The effects of price promotion on relative virtue and vice food products

RESEARCH ARTICLE

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Abstract

Retailers use price promotion of light and regular products, but not all of these products are perceived as relative virtues and vices, respectively. This paper aims to identify whether consumers distinguish between the two product categories. Survey data is used to distinguish between each product category, and identifies low-fat milk as a light product that gives both immediate and delayed rewards. Daily scanner data from a hypermarket supports the effects of price promotions on sales within and between product categories, as expected. We expect that, (1) due to these light products representing more enduring involvement, demand is less price sensitive compared to demand for regular products; (2) as nonimpulse purchase products, price promotions of light products cannibalize the sales of other light products; and (3) the loss of light product benefits associated with switching means that price promotions of light products hurt regular product sales more than vice versa.

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1. Introduction

Verbal descriptors are useful in product labeling to indicate that foods and drinks are *low* in specific nutrients (Arambepola *et al.*, 2008). These words include light, zero calorie, low fat, no fat and sugar free (hereafter, light product). They refer to diet food – that is, any food or drink whose recipe has been altered in some way to make it part of a body-modification diet (FDA, 2013). Light/regular classification has become widespread and is regulated by law, but there are doubts around whether consumers consider products with these labels as relative virtue or vice items, respectively. The virtue – vice distinction denotes which in a pair of goods is preferable when one considers the immediate and delayed consumption consequences (Wertenbroch, 1998). Relative virtues exchange small immediate costs (e.g. poorer taste of light cream cheese) for larger delayed rewards (e.g. health), whereas relative vices exchange small immediate rewards (e.g. good taste of regular-fat cream cheese) for larger delayed costs (e.g. future health problems) (Milkman *et al.,* 2008; Okada, 2005; Van Doorn and Verhoef, 2011). Some authors, such as Wertenbroch (1998), have suggested that the vice-virtue distinction is not absolute; in fact, Wertenbroch's study analyzed a total of 30 light and regular product categories, but only classified 21 of them as relative virtues and vices.

Researchers have found a negative taste association (which equates to a short-term sacrifice) with healthy products (Raghunathan *et al.,* 2006). Despite this, many people consume certain light products (e.g. light fruit drinks instead of regular fruit drinks) that give them a delayed reward (long-term social or health effects or any other long-term benefits) and do not consider these products as imposing an immediate, nonpecuniary cost – that is, a reason to believe that they are doing something they dislike in return for a future benefit. In fact, evidence has also pointed to a positive taste association with healthy products (Drewnowski, 1997; Smith, 2004). This implies that light products, which give a delayed reward, can be perceived as either having an immediate cost (i.e. relative virtue) or as not having an immediate cost.

In the same way, people consume certain regular products (e.g. regular coffee instead of decaffeinated coffee) that give an immediate reward (pleasure, flavor, ease of use, fun, temptation, or anything else that makes the product appealing to the consumer in the short term), but do not regard these products as imposing a delayed, nonpecuniary cost – that is, a reason to believe that they are doing something they like to their future detriment. This implies that regular products, which give an immediate reward, can be perceived as either having a delayed cost (i.e. relative vice) or as not having a delayed cost. In this way, we can put light and regular products on a continuum along with relative virtue and vice products (Figure 1). In this paper, we empirically test this continuum of product forms based on the two extremes of immediate and delayed consequences.

We build on several extant works (e.g. Dhar and Simonson, 1999; Hoch and Loewenstein, 1991) that have focused on whether consumers choose to forgo temptation to achieve a goal that lies on the opposite end of a single continuum, which ranges from a short-term desire for pleasure to a long-term goal that requires abstention from desired behaviors (e.g. indulging in tasty foods versus minimizing calories). This logic was
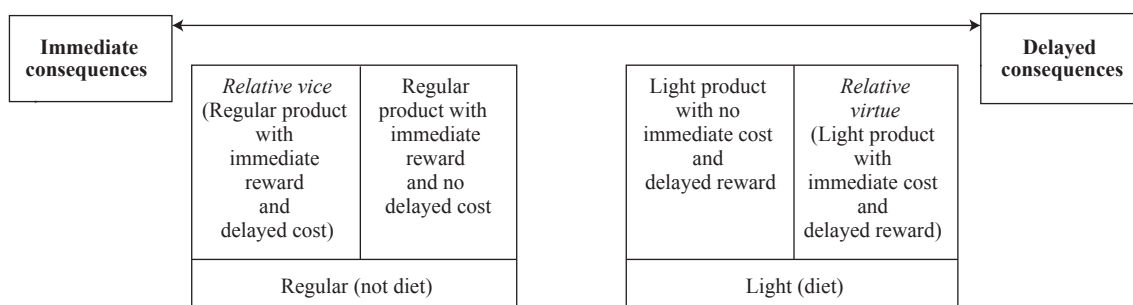
Figure 1. Continuum of products.

discussed by Haws and Winterich (2013); in situations where consumers must navigate multiple goals, they tend to concentrate on one goal at a time, often at the expense of other goals, with affect-driven motivations often overriding cognitions. In a more general form, whichever goal is made more salient by the environment will take priority over other goals, and will inhibit the accessibility of competing goals through a shielding process. Accordingly, we consider a continuum between immediate and delayed consequences where it is possible to integrate a relative vice-virtue structure and a light-regular distinction.

In addition, we build on the means-end chain model (Gutman, 1982), which emphasizes the role of values (defined as desirable end-states of existence) as a powerful force that governs individuals' choices; that is, the way in which people cope with a wide diversity of products that can satisfy their own values, grouping them into classes to reduce the complexity of choice. This model considers situation influences; thus, in some cases the relation between attributes of products and consequences for consumers are easy to determine. For example, for beer drinkers, the ability to control weight is clearly tied to the caloric level in beer, resulting in the category of light beer as opposed to regular beer. However, in other cases such relations are not easy to determine, requiring intermediate distinctions between the desired consequences and the actual product attributes, which are part of the distinctions made at the grouping level. For example, a consumer who wants good health and sees a connection between diet and health could form a natural-artificial distinction that could apply to drinks by grouping them according to type in an ordered array of categories along the dimension defined by the natural-artificial distinction. Accordingly, we integrate the light-regular distinction into the relative vice-virtue structure in a continuum between immediate and delayed consequences.

