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To Buy or Not to Buy: Consumers' Demand Response Patterns for Healthy Versus Unhealthy Food

The authors integrate research on impulsivity from the psychology area with standard economic theories of consumer demand to make novel predictions about the effects of market price changes on consumers' food consumption behavior. The results from multiple studies confirm that consumers exhibit undesirable asymmetric patterns of demand sensitivity to price changes for healthy and unhealthy food. For healthy food, demand sensitivity is greater for a price increase than for a price decrease. For unhealthy food, the opposite holds true. The research further shows that the undesirable patterns are attenuated or magnified for key policy-relevant factors that have been shown to decrease or increase impulsive purchase behavior, respectively. As the rising obesity trend brings American consumers' food consumption behavior under increased scrutiny, the focal findings hold significant implications for both public policy makers and food marketers.

Keywords: pricing, food, health, social networks, fear

Obesity has recently reached epidemic levels in the United States, and as a result, U.S. consumers' food consumption behavior has come under increased scrutiny (Seiders and Petty 2004). The public health literature suggests that a large percentage of food products purchased from grocery stores are unhealthy (Treuhaft and Karpyn 2010). Thus, a natural public policy imperative is to identify avenues that may nudge consumers from the consumption of unhealthy food choices to healthier food options (Thaler and Sunstein 2008). A potential avenue for altering the composition of consumers' food baskets that has received increased attention of late is the link between food prices and consumers' food consumption behavior (Drewnowski and Darmon 2005). In particular, emphasis has been on the role of economic policy tools, in the form of surcharges and subsidies on food products, to promote healthier food consumption behavior (Brownell and Frieden 2009). An important prerequisite to effective design of such economic policy tools is a clear understanding of the underlying nature of consumers' demand response patterns to price changes for healthy and unhealthy foods (Epstein et al. 2010).

In this context, imagine the following typical market setting for a hi-lo grocer. Assume that the price for a healthy and an unhealthy food item is \$1 each in March, \$.90 in April, and \$1 again in May. In addition, assume that the initial quantity demanded in March is 100 units for each item. On the one hand, if the underlying nature of consumers' demand response pattern to price changes is symmetric (say, with a price elasticity of –.75 for a price increase/decrease for each item), the quantity demanded for each item in April and May will be 107.5 units and 99.99 units, respectively. On the other hand, if the underlying nature of consumers' demand response pattern to price changes is asymmetric (say, with a price elasticity of –.5 for a price increase and –1 for a price decrease for the healthy item, and –1 for a price increase and –.5 for a price decrease for the unhealthy item), the quantity demanded for the healthy item in April and May will be 105 units and 93.45 units, respectively; the quantity demanded for the unhealthy item in April and May will be 110 units and 103.95 units, respectively.

Note that in the preceding example, the average price elasticity values for both types of food items are the same between and across the symmetric and asymmetric scenarios, and yet the final quantities demanded are substantially different between the symmetric versus asymmetric scenarios for each food item. Equally noteworthy are the contrasting final demand quantities between the two food items under the asymmetric scenario. Specifically, even though the price in May is back to its initial value, quantity demanded is lower than the original quantity demanded for the healthy item but higher than the original quantity demanded for the unhealthy item. In other words, from a public health perspective, this illustrates a case of undesirable asymmetry in consumers' demand response patterns.

The previous example highlights how a clear understanding of the underlying nature of demand response patterns to price changes—whether they are symmetric or asymmetric and the specific direction of asymmetry—is essential to evaluating how such price changes will affect

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consumers' food consumption behavior. Unfortunately, despite the recent research focus on food consumption in the face of rising obesity, there is still a paucity of research that investigates demand response patterns to price changes for both healthy and unhealthy food, employing grounded theory and using primary and secondary data sources—thereby limiting the current level of understanding for developing effective economic policy tools to promote healthier food consumption (Andreyeva, Long, and Brownell 2010; Epstein et al. 2010).

The current article integrates impulsivity research from psychology with standard economic theories to make novel predictions about the effect of price changes on demand response sensitivity for healthy and unhealthy food. We first test these predictions by using extensive supermarket scanner data, consisting of consumers' demand responses to price increases and decreases across multiple product categories. A unique prediction and finding is that not only do consumers exhibit asymmetric patterns of demand sensitivity to price changes for both healthy and unhealthy food, but they do so in opposite and undesirable directions. Specifically, demand sensitivity for healthy food is greater for a price increase than for a price decrease, whereas the pattern is reversed for unhealthy food. An experimental survey and a controlled experiment conceptually replicate the key results from the supermarket study.

From a public policy perspective, the preceding finding implies that the effectiveness of economic interventions in inducing healthier food consumption—through price increases (decreases) from surcharges (subsidies) on unhealthy (healthy) food—will be much more limited than typically projected, on the basis of the default but misplaced premise of symmetric patterns of demand response in the current public policy discourse. From a food marketing perspective, the preceding finding sheds important new light on the relative efficacy of price promotions for healthy versus unhealthy food. For example, demand for a healthy food item is likely to receive a more limited boost than expected from a price promotion and may actually fall below its baseline demand level after the promotional price reverts to its regular price.

Finally, our series of studies further predicts and shows that the undesirable asymmetric demand response patterns are moderated by several policy-relevant variables, which have been shown to either attenuate or exacerbate impulsive purchase behavior. Perhaps the most notable one, from both food marketing and public policy perspectives, is that food demand response patterns may be nudged in a healthier direction by merely priming participants to think about the enabling peer support aspects of social networks or by exposing participants to specifically constructed social network appeals. Next, we discuss our conceptual framework, followed by a delineation of the associated hypotheses.

Conceptual Framework

Rational Demand

The economic theory underlying consumers' demand response to price changes is well established and follows the so-called law of demand (Marshall 1895). The law states that, except for a few products called "Giffen goods," for which demand *increases* in response to a price increase, there is an inverse relationship in the directionality between price change for products and consumers' demand response (Jensen and Miller 2008). This law implies that the rational response for consumers is to demand less of a product whenever its price increases, and vice versa. A fundamental concept related to the law is the notion of price elasticity, which measures the sensitivity of consumers' demand response to price changes (i.e., the percentage change in demand for a 1% change in price).

