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THE IMPACT OF ASSORTMENT REDUCTIONS AND EXTENSIONS ON CATEGORY SALES

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ABSTRACT

The authors develop a conceptual framework concerning the implications of assortment changes on category sales. They argue that the category sales effect of assortment reductions and extensions is moderated by (1) characteristics of the specific items removed or added, and (2) characteristics of the category in which the changes take place. The authors then estimate the category sales impact of additions and deletions, and test the hypothesized moderator effects in the Netherlands, using IRI / Europanel data from 1997–1998. This data set is unique in that it covers no less than 63 categories and 358 Dutch supermarkets, the richness of the database providing a broad empirical basis to test the framework and yield generalizable findings. Key variables moderating the effectiveness of assortment changes are found to be the items' uniqueness, private-label nature and display support, as well as the category's total number of SKUs, concentration, propensity to stockpile and degree of addition activity.

Keywords: Grocery retailing, Assortment composition, Item addition, Item deletion

1. INTRODUCTION

Assortment management is a critical part of a retailer's marketing program, as the assortment affects the store's positioning (Corstjens and Corstjens 1999) and expresses its strategic differentiation (The Partnering Group 1998).

Given the limited amount of shelf space, retailers have to decide which items should be added to or deleted from the assortment. This is a difficult task, which requires a careful balancing act between offering assortments that are attractive to customers, yet do not jeopardize retail efficiency. Still, retailers faced with these decisions, tend to be guided by rules of thumb rather than good theory and hard evidence (Drèze, Hoch, and Purk 1994). Bucklin and Gupta (1999), for example, report that retailers tend to follow a simple procedure of deleting, say, the bottom third (in terms of sales or profits) of the items in a category. Even though this heuristic is intuitively appealing, it ignores substitute and complementary relationships between items in a category, leading these authors to conclude that practitioners could benefit from better methods to determine the costs and benefits from broader versus narrower product assortments.

In spite of the ubiquity of the assortment composition problem, surprisingly little research has addressed the effect of assortment-composition strategy on retailer category sales. Moreover, available studies lead to the intriguing observation that both additions and deletions often imply positive results. At the same time, these studies show quite some divergence and even inconsistencies in both the direction and the magnitude of the impact of assortment changes. The reasons underlying these varying results are not yet well understood. Although the importance of item and category factors for explaining differences in assortment strategy effectiveness is generally acknowledged, a *conceptual* framework seems to be lacking. In addition, apart from some notable exceptions, *empirical* research on whether and how these factors shape the impact of assortment changes has been non-existent, leaving academics and practitioners in need for 'generalizable findings' on the issue.

This paper attempts to cover some of this ground, by addressing two research questions. The first is whether, and if so, in which direction and to what extent, changing the composition of an assortment affects category sales. In studying this issue,

we separately consider the impact of adding items to the category versus deleting them. Second, having uncovered the main effects of both types of assortment changes, we identify characteristics of the specific items added or removed, and of the category under study, that moderate these effects. Our contribution to the literature is both conceptual and empirical. On the conceptual side, we propose a parsimonious research framework for reactions to assortment changes, from which hypotheses on a set of moderating variables can be derived. On the empirical side, we analyze a large database, encompassing more than 60 categories and over 350 supermarkets, to arrive at generalizable observations.

The remainder of this paper is organized as follows. We start with a review of the empirical literature on the category sales effects of assortment changes. Section 3 and 4 present the conceptual framework and hypotheses. Section 5 provides details on the data and methodology. Results of the main effects and moderating analyses are reported in section 6. Section 7, finally, discusses conclusions, managerial implications, limitations and future research opportunities.

2. LITERATURE REVIEW

Studies available in the literature typically concentrate on the impact of *either* item deletions or additions. We discuss each of these decisions in turn.

2.1. Item Deletions

In a pioneering study on the effect of reducing the number of SKUs (stock-keeping-units), the Food Marketing Institute (1993) removed duplicate items from 6 test categories, with assortment cuts ranging between 6% and 22% of the item counts. It was found that eliminating SKUs sometimes leads to sales increases, sometimes to sales decreases. This variation in response was attributed to differences in the 'degree of deletion activity', positive (negative) sales effects being caused by small (deep) assortment cuts. A subsequent industry study by Krum (1994), however, showed that reducing the number of SKUs in the cat box filler category from 26 to 16 (a 38% cut!) did not imply significant losses in category sales in any of the 23 test stores.

Recent academic studies have revealed equally ambiguous effects. As part of an extensive set of in-store shelf management experiments, Drèze et al. (1994) customized shelf space allocation in 8 test categories in a large grocery chain. Keeping total category space constant, shelf facings of SKUs were increased or decreased according to historical sales movement, deleting approximately 10% of the less popular SKUs. This change resulted in an aggregate sales *increase* of nearly 4% between the 30 control and 30 test stores. A closer examination of the individual category results, however, showed substantial variation in the sales impact of deletions across categories, percentage sales changes ranging from –2 to +8.4. These findings therefore suggest that individual category results or summary measures using pooled data across categories may produce misleading or incomplete results, and one needs to look at multiple categories in order to better understand the impact of assortment changes.

Building upon these earlier papers, Broniarczyk, Hoyer and McAlister (1998) conducted lab experiments, a field study and surveys to investigate the effect of item reductions on consumer assortment perceptions and shopping behavior. They found that even substantial reductions (up to 50% of the original assortment) in the number of low selling SKUs did not significantly change consumers' assortment perceptions or category sales, as long as (1) category shelf space was held constant and (2) most consumers could find their favorite available. Interestingly, consumers reported stores with SKU reductions as easier to shop. The study is especially valuable for our purposes, as it suggests that 'presence of favorites' and 'ease of shopping' are key determinants of assortment strategy effectiveness.

In a further attempt to uncover the drivers of deletion effects, Boatwright and Nunes (1999) carried out a large scale study to examine how different 'scenarios' of SKU reductions - defined by how they influence the remaining attributes and attribute levels in the category - affect sales differently. Their study used data from a natural experiment conducted by an online grocer, and covered 42 product categories. A crucial finding from their study is that sales changes triggered by item deletions do not depend on the number of SKU's removed as such, but rather on how assortment cuts affect availability of alternative attributes such as brands, flavors and sizes. Depending on the reduction scenario, sales increases as well as decreases of over 50% were recorded.

2.2. Item additions

Compared to item deletions, the *introduction of new products* has received far more attention - contributions being found in the marketing, strategic management, and economic literature. However, this research has primarily examined the effect of new product introductions at the brand level, and shows a conspicuous lack of attention to the impact of item additions on category sales (Kim, Brigdes, and Srivastava 1999; Mahajan, Sharma, and Buzzell 1993). The studies by Kim et al. (1999), Mahajan et al. (1993), Mason (1990), and Nijs et al. (2001) do consider such category sales effects; they are briefly described below.

Mason (1990) was the first to propose and test a model which extended the traditional market share approach of concept evaluation models to include the potential for market expansion. In her study on the relationship between new product additions and product class demand, addition effectiveness was hypothesized to be affected by (1) the degree to which the new product is different from previous products, (2) utility from increased consumption, (3) the number of products available in the market, and (4) the type of need satisfied by the product class. Testing this relationship using data from an established product class of fast moving consumer goods (FMCGs), she found that a key issue in increasing category sales is not having *more*, but having *better* (i.e. more preferred) products added to the category.

Empirical support for the idea that new product introductions may lead to category expansion was also provided by Mahajan et al. (1993). Using a diffusion modeling approach, they assessed the impact of a new durable entry on category demand. They found that the introduction of a new product increased the combined sales of both the expanding and the rival firm, and thus concluded that market entry may result in market expansion. Interestingly, the authors briefly mentioned (but did not investigate) that variables such as the degree of new product activity, reputation of the innovating firm, promotional activity and uniqueness of the new product may influence the potential of the new product to expand category sales.

