use the concept of state dependence as a direct modifier of current product utility. The implicit behavioral mechanism represented by inclusion of lagged choice variables in the utility function as representations of state dependence is that repetition is the de facto end state of dynamic choices in the type of product categories we examine here. However, the data on the occurrence of repetition, presented earlier in Figure 1, militates against such a conclusion.

In our approach (see Figure 2), at each purchase occasion product utility in the evaluative mode is a function of (temporally stable) tastes with no utility dependence on past behavior. Rather, at each purchase occasion, the buyer decides first on the decision strategy to be employed through an explicit decision cost versus outcome benefit comparison. Past purchase behavior influences this higher-level decision between the strategies of habit (choose the same as last period, at negligible cost and yielding a known benefit), variety seeking (choose something other than last period, at negligible cost and a known variety premium) and full evaluation (choose the best product, based on forecasting the benefit as the expected maximum utility using last period's choice set). However, in this framework past purchase behavior does not alter the evaluation of the products themselves. In the empirical study that follows, we also present a more traditional model with lagged choice in the utility function, to enable a more substantive evaluation of the two-stage decision model we propose as current state-of-the-practice with respect to state dependence modeling.

Empirical Investigation

We estimate the proposed model described above for two consumer packaged good (CPG) categories, catsup and yogurt. The scanner panel data we employ were sourced from AC Nielsen single-source data for Springfield, MO. The period covered is from January 1986 to February 1988. The catsup data include 17,504 purchases over 22 SKUs, and yogurt, 3,885 purchases over 67 SKUs.

Model 1: The Basic Decision Strategy and Product Choice Model

The statistical implementation of the basic model described above proceeds by assuming that the error terms associated with the systematic SKU (product) utilities are IID Gumbel (or Extreme Value Type I) with scale μ_E, resulting in a multinomial logit model for the

SKU choice within the full evaluation mode. The other two decision modes (pure habit and pure variety-seeking) do not use concurrent product utility measures, hence need no stochastic specification to be made. The likelihood function for this model is given by

$$L = \prod_{h} \prod_{t=1}^{T_h} \prod_{j \in C_{th}} P_{jth}^{\delta_{jth}} \tag{6}$$

where h is a household, t a purchase occasion from 1 to T_h, and j a SKU; C_{th} is the set of available SKUs; δ_{jth} is one if h chooses j at t, and zero otherwise. The probability of choice is expressed below:

$$P_{jth} = \sum_{r=H,V,E} \pi_{jth|r} Q_{rth} \tag{7}$$

where Q_{rth} is the probability of decision strategy r (H-habit, VS-variety, E-full evaluation) on purchase occasion t for h, as specified in (5); finally, the probability of choosing j conditional on strategy r is

$$\pi_{jth|H} = \begin{cases} 1 & if\ \delta_{j,t-1,h} = 1 \\ 0 & if\ \delta_{j,t-1,h} = 0 \end{cases} \tag{8a}$$

$$\pi_{jth|VS} = \begin{cases} (|C_{th}|-1)^{-1} & if\ \delta_{j,t-1,h} = 0 \\ 0 & if\ \delta_{j,t-1,h} = 1 \end{cases} \tag{8b}$$

$$\pi_{jth|E} = \frac{\exp(\mu_E \beta' X_{jth})}{\sum_{i \in C_{th}} \exp(\mu_E \beta' X_{ith})}. \tag{8c}$$

The vector X_{jth} contains the attributes of alternative j on purchase occasion t, as faced by household h, and β is a commensurable vector of tastes; in 8(b), the notation |A| represents the number of elements in set A; and other quantities have been previously defined. Note that in (8c) the product attributes refer only to the current period, implying that the utility is not dependent on past choices as would be the case in a state dependent model. Rather, dependence on the past is built into the strategy selection model Q_{rth}: it is a function of prior choice in the habit strategy and of prior utilities via the logsum variable in the full evaluation strategy.

The propensity to adopt a given decision strategy (probability Q) is specified in expression (5) to include the logsum and/or the systematic utility of the chosen alternative of the previous period (note the unit coefficients in front of these quantities). Empirically, this propensity is additively augmented by the following factors: a strategy-specific constant (of different interpretation depending upon the strategy), interpurchase time T and T^2 (applicable to full evaluation and variety seeking), number of SKUs on in-store display and number of SKUs featured in the weekly supermarket insert (for both full evaluation and pure variety-seeking). The last two variables are intended to capture intensity of marketing activity in the store environment, and thus are not SKU-specific. (Both variables are available for the catsup category, but only insert information is available for yogurt.) These variables describe the influence of the store environment in triggering the desire to adopt the full evaluation and pure variety seeking strategies, relative to pure habit. Since these factors are constant at any point in time, only the relative impact of the independent variables is identifiable. In effect, we employ a polytomous logit model to describe decision strategy selection, using pure habit as the base strategy.

Table 1 presents the maximum likelihood parameter estimates for the full evaluation mode utility functions, which are jointly estimated with the decision mode selection model (also in the table). To briefly assess the utility parameter estimates, price sensitivity is negative and statistically significant in both categories at the 90% confidence level or better, in-store display and presence in the weekly insert increase utility, all effects in the expected directions. In both these categories, larger sizes are more attractive up to a certain point, then size begins to generate disutility. Other parameters refer to brand and attribute effects, which are not of specific interest to our research. We also estimate μ_E, the scale of the utilities in the evaluative mode (note that we actually report the square root of scale; the transform was used to impose non-negativity). In both product categories the scale is significantly different from unity and in the catsup category in particular the scale appears to be very large (relative to the yogurt scale).

--- Table 1 about here ---

Turning our attention to the decision strategy propensity functions, note that, *ceteris paribus*, in the yogurt category the evaluative mode is most likely while habit and variety seeking only have probabilities of about 10%. In the catsup category, however, all else equal, full evaluation is the most likely mode (about 55%), followed by habit (about 32%) and then by pure variety seeking. These two product categories reflect quite different strategy selection processes, likely because of the difference in the products (e.g. the higher perishability and rate of consumption of yogurt relative to catsup). Studying in detail the decision strategy model for catsup, the constant of the variety seeking strategy is negative and significant, indicating that relative to habit there is a "net cost" of variety seeking likely arising from the higher chance of selecting a poor alternative using the latter strategy. The constant in the evaluative strategy is not significant, suggesting no net utility difference between habit and full evaluation, all else held constant. This indicates that the cognitive cost savings of the habit strategy are offset by the benefits of knowing that the best option will be selected. In the case of yogurt the constant in the evaluative strategy is positive and significant, indicating a premium for evaluation relative to habit strategy.

We note also that in the catsup category interpurchase time T has a positive effect on (i.e. makes more likely) the adoption of both the evaluative and pure variety-seeking modes relative to pure repetition, as expected. Interestingly, however, T has no discernible effect on selection of decision mode in the yogurt category. This no doubt reflects the fact that interpurchase times for catsup tend to be significantly longer than for yogurt.

With respect to in-store promotional activity, the model for the catsup category discerns a significant impact for the number of SKUs on display and for the number of SKUs featured in the weekly insert. Both effects increase the propensity to engage in full evaluation and pure variety-seeking, though the effects are smaller for the latter decision mode. In the yogurt category, for which only product insert data are available, the number of products in the weekly insert leads to a higher propensity to adopt the full evaluation strategy relative to habit, but does not significantly affect adoption of pure variety seeking.