A typical premise in studies of price elasticity, including those focusing on food items, is that while consumers' demand response exhibits a negative relationship with price change, the sensitivity of such response is identical or symmetric with respect to the directionality of the price change (Andreyeva, Long, and Brownell 2010; Bijmolt, Van Heerde, and Pieters 2005; Epstein et al. 2010). In other words, while the price elasticity value will always have a negative sign, the value itself will remain the same irrespective of a price increase or decrease. However, there is empirical evidence from studies in the marketing area that, for some consumer packaged goods, consumers may exhibit an asymmetric pattern of demand response sensitivity with respect to the directionality of the price changes (Johnson and Meyer 1994). In the context of the present study, this raises the following important questions: Should we expect an asymmetric pattern of demand sensitivity to price changes for common food items? If so, should such patterns be the same for healthy and unhealthy foods? If not, why and how should we expect them to differ? We next discuss relevant theoretical perspectives from the psychology area, which, when integrated with those from the economics area, help address these questions.

Impulsive Demand

Prior research in consumer psychology has shown that consumers exhibit natural consumption tendencies for both unhealthy and healthy food, but in opposite directions—an overconsumption impulse for unhealthy food and an underconsumption impulse for healthy food (e.g., Finkelstein and Fishbach 2010; Loewenstein 1996; Raghunathan, Naylor, and Hoyer 2006; Wansink and Huckabee 2005). The underlying reason for these natural impulses reflects fundamental perceptual and sensory differences in palatability for unhealthy and healthy food. For example, researchers have found systematic evidence suggesting that people operate under the implicit intuition that "unhealthy food = tasty" (Raghunathan, Naylor, and Hoyer 2006, p. 170). In contrast, healthy foods are intuitively assumed to be bland. Several studies have explored the sensory basis for such perceptions and have demonstrated that unhealthy food is typically considered more palatable than healthy food, with palatability ratings being positively correlated to fat content and macronutrient intake (Stubbs and Whybrow 2004).

Researchers posit that these natural over- and underconsumption impulses for unhealthy and healthy foods, and their perceptual and sensory drivers, have an evolutionary basis. For example, Wansink and Huckabee (2005, p. 8) note that "fatty foods helped our ancestors weather food shortages,… [and] sugar and the sweetness associated with it helped them distinguish edible berries from poisonous ones." Furthermore, studies show that energy-dense (i.e., unhealthy) foods, while worse for long-term health, are better than non-energy-dense foods in providing short-term energy stores, which human beings have been hardwired to favor (Ostan et al. 2010).

Exacerbating and Mitigating Factors for Impulsive Demand

The previously discussed natural impulses to overconsume unhealthy food and underconsume healthy food runs counter to the desire of "most people to cherish long and healthy lives" (Thomas, Desai, and Seenivasan 2011, p. 127). This tension highlights the inherent conflict between the impulsive and reflective or regulatory behavioral systems (Loewenstein 1996; Metcalfe and Mischel 1999), most recently denoted as Systems 1 and 2 by Kahneman (2011). System 1 is present oriented and driven by emotion and desire, while System 2 is future based and driven by cognition and willpower. For example, "urges to consume … junk food occur in System 1 and lead to impulsive behavior when System 2 is not able to control System 1" (Lades 2012, p. 5). A key finding in this research domain is that the degree of impulsive behavior for a person in any specific decision scenario is contingent on the level of willpower that System 2 exerts on System 1 (Loewenstein 1996).

Thus, factors that have been shown to moderate reflective or regulative behavior can be expected to influence the intensity of consumers' natural impulses to overconsume unhealthy food and underconsume healthy food. Such factors may be attributable to individual differences or be contextual in origin. For example, research has shown that income and age can influence regulatory behavior and thus impulsive consumption (Killgore and Yurgelun-Todd 2005). Recent research has also shown that the method of payment at the time of a purchase can make it either viscerally more difficult to resist or easier to give in to impulsive urges (Thomas, Desai, and Seenivasan 2011).

Summary of Key Elements

Our focus is on demand response to price changes in the marketplace for healthy and unhealthy food. Taking into account only rational economic forces, demand response should have a negative relationship with price change, but the sensitivity of such response should be identical or symmetric in terms of directionality of the change (Andreyeva, Long, and Brownell 2010; Bijmolt, Van Heerde, and Pieters 2005; Epstein et al. 2010). However, consumers are also subject to psychological impulses when it comes to food consumption behavior—to overconsume unhealthy food and underconsume healthy food (e.g., Finkelstein and Fishbach 2010). In addition, given the presence of dual or competing (impulsive vs. regulatory) behavioral systems (Kahneman 2011; Loewenstein 1996; Metcalfe and Mischel 1999), factors that influence willpower can exacerbate or mitigate these natural consumption impulses. We next integrate the aforementioned three key elements of our conceptual framework to develop a set of empirically testable hypotheses in terms of consumers' demand response patterns to price changes for healthy and unhealthy foods.

Hypotheses

Main Asymmetric Effect

As we noted previously, people's sensory- and perceptual-based preferences for unhealthy versus healthy food result in an impulsive tendency to overconsume the former and underconsume the latter (e.g., Hausman 2012). When this impulsive behavioral tendency is considered in light of the rational economic behavioral tendency as per the law of demand, the following suppositions unfold. For healthy food, the rational economic response to decrease quantity demanded for a price increase is reinforced by the natural impulse to underconsume. Moreover, the rational economic response to increase quantity demanded for a price decrease is counteracted by the natural impulse to underconsume. Consequently, for healthy food, we expect the rational demand response to reduce quantity when faced with a price increase to be stronger than the rational demand response to increase quantity when faced with a price decrease. In contrast, because of the natural impulse to overconsume unhealthy food, analogous reasoning implies the opposite outcome for unhealthy food.