The results of Kim et al. (1999) largely corroborate these earlier findings. They developed a model in which the dynamics of demand influence entry and exit, and vice

versa. This model was empirically tested in three technology-intensive markets. The authors reported that adding new products expands the pool of potential buyers, and hence enlarges the market. This market expansion could be attributed to increased quality and variation of the market offer, and/or to stronger promotional support. An interesting feature of this study is that it recognized the potential endogeneity of entry and exit decisions.

Empirical evidence for the effect of new product introductions on retailer category sales was also provided in a recent time-series study by Nijs et al. (2001). Even though the authors' main focus was on the over-time impact on category sales of price promotions, they also reported that major new product introductions increased primary demand in over 30 % of the categories.

In sum, despite the commonly accepted importance of the subject (see, e.g. Kahn 1999) the number of studies *directly* addressing the impact of item deletions or additions on category sales remains limited. The available studies do provide preliminary evidence, however, that deletions and additions may both impact category sales, and that the direction of this effect is often positive. At the same time, these studies suggest that the effects are likely to differ substantially across a broader set of items and categories. However, little work seems to have been done in terms of explaining this divergence, neither in terms of a comprehensive conceptual framework, nor in terms of a large scale empirical investigation that would allow generalizable conclusions. Both issues will be addressed in the following sections.

3. THEORETICAL BACKGROUND

Our primary interest is to assess the effectiveness of assortment reductions and extensions, *effectiveness being defined as the impact of these assortment changes on retail category sales*. This is a performance measure commonly used by academics (e.g., Broniarczyk et al. 1998; Nijs et al. 2001), and of particular relevance to retailers, as their revenues are usually more closely linked to overall category sales than to the sales of any particular SKU (Drèze et al. 1994).

Understanding and explaining these category sales implications requires insights into the consumer decision processes underlying them. We propose that consumers

evaluate assortments by trading off the *benefits* and *costs* associated with these assortments. On the basis of this cost-benefit framework, we predict that sales increases can be produced in either of two ways: (1) by increasing benefits or (2) by reducing costs. Theoretical support for the cost-benefit approach can be found in recent review articles by Kahn (1998), Lehmann (1998) and Schwartz (2000). In what follows, we consider these two opposing dimensions that underlie consumers' reactions to assortment changes in more detail.

3.1. Benefits

Large assortments may provide benefits to the consumers by (1) meeting the diverse tastes of heterogeneous consumers, (2) catering to variety seeking needs, (3) providing insurance against uncertain preferences, and (4) enhancing feelings of autonomy.

Heterogeneity in tastes. Different individuals may have different preferences. As more choices are available, more people will be able to find and select alternatives that best match their personal preferences. Thus, the larger the assortment, the more likely a consumer is to find the product that matches his/her exact specifications (Baumol and Ide 1956). Reibstein, Youngblood, and Fromkin (1975) note in this respect that those who choose an item from a larger choice set will be more satisfied with and consume more of their choice, merely because of the higher probability that the enlarged choice set contains the preferred product. Hence, offering a large assortment should allow the retailer to meet the diverse preferences of ever finer segments more precisely, and, in doing so, increase sales.

Variety seeking. In addition to interpersonal taste differences, individual consumers may have a liking for varied assortments because of their desire to choose and consume different alternatives within and across occasions. Models of variety seeking posit that satiation on item characteristics (McAlister 1982) or the need for stimulation achieved through exposure to novelty, variety and/or changes from established patterns (Steenkamp and Baumgartner 1992) lead consumers to seek variety over time.[1] Large

assortments may therefore offer benefits because they provide the diversity needed for the consumer to satisfy his/her need for variety over time (Kahn 1998).

Preference uncertainty. Tastes may not be well formed and, as a result, consumers may be uncertain about their *current* preferences (see, e.g., Simonson 1990). Moreover, tastes or preferences may also change over time (Kreps 1979), and hence consumers find it difficult to predict their *future* preferences (Kahneman and Snell 1992). To accommodate this uncertainty about current and future preferences, consumers look for a set of options that offers flexibility (Kahn and Lehmann 1991). Large assortments offer consumers "option value" (Hoch, Bradlow, and Wansink 1999), and could help ensure that acceptable alternatives will likely be available. In fact, the consumer's preference uncertainty and his/her resulting desire for large assortments may be a key factor driving store choice, and thus sales (Hoch et al. 1999; Kahn and Lehmann 1991). Additionally, consumers who want to learn about their preferences may seek out several items. In sum, assortments that offer a wider variety can better cater to preference uncertainty, and therefore elicit higher sales.

Autonomy. In Western societies, most consumers value decision autonomy (Iyengar and Lepper 1999a; Ryan and Deci 2000). A wide range of choice options allows people to exercise this fundamental need in their buying behavior, which should lead to higher purchases. Empirical research by Reibstein et al. (1975) indeed shows that people buy more when their perceived decision freedom increases due to higher numbers of choice options.

3.2. Costs

Studies from several disciplines suggest possible explanations for the potential deleterious effects of large assortments on the basis of costs incurred by consumers. Typical costs involved with large assortment strategies include (1) information overload, (2) decision conflict, and (3) regret.

Information overload. Information load is generally conceived as the amount of information to be processed per unit of time. Information load rises with (1) increasing

amounts of data to be processed and/or (2) decreasing *time* available to process the information (Wright 1975). If consumers are provided with 'too much' information at a given time, such that it exceeds their processing limits, overload may occur (Malholtra 1982). Such a state of overload might well exist in the supermarket (Fournier, Dobscha, and Mick 1998), for several reasons.

First, the larger the number of SKUs stocked by the retailer, the more data are to be processed. Second, because of increasing time constraints, the amount of time spent on processing any item decreases substantially (Payne, Bettman, and Johnson 1992). Consequently, large assortments can result in information overload and potential confusion about the products' characteristics and availability, such that the consumer feels overwhelmed, demotivated and dissatisfied, makes poor choices or chooses not to make a choice at all (Huffman and Kahn 1998; Iyengar and Lepper 1999b).

Decision conflict. Choice often produces conflict. Conflict arises when decisions involve a choice among options and no option best meets all of our objectives. When no alternative is dominant, selecting one alternative means that one has to give up something else of value which creates psychological conflict (Tversky and Shafir 1992). There is general theoretical agreement that the potential for conflict increases with the number of alternatives (Kiesler 1966). As most people seek to avoid conflict-laden decision problems, they may simply opt not to buy when faced with larger assortments, and this decreases sales. Empirical support for this is provided by Dhar (1997) and Tversky and Shafir (1992).

Regret. Regret is used to describe the sense of disappointment over something done or not done. Disappointment may result from a comparison of the actual outcome (e.g., the performance of the chosen SKU) with the alternative outcome (e.g., no-choice or the performance of non-chosen SKUs) and from feelings of responsibility for the disappointing outcome (Simonson 1992).

A wider assortment holds a greater potential for regret because of the greater chance that something attractive was lost. Recent research indicates that consumers anticipate regret (Inman, Dyer, and Jai 1997), and that the anticipated regret is incorporated in the

decision process (e.g., Bell 1982; Simonson 1992). The desire to avoid regret often leads to inaction or no choice, and thus a loss of sales (Dhar 1997; Iyengar and Lepper 1999b).

4. HYPOTHESES

In light of the evidence presented, we anticipate that assortment changes may trigger two opposite effects on sales. On the one hand, changes in the number of SKUs that lead to benefit increases and/or cost decreases for the consumer, exert upward pressure on category sales. On the other hand, SKU additions and deletions may also lead to decreased consumer benefits and/or increased consumer costs, which would tend to reduce satisfaction and sales.

For additions, the net outcome of these forces is generally expected to be positive, an expectation supported by available evidence (e.g., Kim et al. 1999; Mahajan et al. 1993; Mason 1990; Nijs et al. 2001) and industry practice. For deletions, the debate is still ongoing. Yet, a general feeling is emerging that for the category reductions observed in practice - like for extensions - the benefits to consumers outweigh the costs, implying a positive net impact on sales. Indeed, as indicated in our literature review, recent studies suggest that the impact of assortment cuts is generally expected to be positive, provided these cuts are not too extreme *and* too carelessly managed (e.g., Boatwright and Nunes 1999; Broniarczyk et al. 1998; Drèze et al. 1994; FMI 1993). Recent observations that '... perhaps the biggest task that category managers will have over the remainder of this decade is reducing the amount of superfluous items on the shelves' (Dussart 1998) support this view. Our conjecture, therefore, is that, on average, deletions positively affect category sales.