These results on decision strategy likelihood are more clearly understood from a graphical presentation than through a perusal of the parameters in Table 1. Figures 3 and 4, respectively for catsup and yogurt, illustrate the decision mode selection probabilities for four selected households as a function of purchase occasion, depicting thus the specific variation of decision mode selection over time (note, however, that the elapsed time between purchase occasions can vary within and between households). In the case of catsup, evaluation dominates as the preferred strategy for all four households over all time periods. However, for household K4, for example, evaluation and habit have similar probabilities for certain periods of time – usually time periods without feature or display. The influence of feature or display generates an increased propensity to evaluate. For this household, the pure variety seeking strategy is always the least preferred. For catsup the probability of habit is quite large relative to variety seeking and often similar to evaluation. In contrast, for 3 of 4 households presented in the yogurt case, full evaluation probabilities strongly dominate. Only for household Y2 do evaluation and variety seeking alternate in terms of dominance. Habit is never higher than a probability of 0.2 for these households. To us, the notable takeaway message from these diagrams is the relatively large variation in decision mode probabilities, over both households and products, that the model is capable of capturing as a function of changes in promotional activity and store environment. In the catsup category the highest probability decisions modes are full evaluation (E) and habit (H), whereas in the yogurt category the evaluation mode (E) dominates with variety seeking (VS) being relatively large for a few cases.

--- Figures 3 & 4 about here ---

As a comparative model, Table 2 presents multinomial logit (MNL) models for the two product categories; both models include a lagged choice variable in the utility function to capture state dependence (SD) effects. In both categories, this specification yields sensible results, describing a strong SD effect (dummy variable LastSKU). In the catsup category, the price equivalence of the SD effect is on the order of $6.55, and in yogurt, $15.12. Compared to unit prices in these categories, these effects are equivalent to multiple units. These results are typical of estimated effects of SD using this type of specification. Now compare these SD models with the corresponding proposed models in Table 1. Note that in both categories the SD models have worse goodness-of-fit than the proposed model. This is particularly the case in the catsup category, where the SD model has a log likelihood difference with respect to the proposed model of almost 800 units, at the cost of only six additional parameters. In both categories, information criteria (AIC, BIC) will strongly select the proposed model over the SD model.

In Figure 5 we compare the own price arc elasticities for each alternative arising from the decision strategy model and the lagged choice model, calculated in-sample. Note that in the case of catsup the lagged choice model overpredicts the sensitivity to price, relative to the decision strategy model. This probably arises because in the catsup case the habit strategy is more likely, and in this case price has no effect on the probabilities of choice. The lagged choice model also generates some very high (in absolute value terms) elasticities for products that are seldom chosen and therefore are not affected by the inertia arising from the last choice effect. In the case of the decision strategy model the range of the elasticities is much smaller. For yogurt, the lagged choice model predicts *less* response to price relative to the decision strategy model. Since habit and variety seeking are far less important in this product category, the decision strategy model results in higher responsiveness to price. The lagged choice model, through the incorporation of previous choice into the utility functions, dampens price responsiveness.

--- Table 2 about here ---

Model 2: Incorporation of Stochastic Brand Level Effects

Table 3 contains the results of the model re-estimated to include stochastic brand level effects, which also incorporate a panel structure on the data relaxing the independence across choice occasions assumption. This is essentially an error-components variant of model 8(c), with each brand having its own effect on the SKUs of that brand; empirically, we assume that the stochastic brand effects are independent normal variates with zero means and a variance to be estimated. We also add an initial prior utility stochastic effect (also assumed normal with a mean and variance to be estimated) to account for potential bias introduced by the fact that we observe only a portion of the household's behavior. The stochastic brand effects and the initial prior utility stochastic effect are assumed to be independent. The likelihood function is

$$L = \prod_{h}\left[\int_{\xi}\left(\prod_{t=1}^{T_h}\prod_{j\in C_{th}} P_{jth}^{\delta_{jth}}(\xi)\ f(\xi)d\xi\right)\right] \quad , \tag{9}$$

where ξ is a vector of stochastic brand effects and initial utility, f(ξ) is its multivariate density function,

$$P_{jth}(\xi) = \sum_{r=H,V,E}\pi_{jth|r}(\xi)Q_{rth} \quad , \tag{10}$$

$$\pi_{jth|E}(\xi) = \frac{\exp(\mu_E(\beta' X_{jth} + \xi_{b(j)}))}{\sum_{i\in C_{th}}\exp(\mu_E(\beta' X_{jth} + \xi_{b(i)}))} \ . \tag{11}$$

In the above expression, $\xi_{b(j)}$ is the stochastic effect for the brand to which alternative j belongs. The probabilities of choice for the habit and variety seeking decision modes continue to be given by (8a,b). As noted before, $f(\xi)$ is the convolution of independent normals for each brand and a further independent normal for the initial prior utility stochastic effect. Simulated maximum likelihood is employed to obtain estimates from (9).

--- Table 3 about here ---

The brand level stochastic effects are all significant (there is one marginally significant estimate in the catsup model), indicating a degree of clustering within brands due to unobserved effects. The initial utility estimate is only significant in the catsup model and the standard deviations in these estimates are not significant in either model – suggesting that the addition of this term to account for initial conditions has relatively little impact on the model. The other parameters in Model 2 are generally similar to Model 1.

Regarding the parameters of the decision strategies, the same patterns emerge from this second formulation, albeit with evidence of habit strategy selection somewhat weaker than in Model 1, and lower likelihood of variety seeking. In the catsup model, the probability of being in evaluative mode is 65%, 25% in habit mode and only approximately 10% in variety seeking mode. In the case of yogurt, the probability of evaluation mode being selected is slightly higher than 90% while variety seeking mode probability is slightly above 5%. The patterns are similar to the model above – evaluation more likely in yogurt than in catsup – but the evaluation dominates to a larger degree.

At the individual consumer level however, different patterns emerge suggesting heterogeneity in strategy choice depending on choice history. Figures 6 and 7 contain the patterns for the same four households used in Figures 3 and 4, illustrating the differences in decision strategy selection probabilities across households depending on history and choices. These patterns are similar to those presented in Figure 3 and 4, but the full evaluation strategy is much more likely to be chosen in these cases. Nevertheless, there remains considerable heterogeneity in response.

--- Figures 6 & 7 about here ---

Table 4 contains the results for the lagged dependent variables models with stochastic brand effects. The statistical performance of these models continues to be worse than the strategy choice models.

--- Table 4 about here ---

Figure 8 presents the in-sample arc own-price elasticities comparing Model 2 with the lagged dependent variable model. The pattern in Figure 8 is similar to that in Figure 5 – the lagged dependent variable model overpredicts relative to the decision strategy model for catsup and underpredicts for yogurt. However, the differences are not as large, particularly in the case of yogurt. Since the yogurt model indicates a high probability of full evaluation, the results mimic the lagged dependent variable model which assumes full evaluation. Nevertheless, the same pattern emerges – for catsup the lagged dependent variable model overpredicts the sensitivity to price because it does not consider those in habit mode who effectively ignore price. For yogurt, since evaluation dominates, the lagged dependent variable model underpredicts the effect of price changes as the inertia of the lagged choice component softens the impact of price changes.

--- Figure 8 about here ---

In our view, the comparison of the lagged choice model with decision strategy Model 2 suggests that the latter is a better paramorphic representation of the data generation mechanism for this type of product category than one based on state dependence, as currently understood in the economics and econometric literatures (e.g. Heckman 1981; Keane 1997; Dube et al. 2009). We believe that further research is needed to distinguish contexts in which state dependence is a more suitable approach to capturing choice behavior than is a strategy selection method as employed in our approach. For the consumer packaged goods that we study strategy selection appears to be a better approach; it is possible that for consumer durables a SD approach may be superior.