In this context, it is pertinent to note that prior research has indicated that consumers perceive price changes in the marketplace in relation to some internal reference prices (IRPs; Mazumdar, Raj, and Sinha 2005). For example, as Winer (1988, p. 35) states, "defining p″ to be the observed retail price and p′ to be the individual's internal reference price, the underlying assumption of this (behavioral pricing) literature is that positive values of (p″ – p′) are perceived negatively … while negative values of (p″ – p′) are viewed positively." Previous research has measured IRP either through the most recent price at which a product was purchased or through an extrapolative model based on a given number of past prices encountered (Janiszewski and Lichtenstein 1999). In our study, we operationalize IRP in terms of the most recent or last purchase price.

The preceding discussion implies that for unhealthy (healthy) food, a given percentage increase in price relative to the last purchase price will elicit a smaller (larger) decrease in demand quantity from consumers than the increase in demand quantity triggered by the same percentage decrease in price. In other words, although the quantity that consumers demand for both unhealthy and healthy food should rise or fall as price decreases or increases (as per the first law of demand), we expect each food type to exhibit an asymmetric pattern of demand sensitivity to price changes, but in opposite directions. Stated formally:

> H_1: For unhealthy food, consumers' demand response sensitivity is greater for a price decrease than that for a price increase, relative to the last purchase price.
>
> H_2: For healthy food, consumers' demand response sensitivity is greater for a price increase than that for a price decrease, relative to the last purchase price.

Exacerbating Factors

Naturally, any factor that exacerbates consumers' impulsive food consumption behavior will accentuate the relative effect of impulsive demand on rational demand, thereby magnifying the main asymmetric patterns in demand response to price changes noted previously. Here, we discuss three specific exacerbating factors highlighted in impulsivity research and delineate the related hypotheses.

Bank card usage. When consumers pay with a credit card, the pleasure derived from acquiring goods is temporally divorced from the "pain of payment," making it easier to give in to impulsive urges (Soman and Gourville 2001). In terms of food choice, recent research has shown that the pain of paying in cash decreases the likelihood that consumers will purchase vice foods, whereas paying with a bank card (credit and debit) increases the likelihood of such purchases (Thomas, Desai, and Seenivasan 2011). The reason cited for this is that both credit and debit card payments are less "vivid and emotionally more inert" than paying in cash and viscerally less painful. Thus, bank card purchases reinforce consumers' impulsive tendency for overconsumption already present for unhealthy foods. The upshot will be more resistance against the rational economic response to decrease quantity demanded for a price increase but a reinforcement of the rational response to increase quantity demanded for a price decrease. Stated formally:

> H_3: The undesirable asymmetric pattern of demand response sensitivity for unhealthy food is magnified for bank card purchases by consumers.

Younger consumers. Research has shown that the tendency to make impulsive food selections is greater for children, teenagers, and young adults than for older people (Killgore and Yurgelun-Todd 2005). One reason for such age-based differences in food preference is that the region of the brain that governs impulsive and risky behavior, the limbic system, is hypersensitive during adolescence, whereas the prefrontal cortex, the rational part of the brain, continues to develop throughout the third decade of life (Dumontheil et al. 2010). In the context of food choice, lower age will thus accentuate the relative effect of impulsive demand (i.e., to overconsume unhealthy and underconsume healthy food) on rational demand, leading to more pronounced asymmetric patterns of demand response for unhealthy and healthy food for younger consumers. Stated formally:

> H_4: The undesirable asymmetric pattern of demand response sensitivity is magnified for younger (vs. older) consumers, with regard to (a) unhealthy food and (b) healthy food.

Lower-income consumers. From the famous Stanford University marshmallow study (Mischel et al. 1989), which tested the ability of 600 hungry four- to six-year-old children to delay gratification (and then tracked them as adults) to more methodologically rigorous neurological studies (e.g., Matthews et al. 2000), research has shown an inverse correlation between impulsiveness and income. Thus, we hypothesize that the relative effect of impulsive demand (i.e., to overconsume unhealthy and underconsume healthy food) on rational demand will be higher for lower-income people. Furthermore, low-income populations have fewer "slack" resources (Bertrand, Mullainathan, and Shafir 2006), and healthy food is more expensive than unhealthy food on a per-calorie basis (see Drewnowski and Darmon 2005). This implies that the natural impulse to underconsume healthy foods will be reinforced even more for lower-income consumers. Thus, the negative link between income and impulsivity as well as the reality of a tighter resource constraint versus food cost will further accentuate the asymmetric patterns of demand response for unhealthy and healthy food for lower income consumers. Stated formally:

> H_5: The undesirable asymmetric pattern of demand response sensitivity is magnified for lower- (vs. higher-) income consumers, with regard to (a) unhealthy food and (b) healthy food.

Mitigating Factors

Any factor that enhances consumers' willpower should reduce the relative impact of impulsive demand on rational demand—thereby mitigating the main asymmetric patterns in demand response to price changes noted in H_1 and H_2. Here, we discuss two specific mitigating factors that have been highlighted in impulsivity research and in a key explanatory health behavior model (protection motivation theory; Rogers 1983) and offer corresponding hypotheses. Specifically, protection motivation theory identifies four variables critical to the success of any health behavior change (Witte 1992). The first two variables, perceived susceptibility/vulnerability and severity, involve threat appraisal, and the second two variables, self-efficacy and response-efficacy, involve coping appraisal. Both sets of variables have been shown to regulate impulsive behavior. We discuss each in turn.