An interesting question that has emerged from research into relative virtues and vices is the effect of price promotions on purchase quantity (Wertenbroch, 1998). This is based on the idea of potential self-control, because consumers are tempted towards excess consumption of the relative vices they have in stock at home. The self-imposed constraint of rationing the quantity bought implies that consumers of relative vices will be less likely to buy large quantities (per shopping trip), compared to consumers of relative virtues, in response to price promotions. Nevertheless, some researchers have considered this effect as being conditioned by promotion type and cultural factors. Mishra and Mishra (2011) and Huyghe and Van Kerckhove (2013) found that consumers prefer a price discount to a bonus pack for relative vices (and vice versa for virtues) because the bonus pack (offering more of the product for the same price) leads to increased consumption of the vice. Similarly, Parreño-Selva *et al.,* (2014) noted a bigger effect on sales for price promotions of regular beer than for alcohol-free beer. This may be because alcoholic beer is not considered a relative vice in Spain (according to the continuum of products in Figure 1, it would be a regular product with no delayed cost), meaning that consumers do not feel the need to use self-control when drinking it. Regular beer is perceived as a natural product of low alcoholic strength, which forms part of a healthy Mediterranean diet and is linked with moderate consumption at social gatherings (Cerveceros de España, 2001). This idea has also been supported by research in recent decades on health, epidemiology, and nutrition, which has found a link between moderate alcoholic beer consumption and health (Kaplan *et al.,* 2000; Klatsky *et al.,* 2003).

Alternatively, we focus on the influence of price promotion on sales of products that are not characterized as relative virtues, and in particular on light products that do not impose an immediate cost and give a delayed reward (Figure 1). We expect that, due to these light products representing more enduring involvement[1], the demand for promoted light products is less price sensitive compared to the demand for promoted regular products; furthermore, as nonimpulse purchase products, price promotions of light products cannibalize the sales of other products within the light category; finally, the loss of light product benefits associated with switching means that price promotions of light products hurt regular product sales more than vice versa.

Our objective is twofold: first, we aim to find out whether consumers see light and regular products as relative virtues and vices, respectively; second, by focusing on one light product with no immediate costs

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[1] Enduring involvement is defined as an individual difference variable representing the arousal potential of a product or activity that causes personal relevance (Higie and Feick, 1989).

and delayed rewards – low-fat milk – we calculate the net effect of price promotion of this light product on sales in comparison to the regular product (whole milk). Survey data on university students finds that light and regular products are seen as being different from relative virtues and vices. Daily scanner data from a hypermarket supports the own and cross effects within and across categories for milk, where low-fat milk is identified as a light product that is preferred from both perspectives – immediate and delayed.

2. Effect of price promotions on retail sales of regular products and light products with no immediate costs

Traditionally, marketing researchers have examined whether price promotions are a useful way to increase sales and, to this end, have developed econometric models to estimate the price sensitivity of retail demand using scanner data (e.g. Blattberg *et al.,* 1995; Pauwels *et al.,* 2002; Van Heerde *et al.,* 2002, 2004). The logic of these studies rests on the impact of promotions on the acceleration of purchases by consumers (buying earlier than usual and/or buying more than usual) and, therefore, on household stockpiling.

Apart from these normative arguments about the effects of inventory size on consumption (lower cost per unit consumed), psychological elements also come into play. Certain product characteristics – for example, vice and virtue – related to inter-temporal distribution of the costs and benefits of consumption could also impact the effect of storage. This raises the possibility that some inventory effects on consumption are impulsive (Wertenbroch, 1998), and incites self-imposition of constraints on consumption.

Alternatively, our study considers that relative virtues and vices are not fully equivalent to light and regular products sold by retailers, which will affect the own and cross effects of price promotions of these product categorizations. By focusing on light products, which do not impose an immediate cost and give a delayed reward, and on regular products, we distinguish the effects described in the following sections.

2.1 Own price promotion effect

The own price promotion effect is the effect of price promotion on the sales of promoted product. Our study expects that sales are less sensitive to the price promotion of a light product that does not impose an immediate cost and gives a delayed reward than to the price promotion of a regular product. This own effect is argued through enduring involvement; an aspect that underlies both light products and the concept of organic (i.e. chemical-free) products.

Basically, a light product that does not impose an immediate cost and gives a delayed reward represents more enduring involvement compared to a regular product (nondiet) because it is a virtuous[2] choice due to its delayed reward (i.e. less negative long-term consequences). Similarly, organic products (natural yogurt, organic milk) represent more enduring involvement for consumers because these products are a means of achieving important life values (Bezawada and Pauwels, 2013). Consumers of organic products perceive these products to offer benefits related to taste, nutritional value, health, environmental protection, animal welfare, and ethics (Bourn and Prescott, 2002). However, despite there being some studies that contradict this (e.g. Gutman, 1982), we follow the common conclusion in the literature (e.g. Van Doorn and Verhoef, 2011) and believe that consumers consider taste and health concerns before more altruistic motivations, such as animal welfare and care for the environment, especially for food purchases, because consumers are characterized as 'unashamedly selfish'. Taste and health benefits are also perceived by consumers of light products as benefits which do not impose an immediate cost and give a delayed reward; in addition, the

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[2] The characterization of involvement as the purchase of anything that is 'virtuous' (i.e. the purchase of any product with a delayed reward must be the act of someone with higher involvement) highlights the idea that people are more committed to 'long-term thinking'. However, it does not correspond very closely with many explanations of consumer involvement in the literature (Laurent and Kapferer, 1985; Mittal and Lee, 1989).

choice of these light food products[3] is not based on social goals either, because individual motives have a stronger influence on food choice compared to social ones (Van Doorn and Verhoef, 2011).

Regarding the price promotion effect, despite the possibility of price promotions of organic products representing a strong buying incentive, with little potential for perceived quality erosion (Delvecchio *et al.*, 2006), price promotions may be less effective for organic products than for conventional products. Organic products represent more enduring involvement (Makatouni, 2002). Thus, consumers not only consider benefits and costs at the moment of purchase when faced with a price promotion for organic products, but also consider the benefits of these products in the future with a reasonably low price (Bezawada and Pauwels, 2013). In consequence, a reduction in regular prices, but without increasing temporary promotions, would be more effective for organic than for conventional products. In terms of the idea that more enduring involvement underlies light products with no immediate cost, we expect that the own price promotion effect will be bigger for regular products than for light products that do not impose an immediate cost.