Conclusions

In this paper we examine routine (or repeated) choices over time. After examination of a set of stylized facts about choices of consumer packaged goods, we construct a conceptual model of consumer choice that includes expected benefits and processing costs (accrued when consumers adopt a particular decision strategy), as well as a variety premium. Our conceptual model is a type of two-stage decision making model in which consumers consider the choice of decision strategies as well as product choice. The choice of decision strategy is analogous to a choice by consumers to use Type 1 (nearly subconscious) versus Type 2 (evaluative) decision making. This model is also based on the notion that consumers have limited processing resources or are cognitive misers, and thus there are costs associated with the evaluation of alternatives. On the other hand, the model also allows utility to arise from access to variety.

To evaluate the conceptual model we examine consumer choices from two types of supermarket goods – catsups and yogurts. The empirical analysis confirms several notions raised by the motivating set of stylized facts. The parameters of the model illustrate that there is significant evidence of the habitual decision strategy, particularly in the case of catsup (a commodity with a relatively longer interpurchase period). There also appears to be evidence of a preference for variety in the yogurt case, perhaps related to the larger choice set (particularly flavor variations), the more frequent replenishment rate vis-à-vis catsup, and the lower unit prices (implying smaller consequences of misjudgments) for this type of good.

Our empirical approach represents a departure from the typical way of dealing with panel data of the type used in our analysis, to wit, the state dependence approach. This latter approach, in the context of the models we employ here, is often implemented by the inclusion of a lagged dependent variable in the utility function, and more generally, by the inclusion of some kind of historical consumption record in the utility function. We re-interpret the influence of past consumption, excluding it from the utility function, and instead include it in the decision strategy choice. In our approach a household's preferences, as reflected in the utility function, are constant over time and utility is stable, in the sense that variations arise only from pricing changes and promotional activities, not from simple cumulative experience with a product. Repeated choice of a product does not affect the utility function, but is instead itself determined by selection of the decision strategy. We view this as a major advantage of our empirical framework. Statistically, our approach significantly outperforms a form of the state dependence model.

It is possible to extend the framework we present in a number of directions. First, we have assumed that the size of the choice set is fixed in our analysis. In principle a shock that induces variety seeking or evaluation may result in an expansion of the choice set (i.e. the consideration of a larger set of goods; Andrews and Srinivasan 1995, Swait and Ben-Akiva 1987a,b). Alternately, in a single period model (which is very commonly estimated in applied discrete choice analysis) a person in habit mode may be observationally equivalent to an individual with a choice set of size one. Incorporating choice set formation into our model of decision strategy and choice will provide for a more in-depth examination of consumer behavior.

Second, we examine choices at the level of stock keeping units. It is possible that for some goods habitual choice involves a choice from a set of products (a choice set with more than one SKU, as has been implemented in this research), or from a different product aggregation level (e.g. brand). Furthermore, it is possible that there is heterogeneity across consumers in terms of decision strategy and that this heterogeneity may be observed or unobserved. Our formulation may be most applicable to a situation where product markets are relatively mature or stable, such as is the case for the product categories we examined empirically. A very dynamic or changing market may instill the use of different heuristics for search or for strategy choice. It may also be possible to integrate models that contain intertemporal components explicitly in the utilities (e.g. Swait et al. 2004) into the framework we describe if changes between time periods trigger changes in strategy. We view these as desirable extensions of the empirical analysis we present here. The proposed model can also be extended to include more complex representations of parameter heterogeneity in both decision strategy selection and utility evaluation. Finally, our models can be extended to include consideration of non-compensatory choice behavior (e.g. Swait 2001) with the possibility, for example, that attribute thresholds (e.g. high prices) trigger changes in decision strategy.

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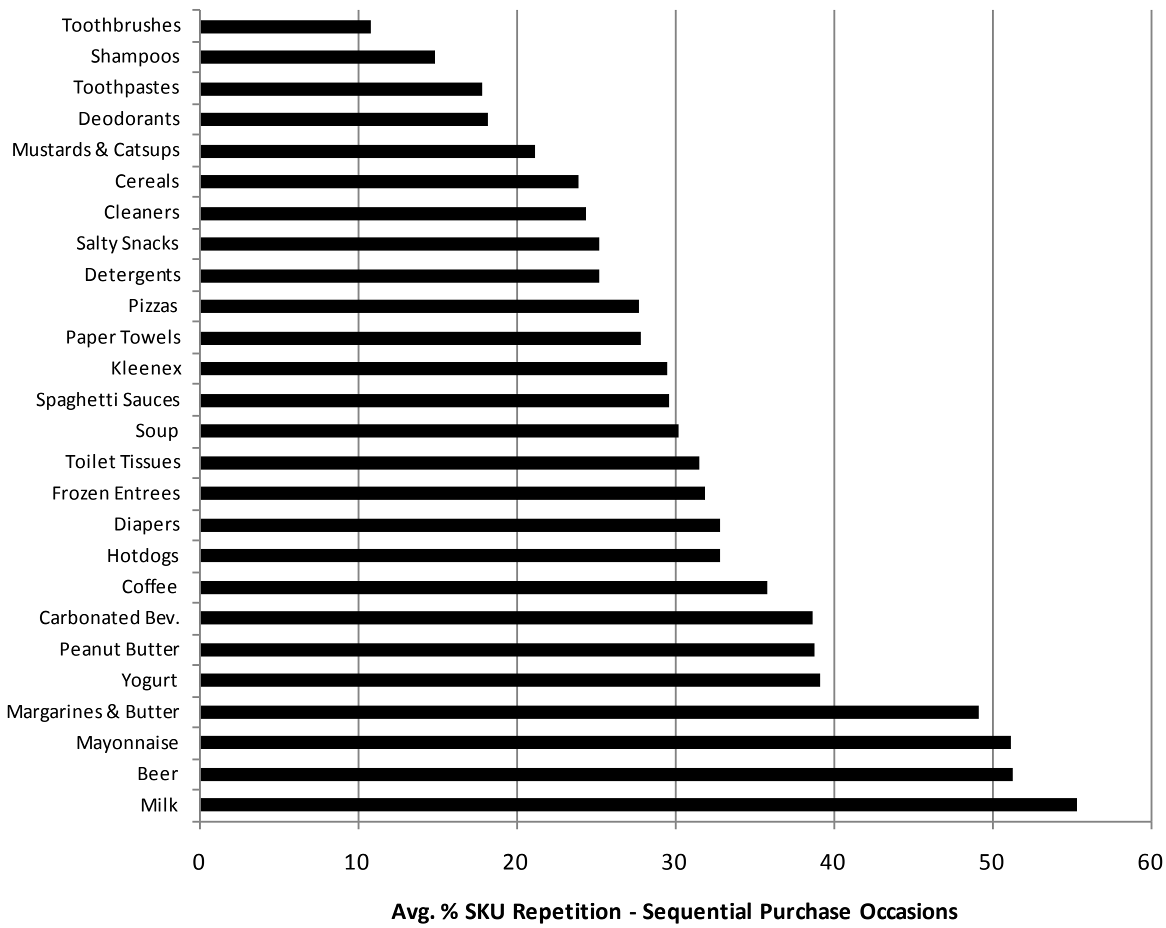
Figure 1 - Percentage of sequential purchase decisions that are repetitions (choice of the same product SKU).