Fear. The first set of variables advanced here, "threat appraisal," is defined as a person's assessment of the level of his or her own personal vulnerability and susceptibility to experiencing a particular negative outcome (Boer and Seydel 1996) and is typically activated through a viscerally aversive cue (Witte 1992). Prior research has suggested that viscerally aversive cues can be effective in the regulation of vice-related products, which tend to be impulsively purchased and consumed (Metcalfe and Mischel 1999; Thomas, Desai, and Seenivasan 2011). One such viscerally aversive cue is fear (Witte 1992). "Fear salience" is defined as the momentary increase in a person's awareness of being afraid of a particular activity or event (Gore et al. 1998). A credible fear cue leads to increased threat appraisal perceptions (Witte and Allen 2000). This has important implications in the food domain, in that the short-term health-related costs of eating unhealthy are not always obvious (Schlosser 2001). Thus, the use of a credible fear cue should increase threat appraisal perceptions surrounding unhealthy eating.

When threat appraisal perceptions increase (and self-efficacy is adequate), people are more likely to adopt adaptive health protection behaviors (Witte and Allen 2000). Given that self-efficacy perceptions related to nutrition are at moderate levels (e.g., Bartfield et al. 2010), the use of a fear cue should lead to positive and adaptive healthy behavior. Thus, threat appraisal perceptions (through fear) should cause consumers to muster more willpower to resist the natural impulsive urge to overconsume (underconsume) unhealthy (healthy) food. Even though the use of fear is arguably the most widely used public service announcement archetype (Witte and Allen 2000), little research has examined its effect on food selection.

Peers (social networks). The second set of variables advanced here, coping appraisal (e.g., efficacy), is frequently activated through peer or social support (Brissette, Scheier, and Carver 2002). While the negative effects of social influence on health outcomes such as obesity, cigarette smoking, and drinking have been well documented (Christakis and Fowler 2008), recent research has begun to examine the positive effects of social influence on such outcomes through the modification of people's social networks (Umberson, Crosnoe, and Reczek 2010). A social network is defined as a "social structure made up of a set of actors (such as individuals or organizations)" (Wasserman and Faust 1994, p. 2). Social networks can be either positive or negative, depending on the type of influence they wield (i.e., good or bad). Such modifications can take the form of "smoking- and alcohol-cessation programs and weight-loss interventions that provide peer support—that is, that modify the person's social network" (Christakis and Fowler 2008, p. 377). Prior research has demonstrated that people who have access to supportive social networks show a greater likelihood of engaging in social support–based coping, through potential interactions with groups and people with a like-minded or common objective (Umberson, Crosnoe, and Reczek 2010).

Such support-based coping has been positively linked to increased feelings of self-efficacy (Brissette, Scheier, and Carver 2002). Self-efficacy is defined as "the belief in one's ability to execute a recommended course of action successfully" (Boer and Seydel 1996, p. 98). In particular, self-efficacy has been shown to be one of the most impactful predictors of healthy eating (Luszczynska, Tryburcy, and Schwarzer 2007). Indeed, "enhancing self-efficacy results in nutritional change" (Luszczynska, Tryburcy, and Schwarzer 2007, p. 630). Thus, enhanced feelings of self-efficacy (induced by social network salience) should lead to increased confidence in a person's ability to regulate or decrease consumption of unhealthy foods and increase consumption of healthy foods. Notably, although several studies have examined the effect of social network membership or modification (e.g., Christakis and Fowler 2008) on health behaviors, no research to date has examined the effect of merely making social networks salient on health behavior. The preceding discussion on fear and peer sources leads to the following predictions:

H_{6a}: The undesirable asymmetric pattern of demand response sensitivity is attenuated for consumers when fear is made salient, with regard to (i) unhealthy food and (ii) healthy food.

H_{6b}: The undesirable asymmetric pattern of demand response sensitivity is attenuated for consumers when positive social networks are made salient, with regard to (i) unhealthy food and (ii) healthy food.

H_{7a}: The effect of making fear salient on demand response sensitivity for food is mediated by consumers' threat appraisal perceptions.

H_{7b}: The effect of making positive social networks salient on demand response sensitivity for food is mediated by consumers' self-efficacy perceptions.

We next present our first empirical study, which uses supermarket scanner data. The nature of the scanner data allows us to test the first three hypotheses: the main asymmetric effects and the first exacerbating factor (mode of payment). We subsequently conduct two other studies that use primary data to test our other hypotheses.

Supermarket Scanner Data: Study 1

Data

The supermarket study uses individual household-level transaction scanner data in eight food categories, from one store of a large regional supermarket chain in the northeastern United States. The transaction data cover 52 consecutive weeks during 2003–2004. The categories included four relatively healthy (fresh broccoli, grapes, raisins, and wholegrain bread) and four relatively unhealthy (fresh nonlean beef, potato chips, nondiet soft drink, and white bread) food categories. These categories are generally considered relatively unhealthy or healthy in the existing literature (e.g., Martikainen, Brunner, and Marmot 2003). Healthy foods are defined as those that are "low [in] fat,... low [in] saturated fat,... and contain at least 10% of daily value ... for vitamins A, C, calcium, iron, protien or fiber," and are limited in amount of sodium and cholesterol (U.S. Food and Drug Administration 2012). Unhealthy food is defined as those foods not meeting these standards. Nonetheless, it is relevant to note that our conceptual framework is based on perceived or subjective rather than objective groupings of healthy and unhealthy food categories. At the same time, as might be expected, groupings based on subjective perceptions and objective criteria are highly correlated in this domain (e.g., Stubbs and Whybrow 2004).