H_{Ma}: The main effect of adding SKUs to the category is positive.

H_{Md}: The main effect of deleting SKUs from the category is positive.

Moreover, the previous studies also suggest that the effect of assortment changes on category sales is expected to be *contingent* upon a number of factors that are hypothesized to influence the consumer cost and/or consumer benefit dimensions. By

carefully selecting items to be added/deleted and categories to be expanded/contracted, both additions and deletions become more likely to be rewarding.

To gain a better understanding of how (1) characteristics of the *SKUs* that were added or removed, and (2) *category* characteristics, influence addition and deletion effectiveness, we use the cost and benefit dimensions introduced before as an integrating framework. A schematic representation is given in Figure 1.

-- Insert Figure 1 about here --

4.1. Item characteristics

Features of the items added or deleted determine in large part the extent to which cost reductions and/or benefit increases are feasible (see, e.g., Mason 1990; Tversky and Shafir 1992). We consider four item specific factors: (1) uniqueness, (2) private-label nature, (3) manufacturer strength, and (4) display support allocated to the items.

Uniqueness.

Additions. Items are considered more or less unique based on the number of attributes they have in common (Hoch et al. 1999; Lattin and McAlister 1985). Adding unique SKUs allows consumers to avoid satiation with the category (Simonson 1992) and to better cater to variety-seeking needs (McAlister and Pessemier 1982; Steenkamp and Baumgartner 1992). The more unique the added SKU, the more likely it is to fill product gaps, and thus the greater the probability that each consumer gets the exact SKU s/he wants. Finally, adding unique items increases the consumers' perceived decision freedom (Reibstein et al. 1975).

Item uniqueness may also reduce decision-making costs. Items that are more unique are usually easier to distinguish, rendering the decision making task less arduous (Glazer, Kahn, and Moore 1991). If the attributes of the added SKUs are significantly different, fewer comparisons are necessary to make a choice (Shugan 1980), and overload decreases.

Deletions. When deleting more unique SKUs, it is more likely that the variety-seeking consumer's desire to consume a portfolio of attributes over time can no longer be fulfilled. Moreover, the probability that strongly preferred SKUs will vanish from the selection increases more with the deletion of unique SKUs (see Van Trijp, Hoyer, and Inman 1996).

In terms of costs involved, evidence indicates that similarity or duplication in the category makes shopping more difficult (Kahn and McAlister 1997), and that an important way to reduce the cognitive burden is "duplication reduction" (Raftery 1993). The deletion of duplicate SKUs makes the differences between alternatives more apparent which facilitates comparisons, decreasing potential conflict and regret. We thus hypothesize:

H_{1a}: Uniqueness of the SKU has a positive impact on addition effectiveness.

H_{1d}: Uniqueness of the SKU has a negative impact on deletion effectiveness.

Private-label nature.

Additions. There is evidence of two distinct segments: manufacturer-brand purchasers and private-label purchasers (Ailawadi, Neslin, and Gedenk 2001; Kim and Parker 1999). Private labels purchasers represent a large and *growing* market segment (Batra and Indrajit 2000), which may indicate an untapped demand, i.e. the existence of needs that are not satisfied by existing national brands. Private label introductions allow to better satisfy the preferences of this growing segment of private label buyers in the market and to cater to their variety seeking needs. Furthermore, the introduction of private label SKUs permits this group to stay with the familiar private label when they have uncertain preferences.

On the cost-side, we expect the degree of information overload, conflict and regret brought about by the introduction to be lower when the introduced SKU is a private label. First, the existence of a store label with a consistent value across a range of product categories can considerably facilitate the shopping experience (Ailawadi et al. 2001). Consumers can "economize" by concentrating their information search on one segment of the product space, and this might reduce information overload. In addition, private labels have become very similar to national brands on most attributes (Bronnenberg and Wathieu 1996), but offer all this at a lower price (Fitzell 1992). Thus, by offering superior value, private label additions may decrease conflict and regret.

Deletions. Deleting a private label SKU is more likely to cause larger benefit decreases, as chances are higher that this results in untapped demand, diminished

opportunities for variety seeking, loss of insurance against uncertain preferences, and the experience of a lack of autonomy for a large - and growing - segment of the market.

The costs of deleting a private label SKU will also be higher, as the overload reduction effect of "umbrella branding" diminishes, the potential for conflict rises with the removal of superior SKUs, and the difficulty to justify choice - and thus potential regret - increases. The net results lead to the following hypotheses:

$\mathbf{H_{2a}}$: Addition effectiveness is higher when the new SKU is a private label.

$\mathbf{H_{2d}}$: Deletion effectiveness is lower when the deleted SKU is a private label.

Manufacturer strength.

Additions. Firm size or market share has often been used as a proxy for market power in the organizational and industrial economics literature (e.g., Weiss 1989). A manufacturer's market share may influence not only the probability of obtaining distribution for newly introduced items (Rao and McLaughlin 1989), but also the quality of their shelf positions (Williams, Mulhern, and Leone 1997). Introductions by large manufacturers, therefore, are more likely to be noticed and increase perceived decision freedom.

Adding an SKU from a large manufacturer may also reduce consumers' decision-making costs. In trying to deal with complex and/or conflict loaden environments, consumers often use simple decision rules (Glazer et al. 1991). One popular and particularly relevant decision rule is 'buy the best known brand' (Hoyer and Brown 1990), which is typically a leading manufacturer's brand. Thus, SKU additions by large manufacturers may generate lower extra costs in terms of overload and conflict compared to SKU introductions by small manufacturers. Choosing a new SKU from a leading manufacturer also implies lower potential regret because the consumer has followed the "normal" heuristic.

Deletions. The removal of SKUs of larger manufacturers is less likely to go unnoticed, and thus more likely to decrease perceived decision freedom. The cost implications of deleting SKUs of large manufacturers will also be more severe, as consumers can no longer rely on the 'buy the best known' heuristic to simplify the

choice task and/or to resolve conflict, and because of the diminished potential for lower felt uncertainty and responsibility.

H_{3a}: The strength of the manufacturer of the new SKU has a positive impact on addition effectiveness.

H_{3d}: The strength of the manufacturer of the deleted SKU has a negative impact on deletion effectiveness.

Display support.

Additions. In-store displays may have a large effect on sales (Drèze et al. 1994). This will apply even more so when the displayed item is a new item, as many consumers may not yet be aware of the item. Moreover, displays often not only enhance the new item's visibility, but also increase the total space devoted to the category in the store.[2] As a result of this space increase, consumers may perceive the category as more varied, even if the actual number of different options remains the same (Broniarczyk et al. 1998).

The addition of SKUs with high display support may help to reduce information overload because processing of an item on display will be easier as the information stands out more (the item achieves more "environmental prominence"; Peter and Olson 1990). Consumers also often use promotion-based heuristics to reduce the assortment into a manageable set of offerings and to resolve (avoid) conflict (Bawa, Landwehr, and Krishna 1989).

Deletions. Because display activity directly touches upon visibility and salience, we expect that deletions of SKUs with a high level of display support are more likely to be noticed by the consumers, and therefore more likely to be accompanied by decreased feelings of perceived decision freedom.

Deletions of SKUs that were often on display may also entail larger costs because of the diminished potential to resort to simplifying and conflict-avoiding decision rules. We therefore advance the following hypotheses:

H_{4a}: Display support for the new SKU has a positive impact on addition effectiveness.

H_{4d}: Deleting SKUs with strong display support has a negative impact on deletion effectiveness.

4.2. Category Characteristics

Research indicates that the cost and benefit implications of assortment changes will be influenced not only by item characteristics, but also by the characteristics of the category in which the changes take place (see, e.g., Broniarczyk et al. 1998). We propose that the following category characteristics influence consumers' reactions to SKU additions and deletions: (1) the total number of SKUs, (2) concentration, (3) the ability-to-stockpile the category, and (4) the degree of assortment change.