Data Source: see Bronnenberg et al. (2008)

Figure 2 - Decision Strategy and Product Choice Selection

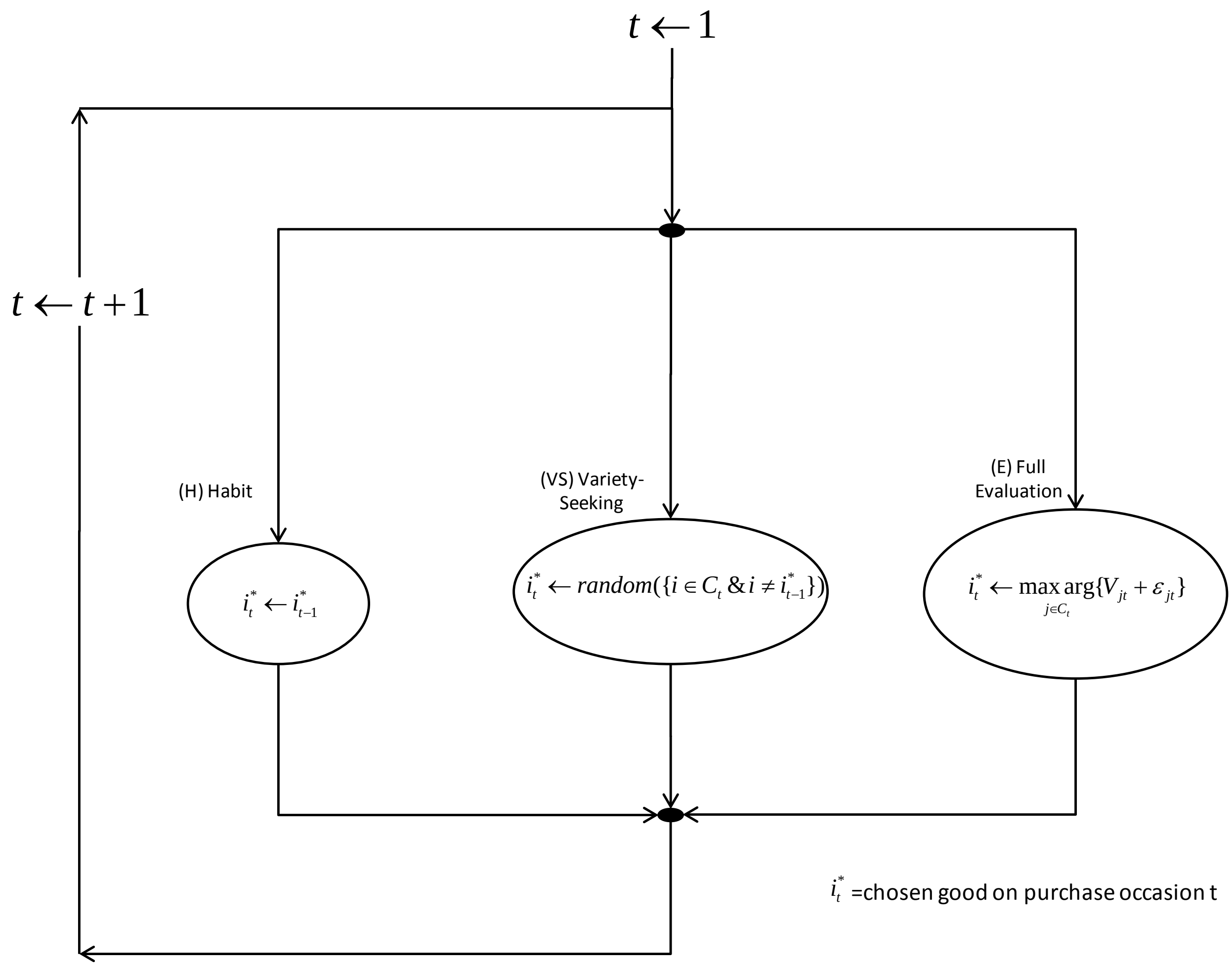


Figure 3 - Model 1 Decision Mode Selection Probabilities for a Set of Specific Households – Catsup Category

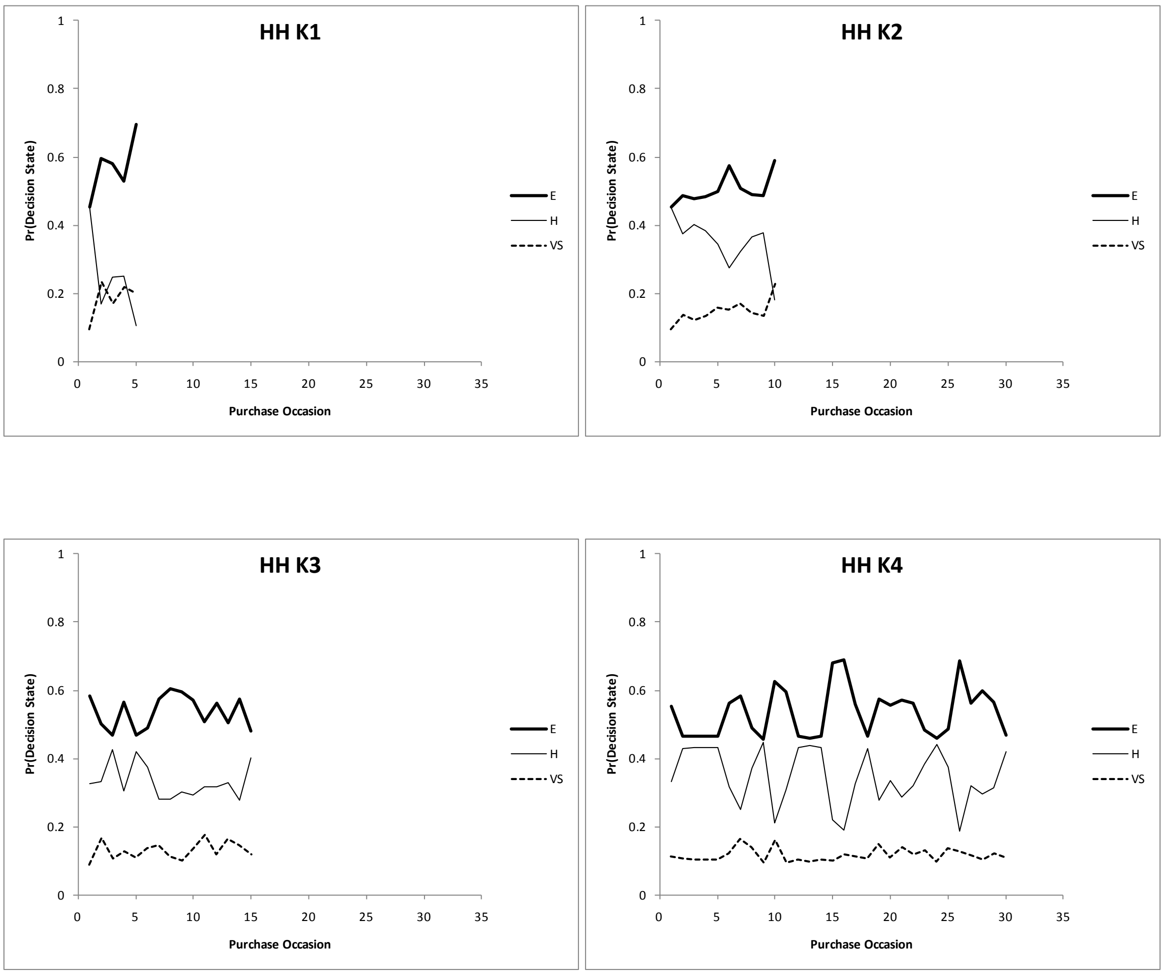


Figure 4 - Model 1 Decision Mode Selection Probabilities for a Set of Specific Households – Yogurt Category