For each category, we obtained the sample of households from the participating store's customer database, and each sample household met the following criteria: (1) It used the participating store as its primary store, and (2) it made at least one purchase in the category each month during the year. Table 1 presents key sample descriptive statistics. In addition to category-specific transaction-level data for each sample household, we had access to information on the mode of payment (e.g., bank card, cash), household size, and census block group code of the household's residence. In absence of direct income information for each household, we used mean household income at the census block group level to capture relative income levels for our sample households (Talukdar, Gauri, and Grewal 2010). Finally, for our participating store, which has a weekly price cycle, we also had information on the overall store price index (OSPI) on a weekly basis. This index is a sales-share-weighted composite price covering top-selling items (using stockkeeping units [SKUs]) across key product cate-

TABLE 1
Study 1: Scanner Data Summary Statistics

A: Healthy Food Categories

Descriptive Variable	Broccoli	Grapes	Raisins	Whole-Grain Bread
Number of all households	993	1029	1107	1094
% of single households	31	29	29	30
Mean number of transactions per household	22	21	27	31
Total number of transactions	21,846	21,609	29,889	33,914
Number of SKUs involved in the transactions	1	2	8	13
% of households using bank card at least once	100	100	100	100
% of transactions on bank card	48	51	50	52
% of transactions with same last purchase price	42	44	43	45
% of transactions with higher last purchase price	30	29	28	30
% of transactions with lower last purchase price	28	27	29	25

B: Unhealthy Food Categories

Descriptive Variable	Beef	Potato Chips	Soft Drinks	White Bread
Number of all households	1038	1059	1127	1098
% of single households	28	30	27	31
Mean number of transactions per household	34	34	42	33
Total number of transactions	35,292	36,006	47,334	36,234
Number of SKUs involved in the transactions	8	16	23	14
% of households using bank card at least once	100	100	100	100
% of transactions on bank card	52	49	47	51
% of transactions with same last purchase price	45	42	43	44
% of transactions with higher last purchase price	30	28	31	30
% of transactions with lower last purchase price	25	30	26	26

Notes: The SKUs for beef used in the study exclude all fresh beef labeled as "lean," and the SKUs for soft drinks used in the study exclude all soft drinks labeled as "diet."

gories and reflects relative differences in overall store price promotion intensity across weekly price cycles.

Analysis

For each product category, we analyzed the data using a household-level random-effects regression model in log-log form (for the model, see Table 2). The price movement indicator (PMI) variable captures the three cases of price movement in terms of the current price paid compared with the last purchase price paid by a household: (1) no change, (2) price went up, and (3) price went down. As in many existing studies (Mazumdar, Raj, and Sinha 2005), we used the last purchase price to operationalize consumers' IRP. Specifically, we measured the last purchase price as the price paid per relevant standardized unit (PR) (e.g., ounces, pounds) on the last purchase occasion by a household in a given category.

It is relevant to note here that although IRP is often modeled at the brand level (e.g., Winer 1986), it is also modeled at the category level (Mazumdar, Raj, and Sinha 2005). The latter approach is used in this study and is justified in our context for two reasons. First, the brand-level approach is not applicable in nonbranded categories—such as the fresh broccoli, grapes, and beef used in our study. Second, even for branded categories, the category-level approach is especially reasonable when relatively small price differentials exist across brands such that the cognitive cost of attempting to retain price data for various brands is perceived to be greater than the benefits derived (Mazumdar, Raj, and Sinha 2005). In our one-year data for the five branded categories, the differentials in mean prices among the most purchased brands (i.e., those accounting for 90% or more of category sales) in each category ranged between only 1% and 3% of the mean category price.

We used the bank card usage indicator (BCUI) variable to capture the following four distinct situations of bank card usage: (1) not used, (2) used when price did not change, (3) used when price went up, and (4) used when price went down. In addition to our three focal independent variables (PR, PMI and BCUI), we also used several relevant control variables—BCCI, LQ, TLP, HS, HI, WD, and OSPI (for definitions of these variables, see Table 2). We used the BCCI control variable only for the analysis in the branded categories to control for individual-level differences in brand loyalty propensity within a given category. It is measured as a Herfindahl concentration index in terms of a household's choice shares across the brands in a category (Sudhir and Talukdar 2004). A higher value of the index reflects a higher level of brand loyalty in the household's choice behavior. In addition, for white bread and whole-grain bread, which are close substitute product categories and for which we have price data, we explicitly use respective cross-category prices to control for any direct substitution effect between these two categories.

The household- and trip-specific control variables capture observed heterogeneity across households, and the random-effects term helps our regression model account for unobserved household heterogeneity. For each category, we estimate the regression model using the generalized estimating equation technique with our transaction panel data across

TABLE 2
Study 1: Regression Model for Each Product Category

$$\ln(Q_{ij}) = \beta_0 + (\beta_1 + \beta_2 PMI_{ij} + \beta_3 BCUI_{ij} + \beta_4 BCCI_i)\ln(PR_{ij}) + \beta_5 \ln(LQ_{ij}) + \beta_6 \ln(TLP_{ij}) + \beta_7 \ln(OSPI_{ij}) + \beta_8 \ln(HS_i) + \beta_9 \ln(HI_i) + \beta_{10} WD_{ij} + \mu_i + \varepsilon_{ij}$$

Variable	Definition
Q_i	Quantity purchased in category relevant standardized unit (e.g., oz. or lb.) by household i on purchase occasion j
PR	Price paid per relevant standardized unit
PMI	Price movement indicator
BCUI	Bank card usage indicator
BCCI	Brand choice concentration index (only for a branded category)
LQ	Quantity purchased in relevant standardized unit on the last purchase occasion
TLP	Time (in days) since the last purchase occasion
HS	Household size
HI	Household income level
WD	Whether the current purchase occurred on a weekend
OSPI	Overall store price index on the current purchase occasion
μ_i	Household-specific random effects
ε_{ij}	Random error term
$\beta_0 \ldots \beta_{10}$	Model coefficients, where β_1 estimates consumers' base level of own price elasticity; β_2 estimates how the base level elasticity is affected by the price movement direction since the last purchase occasion; and β_3 estimates how the base level elasticity is affected by the price movement direction and by its interaction with bank card usage

households (Liang and Zeger 1986). The technique allows for heteroskedasticity as well as clustering across households. The clustering enables within-household serial correlation in the error term to account for the expected nonindependence in within-household observations across different purchase occasions. The log-log functional form of our regression model is consistent with the dominant approach in the literature for empirically estimating a consumer demand function as a multiplicative model, especially when the primary focus is on estimating consumers' price elasticity (Bijmolt, Van Heerde, and Pieters 2005). The log-log functional form of our regression model means that the parameters, β_1–β_3, are of focal interest to us because they capture consumers' demand response sensitivities to price and bank card usage. Per the first law of demand, we expect $\beta_1 < 0$—that is, own price elasticity should be negative. The parameters β_2 and β_3 test H_1, H_2, and H_3. For example, a negative (positive) sign for β_2 indicates that a specific direction of price movement since last purchase increases (decreases) consumers' demand sensitivity to price.