2.2 Cross effects within the light product (or regular product) category

Cross effects within the category are the effects of price promotion on the sales of products that belong to the same product category as the promoted product (within-category effects). These cross effects can be complementary if the price promotion increases the sales of other products, or substitutive if the price promotion damages the sales of other products. Our study expects that complementary within-category effects of promoted regular products are greater than those of promoted light products, while the substitutive within-category effects of promoted regular products are smaller than those of promoted light products. These within category cross-effects are argued to rely on the degree to which the product counts as an impulse buy.

In general terms, the extent to which a product category is impulse bought supports the expansion of the category produced by promotion (complementariness effect) (Narasimhan *et al.,* 1996). The logic rests on the idea that promotion attracts consumers to the category and stimulates impulse buying. However, promotion does not generate a brand switch (nonsubstitution effect), given that a brand switch effect would imply that the consumer was planning to buy a specific brand but this intention was changed by the promotion, whereas impulse buying is, by nature, an unplanned purchase.

Conversely, nonimpulse-bought products (i.e. relative necessities) are less elastic in terms of purchase incidence and stockpiling; therefore, promotions of these products will have a lesser sales effect within their own category (noncomplementariness effect) (Bell *et al.,* 1999). Moreover, insofar as a product is a necessity (planned purchase), which implies that consumers have little flexibility to adjust the demand of the category, the only way for consumers to save money is via brand switching, which suggests a greater within-category cross-sales (substitution) effect.

Basically, regular products are more likely to be bought on impulse (unplanned) compared to light products with no immediate cost. For example, Narasimhan *et al.* (1996) found that the following products show a drastic difference in their propensity for impulse buying: diet pills, which are perceived as a low-impulse product; and candy and mints, which are perceived as high-impulse products. Similarly, Wertenbroch (1998) considered candy and alcohol as impulse goods. That is, regular (nondiet) products are mainly characterized based on their immediate reward and, therefore, based on greater short-term temptation, and tend to be impulse bought. Conversely, light products with no immediate cost represent a virtuous choice as they are mainly characterized by less negative long-term consequences, and therefore tend to be bought less on impulse and more as a planned purchase. Thus, we can predict a complementary effect for the price promotions of regular products on the sales of other regular products within this category, and a substitution effect for price promotions of light products on sales of other light products within this category. That is, we can expect that

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[3] A difference regarding these light products is that organic product purchase is inhibited by low availability and distribution, price premium, and lack of consumer knowledge (Bezawada and Pauwels002C 2013); as credence goods (associated with a high degree of uncertainty), they require appropriate labeling (third-party certification) to mitigate uncertainty.

the complementary within-category effects of promoted regular products are greater than those of promoted light products with no immediate costs. In addition, we can expect that the substitution within-category effects of promoted regular products are smaller than those of promoted light products with no immediate costs.

2.3 Cross effects between categories

The cross effects between categories are the effects of price promotion on the sales of products that belong to different categories of promoted product (cross-category effects). These effects can also be complementary or substitutive. Our study expects a greater substitutive price promotion effect of a light product on sales of regular products (substitution cross-category effects) than vice versa, as well as a smaller complementary price promotion effect of a light product on sales of regular products (complementary cross-category effects) than vice versa. These cross effects between categories are argued to be based on the loss of light-product quality benefits associated with product switching; an aspect that also underlies organic products.

This hinges on the idea that if light products with no immediate costs, such as with organic products (see above), offer intrinsic quality benefits to consumers (e.g. health benefits and taste), especially for food purchases, switching to conventional products represents a loss of these benefits, which consumers would seek to avoid (Bronnenberg and Wathieu, 1996). Thus, price promotions of organic products (and of light products) would hurt conventional product sales more than vice versa (Bezawada and Pauwels, 2013). In addition, we consider that the purchase of a promoted light product would reduce additional regular product purchases (substitution cross-category effect) more than vice versa, whereas purchase of a promoted regular product would increase additional purchases of light products (complementary cross-category effect) more than vice versa. That is, we can expect that the substitution cross-category effects of promoted light products – which do not impose an immediate cost – on regular product sales are greater than vice versa. In addition, we expect that the complementary cross-category effects of promoted light products – which do not impose an immediate cost – on regular product sales are smaller than vice versa.

3. Identifying light and regular product categories and relative virtue and vice product categories

Analysis of the first objective of our study requires a research design suited to examining whether light and regular products are equivalent to relative virtues and vices for consumers. In order to identify light and regular product categories by distinguishing between relative virtue and vice product categories, we use Wertenbroch's (1998) procedure, which uses a consumer survey to identify individuals' temporal preference order for pairs of product categories. The study's sample consists of 176 university students in the third year (an average age of 21 years) of a business and administration degree in Spain. The students were invited to dedicate five minutes to complete a questionnaire after class. The participant motivation was the possibility of receiving a reward, since they were told that €10 would be given to 10% (decided via raffle) of the students (randomly selected) who filled out the questionnaire. Finally, 52% of the 340 students who received the questionnaire completed it.

We use seven pairs of product categories (butter vs margarine, regular vs decaffeinated coffee, regular vs light mayonnaise, regular vs diet soft drinks, white vs brown sugar, sugared vs low-sugar cereal, and whole vs low-fat milk). These pairs of product categories were selected by following the list of categories used by Wertenbroch (1998), and taking into account the criterion that surveyed students could understand them. For each pair, students rated (using a nine-point scale anchored at 1 and 9 by the two categories) the category that they would prefer to consume, considering first the immediate consequences (hereafter i) of consumption (e.g. taste, ease of use, fun, temptation, or any other short-term benefit) assuming identical delayed consequences (e.g. long-term social or health effects or any other long-term costs or benefits); and second only considering the delayed consequences (hereafter d) of consumption, assuming identical immediate consequences.