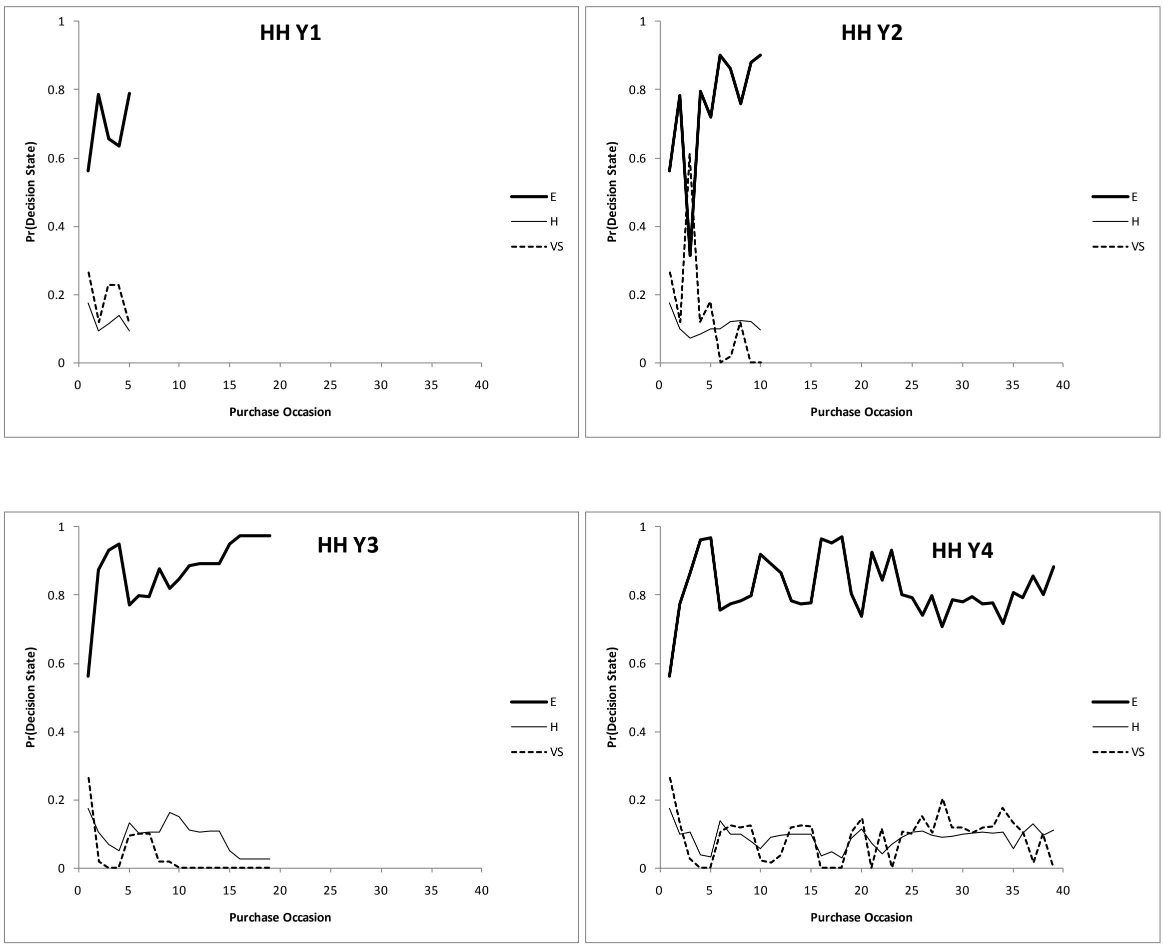


Figure 5 - Comparison of Own-Price Arc Elasticities between Decision Strategy Model 1 and Lagged Choice MNL Model

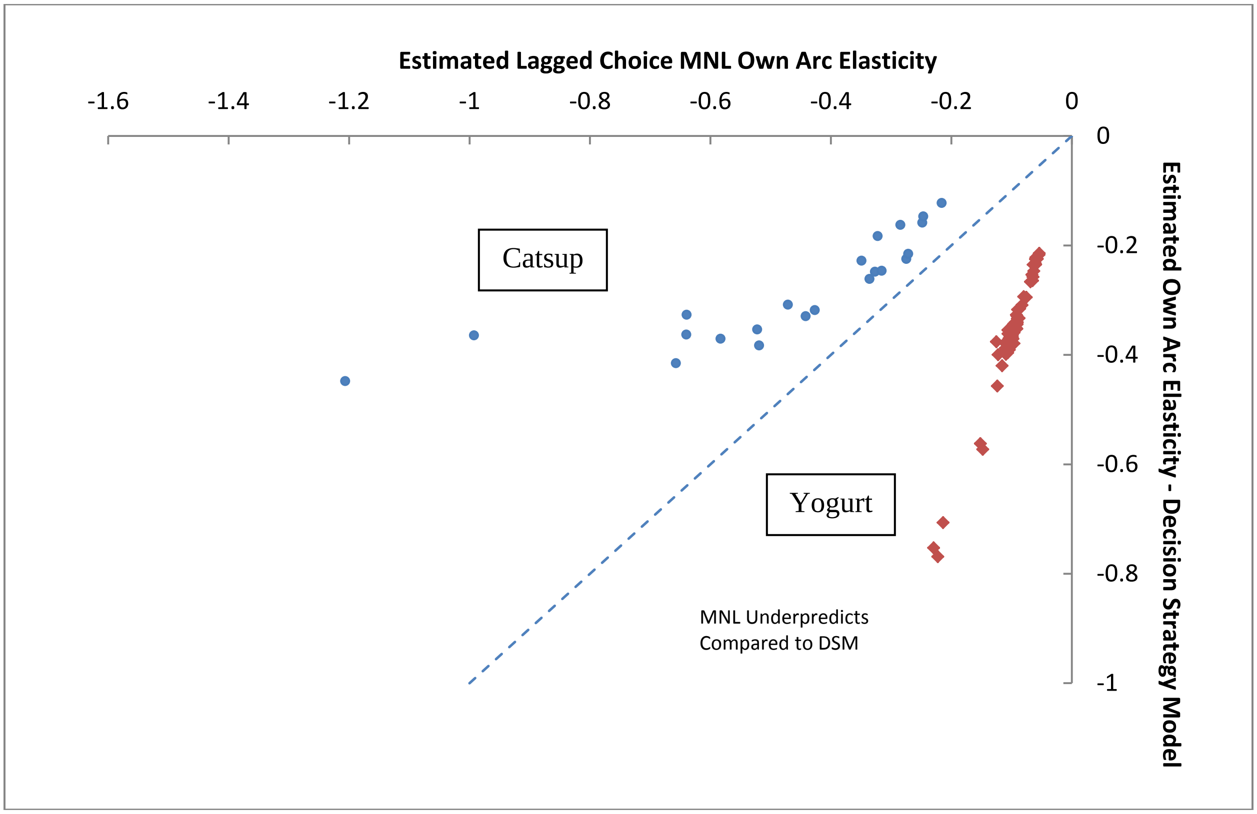


Figure 6 - Model 2 Decision Mode Selection Probabilities for a Set of Specific Households – Catsup Category (Includes Stochastic Brand Level Effects)