Results

Table 3 presents the results of our regression analyses. The coefficient of current price paid in our model estimates the base level of consumers' own price elasticity, and it is negative and significant ($p < .01$) for all eight categories. Next, the coefficient of the indicator for price change since last purchase is negative and significant ($p < .01$) when prices went up but insignificant ($p > .1$) when prices went down for all the healthy food categories. In contrast, for all the unhealthy food categories, the coefficient is negative and significant ($p < .01$) when prices went down but insignificant ($p > .1$) when prices went up. Thus, for healthy food, consumers' demand sensitivity (i.e., absolute value of own price elasticity) exhibits a greater relative increase in response to a price increase than a price decrease since last purchase. However, we found the opposite for unhealthy foods. Thus, H_1 and H_2 are supported.

As for the coefficient of the indicator for bank card usage, we found it to be insignificant ($p > .1$) for the healthy food categories. In contrast, for the unhealthy food categories, we found the coefficient to be positive and significant ($p < .01$) when bank cards are used in conjunction with a price increase since last purchase and negative and significant ($p < .01$) when bank cards are used in conjunction with a price decrease since last purchase. Thus, for the unhealthy food categories, consumers' demand sensitivity is accentuated when bank cards are used in conjunction with a price decrease since last purchase but mitigated when bank cards are used in conjunction with a price increase since last purchase. Thus, H_3 is supported.

Finally, although we advanced no formal predictions with regard to the control variables, we briefly note the following findings. The results show that the coefficients of the cross-category prices between white and whole-grain breads are positive and significant ($p < .05$ or less), indicating the expected demand substitution effects between the two categories. In addition, for each of the branded categories, the coefficient of the brand choice concentration index is positive and significant ($p < .05$ or less). This finding is again consistent with the expectation that a higher level of a consumer's brand-loyal behavior in a category will lower the absolute value of his or her price elasticity for the category.

Discussion

The supermarket study confirms our predictions regarding asymmetric and opposite patterns of demand response for unhealthy and healthy food. From a nutritional standpoint, the asymmetries in demand response are in undesirable directions for both types of food. Thus, an important next step is to understand the various factors that might mitigate or accentuate the observed asymmetric patterns. Toward this end, the supermarket study already demonstrates that

TABLE 3
Study 1: Scanner Data–Based Regression Analysis Results for Quantity Purchased

A: Healthy Food Categories

Independent Variables	Coefficient Estimate (SE)			
	Broccoli	**Grapes**	**Raisins**	**Whole-Grain Bread**
Current price paid	–.593 (.113)**	–.624 (.133)**	–.609 (.125)**	–.686 (.098)**
Indicators for Price Change Since Last Purchase				
Remained same (base)	—	—	—	—
Went up	–.384 (.077)**	–.297 (.056)**	–.326 (.071)**	–.298 (.052)**
Went down	–.107 (.087)	–.134 (.101)	–.121 (.098)	–.124 (.097)
Indicators for Bank Card Usage Context				
No usage (base)	—	—	—	—
Used and price remained same	.026 (.027)	.012 (.011)	.029 (.033)	.038 (.042)
Used and price went up	.019 (.018)	.016 (.012)	.021 (.017)	.023 (.017)
Used and price went down	–.008 (.006)	–.011 (.010)	–.006 (.005)	–.002 (.002)
Brand choice concentration index	N.A.	N.A.	.044 (.020)*	.051 (.025)*
Current price for white bread	N.A.	N.A.	N.A.	.127 (.063)*
Last purchase quantity	–.119 (.060)*	–.126 (.062)*	–.114 (.052)*	–.164 (.059)**
Time since last purchase	.188 (.091)*	.133 (.067)*	.098 (.048)*	.116 (.045)**
Household size	.114 (.075)	.101 (.078)	.076 (.049)	.131 (.050)**
Household income	.271 (.094)**	.212 (.081)**	.186 (.066)**	.242 (.108)*
If purchased on weekend	.009 (.010)	.109 (.107)	.008 (.006)	.002 (.002)
Overall store price index in current purchase week	–.441 (.127)**	–.204 (.055)**	–.164 (.057)**	–.184 (.059)**
Intercept	.182 (.021)**	.095 (.010)**	.326 (.038)**	.376 (.040)**
N	20,853	20,580	28,782	32,820
Pseudo R^2	.64	.69	.72	.77

B: Unhealthy Food Categories

Independent Variables	Coefficient Estimate (SE)			
	Beef	**Potato Chips**	**Soft Drinks**	**White Bread**
Current price paid	–.681 (.123)**	–.688 (.112)**	–.707 (.102)**	–.679 (.090)**
Indicators for Price Change Since Last Purchase				
Remained same (base)	—	—	—	—
Went up	–.012 (.013)	–.006 (.004)	–.011 (.008)	–.142 (.117)
Went down	–.329 (.059)***	–.414 (.076)***	–.476 (.082)***	–.352 (.060)***
Indicators for Bank Card Usage Context				
No usage (base)	—	—	—	—
Used and price remained same	.019 (.016)	–.006 (.006)	–.008 (.006)	–.024 (.023)
Used and price went up	.221 (.083)**	.155 (.058)**	.183 (.066)**	.103 (.038)**
Used and price went down	–.276 (.092)**	–.299 (.086)**	–.301 (.090)**	–.246 (.080)**
Brand choice concentration index	N.A.	.093 (.040)*	.106 (.037)**	.032 (.016)*
Current price for whole-grain bread	N.A.	N.A.	N.A.	.188 (.067)**
Last purchase quantity	–.196 (.076)**	–.177 (.067)**	–.211 (.076)**	–.187 (.063)**
Time since last purchase	.242 (.118)*	.328 (.144)*	.384 (.163)*	.162 (.061)**
Household size	.438 (.121)**	.251 (.103)*	.295 (.123)*	.138 (.052)**
Household income	.225 (.075)**	.153 (.106)	.123 (.085)	.197 (.125)
If purchased on weekend	.184 (.068)**	.181 (.052)**	.148 (.049)**	.012 (.006)*
Overall store price index in current purchase week	–.152 (.073)*	–.018 (.016)	–.007 (.005)	–.129 (.081)
Intercept	.474 (.044)**	.407 (.041)**	.576 (.049)**	.376 (.040)**
N	34,254	34,947	46,207	35,136
Pseudo R^2	.73	.71	.76	.74