Total number of SKUs: Additions/Deletions. The number of SKUs available in the category may affect addition and deletion effectiveness in two ways. First, using Weber's Law (Assael 1995), adding or deleting one SKU can only trigger responses if it exceeds the threshold of a 'just noticeable difference'. This threshold is proportional to the number of SKUs in the assortment. It follows that in larger categories, consumers are less likely to be aware of individual SKU additions or deletions, such that their (positive) impact on category perceptions - and hence consumer responses - becomes less pronounced (see Broniarczyk et al. (1998) for a similar observation). Therefore,

H_{5a}: The higher the number of SKUs in the category, the lower the addition effectiveness.

H_{5d}: The higher the number of SKUs in the category, the lower the deletion effectiveness.

Concentration: Additions/Deletions. As argued by and Dhar and Hoch (1997) and Narasimhan, Neslin, and Sen (1996), concentrated categories are typically categories with few market segments or low levels of variety seeking. Hence, adding new SKUs in such categories is not likely to substantially increase benefits, as consumers'

heterogeneity or need for variation is already catered for by available SKUs. In a similar vein, in view of their lower levels of preference heterogeneity and variety seeking, deleting items in higher concentration categories should entail smaller benefit reductions. Based on these observations, we hypothesize addition (deletion) effectiveness to be lower (higher) in concentrated categories.

H_{6a}: The higher the level of concentration in the category, the lower the effectiveness of an addition.

H_{6d}: The higher the level of concentration in the category, the higher the effectiveness of a deletion.

Stockpiling

Additions. Consumers choose higher levels of variety when pre-buying an inventory of SKUs for future consumption occasions (Simonson 1990; Simonson and Winer 1992). Buying a greater quantity lengthens the consumption horizon, thereby raising uncertainty about preferences at future consumption occasions. Shoppers handle this uncertainty by broadening the assortment of SKUs that they select at the time of purchase (Bucklin, Gupta, and Siddarth 1998). This implies that adding SKUs might be more beneficial in categories characterized by a higher propensity to stockpile. The opportunity for consumers to build an inventory of different SKUs in those categories also allows to reduce the potential for conflict and regret.

Deletions. Because consumers are likely to be more uncertain about preferences at the time of consumption when making purchases for multiple consumption occasions, the benefit reduction effect of deletions is likely to be stronger in categories with a high propensity to stockpile. The cost reduction effect of deletions, on the other hand, is less likely to be observed in categories with a high propensity to stockpile, as deletions may force consumers to buy multiple units of the same SKUs rather than a varied assortment, which may lead to higher experienced feelings of conflict and regret. Thus,

H_{7a}: The higher the ability to stockpile the category, the higher the effectiveness of an addition.

H_{7d}: The higher the ability to stockpile the category, the lower the effectiveness of a deletion.

Degree of assortment change: Additions/Deletions. In categories characterized by a great degree of assortment change, individual additions or deletions stand out less. As a result, they generate less pronounced shifts along the benefit and the cost dimensions, and hence less outspoken consumer responses.[3] Moreover, categories with a high degree of new SKU introductions constitute a high stimulation environment. In such a stimulating and complex context, consumers may seek out less purchase variation (Menon and Kahn 1995), such that the benefits of additions via increased variety seeking opportunities become less prominent. Hence, we hypothesize:

H_{8a}: The higher the degree of addition activity in a category, the lower the effectiveness of an addition.

H_{8d}: The higher the degree of deletion activity in a category, the lower the effectiveness of a deletion.

5. METHODOLOGY

5.1. Data

The data consisted of store-level scanner data provided by IRI / Europanel. Information was available on 63 product categories in the Netherlands. Product categories were delineated based on IRI ' s classification of product types, and represented a wide range of fast moving consumer goods found in a typical supermarket. Unlike previous studies that dealt with one chain or a few stores, our study covered a nationally representative sample of 358 supermarkets. In total, the data spanned 104 weeks. For each store, the data set included weekly SKU-level sales, price, and display and feature information for every category in 1997 and 1998. These IRI / Europanel SKU movement data allowed us to identify when SKUs were added to or deleted from the category, enabling us to establish the effect of additions and deletions at the SKU level.

The data set had two unique features, which make it especially appealing for our research purposes. First, the wide coverage of product categories and stores provided a basis for deriving empirical generalizations. Our categories varied not only in nature, but also in size, ranging from small (e.g. salt and light beer, with a store average of 12 and 7 SKUs, resp.) over medium sized (such as cola, cottage cheese and diapers, with an average of 34, 35 and 47 SKUs per store, resp.) to large categories (e.g. chips and babyfood, comprising no less than 131 and 144 SKUs, resp., in the average supermarket).

Second, the Dutch grocery retailing industry over this two-year period offered an excellent setting in which to examine the effects of assortment changes on category sales. Many retailers were engaged in category management projects and *deleted* SKUs from their assortment. At the same time, the *addition* of new SKUs continued at an overwhelming pace (Van Vught 1998). This was clearly reflected in our data set. While, in general, the number of additions in a category exceeded the number of deletions, the patterns of assortment extension and reduction *did* vary substantially across categories. For instance, while a substantial (net) expansion was observed for babyfood (with a yearly store average of 18 item deletions and no less than 45 introductions), the chips category was mainly subject to pruning (60 deletions versus 42 additions in the average store). Categories not only differed in the 'net' evolution of assortment size, but also in the degree of assortment volatility. Striking examples of categories with *high* volatility are diapers and cottage cheese where, out of the original assortment (48 and 35 SKU's, resp., in the average store), about one third (15 and 10 SKU's, resp.) was deleted in the course of the next year, the number of added items (27 and 18 SKU's, resp.) amounting to more than half the original number of SKU's. Examples of categories with *low* degrees of addition and deletion activity, on the other hand, are cola (with a yearly store average of about 6 additions and 6 deletions on a 34 item assortment) and rice (with 12 and 3 SKU's introduced to and removed from the 41 item category). Our data set, therefore, tends to cover the whole spectrum of situations encountered in practice.

5.2. Empirical analysis

Our empirical analysis was conducted in two stages. In a first stage, we derived the impact of additions and deletions on category sales for the various categories under study. Subsequently, we explained the differences in category effects on the basis of item and category characteristics. A similar 2-step procedure has been applied by, e.g. Bolton (1989) and Nijs et al. (2001), among others.

Derivation of the addition and deletion parameters

Estimates of addition and deletion effectiveness were derived from the estimation of sales response equation (1), applied to each of the 63 categories. The two key constructs in our research design are the number of additions (NP) and the number of deletions (DP), which may impact category sales (S). However, sales in a given category may not only be influenced by additions and deletions, but also by marketing-mix and/or other driving variables. For marketing-mix variables, we included display activity (DIS) and price (P).[4] Including the lagged sales variable, which serves as a proxy for time-invariant unobserved variables (like, e.g. the socio-demographic profile of the trading zone), allowed to correct for unobserved heterogeneity across stores (see, e.g., Leeflang et al. 2000; Putsis and Dhar 1999). To ensure comparability of effect sizes across product categories, we standardized all variables prior to estimation.

When looking at the monthly or weekly level, the dependent variable may be highly volatile due to seasonal factors not of interest to our study (e.g. weather conditions, holidays).[5] Moreover, as suggested by Broniarczyk et al. (1998) and Hoch et al. (1999), changes in category sales do not necessarily take place in the week or month in which the introductions or deletions take place. We therefore aggregated the data to an annual level, and focused on the explanation of store performance in the second year of our data (indicated by the subscript 2 in equation 1), in a model estimated across all 358 stores:[6]

$$(1) \qquad S_{i,2} = \beta_a NP_{i,2} + \beta_d DP_{i,2} + \delta_1 DIS_{i,2} + \delta_2 P_{i,2} + \delta_3 S_{i,1} + \varepsilon_{i,2}$$

where i is a store subsript (i =1,..., 358), and 1(2) denotes year 1(2).