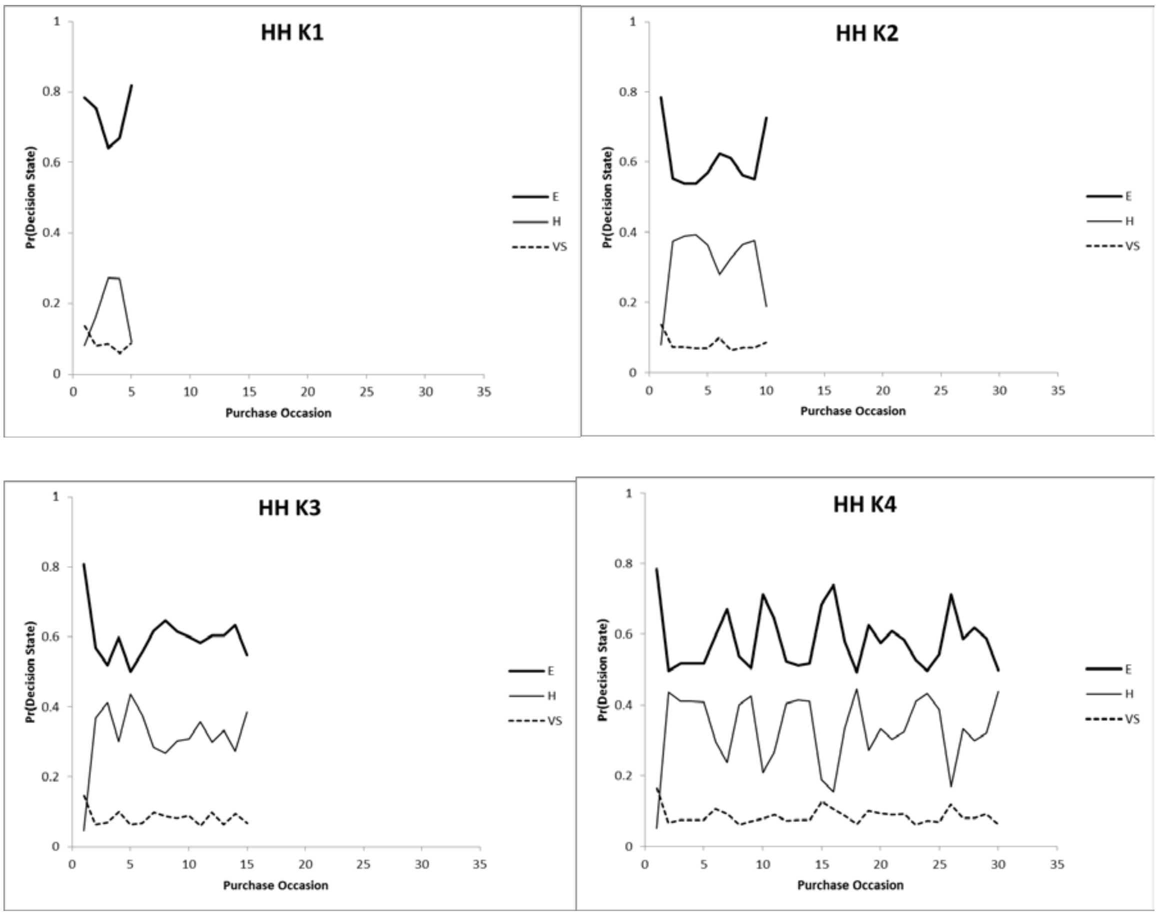


Figure 7 - Model 2 Decision Mode Selection Probabilities for a Set of Specific Households – Yogurt Category (Includes Stochastic Brand Level Effects)

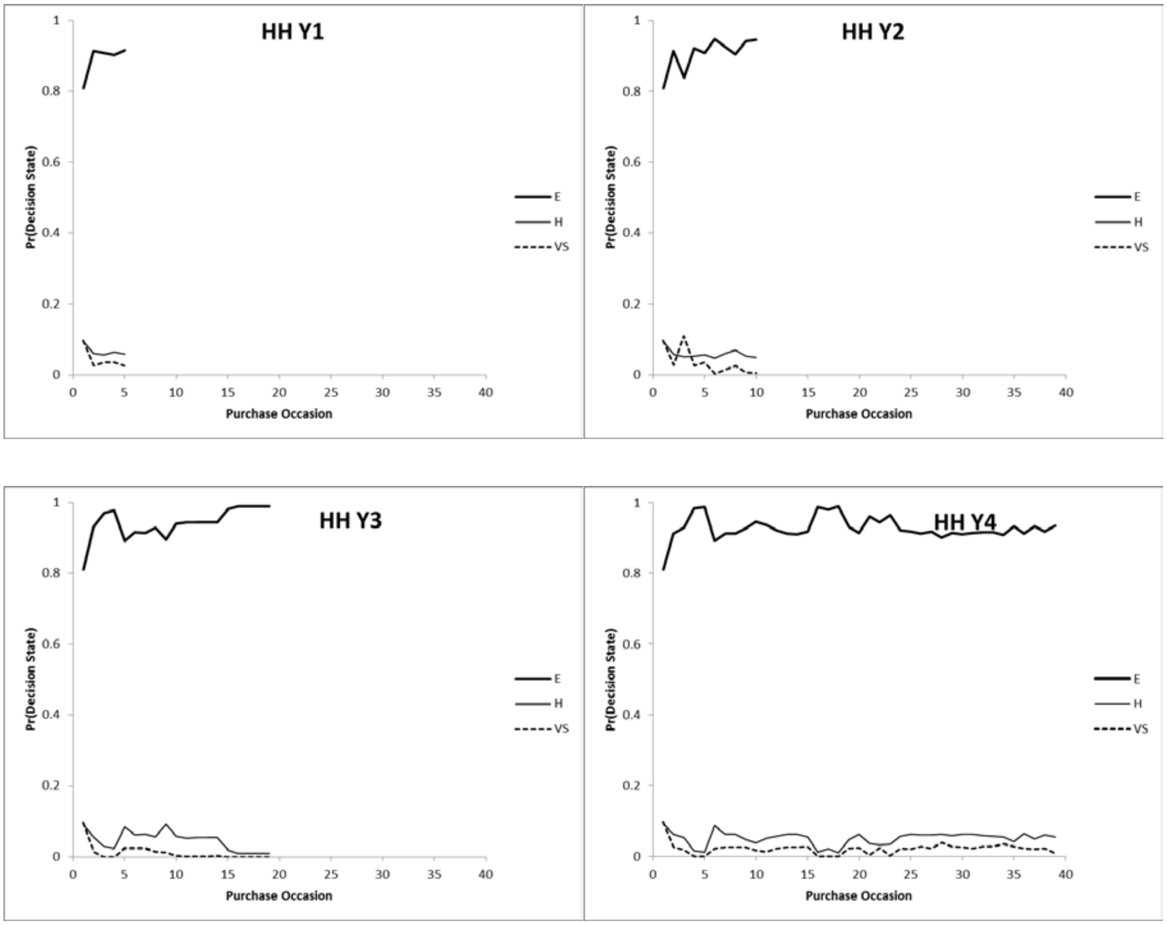


Figure 8 - Comparison of Own-Price Arc Elasticities between Decision Strategy Model 2 and Lagged Choice MNL Model (Includes Stochastic Brand Level Effects)