*$p < .05$.
**$p < .01$.
Notes: N.A. = not applicable.

paying with a bank card (vs. cash) magnifies the asymmetry for unhealthy food. Unfortunately, the nature of typical supermarket scanner data does not lend itself to testing the other factors from our conceptual framework (i.e., fear, social networks, age, and income) that are predicted to moderate the observed asymmetric patterns of demand. Therefore, to test the other factors, we turn to primary data collected through experimental studies.

Experimental Data: Studies 2a and 2b

We conducted two experimental studies that complement one another by incorporating competing alternatives on two important aspects of the experimental design. The first aspect focuses on how different forms of salience for fear and social network stimuli can moderate the observed asymmetrical patterns of demand found in the supermarket study. Research suggests that salience can be manipulated through environmental primes or through specifically constructed advertisements/appeals (e.g., Obermiller and Spangenberg 2000). Second, in situations in which a topic is perceived to be of a sensitive nature, as may be the case with diet, existing literature suggests that people may respond differently to questions depending on whether they or others are the focus of inquiry (Mick 1996). Thus, another aspect of our experimental studies is to examine both people's own demand estimates in response to changes in food prices as well as their cognitions about how others will respond to such price changes.

Accordingly, we designed one experimental study (Study 2a) to examine participants' cognitions about how others will react to price changes for food items and the effect of fear and social network environmental primes (in the form of actual newspaper articles) on those cognitions. The other experimental study (Study 2b) involves a controlled experiment that assesses participants' own estimates of demand in response to price changes for food items and examines the effect of specifically constructed fear and social network appeals on those demand estimates. Taken together, the two experimental studies thus provide a stronger basis on which to draw our empirical conclusions than would be the case with either one on its own.

Experimental Survey: Study 2a

Method. Participants for the experimental survey were employees of a large nonprofit organization in the northeastern United States (male = 52%, M_{age} = 36 years, M_{income} = \$47.5K/year). Experimental surveys were distributed through the organization's internal mail system and/or were dropped off to respondents. The survey was administered in a staggered manner over a five-week period in 2010. Participation was based on a pre-request, comprising 613 respondents, or 73% of those initially surveyed. In-person follow-up resulted in a 100% response rate for the subsequent survey. The survey was a 3 (newspaper article: pro–unhealthy food prime [Fernandez 2010], fear prime [Leeder 2009], and peer prime [Landro 2006]) × 2 (food category: healthy, unhealthy) × 2 (price change: increase, decrease) mixed design, with newspaper article serving as the between-subjects factor. All participants responded to the same question pertaining to a 20% price increase and 20% price decrease for a healthy (broccoli) and unhealthy (soda) food category (for article excerpts and links to full articles, article pretesting, and experimental survey procedures, see the Web Appendix at www.marketingpower.com/jm_webappendix).

Results (demand asymmetry). Statistical tests show no significant difference (p > .1) across the three experimental conditions in terms of age, income, or general food attitude scores. As such, we dropped these variables from further analysis. We calculated the degree of demand response asymmetry, δ_{kc}, for respondent k in product category c as $\delta_{kc} = |\epsilon_{kc}^{pd}| - |\epsilon_{kc}^{pi}|$, where $|\epsilon_{kc}^{pd}|$ is the absolute value of the estimated price elasticity in response to a price decrease since last purchase and $|\epsilon_{kc}^{pi}|$ is the absolute value of the estimated elasticity in response to a price increase since last purchase. A nonzero value of δ_{kc} indicates an asymmetry in demand sensitivity in response to a price decrease versus a price increase since last purchase in a product category. Note that from a public policy perspective, it is desirable for δ_{kc} to exhibit positive or higher values for healthy food and negative or lower values for unhealthy food categories. As Table 4, Panel A, indicates, the experimental survey results show that the mean values of δ_{kc} for the pro–unhealthy food condition (i.e., the typical media/advertising environment consumers face) are significantly different than zero in the predicted undesirable directions ($\delta_{kc\ Healthy}$ = –.46, t(207) = 3.29, p < .01; $\delta_{kc\ Unhealthy}$ = .68, t(207) = 3.29, p < .01). Thus, the intention data in Study 2a provide a replication of the revealed data in Study 1 for H_1 and H_2.

Results (primes). Table 4, Panel A, also demonstrates that the fear and peer primes attenuate the undesirable asymmetry of demand sensitivity for unhealthy/healthy food. For healthy food, an analysis of variance (ANOVA) shows a significant difference across values of δ_{kc} for the three conditions (F(2, 610) = 12.94, p < .01). Furthermore, Dunnett tests show that relative to the pro–unhealthy food condition (δ_{kc} = –.46), the value of δ_{kc} is higher for both the fear prime (δ_{kc} = .05, p < .01) and the peer prime (δ_{kc} = .29, p < .01). For unhealthy food, an ANOVA also shows a significant difference across values of δ_{kc} for the three conditions (F(2, 610) = 14.27, p < .01). Moreover, Dunnett tests again show that relative to the pro–unhealthy food condition (δ_{kc} = .68), the value of δ_{kc} is lower for both the fear prime (δ_{kc} = .16, p < .01) and the peer prime (δ_{kc} = –.11, p < .01). Thus, the experimental survey data also provide preliminary support for H_{6a} and H_{6b}, that is, the ability of the selected noneconomic policy factors to mitigate the undesirable patterns of demand asymmetry.