We then rescaled the subjects' i and d ratings from -4 to +4, such that a preference for the hypothesized vice (virtue) in a pair would always be indicated by a negative (positive) rating. Subsequently, we sorted responses (Table 1) depending on whether an individual preferred one category from one temporal perspective but expressed the reverse preference from the other temporal perspective ($d>0$ and $i<0$, or $d<0$ and $i>0$), or whether the individual at least weakly preferred the same category in a pair from both temporal perspectives ($d\geq0$ and $i\geq0$, or $d\leq0$ and $i\leq0$). Positive temporal reverse scores[4] ($d-i>0$, because $d>0$ and $i<0$) mean that the category was preferred based on the delayed consequences but not on the immediate consequences, so it is a relative virtue, while the other category in the pair is a relative vice. Negative temporal reverse scores ($d-i<0$, because $d<0$ and $i>0$) mean that the category not preferred from the delayed consequences was preferred from the immediate consequences, so it is a relative vice, while the other category in the pair is a relative virtue. Finally, a pair in which a category was at least weakly preferred in both temporal perspectives, immediate and delayed ($d\geq0$ and $i\geq0$, or $d\leq0$ and $i\leq0$), received a temporal reversal score of zero ($d-i=0$), which indicates no inconsistent temporal preferences. This latter case would represent a light product with no immediate cost ($d\geq0$ and $i\geq0$), or a regular product with no delayed cost ($d\leq0$ and $i\leq0$), respectively.

3.1. Results of identification of light and regular product categories and relative virtue and vice product categories

Our results (Table 1) allow us to distinguish the cases of relative virtue and vice, where individuals have temporal reversal preferences ($d>0$ and $i<0$), from the cases of light or regular products, where individuals prefer the same category in a pair from both temporal perspectives ($d>0$ and $i\geq0$, and $d=0$ and $i<0$). The pairs of mayonnaise, cereal, and soft drinks products present mean values that are positive for d, negative for i, and significantly different from zero ($d>0$ and $i<0$), and positive mean temporal reverse scores that differ from zero at a 99% confidence level. This shows that the categories in these pairs create intertemporal conflict between preferences, so they can be characterized as relative vices and virtues. For example, with mayonnaise, the light-mayonnaise category gives people a delayed reward ($\bar{d}$=0.94; $P<0.0000$) while the regular mayonnaise category gives an immediate reward ($\bar{i}$=-0.77; $P<0.0000$), with positive temporal reverse

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[4] For example (adapted from Wertenbroch, 1998), if an individual selected '1' on the immediate scale (indicating a preference for one anchor; e.g. regular mayonnaise) and '8' on the delayed scale (indicating a preference for the other anchor; e.g. light mayonnaise), these values were rescaled to -4 (immediate) and +3 (delayed). The temporal reversal score (delayed minus immediate) would be +7, so that regular mayonnaise would be classified as a relative vice and light mayonnaise as a relative virtue.

Table 1. Relative vice and virtue product categories and regular and light product categories.[1]

Product category	Immediate consequences (i)	Delayed consequences (d)	Product category	Mean temporal reversal score	n
Relative vice	$i<0$ and $d>0$		Relative virtue		
Regular mayonnaise	-0.772****	0.943*****	Light mayonnaise	1.35*****	176
Sugared cereal	-1.153*****	0.454**	Low-sugar cereal	1.26*****	176
Regular soft drinks	-0.676****	0.750****	Diet soft drinks	1.05*****	176
Regular product with no delayed cost	$i<0$ and $d=0$		Light product		
Sugar	-1.630*****	0.125	Brown sugar	1.26*****	176
Regular coffee	-1.034*****	0.079	Decaffeinated coffee	0.58*****	176
Regular product	$i\geq0$ and $d>0$		Light product with no immediate cost		
Butter	-0.284	0.914*****	Margarine	0.95*****	176
Whole milk	0.358*	1.534*****	Low-fat milk	0.09	176

[1] * $P<0.10$, ** $P<0.05$, *** $P<0.01$, **** $P<0.001$, ***** $P<0.0001$ in two-sided test.

scores (d-i>0). This implies that the light-mayonnaise category preferred in terms of delayed consequences was not preferred in terms of immediate consequences, so it is a relative virtue while the other category is a relative vice.

However, for the four remaining pairs of products (sugar, coffee, butter, and milk), consumers showed a preference for the same category from both temporal perspectives (immediate and delayed); thus, these regular and light pairs of products were deemed not to induce time-inconsistent preferences and cannot be characterized as relative vices or relative virtues. The butter and milk pairs show average values of d>0 that are significantly distinct from zero, being average values of i that are significantly distinct from zero (i>0) for milk and not statistically different from zero (i=0) for butter. Thus, for milk, the low-fat milk category gives a delayed reward ($\bar{d}$=1.53; P<0.0000) and a weak immediate reward ($\bar{i}$=0.36; P<0.10). This preference for the same category suggests that this category represents a light product that does not impose an immediate cost. A similar result is evidenced in the margarine category. The margarine category gives people a delayed reward ($\bar{d}$=0.914; P<0.0000) but the immediate reward is not significant ($\bar{i}$=-0.284; P>0.10). In consequence, there is no evidence that low-fat milk or margarine are relative virtues that impose an immediate cost.

The product pairs of sugar and coffee have average values of d that are not statistically different from zero, while those of i are negative and significantly different from zero. The regular coffee category gives an immediate reward ($\bar{i}$=-1.03; P<0.0000), but its delayed reward is not statistically significant ($\bar{d}$=0.07; P>0.10). That is, there is no evidence that regular coffee is a relative vice product that imposes a delayed cost. Hence, regular coffee can be identified as a regular product with no delayed cost. Similar results are found in the sugar category. In other words, the participants did not regard sugar and regular coffee as imposing a delayed cost.

In brief, our results reveal that consumers distinguish light and regular products from relative virtues and vices, according to the continuum of Figure 1; thus, virtues and vices are not equivalent to light and regular products.

4. Estimating the net effect of price promotion of low-fat milk (light product) on sales in comparison to whole milk (regular product)

Analysis of the second objective of our study required a research design suitable for estimating the total effect of price promotion. In this section, we focus on milk as an example of light and regular products, where whole milk is identified as a regular product while low-fat milk is identified as a light product that does not impose an immediate cost and gives a delayed reward.