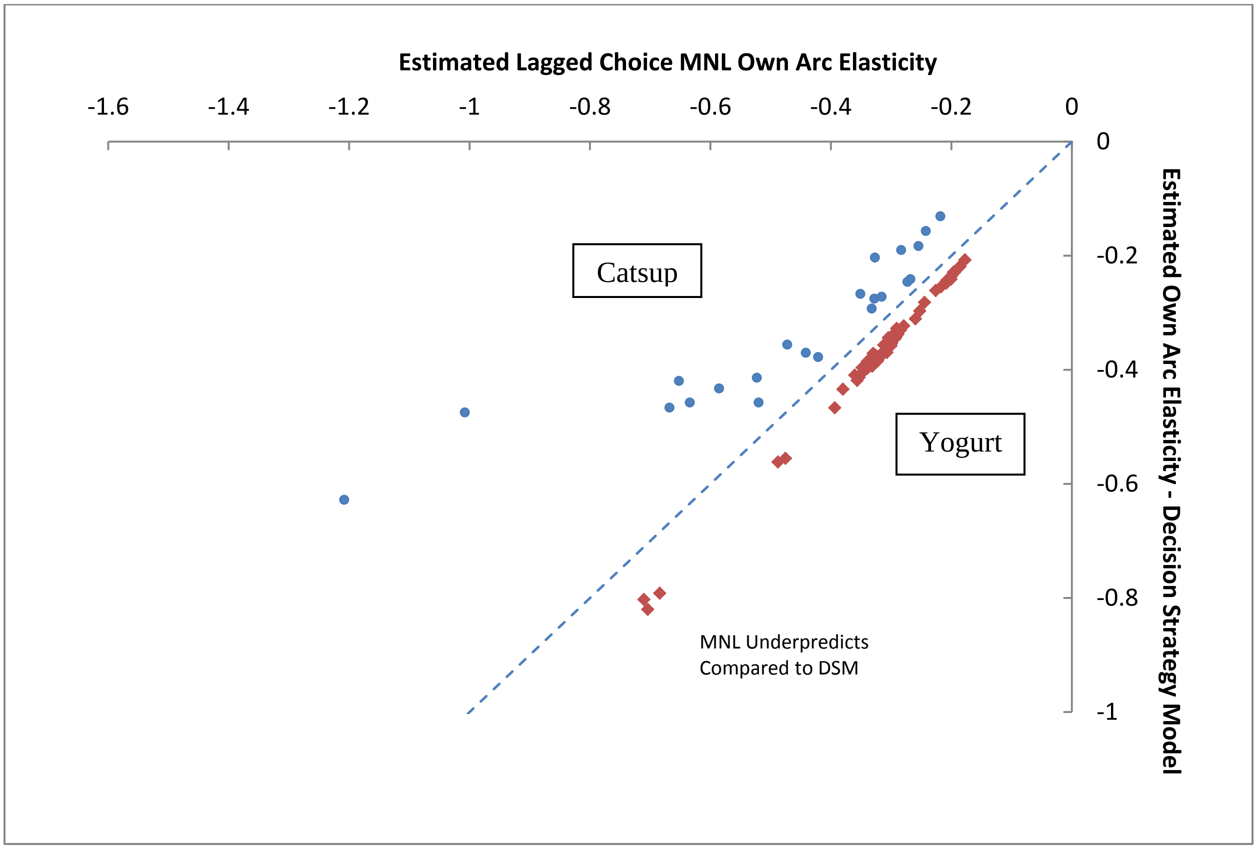


Table 1 – Model 1: Decision Mode and Product SKU Selection Models

(asymptotic t-stats)	Catsup	Yogurt
Evaluative Mode - SKU Utility Function		
Brand 1	-0.0133 (-0.37)	0.1845 (1.29)
Brand 2	-0.0112 (-0.31)	0.1784 (1.26)
Brand 3	-0.0235 (-0.63)	0.1538 (3.09)
Brand 4	-0-	0.0017 (0.03)
Brand 5		0.1664 (1.07)
Brand 6		-0.0491 (-1.11)
Brand 7		-0-
Attribute 1	0.0297 (0.77)	-0.491 (-2.52)
Attribute 2	0.0016 (1.59)	-0.371 (-3.33)
Attribute 3		-0.6291 (-2.90)
Attribute 4		0.8651 (3.07)
Attribute 5		0.8185 (3.01)
Attribute 6		0.6306 (2.65)
Attribute 7		0.7908 (2.96)
Attribute 8		0.6083 (2.58)
Size (oz)	0.0152 (1.78)	0.0854 (1.63)
Size^2	-0.1419 (-1.82)	-0.2302 (-2.36)
SKU Price ($)	-0.0026 (-1.79)	-0.1249 (-3.61)
In-Store Display	0.0223 (1.81)	---
Weekly Insert	0.0212 (1.81)	0.5216 (3.61)

(Continued)

Table 1 – (Continued)

(asymptotic t-stats)	Catsup			Yogurt		
Decision Mode	Evaluative	Pure Variety Seeking	Pure Habit	Evaluative	Pure Variety Seeking	Pure Habit
Utility Scale - $(\mu_E)^{1/2}$	13.806 (3.62)	---	---	2.1654 (7.29)	---	---
Propensity Function						
Constant	0.0023 (0.05)	-1.545 (-14.61)	-0-	1.1725 (4.68)	0.4121 (1.00)	-0-
Last Trip Logsum	1.0	-0-	-0-	1.0	-0-	-0-
Utility of Previous Choice (V_p)	-1.0	-1.0	-0-	-1.0	-1.0	-0-
T (Interpurchase Time in weeks/100)	2.6646 (7.25)	6.1542 (9.63)	-0-	-1.0641 (-0.61)	1.3982 (0.41)	-0-
T^2	-1.6345 (-3.02)	-5.9892 (-6.35)	-0-	0.4861 (0.15)	0.4693 (0.11)	-0-
Number of SKUs on Display	0.507 (10.43)	0.4661 (5.76)	-0-	---	---	-0-
Number of SKUs Featured	0.5761 (12.55)	0.2548 (3.34)	-0-	0.0959 (4.32)	-1.7574 (-0.37)	-0-
Decision State Probabilities (average)	0.549	0.134	0.317	0.794	0.104	0.102
Goodness-of-fit						
LL(0)		-54105.61			-16335.23	
LL(Convergence)		-37104.24			-15136.87	
Number of Parameters		21			27	
ρ^2		0.3142			0.0734	
$\bar{\rho}^2$		0.3138			0.0717	
Number of Choices		17504			3885	
Number of Alternatives		22			67	

Table 2 – MNL Choice Models with Lagged Choice Variable

(asymptotic t-stats)	Catsup	Yogurt
SKU Utility Function		
Brand 1	-0.4304 (-1.50)	-0.2332 (-0.60)
Brand 2	0.0083 (0.00)	0.0098 (0.00)
Brand 3	-1.1767 (-3.90)	0.4044 (4.00)
Brand 4	-0-	-0.2684 (-1.20)
Brand 5		-0.4507 (-1.00)
Brand 6		-0.3586 (-2.40)
Brand 7		-0-
Attribute 1	2.3993 (11.60)	-1.1552 (-2.80)
Attribute 2	1.4368 (4.90)	-1.4025 (-7.70)
Attribute 3		-1.8976 (-4.90)
Attribute 4		1.4541 (5.00)
Attribute 5		1.2849 (4.70)
Attribute 6		0.5199 (1.90)
Attribute 7		1.1479 (4.10)
Attribute 8		0.6238 (2.10)
Size (oz)	0.6506 (7.00)	-0.0306 (-0.20)
Size^2	-1.8184 (-12.20)	-0.6500(-2.40)
SKU Price ($)	-0.3655 (-20.60)	-0.1231 (-2.60)
Display	2.6584 (73.70)	---
Feature	2.6491 (76.60)	2.2964 (31.90)
LastSKU	2.3958 (121.70)	1.8610 (33.50)
Goodness-of-fit		
LL(0)	-54105.61	-16335.23
LL(Convergence)	-37903.50	-15218.50
Number Params.	11	19
ρ^2	0.2995	0.0684
$\bar{\rho}^2$	0.2992	0.0672
Number Obs. Choices	17504	3885
Number Alternatives	22	67