Some additional comments regarding specification and estimation are warranted. It has been argued that addition and deletion decisions are typically under retailer control, and therefore should be treated as endogenous (Dhar and Hoch 1997). Technically, these decisions may be affected by omitted determinants of the category's sales (expectations), causing a correlation between these decisions and the error term, which could lead to inconsistent parameter estimates. We tested for the endogeneity of the addition and deletion decisions using Hausman's test (Hausman 1978), and found that in a vast majority of cases, they were indeed endogenous. We therefore used instrumental-variable estimation to break the dependence between the error term and the assortment decision variables. Following Dhar and Hoch (1997), instruments for these decisions were constructed based on their one-period lags.[7]

The moderating impact of item and category characteristics.

Equation (1) was estimated on a category-by-category basis, resulting in 63 separate estimates (one for each category) of the effect of (1) item additions (β_a) and (2) item deletions (β_d) on category sales. Denoting the estimates for category j as $\beta_{a,j}$ and $\beta_{d,j}$, we propose the following equations (2) and (3) to link the vector of parameter estimates to a set of item and category characteristics:[8]

$$(2) \qquad \beta_{a,j} = \chi_1 + +\chi_2 \mathrm{NPUNIQ}_j + \chi_3 \mathrm{NPPL}_j + \chi_4 \mathrm{NPTOP3}_j + \chi_5 \mathrm{NPDIS}_j + \chi_6 \mathrm{TOT}_j + \chi_7 \mathrm{CONC}_j + \chi_8 \mathrm{STOCKP}_j + \chi_9 \mathrm{NPDEGREE}_j + \varepsilon_{1,j}$$

$$(3) \qquad \beta_{d,j} = \gamma_1 + \gamma_2 \mathrm{DPUNIQ}_j + \gamma_3 \mathrm{DPPL}_j + \gamma_4 \mathrm{DPTOP3}_j + \gamma_5 \mathrm{DPDIS}_j + \gamma_6 \mathrm{TOT}_j + \gamma_7 \mathrm{CONC}_j + \gamma_8 \mathrm{STOCKP}_j + \gamma_9 \mathrm{DPDEGREE}_j + \varepsilon_{2,j}$$

where UNIQ is the SKUs' uniqueness (the prefix NP and DP denoting new versus deleted products), PL their private-label nature, TOP3 represents the manufacturer strength, DIS is the extent of display support, TOT stands for the total number of SKUs in the category, CONC is concentration, STOCKP is the ability-to-stockpile the category, NPDEGREE and DPDEGREE are the degree of addition or deletion activity, and j indexes categories (j=1,...,63).

As the dependent variables in the second stage are parameter estimates, we weighted for the reliability of their estimation using the inverse of their estimated standard error as a weight factor for all variables. Finally, to capitalize on potential efficiency gains from their joint estimation, we estimated equations (2) and (3) using Seemingly Unrelated Regression (SUR).

6. RESULTS

6.1. Impact of item additions and deletions in various categories.

In a first step, sales equation (1) was estimated for each of the 63 categories separately. Given the focus of the research and to avoid overwhelming the reader with all the minutiae inherent in considering the influence of 5 predictor variables for 63 categories, we focus on the two key parameters: β_a and β_d. Table 1 displays a summary of the results.

Table 1: Summary of main effects.

Independent variable	#Pos. / #Neg. coefficients	# Significant coefficients: # + / # -	Mean effect size	Heterogeneity in effect sizes
Addition (NP)	41 / 22	28 / 7[a,c]	.08[b]	$\chi^2(62) = 566$, $p = .000$
Deletion (DP)	35 / 28	20 / 13[a]	.03[b]	$\chi^2(62) = 477$, $p = .000$

[a] $p < .05$ (one-sided)

[b] $p < .0005$ (one-sided)

[c] To be read: 28 coefficients were significant and positive, 7 coefficients were significant and negative.

Table 1 reveals that a positive response is the most common effect for additions. Still, it characterizes only 41 out of 63 categories (column 2). The number of categories where new product introductions *significantly* increase sales is smaller: a significant and positive response is observed in 28 out of 63 categories (column 3). For item deletions, we find a positive effect on category sales in 35 cases, and a negative influence in 28 categories (column 2). The number of categories where deletions *significantly* increase sales is also larger than the number of categories where deletions significantly decrease sales, i.e., 20 versus 13 (column 3).

This indicates that in many cases, the benefit implications of assortment changes outweigh the cost implications. Still, there seems to be a fair amount of variation across the categories in the ability of additions and deletions to expand category sales. We investigated this formally. A meta-analysis was conducted to obtain an estimate of the mean effect size across all 63 categories, its associated probability, and a formal test of homogeneity of the effect sizes across the categories (columns 4 and 5). The correlation coefficient r between item additions/deletions and category sales was used as estimate of effect size.[9] The method of adding z-values was adopted to assess the significance of the relation between item additions/deletions and category sales, and a chi-square test was used to test for heterogeneity of the effect sizes (see Rosenthal (1991) for details).

The meta-analysis revealed that, collectively, the product category analyses showed a significant and positive effect of item additions on category sales (average r = .08, $p < .001$). The same picture emerged for the effect of item deletions: the mean effect size for the relationship between deletions and category sales was .03, which is significant ($p <$ .001). Thus, on average, both item additions and deletions lead to an increase in sales, providing support for H_{Ma} and H_{Md}. Note that the coefficient of additions is twice as high as that of deletions, indicating that - on average - the category sales increases from assortment expansion by far exceed those from assortment reduction. This provides some rationale for current industry practice where - as we observed - addition activity is generally more prevalent than deletion activity.

At the same time, the chi-square homogeneity test, conducted to assess the significance of the *variance* in effect sizes, revealed that there is significant heterogeneity among the 63 effect sizes, both for additions and deletions (see column 5). Not just the size, but also the direction of these effects exhibited a varied pattern across categories. In a number of instances, adding as well as deleting items produced a positive effect (25 categories), while in other instances, both additions and deletions had a negative impact (12 cases). In still other categories, the effects went in opposite directions, where positive addition and negative deletion impacts was the more common situation (16 categories), but the mirror pattern also occurred (negative addition and positive deletion influences found in 10 categories). This observed heterogeneity is consistent with previous research. Thus, any general conclusion about the ability of

additions and deletions to produce increases in sales must recognize that such a statement will likely be right on average, but not necessarily for specific individual items or categories. We therefore conducted a moderator analysis.

6.2. Moderators of addition and deletion effectiveness

The moderator model specified in equations (2)-(3) was estimated to uncover systematic influences of two basic categories of variables – viz. item and category characteristics- on the strength of the relationship between additions/deletions and category sales. Note that even though our number of categories is considerable from a substantive viewpoint, statistically speaking, it leaves us with a modest number of observations in the second step of the analysis. Therefore, to ensure sufficient stability of the estimated coefficients of our SUR system (2)-(3), we computed Jacknife estimates[10] and their significance. The results are given in Table 2. Positive coefficients indicate that the variable increases the ability of additions/deletions to generate positive sales response while negative coefficients imply the opposite.[11]

-- Insert Table 2 about here --

With respect to the impact of item-specific characteristics, we find that the uniqueness of the SKUs has the effect of increasing addition effectiveness (b = .59, p < .05) and decreasing deletion effectiveness (b = -1.00, p < .05). Therefore, both H_{1a} and H_{1d} are supported. Contrary to our expectations, the private-label nature of the SKUs does not affect addition effectiveness (H_{2a}; p > .10), while it increases deletion effectiveness (H_{2d}; b = .61, p < .10). H_{3a} states that additions from large manufacturers may be more successful than those of small manufacturers. This hypothesis is not supported (p > .10). The effect of manufacturer strength on deletion effectiveness is negative - which is in line with H_{3d} - but not statistically significant (p > .10). Finally, we find a significant and positive coefficient associated with display support for item additions (b = .42, p < .01), confirming H_{4a}. Display support, however, does not have a significant effect on the sales implications of item deletions (p > .10). Therefore, H_{4d} is not supported.