4.1 Data

Our study uses data from a hypermarket chain with 56 stores in the Alicante province (Spain). Insofar as the residents of the area have weekly incomes, live in apartments, and the parking in the hypermarket is restricted, we can expect that customers do not acquire many products during price promotions to store them and consume them later (no stockpiling effect). The database comprises daily data, for two years (2009-2010), at the item level of different products. Milk was chosen because, first, application of the Wertenbroch procedure (1998) to the data from the survey of Spanish university students (see previous section) classifies whole milk within the regular products category and low-fat milk within the category of light products that do not impose immediate costs and give delayed rewards. In particular, our analysis of price promotion groups two low-fat milk products, semi-skimmed and skimmed milk, into the light products category. Semi-skimmed and skimmed milk have different nutrient levels; however, the delayed reward explains why they are included in this category of light products, since both are specifically indicated for diets that prohibit the consumption of full-fat milk due to the saturated fats, contained in its cream, that increase blood cholesterol levels. Second, the milk products family is ideal for the objectives of this study because the products of whole, semi-skimmed, and skimmed milk vary greatly in terms of sales and price promotions.

The descriptive analysis on milk products is shown in Table 2. From the items belonging to these products, we selected those that had been for sale for more than 450 days. A similar procedure was used by Leeflang *et al.* (2008). For each item, Table 2 shows the total sales income (regular price × product units) during the study period; the use of price changes; the average price; and the number of days that the product had a sales volume different from zero. At the price level, in Alteza 1 l there is no variability among whole, semi-skimmed, and skimmed versions, so these variables were removed from all sales models. Of the whole-milk products, Puleva calcio completa 1 l and Puleva 1 l have almost no price variability (6.03 and 6.20%, respectively);

Table 2. Descriptive statistics at the item level.

	Item[1]	Sales income (euros)	Number of days with sales	Average price	Percentage of days with change in daily price over 5%
Whole milk	Pascual Calcio 1 l	5,521.25	556	1.26	16.73
	Puleva Calcio 1 l	7,178.94	556	1.15	20.14
	Puleva Omega 3 1 l	40,071.27	598	1.35	23.08
	Puleva Calcio Completa 1 l	6,822.58	580	1.34	6.03
	Alteza Calcio 1 l	1,539.28	454	0.78	0.00
	Pascual 1 l	17,304.72	600	0.90	13.33
	Puleva 1 l	6,525.71	581	0.85	6.20
	Asturiana 1.5 l	11,292.47	588	1.33	11.22
	Asturiana 1 l	8,781.31	591	0.82	15.57
	Alteza 1 l	10,922.37	599	0.63	0.00
Semi-skimmed milk	Pascual Calcio 1 l	13,811.58	598	1.26	22.58
	Puleva Calcio 1 l	7,463.35	595	1.15	20.00
	Asturiana Naturfibra 1 l	5,592.56	571	1.17	31.17
	Alteza Calcio 1 l	3,807.00	547	0.78	1.10
	Puleva Calcio Soja 1 l	3,490.19	511	1.26	5.09
	Puleva A+D 1 l	7,757.70	592	0.95	6.25
	Flora 1 l	5,281.48	540	1.28	3.89
	Ram 1 l	6,116.18	583	0.78	0.86
	Pascual 1 l	26,396.49	600	0.90	13.50
	Asturiana 1.5 l	22,919.57	600	1.33	11.00
	Asturiana 1 l	21,914.58	597	0.82	15.58
	Asturiana Naturlinea 1 l	2,323.08	452	1.52	24.56
	Alteza 1 l	10,348.46	598	0.63	0.00
Skimmed milk	Pascual Calcio 1 l	21,628.02	575	1.26	16.52
	Puleva A+D 1 l	7,377.81	587	0.85	6.30
	Puleva Calcio 1 l	17,387.43	595	1.15	20.17
	Alteza Calcio 1 l	4,611.60	579	0.78	1.04
	Puleva Calcio Soja 1 l	3,224.46	482	1.25	6.43
	Ram 1 l	4,782.92	568	0.78	3.52
	Pascual 1 l	20,556.30	600	0.90	17.17
	Asturiana 1.5 l	9,360.06	592	1.33	11.15
	Asturiana 1 l	9,959.75	599	0.82	15.53
	Asturiana Naturfibra 1 l	3,618.69	515	1.17	24.66
	Alteza 1 l	8,524.39	572	0.63	0.00

[1] These items have a sell by date of 3 months.

the same applies to the semi-skimmed (Puleva calcio soja 1 l, Puleva A+D 1 l, Flora 1 l and Ram 1 l) and skimmed products (Puleva A+D 1 l, Puleva calcio soja 1 l and Ram 1 l). This lack of variability led us to exclude these price index variables from the sales models.

4.2. Methodology

The applied methodology is based on several models that estimate the total net effect of price promotions of light and regular milk products on sales, distinguishing the following effects: (1) own-item sales effect (effect of price promotion of light or regular product on own sales); (2) cross-period sales effect (cross effects between periods); (3) within-category sales effect (effect of price promotions of light products on sales of other light products, and effect of price promotions of regular products on sales of other regular products); and (4) between-category sales effect (effect of price promotions of light products on sales of regular products, and effect of price promotions of regular products on sales of light products). This entails modeling to enable decomposition of the impact of price promotions from previous effects.

To this end, we adapt the decomposition model of the effect of price promotions on sales proposed by Leeflang *et al.* (2008), considering the possible differences between categories of light and regular products. Leeflang *et al.* (2008) assumed that the substitution effect between categories (the reduction in sales of some products of a category due to price promotion of products of another category) accounts for part of the category expansion effect. In this sense, the category expansion effect plus the between-categories substitution effect equals the net category expansion effect. This net effect measures the increase in the consumption ratio of the products in the category and the possible cross-store effects (sales increases resulting from attracting customers from competing stores) as a consequence of the price promotion. However, the profits gained from price promotions by retailers and manufacturers with products in different categories (*c* and *c'*) is the sum of the net expansion effect of the category and the complementariness effect between categories, and is known as the total effect.