Table 3 – Model 2: Decision Mode and Product SKU Selection Models (Includes Stochastic Brand Level Effects)

(asymptotic t-stats)	Catsup	Yogurt
Evaluative Mode - SKU Utility Function		
Brand 1	-0.4318 (-4.29)	0.1244 (1.04)
Brand 2	-0.4163 (-4.11)	0.1792 (1.41)
Brand 3	-0.4944 (-4.97)	0.1515 (2.41)
Brand 4	-0-	0.1140 (1.28)
Brand 5		0.1748 (1.22)
Brand 6		-0.0838 (-1.17)
Brand 7		-0-
Attribute 1	0.5227 (5.31)	-0.4430 (-2.79)
Attribute 2	0.0135 (4.07)	-0.4030 (-3.22)
Attribute 3		-0.6313 (-3.3)
Attribute 4		0.6357 (3.39)
Attribute 5		0.5866 (3.29)
Attribute 6		0.3706 (2.81)
Attribute 7		0.5399 (3.28)
Attribute 8		0.4061 (2.75)
Size (oz)	0.0126 (1.85)	0.0241 (0.68)
Size^2	-0.3243 (-7.92)	-0.1433 (-2.15)
SKU Price ($)	-0.0200 (-7.27)	-0.1358 (-3.73)
Display	0.1676 (7.49)	---
Feature	0.1606 (7.49)	0.6538 (3.56)

(continued)

Table 3 – (cont.)

(asymptotic t-stats)	Catsup	Yogurt
Initial Prior Chosen Alternative's Utility – N(μ,ω^2)		
μ	-2.2609 (-2.41)	0.7786 (0.68)
ω	0.2634 (0.08)	0.2459 (0.10)
Brand Stochastic Effects - Independent N(0,σ^2)		
σ(Brand 1)	0.0274 (6.06)	0.6671 (3.82)
σ (Brand 2)	0.0619 (7.41)	0.4930 (3.64)
σ (Brand 3)	0.0116 (1.84)	0.7636 (3.68)
σ (Brand 4)	-0-	-0-
σ (Brand 5)		-0-
σ (Brand 6)		0.5262 (3.25)
σ (Brand 7)		0.5109 (3.53)

(continued)

Table 3 – (cont.)

(asymptotic t-stats)	Catsup			Yogurt		
Decision Mode	Evaluative	Pure Variety Seeking	Pure Habit	Evaluative	Pure Variety Seeking	Pure Habit
Utility Scale - $(\mu_E)^{1/2}$	4.8536 (14.86)	---	---	1.9639 (7.18)	---	---
Propensity Function	0.0319 (0.80)	-1.7174 (-15.08)	-0-	1.3970 (5.43)	-0.7233 (-1.43)	-0-
Constant	1.0	-0-	-0-	1.0	-0-	-0-
Last Trip Logsum	-1.0	-1.0	-0-	-1.0	-1.0	-0-
Utility of Previous Choice (V_p)	2.1355 (5.72)	0.7042 (0.9)	-0-	0.2112 (0.12)	0.7208 (0.14)	-0-
T (Interpurchase Time in weeks/100)	0.6571 (1.00)	1.0501 (0.87)	-0-	-0.0817 (-0.03)	0.8334 (0.13)	-0-
T^2	0.4940 (10.59)	0.6881 (7.19)	-0-	---	---	-0-
Number of SKUs on Display	0.5788 (12.01)	0.6245 (6.84)	-0-	0.1206 (3.54)	-0.3978 (-0.37)	-0-
Decision State Probabilities (average)	0.655	0.093	0.252	0.918	0.057	0.025
Goodness-of-fit						
LL(0)		-54105.6			-16335.2	
LL(Convergence)		-36897.7			-13855.2	
Number Params.		26			34	
ρ^2		0.3180			0.1518	
$\bar{\rho}^2$		0.3176			0.1497	
Number Obs. Choices		17504			3885	
Number of Households		3242			262	
Number Alternatives		22			67	

Table 4 – Brand Error Components Choice Models with Lagged Choice Variable

(asymptotic t-stats)	Catsup	Yogurt
SKU Utility Function		
Brand 1	0.6638 (5.10)	0.1802 (0.58)
Brand 2	1.0013 (7.71)	0.6386 (2.09)
Brand 3	0.0198 (0.16)	0.5583 (3.96)
Brand 4	-0-	0.4194 (1.59)
Brand 5		0.5783 (1.37)
Brand 6		0.1402 (0.59)
Brand 7		-0-
Attribute 1	1.3265 (14.9)	0.4147 (1.23)
Attribute 2	0.2612 (5.87)	0.2828 (1.90)
Attribute 3		-0.2425 (-0.83)
Attribute 4		0.7240 (2.69)
Attribute 5		0.7688 (3.19)
Attribute 6		0.1703 (0.67)
Attribute 7		0.6111 (2.31)
Attribute 8		0.2780 (1.02)
Size (oz)	-1.6376 (-19.94)	-0.1393 (-1.52)
Size^2	1.3265 (14.9)	0.1694 (1.09)
SKU Price ($)	-0.3708 (-26.45)	-0.4083 (-18.58)
Display	2.8939 (89.64)	---
Feature	2.7013 (97.22)	2.3035 (39.38)
LastSKU	2.1822 (150.84)	1.1291 (28.05)
Brand Stochastic Effects - Independent $N(0,\sigma^2)$		
σ(Brand 1)	0.7425 (18.28)	2.1332 (17.44)
σ (Brand 2)	1.2523 (29.83)	1.2306 (16.65)
σ (Brand 3)	0.1281 (1.25)	2.9023 (22.12)
σ (Brand 4)	-0-	-0-
σ (Brand 5)		-0-
σ (Brand 6)		1.0938 (19.66)
σ (Brand 7)		1.5844 (13.32)

(continued)

Table 4 – (cont.)

Goodness-of-fit		
LL(0)	-54105.61	-16335.23
LL(Convergence)	-37429.72	-14014.25
Number Params.	14	24
ρ^2	0.3082	0.1421
$\bar{\rho}^2$	0.3080	0.1406
Number Obs. Choices	17504	3885
Number of Households	3242	262
Number Alternatives	22	67

Endnotes

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[i] These data are available for purchase from Information Resources Inc., as detailed in Bronnenberg et al. (2008). Its use is limited to academic research. The database description can be found in Kruger and Pagni, 2008. The data set includes 30 categories of consumer packaged goods and Universal Product Code (UPC) or Stock Keeping Unit (SKU) information. The data available were collected over a 5 year period starting January 1, 2001 on a weekly basis. The data set covers 47 market areas in the United States. This is a subset of the total of 64 markets examined by Information Resource Inc. as some markets have a high concentration of sales from one firm and these markets are not released for confidentiality reasons. In two markets (the two largest markets) panel data on purchases are available as well as store level data. The panel is an annual static sample of households that have continued in the panel for the entire year.