Our framework also posits effects of category characteristics on addition and deletion effectiveness. With respect to the total number of SKUs in the category, H_{5a}

and H_{5d} suggest that a larger number of SKUs is associated with lower addition and deletion effectiveness. In contrast with these hypotheses, the coefficient of the total number of SKUs is positive and significant in the addition ($b = .00$, $p < .10$) and the deletion equation ($b = .01$, $p < .01$). As expected (H_{6a}), high levels of concentration are found to reduce the impact of item additions ($b = -.29$, $p < .10$). Deletions, on the other hand, are found to be more effective in categories with a higher degree of concentration ($b = .51$, $p < .05$), which confirms H_{6d}. The ability-to-stockpile the category does not affect addition effectiveness ($p > .10$), such that H_{7a} is not supported. However, in line with our expectations (H_{7d}), a significant and negative impact is observed for the ability-to-stockpile in the deletion equation, implying that deletions tend to be less effective in categories with a higher ability-to-stockpile ($b = -.29$, $p < .05$). Lastly, the coefficient for the degree of new product activity is negative and statistically significant ($b = -.15$, $p < .05$), which is consistent with H_{8a}. We also expected the effect of item deletions to be lower in categories with a higher degree of deletion activity (H_{8d}). Though the observed effect has the expected sign, it is not statistically significant ($p > .10$).

7. CONCLUSIONS

7.1. Discussion and implications

While assortment composition is a core issue for retailers, it is also a painstaking undertaking. Retail store and category managers often find themselves caught in the middle between the need to 'enhance assortment appeal' and 'maintain assortment efficiency', yet with little systematic knowledge to go on. The aim of this study is to improve our understanding of assortment change effects, and to provide guidelines to managers on how to exploit these insights.

To this end, we developed a conceptual framework -grounded in theory and research from several disciplines- that unravels the cost-benefit trade-off inherent in retail assortments, and its consequences for the relationship between assortment changes and category sales. While showing the common elements underlying reactions to assortment increases on the one hand and decreases on the other, this framework also explains why consumer response to additions and deletions may not be symmetric counterparts.

Moreover, it indicates that statements about the net effect of assortment changes are not necessarily generally applicable, but idiosyncratic to items and categories.

Empirical analysis sheds further light on the hypotheses derived from the framework and - given the richness of the database - leads to generalizable findings on the sales impact of assortment changes. To begin with, our meta-analysis shows that, on average, the benefit increases (cost decreases) from assortment changes outweigh the cost increases (benefit reductions), as both observed expansions and contractions of categories result in enhanced category sales. This points to the potential pay off from both introducing new and dropping existing items. The positive main effect for item additions is consistent with, and justifies the abundance of, new product introductions in the FMCG industry. The positive main effect of deletions, on the other hand, may reduce the reluctance of some retailers to cut back on assortments out of fear to lose customers (Boatwright and Nunes 1999; Broniarczyk et al. 1998), and corroborates the recent trend among others to rationalize their product lines.

At the same time, the results point to substantial heterogeneity in effects across categories. Not only the strength, but also the direction of the impact of assortment changes varies: while the most frequently observed response is positive, one cannot ignore that in 7 (13) out of the 63 categories investigated additions (deletions) also harm sales. It follows that general comments about the effect of assortment changes on category sales can be quite misleading, implying the need to identify factors moderating this relationship.

Item as well as category characteristics are found to significantly explain the divergence in effectiveness of assortment changes. Item uniqueness is a key determinant of the impact of both item additions and deletions. Addition effectiveness is higher for more unique SKUs, which is consistent with the findings of Kahn and Lehmann (1991). We also find that uniqueness of the deleted items negatively affects the impact of assortment reduction on category sales. Taken together, these results support Hoch et al.'s (1999) view that item uniqueness is key to assortment perceptions. As hypothesized, concentration decreases the positive impact of additions, and increases the effectiveness of deletions. The underlying rationale is that concentration signals low heterogeneity in consumer tastes, and hence implies (few) opportunities to (expand)

simplify assortments without jeopardizing their customer appeal. Somewhat surprisingly, addition as well as deletion effectiveness is higher in categories with many SKUs. Tentatively, one might argue that the presence of many SKUs points to consumer heterogeneity and variety seeking. Adding new items caters to these varied consumer needs, while deleting (old) SKUs ensures that the assortment remains manageable.

Other moderators operate only in one direction, affecting the category sales consequences of either additions or deletions. Addition effectiveness is moderated by the level of item display – clearly indicating the need of making people aware of the new SKUs - and declines with previous assortment volatility. Deletions, on the other hand, are more effective in categories with low storability and, somewhat unexpectedly, for private label items. Potential explanations for the latter finding are that consumers' switching costs to national brand SKUs when a private label item is deleted are lower than vice versa (Blattberg and Wisniewski 1989), or that private label items will only be removed if they are truly redundant or unsuccessful.

The only variable that influences neither addition nor deletion effectiveness is 'manufacturer strength'. This lack of a relationship may indicate that consumers are either unaware of who produces a SKU (manufacturer names and brand names often not coinciding), or are more concerned with intrinsic product attributes.

In addition to furthering our understanding of the assortment change-category sales relationship, this study provides useful information to assist *managers* in implementing assortment strategies. A core finding is that both increasing and reducing the assortment are potentially rewarding. Obviously, the challenge for today's retailers is to pick the 'safe' items to add/remove, and add/remove them in the 'right' categories. Our study generates the following guidelines on these issues: When adding SKUs to a category, retailers should focus on items that offer something 'unique', and make sure these items receive sufficient display. At the same time, further category expansion should be avoided in categories where concentration or volatility - i.e. the previous rate of introductions - is high. Conversely, efforts at assortment downsizing should primarily take place in non-storable, high concentration categories with many SKUs, where duplicate items or private label SKUs are prime candidates for deletion.

Interestingly, our analysis also shows that the average increase in category sales from introductions exceeds that of SKU deletions. Despite the growing concern for item proliferation shared by many academics and practitioners, this finding seems to justify the continuing trend in FMCG categories to add more items than are deleted, thereby leading to ever larger numbers of SKUs stocked in the average store (see, e.g., Bucklin and Gupta 1999; Kahn and McAlister 1997). However, managers should interpret this result with caution, as this 'trend' may not continue in the future. First, the explosive category growth in assortments may render it increasingly difficult to come up with truly 'novel' items in the future (Kahn and Lehmann 1991). As introduction effectiveness is strongly correlated with item uniqueness, this may place downward pressure on the success of future additions. Further, our analysis clearly shows addition effectiveness to decrease with the rate of new product introductions. In light of this evolving reality, managers should keep track of customer response to assortment changes, and make sure to adapt their 'strategy' as adding more items becomes less rewarding.

Clearly, for retailers, these findings provide key inputs for improving category sales but also, from a broader perspective, for successfully balancing the store's customer appeal and operating costs. Manufacturers may find these insights beneficial to increase the success rate of their new product introductions, and to (re)direct promotional and R&D budgets. Last but not least, the findings of this study may further the development and successful implementation of mutually beneficial category management projects between retailers and manufacturers.

7.2. Limitations and future research

Like all research, this study has several limitations, which provide interesting avenues for future research. First, while our analysis points to significant associations between several item and category characteristics on the one hand, and addition or deletion effectiveness on the other, we should be cautious in making strong causal inferences. Indeed, as we used an observational rather than an experimental design, we cannot completely rule out the possibility of reverse causality.

Second, additional moderators could be examined. Advertising was not included in the empirical study because data were not available. To the extent that advertising is

correlated with manufacturer strength and/or display support (see, e.g., Reddy, Holak, and Bhat 1994), including a separate advertising variable may not offer significant new insights. Nevertheless, exploring the role of advertising support - and possibly other factors - on addition and deletion effectiveness may be useful.