Given that this study aims to analyze the existence of differences in the effects described above, at the level of light and regular product categories, incorporation of this differentiation results in the following relationships between the effects (we use the example of the promoted item belonging to the light category, *c*)

$$LI = CE - OLWC - OLWCOP \qquad (1)$$

$$OLWC = POLWC - NOLWC \qquad (2)$$

$$NCE = CE + SBROC \qquad (3)$$

$$TC = NCE + CBROC \qquad (4)$$

Where LI is the effect on sales of the light promoted item; CE is the category expansion effect; OLWC is the effect on sales of other light products within the same category; OLWCOP is the effect on sales of light products within the same category in other periods; POLWC is the positive effect on sales of other light products within the same category; NOLWC is the negative effect on sales of other light products within the same category; NCE is the net category expansion effect; SBROC is the substitution effect between regular products in other categories; TC is the total effect of a combination of categories; and CBROC is the complementary effect between regular products in other categories.

There is an exact relationship between total sales of a combination of categories (1, ..., *c*,... , *c'*,... *C*) (TC_c) in a certain period of time (*t*, *t+w*, where *w* refers the time period after the price promotion has occurred; *w*=1, 2, ...) and the following elements: sales of the promoted item in the category *c* (PI_c); sales of other items in category *c* with the same brand and with different brands to the promoted item that substitute sales of this product ($OISBS_c/OIDBS_c$); sales of other items in category *c* with the same brand and with different

brands to the promoted item that complement its sales ($OISBC_c/OIDBC_c$); sales of other items in category c' with the same brand and with different brands to the promoted item that substitute sales of this product ($OISBS_c/OIDBS_c$); sales of other items in category c with the same brand and with different brands to the promoted item that complement its sales ($OISBC_c/OIDBC_c$); and sales in other periods (OP_c). Consequently, we obtain the following expression for decomposition of the effect of price promotions, which is similar to that used by Leeflang *et al.* (2008):

$$
\begin{aligned}
TC_c = {}& PI_c + OISBS_c + OIDBS_c + OISBC_c + OIDBC_c + OP_c \\
& + \sum_{\substack{c'=1 \\ c \neq c'}}^{C} (OISBS_{c'} + OIDBS_{c'} + OISBC_{c'} + OIDBC_{c'})
\end{aligned}
\tag{5}
$$

Estimation of the demand (*SALES*) for a product, either regular or light, is conducted through the following regression model:

$$
SALES_{j_c,t} = C_{j_c} + \sum_{c'=1}^{C} \sum_{j'_{c'}=1}^{J_{c'}} \left(\gamma^*_{j'_{c'} j_c} IP_{j'_{c'} t} \right) + \sum_{r=0}^{R_{j_c}} \left(\gamma^*_{j_c j_c, r} \sum_{s=1}^{6} IP_{j_c, t-(s+6r)} \right) + v_{j_c,t}
\tag{6}
$$

Where $SALES_{j_c,t}$ are the sales of item j_c; $IP_{j'_{c',t}}$ is the price index of item $j'_{c'}$; $\sum_{s=1}^{6} IP_{j_c,t-(s+6r)}$ is the sum of the price index of item j_c in the days of the week previous to the promotion ($r=0$ week previous; $r=1$ two weeks previous, etc.); and $v_{j_c,t}$ is the error term. Furthermore, ($R_{j_c}+1$) is the number of retards of item j_c; $\gamma^*_{j'_c j_c}$ is the parameter for the price index of item $j'_{c'}$ on product j_c; and $y^*_{j_c j_c, r}$ captures the retarded effects of the aggregated price index.

By using the same explanatory variables for all components of Equation 5, as per Van Heerde *et al.* (2004) and Leeflang *et al.* (2008), the identity in Equation 5 leads to the following expression:

$$
\begin{aligned}
\gamma_{tc_c} = {}& \gamma_{pi_c} + \gamma_{oisbs_c} + \gamma_{oidbs_c} + \gamma_{oisbc_c} + \gamma_{oidbc_c} + \gamma_{op_c} \\
& + \sum_{\substack{c'=1 \\ c \neq c'}}^{C} \left(\gamma_{oisbs_{c'}} + \gamma_{oidbs_{c'}} + \gamma_{oisbc_{c'}} + \gamma_{oidbc_{c'}} \right)
\end{aligned}
\tag{7}
$$

Where γ_{tc_c} is the total effect of the combination of categories; γ_{pi_c} is the effect of the price index on sales of the promoted light (regular) item of category c; γ_{oisbs_c} and γ_{oidbs_c} refer to the within-substitution effects between the promoted item and other light (regular) items of category c, with the same brand and with other brands, respectively; γ_{oisbc_c} and γ_{oidbc_c} refer to the complementary effects between the promoted and other light (regular) items of category c, with the same brand and with other brands, respectively; and γ_{op_c} is the cross effect between periods. Similarly, $\gamma_{oisbs_{c'}}$ and $\gamma_{oidbs_{c'}}$ ($\gamma_{oidbc_{c'}}$ and $\gamma_{oidbc_{c'}}$) are the substitution (complementary) effects of products with the same brand and with other brands in categories $c' \neq c$.

Hence, the estimation for each individual item in category c ($c=1,...,C$) of the demand Equation 6, $\hat{\gamma}^*_{j'_c j_c}$ and $\hat{\gamma}^*_{j_c j_c, r}$, gives us, by adding the corresponding parameters, the effects of Equation 7, and therefore the decomposition of the effect of price promotions, differentiating between light and regular products. Specifically, decomposition of the sales effect of price promotions entails seven modeling stages. Table 3 shows a summary of these stages. For more modeling details, see Parreño-Selva *et al.* (2014).

Table 3. Modeling steps (adapted from Leeflang *et al.,* 2008).

Step	What	Why
1	Multiply daily unit sales by average price	To obtain comparable sales measures across categories
2	Divide daily price by average price	To obtain comparable price measures across categories
3	Standardize sales per day	To eliminate day-of-the-week effects
4	Filter sales, price	To eliminate trend and seasonality
5	Model estimation using transformed variables	To obtain parameter estimates
6	Multiply regression coefficients by average standard deviation per day	To obtain average daily effects in terms of sales
7	Use significant coefficients to obtain decomposition effects	To obtain reliable decomposition results

4.3. Total effect of price promotion of the light product (low-fat milk; no immediate costs and delayed rewards) on sales in comparison to this effect for the regular product (whole milk)

By focusing on milk as an example of light and regular products, we estimate the effects of the own and cross-filtered price index on filtered standardized sales for 34 item sales (10 regular item sales and 24 light item sales) and within- and cross-category variables. Hence, we estimate 34 sales equations. Our analysis of all series of residuals indicates no serious autocorrelation problems. We find serious correlation problems across three groups of covariates, because prices are frequently used simultaneously for these three groups of items with the same brand. As the prices are identical, we use the common index price. Table 4 shows the results of the decomposition of the three milk categories.