Third, our study does not explicitly model cross-category effects. Cross-category relationships may occur as a result of purchase complementarity and/or substitutability of items included in a consumers' shopping basket (Mulhern and Leone 1991), and because of the existence of manufacturer loyalty across categories (Harlam and Lodish 1995). Future research should shed more light on how assortment changes in one category affect the sales performance of others. It may, for example, be that the private label - national brand distinction has a different impact when explicitly incorporating these interdependencies. Related to this is the fact that our study took the space allocated to a category as given – an assumption backed up by feedback from several industry experts. Yet, a key issue for future research is how space allocation to categories should be reconsidered as their number of SKUs evolves (Campo et al. 2000). Should the retailer continue to devote the same space to a category regardless of how many items it carries? Or should he, as suggested by Drèze et al. (1994), consider allocating the 'freed up' space to other categories more highly valued by the installed (or even expected future) customer base? Future studies could shed more light on these cross-category effects.

In a somewhat similar vein, our empirical study concentrated on the 'net' sales effects of category assortment changes, ignoring the underlying pattern of competitive interactions. Additions/deletions on the part of one retailer may trigger reactions from others (see, e.g., Simonson 1999), affecting the ultimate outcome of the decision. For store managers considering a specific assortment change, anticipating such competitive reactions may prove crucial to assess its ultimate implications for category sales. Conversely, they may have to act upon competitors' assortment moves to maintain their relative customer appeal. From this perspective, future research on competitive interaction patterns related to assortment changes appears of primary importance.

Fifth, by focusing on the category sales impact, the paper considers only the demand effects of assortment change strategies. Clearly, assortment expansions or

reductions also entail important cost consequences for retailers, triggering changes in inventory, handling, administration and out-of-stock costs. With appropriate data, future research on these cost consequences is conceivable. Such research would shed more light on the relationship between assortment changes and profitability.

Sixth, while our data set covers a wide range of stores and a diverse set of categories, all the data were obtained from one country, i.e. the Netherlands. The Netherlands is a highly industrialized country with an advanced distribution system, many of its chains (e.g. Ahold) being known for their professional category management applications (Coupe 1995). Furthermore, the presence of few restrictions on assortment and promotion practices makes the country an interesting 'test case' for studying the impact of assortment changes. Even so, verifying the validity of our findings in different settings should be useful, and further contribute to the development of generally applicable managerial guidelines for assortment composition.

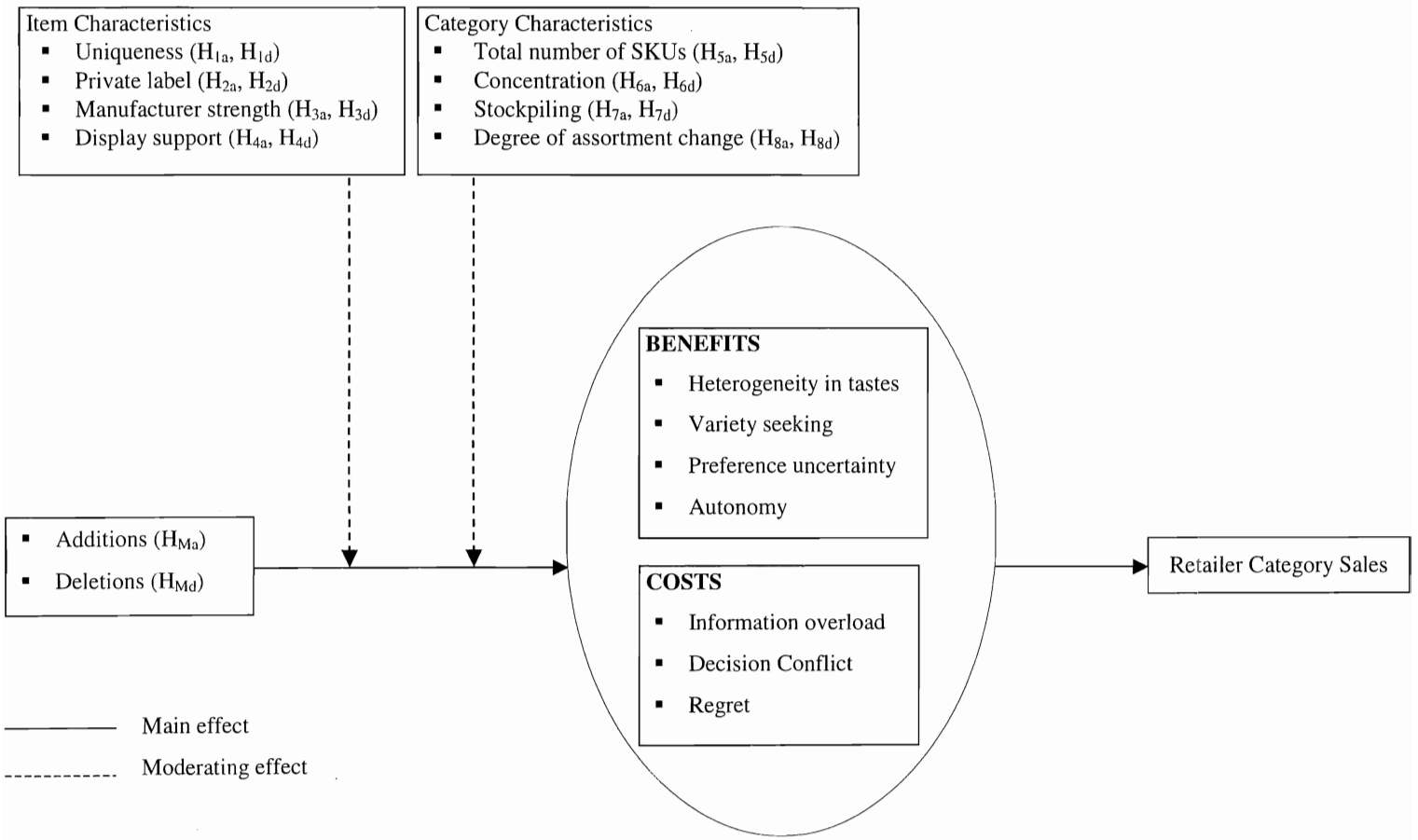
Finally, our study does not explicitly account for the time dimension in customer reactions. As indicated by Broniarczyk et al. (1998), and Hoch et al. (1999), immediate reactions to assortment changes may differ from long term responses, the latter being shaped by altered category perceptions and, in the case of SKU reductions, expected to be less positive. Given our focus on annual data and on (much more) frequently purchased categories, the effects obtained in our study will encompass at least some of these longer-term implications. Closer analysis of the dynamic reaction patterns underlying these effects may be a worthwhile next step, which could guide retailers in deciding upon the timing and frequency of assortment changes.

Table 2: Results of the moderating analyses. [12]

Dependent variable: *Addition* response (β_a)			
Independent Variable	Expected sign	b	t-value
Item characteristics			
Uniqueness (H_{1a})	+	.59[b]	1.73
Private label (H_{2a})	+	-.21	-.55
Manufacturer strength (H_{3a})	+	-.12	-.78
Display support (H_{4a})	+	.42[a]	2.99
Category characteristics			
Total number of SKUs (H_{5a})	-	.00[c]	1.51
Concentration (H_{6a})	-	-.29[c]	-1.57
Stockpiling (H_{7a})	+	-.01	-.21
Addition activity (H_{8a})	-	-.15[b]	-2.06
Dependent variable: *Deletion* response (β_d)			
Independent Variable	Expected sign	b	t-value
Item characteristics			
Uniqueness (H_{1d})	-	-1.00[b]	-1.92
Private label (H_{2d})	-	.61[c]	1.47
Manufacturer strength (H_{3d})	-	-.25	-.91
Display Support (H_{4d})	-	-.47	-.88
Category characteristics			
Total number of SKUs (H_{5d})	-	.01[a]	2.98
Concentration (H_{6d})	+	.51[b]	1.72
Stockpiling (H_{7d})	-	-.29[b]	-2.04
Deletion Activity (H_{8d})	-	-.13	-.92

[a] $p < .01$ (one-sided)
[b] $p < .05$ (one-sided)
[c] $p < .10$ (one-sided)

Figure 1: Research overview



APPENDIX A

Measures Step 1

For the estimation of the sales equations, all measures are developed at the individual retailer level. Yearly aggregates are created for each measure, resulting in two data points per retailer per category (i.e. one for the focal year 2 and one for the one-period lagged first year).

1. **'$S_{i,t}$ '** (Sales): The sum of the weekly volume sales of all SKUs in category *i* in a given year (t = 1,2; i =1, .., 358).
2. **'$NP_{i,2}$'** and **'$DP_{i,2}$'** (Addition/Deletion): For each SKU, information is available on 'first week moved' and 'last week moved' as defined by IRI / Europanel. New (deleted) SKUs are defined on the basis of this information on first (last) week moved. 'Addition activity', $NP_{i,2}$, is calculated by counting the total number of new SKUs that were sold in category *i* between the beginning and the end of year 2. Similarly, 'deletion activity', $DP_{i,2}$, is measured by counting the total number of SKUs that was deleted from category *i* between the beginning and the end of year 2.
3. **'$DIS_{i,2}$'** (Display): Display is measured as the total volume sold with display support in category *i* during year 2.
4. **'$P_{i,2}$'** (Price): Price is obtained by dividing value sales by volume sales for each SKU, and subsequent averaging across all SKUs within category *i* in year 2.

Measures Step 2

Each category (j = 1, …, 63) in essence serves as a single data point in the analysis of step 2, where we model $\beta_{a,j}$ and $\beta_{d,j}$ as a function of a set of item and category characteristics. For every category, measures of these item and category characteristics are calculated separately for each individual retail store *i*, and subsequently averaged. As such, each data point is computed using observations from 358 individual retail stores. All variables were operationalized on year 2 data.

Operationalization of the *item* characteristics:

1. **'$NPUNIQ_j$' ('$DPUNIQ_j$')** (Uniqueness): IRI / Europanel provided store level information about product characteristics for each of the categories, which allowed us to calculate a uniqueness measure. This measure assesses the degree to which the new (deleted) SKUs are different from the other SKUs in category *j*, and is based on

the count of the number of different attribute values between the new (deleted) SKUs and the other SKUs in category *j*. In particular, for each SKU we first compute a uniqueness measure that equals the number of unique attribute values divided the number of considered attributes (M_j).[13] Thus our *individual* SKU uniqueness measures range from 0 (when the added/deleted SKU is identical to another SKU in the category) to 1 (when the added/deleted SKU differs on all attribute values, i.e. when not a single item in the assortment has a common attribute value with the added/deleted item). We then define $NPUNIQ_{i,j}$ ($DPUNIQ_{i,j}$) to be the sum of the individual new (deleted) SKUs' uniqueness values, divided by the total number of SKUs introduced (deleted) in category *j* NP_j (DP_j). In case of additions, this becomes: [14]

$$NPUNIQ_{i,j} = \frac{\sum_{n=1}^{NPj} \sum_{m=1}^{Mj} d_{nm} \; / \; M_j}{NP_j}$$

where d_{nm} equals 1 when the value for attribute *m* of SKU *n* differs from all other SKUs, and 0 when the attribute value for SKU *n* and at least one other SKU is identical, and M_j = total number of considered attributes in category *j*. These key considered item attributes were defined by IRI / Europanel, and differed across categories. For example, the relevant attributes in the detergent category (e.g., concentration, usage, package, size and brand) were different from those in the yogurt category (e.g., flavor, fat content, size and brand).

2. **'$NPPL_j$' ('$DPPL_j$')** (Private label): This variable measures how important private labels are in the addition/deletion activity of category *j*. It is calculated as the ratio of the total number of new (deleted) private label SKUs in category *j* between the beginning and the end of year 2 to the total number of new (deleted) SKUs for category *j* as a whole for that same period.
3. **'$NPTOP3_j$' ('$DPTOP3_j$')** (Manufacturer strength): This variable equals the total number of SKUs introduced (deleted) by one of the top 3 manufacturers in category *j* between the beginning and the end of year 2, expressed as a fraction of the total number of new (deleted) SKUs in category *j* for that same period.
4. **'$NPDISP_j$' ('$DPDISP_j$')** (Display support): This variable measures the retail display support for the new (deleted) SKUs in category *j*. It is defined as the total number of

weeks in which there is a display for the new (deleted) SKUs during year 2, expressed as a fraction of the total number of display weeks for all SKUs in the category *j* during the second year. Thus, for each SKU in category *j* we counted the total number of weeks that there was display support in year 2. Subsequently, we sum across all new (deleted) SKUs and divide by the sum across all SKUs in that category.

Operationalization of the *category* characteristics:

1. **'TOT_j'** (Total number of SKUs): Represents the total number of distinct SKUs in category *j*, measured at the beginning of year 2.
2. **'$CONC_j$'** (Concentration): The concentration of category *j* is defined as the sum of the market shares of the three largest brands in year 2.
3. **'$STOCKP_j$'** (Stockpiling): Five expert judges were asked to rate the 63 categories on their ease to stockpile, using a 0-1 scale. There was considerable agreement across the raters (κ=.416, p<.001).[15] Their responses were subsequently combined into a single overall stockpiling score by taking the score of the majority. This yielded one stockpiling score per category, equal to 1 (=0) if category *j* exhibited high (low) ability-to-stockpile.
4. **'$NPDEGREE_j$'** (**'$DPDEGREE_j$'**) (Degree of assortment change): Measures whether category *j* is characterized by a high or low degree of addition (deletion) activity. It is operationalized through a dummy variable, taking on the value of 1 when the number of new (deleted) SKUs in category *j* between the beginning and the end of year 2 is higher than the average number of new (deleted) SKUs during this period across all categories, 0 else.

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FOOTNOTES

[1] For a review see e.g. Kahn 1995

[2] If regular shelf space for the category remains the same – which, according to industry experts, is the rule rather than the exception even if new SKUs are introduced in the category – end-of-aisle displays may still lead to an increase in total category space.

[3] In fact, one could consider this to be another consequence of Weber's Law, where a specific item addition becomes less 'noticeable' against the experience of a multitude of other additions (see Broniarczyk et al. (1998) for a similar argument).

[4] In addition to display, we also considered a measure of feature activity. The joint inclusion of display and feature activity, however, produced significant collinearity problems in the equation. We also conducted the estimations using feature activity only, but very similar results were obtained.

[5] For some categories, weekly or monthly volatility is also due to low category purchase incidence.

[6] Details on the specific operationalization of the variables are given in appendix A.

[7] These instruments were constructed using the standard two-stage least squares technique. We regressed the current endogeneous variables against their one-year lagged values, the predicted values of these regressions yielding our instrumental variables.

[8] Again, a detailed description of the actual operationalization of the variables is given in appendix A.

[9] This correlation coefficient was obtained by converting the Student's *t*-ratio associated with the estimated regression coefficient to a point biserial correlation by means of the formula given in Hunter and Schmidt (1990, p.272). A Fisher *r* - *z* transformation was then applied to the individual effect sizes, while their associated p-values were transformed to standard normal deviates. The mean effect size was estimated by averaging the transformed individual effect sizes and transforming this average back to the corresponding correlation.

[10] Jacknife estimates were obtained by subsequently leaving out each of the product categories in the addition and the deletion equation, and re-estimating the models on all the remaining categories. For more details on the computation of the Jacknife estimates and their significance, we refer to Fenwick (1979). Our full sample and Jacknife coefficients were very similar in magnitude and significance, indicating that the outcomes of the simple SUR estimation in step 2 were already quite stable.

[11] Condition indices in the test proposed by Belsley, Kuh and Welsley (1980) remained well below 20, suggesting no serious multicollinearity problems.

[12] The correlation between residuals across equations amounts to .372.

[13] We use the term uniqueness, rather than dissimilarity or distinctiveness, because the latter terms (or more precisely their opposites, similarity and substitutability) are generally used with regard to pairwise comparisons. We are considering the uniqueness of an SKU with respect to all SKUs in the assortment rather than with respect to just one SKU (see Kahn and Lehmann 1991, p.280).

[14] A comparable equation can be specified for item deletions.

[15] For a detailed discussion on the use of Kappa as a measure of inter-rater agreement, see e.g. Jones et al. (1983) and Light (1971).