■ *Effect of price promotion of light and regular products on own sales*

In the regular-milk category, only one own significant effect was noted; this is for Puleva omega 3 1 l, and is equal to 146.63. For the light items, more products have an own significant effect; however, their sizes are lower – between 9.64 and 99.89, with an average of 52.53. Consequently, on average, price promotions increase own sales of regular products almost three times more than sales of light products. Given that prices are estimated in terms of €10, the coefficients in Table 4 represent the effect of a 10% reduction on a price of €10. For example, the estimated effect for semi-skimmed Puleva calcio 1 l reflects a sales increase (units × regular price) of 68.14 Euros after a 10% price reduction. Hence, Whole Puleva omega 3 1 l has the largest sales income over the study period. As we expected, the results show that the own price promotion effect is bigger for regular products than for light products that do not impose an immediate cost. It seems that due to the more enduring involvement implicit in these light products, consumers place limited importance on temporary price promotions at the moment of purchase.

■ *Cross effects between temporal periods*

We did not expect to find a stockpiling effect for light and regular products due to the characteristics of the local residents (with weekly wages and living in apartments) and of the hypermarket (with reduced parking). Indeed, we only found a significant effect for whole Puleva omega 3 1 l. Therefore, price promotions of regular products can be said to have a greater negative impact on sales in the periods following the promotion, compared to promotions of light products. That is, customers of this establishment do not buy light products during price promotions in order to store them for future consumption. In any case, the context of the study influences the stockpiling effect results and impedes adequate testing of the stockpiling effect.

Table 4. Decomposition of the effects of price promotions for regular and light products[1].

| | Own effect | Stockpiling effect (%) | Cross effects within the category | | | | | | Category expansion (%) | Net category expansion (%) | Total effect (%) | Cross effects between categories | | | |
| | | | Substitution | | Complementary | | Total | | | | | Substitution | | Complementary | |
			Same brand (%)	Other brand (%)	Same brand (%)	Other brand (%)	Same brand (%)	Other brand (%)				Same brand (%)	Other brand (%)	Same brand (%)	Other brand (%)
Light products															
Semi Skimmed Puleva Calcio 1 l	68.14	0	0	0	69	110	69	110	279	279	406	0	0	85	42
Semi Skimmed Pascual 1 l	84.36	0	0	0	0	22	0	22	122	91	246	0	30	0	155
Semi Skimmed Asturiana 1 l	47.86	0	0	0	66	0	66	0	166	166	183	0	0	0	17
Skimmed Puleva Calcio 1 l	43.18	0	0	0	0	0	0	0	100	100	100	0	0	0	0
Skimmed Asturiana Fibra 1 l	9.64	0	129	0	242	0	113	0	213	213	345	0	0	132	0
Skimmed Pascual 1 l	99.89	0	0	0	0	30	0	30	130	130	130	0	0	0	0
Skimmed Asturiana 1.5 l	14.64	0	0	0	0	0	0	0	100	100	100	0	0	0	0
Average	52.53	0	18	0	54	23	35	23	158	154	216	0	4	31	31
Regular products															
Whole Puleva Omega 3 1 l	146.63	39	0	0	14	6	14	6	81	81	98	0	0	11	6
Average	146.63	39	0	0	14	6	14	6	81	81	98	0	0	11	6

[1] Whole-milk items: Pascual Calcio 1 l Puleva Calcio 1 l, Puleva Calcio, Pascual 1 l, Asturiana 1.5 l and Asturiana 1 l; semi-skimmed-milk items: Pascual Calcio 1 l and Asturiana Fibra l1, Asturiana Linea 1 l and Asturiana 1.5 l; skimmed-milk items: Pascual Calcio 1 l and Asturiana 1 l are not included because they show no significant own effects.

■ *Cross effects within the category*

In regular products, complementary effects can be seen both with the same brand and with other brands (14% for items with the same brand and 6% for items with other brands). In addition, in light products there are complementary effects of price promotions on sales of other products within the same category, with an average of 54% of items with the same brand and 23% for items with other brands. These average results are not what we expected for the complementary effects. A possible explanation for the obtained result of greater complementary effects for light products than for regular products is that categories could be different with respect to other characteristics; for example, in market share (Narasinham *et al.,* 1996). Thus, light labels may have been able to obtain high market shares because they are resistant to the effects of brand switching due to promotions of regular labels.

With regard to substitution effects within the respective categories, in the case of skimmed Asturiana fibra 1 l, this effect is considerable (129%); for light products on average, the effect is 18%. However, for regular products the effect is null, and there is no cannibalization. That is, the substitution effects within the respective categories are bigger for light products than for regular products. These results are as expected. It seems that light products with delayed health benefits and no immediate costs are nonimpulse products (i.e. relative necessities), where purchase is planned, which implies that consumers have little flexibility to adjust the demand of the category, and the only way for consumers to save money is to switch brands (Bell *et al.,* 1999). This suggests a substitution effect for price promotions of light products on sales of other light products within the category. Therefore, it implies that the effects of price promotions of light products on total sales of their own category could be null or negative; that is, the total sales of the category promoted could be reduced or, in the best case, unaltered.

In summary, considering the total cross effects within the category, we can see that the complementary effect is bigger than the substitution effect, and is bigger for light products (77 and 18%, respectively) than for regular products (20 and 0%). In addition, the total cross effect within the category is bigger across items with the same brand than for items with other brands, for both light products (35 and 23%, respectively), and for regular products (14 and 6% respectively). This suggests that there is an umbrella effect and that this is stronger for the light category.

■ *Cross effects between categories*

In terms of the substitution effect between categories, unlike with regular products, with light products there is a substitution effect between brands (4%). In other words, buying promoted light products reduces additional purchases of regular products with other brands (substitution effect across categories). This result is as expected for the substitution effect, although in a smaller quantity. It seems that the consumer would lose the intrinsic quality benefits of light products[5] (e.g. health benefits and better taste) when switching to regular products, which means that price promotions of light products hurt sales of regular products. This result suggests that if the managers want consumers to buy light products instead of regular products, price promotions could be an appropriated tool.

We find a large number of complementary effects between categories. In fact, we evidence this effect in 63% (five out of eight) of the products. In addition, on average, the complementary effect is much higher in light than in regular products for both the same brand and for other brands (31 and 31; 11 and 6%, respectively). This result is not as expected for the complementary effect.

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[5] Specifically, the fact that consumers value highly the intrinsic quality benefits of light products would be opposite to that suggested by sustainable consumption research (Luchs *et al*., 2010).

In brief, we can conclude that the cross effects between categories differ significantly between regular and light products. This result is supported by other studies' suggestions that the cross effects differ greatly from one product category to another (Leeflang *et al.,* 2008).

Finally, if we jointly consider the estimated decomposition of the above effects of price promotions of regular and light products, we find that the total effect, in percentage terms, is much higher in light products than in regular products. This result is not as expected, given that we expected a bigger own effect, complementary within-category effect, and complementary between-category effect for regular products than for light products. Specifically, we find that the complementary cross effect between categories is much higher for light products, and there is no substitution effect for regular products (either within or between categories), nor is there a stockpiling effect for light products. If we only consider own effects price promotions of light products are less profitable than promotions of regular products. However, thanks to complementary cross effects within the category and cross effects between categories and to the lack of stockpiling effect, price promotions of light products are more profitable than promotions of regular products. This result is supported by other studies that have revealed the importance of considering the effect of price promotion across categories to identify the profitability of price promotion (Leeflang and Parreño-Selva, 2012).

5. Conclusions

Analysis of the survey data reveals that light and regular products are not equivalent to relative virtues and vices. In addition, our results evidence that the own sales effect and the stockpiling effect of price promotions for milk is greater for the regular product than for the light product with no immediate cost. Similarly, we find a cannibalization effect of price promotions of light products on sales of other light products, as well as a substitution effect of promoted light products on additional purchases of regular products. Despite this, as there is no substitution effect for regular products within or between categories, and as the complementary effect is much higher for light products, the category expansion effect and the total effect is much higher for light products than for regular products. In this sense, although price promotions of light products are less profitable than promotions of regular products in terms of their own effect, the between-categories complementary effects and the lack of stockpiling effect allow price promotions of light products to be more effective.

The management implications of these results are as follows: first, retailers and manufacturers should analyze consumers' perceptions and the impact of price promotions on sales from the perspective of light and regular products on a continuum along with relative virtues and vices. The idea of this single continuum was suggested previously by Hoch and Loewenstein (1991) and Haws and Winterich (2013), and ranges from a short-term desire for pleasure to a long-term goal requiring abstention from desired behaviors; e.g. indulging in tasty foods versus minimizing calories. It is also supported by the logic of Gutman (1982), who stated that consumers who want good health and sees a connection between diet and health could form a natural-artificial distinction that could be applied to products by grouping them according to type in an array of categories along the dimension defined by the natural-artificial distinction. Furthermore, increasing consumer sensitivity to health issues in developed countries and the results obtained in this study support consumer interest in relation to light products with no immediate costs and delayed rewards, as well as to light products with immediate costs and delayed rewards (i.e. relative virtue). In addition, managers in certain countries must concentrate more on dairy products than on other products because dairy products comprise eight of the top 10 light products in countries such as Belgium (Viaene, 2015).

Second, the larger own effect of virtue over vice price promotions, as detected by Wertenbroch (1998), suggests that consumption self-control of vice products (e.g. chocolate, alcoholic beer, and regular cigarettes) could lead marketing managers to segment and discriminate prices, offering a variety of packet sizes that in particular include small-sized vice products with price premiums (e.g. M&Ms sold in vending machines, alcoholic beer sold in packs of 25 cl bottles and in packs of 33 cl bottles, and cigarettes sold in packs of 10 and in packs of 20), as opposed to the discounts applied to virtue products. In this way, manufacturers of

vice products could meet the demands of consumers that practice rationing and those that do not in order to increase profits. However, the larger own effect of price promotions of regular products (whole milk) compared to that of light products (low-fat milk) that is found in our study would make price discrimination unnecessary in regular-product segmentation (e.g. whole milk in packs of 50 cl cartons and in school size cartons) because it seems that consumption self-control of this regular product is not present.

Third, although the own effect of price promotions of the regular product, whole milk, is higher than for the light product, low-fat milk, the cross effects between categories allow price promotions of these light products to be more effective than those of regular products in terms of increasing the store's general sales and profits. In particular, retailers may benefit from cross effects of price promotion between categories for low-fat milk, given that the complementary effects between categories are greater than the substitution effects between categories. From this perspective, for retailers it is more profitable to promote low-fat milk than whole milk. To summarize, retailers can use promotions of these regular products and light products (with no immediate cost) with little risk.

Fourth, retailers should consider for milk that promotions of light products with no immediate cost hurt other light-product and regular-product sales. This cross effect within and between categories shows that a substitution effect (which becomes cannibalization when it affects the same brand) should be born in mind by retailers.

This paper has certain limitations that represent potential areas for future research. First, the identification of light and regular product categories and relative virtue and vice product categories followed the procedure proposed by Wertenbroch (1998), which found that the category sets are not equivalent. However, Wertenbroch's study is almost 20 years old, and during the last two decades the prevalence of light products has increased significantly, which has likely had an impact on individuals' ratings of these products. Second, the focus on a student survey and on product categories of one hypermarket impedes generalization of the results regarding the continuum of products and better understanding of the behavior of promotions of light and regular products, respectively. Third, the data from a hypermarket with reduced parking space and situated in an area in which the residents have weekly incomes and live in apartments prevents analysis of the inventory effect, and therefore of the strategies used by establishments that want their customers to buy large quantities of products during price promotions to store for later use. Fourth, the reduced use of flyers by this hypermarket prevented us from studying this competitive instrument, which could have affected the results.

Acknowledgements

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