Discussion. Using cognitions about other consumers in the marketplace, the experimental survey corroborates the patterns of demand response observed in the supermarket scanner data from Study 1. Study 2a also demonstrates that merely exposing people to environmental fear and social network primes can mitigate the undesirable pattern of demand response (in the form of cognitions about how others will react to price changes for food items). Study 2b, which we present next, uses a traditional media operationalization—specifically constructed appeals—to assess the impact of fear and peer (social networks) salience on participants' own demand estimates for food. Given that Study 2b investigates participants' own demand estimates, we are also able to test the exacerbating influences predicted for age and income (H_4 and H_5). Finally, Study 2b also examines the underlying mechanisms posited to mediate the

TABLE 4
Demand Sensitivity Results

A: Study 2a: Experimental Survey

Experimental Condition	Demand Sensitivity Measures	Mean Value of Demand Sensitivity Measures: Healthy Food	Mean Value of Demand Sensitivity Measures: Unhealthy Food
1. (N = 208)	$\lvert\epsilon_{kc}^{pd}\rvert$	.48	1.02
Pro–unhealthy prime	$\lvert\epsilon_{kc}^{pi}\rvert$	.94	.34
	δ_{kc}	–.46[a]	.68[a]
2. (N = 201)	$\lvert\epsilon_{kc}^{pd}\rvert$	.72	.67
Fear prime	$\lvert\epsilon_{kc}^{pi}\rvert$	.67	.51
	δ_{kc}	.05[b]	.16[b]
3. (N = 204)	$\lvert\epsilon_{kc}^{pd}\rvert$	.81	.55
Peer prime	$\lvert\epsilon_{kc}^{pi}\rvert$	.52	.66
	δ_{kc}	.29[b]	–.11[b]

B: Study 2b: Controlled Experiment

Experimental Condition	Demand Sensitivity Measures	Mean Value of Demand Sensitivity Measures: Healthy Food	Mean Value of Demand Sensitivity Measures: Unhealthy Food
1. (N = 40)	$\lvert\epsilon_{kc}^{pd}\rvert$	.66	1.12
Control group	$\lvert\epsilon_{kc}^{pi}\rvert$	1.30	.53
	δ_{kc}	–.64[c]	.59[c]
2. (N = 40)	$\lvert\epsilon_{kc}^{pd}\rvert$	1.07	.54
Fear appeal	$\lvert\epsilon_{kc}^{pi}\rvert$	.92	.84
	δ_{kc}	.15[d]	–.30[e]
3. (N = 40)	$\lvert\epsilon_{kc}^{pd}\rvert$	1.22	.58
Peer appeal	$\lvert\epsilon_{kc}^{pi}\rvert$	.69	.96
	δ_{kc}	.53[f]	–.38[e]

[a]Significantly different than zero at $p < .01$ level.
[b]Comparison with pro–unhealthy prime condition is significant at $p < .01$ level.
[c]Significantly different than zero at $p < .05$ level.
[d]Comparison with control group is significant at $p < .1$ level.
[e]Comparison with control group is significant at $p < .05$ level.
[f]Comparison with control group is significant at $p < .01$ level.
Notes: $\delta_{kc} = \lvert\epsilon_{kc}^{pd}\rvert - \lvert\epsilon_{kc}^{pi}\rvert$, where $\lvert\epsilon_{kc}^{pd}\rvert$ and $\lvert\epsilon_{kc}^{pi}\rvert$ are the absolute values of estimated price elasticity for a price decrease and increase, respectively.

effect of fear and peer salience on demand response (H_{7a} and H_{7b}).

Controlled Experiment: Study 2b

Participants and data. One hundred twenty working adults (male = 45%, M_{age} = 28 years, M_{income} = $34.3K/year) from local firms in a large northeastern city in the United States were offered gift cards in return for participation. Data were collected over one day in 2011.

Stimuli and cover story. The experiment consisted of three conditions: control, a fear appeal, and a peer (social network) appeal (for stimuli, see the Appendix). To minimize the likelihood of demand effects, a cover story advised participants that they would be taking part in multiple, independent school of management research studies. This included examining the income statement of a firm for numerical discrepancies, which also served as a filler task, and answering questions regarding shopping behavior. In addition, in accordance with previous research, participants in the treatment conditions received an extra set of cover story instructions for the stimuli (e.g., Starcke, Catrin-Ludwig, and Brand 2012). Specifically, treatment participants were informed that another feature of the multiple, independent research studies, was to gauge ad error rates for certain magazines over the past three years. In keeping with this aspect of the cover story, the participants were told to view the ad appeals as they normally would at home but to also pay attention to copy editing (modified from Hoch and Ha 1986). This was a further attempt to minimize hypothesis guessing (for calibration testing and controlled experiment procedures, see the Web Appendix at www.marketingpower.com/jm_webappendix).

Measures. The experiment uses the same demand response question as in the experimental survey, except for two modifications. First, participants were asked to estimate their own changes in demand. Second, the unhealthy and healthy product categories were different (unhealthy food category: potato chips; healthy food category: raisins). The following depicts the price increase scenario for raisins: "Suppose that the price of raisins went up by 20% compared to what was the last purchase price. (a) I would still buy the same quantity as purchased last time or (b) I would buy less (more) than the quantity purchased last time, by about ________%." Participants responded to the price increase and price decrease scenarios for each food category. We counterbalanced the categories and the pricing scenarios ($p > .1$). Participants also estimated what their changes in demand would be for the same price increase and same price decrease scenarios for four non-food-related, decoy categories (i.e., bath soap, ballpoint pens, socks, and notepads). The healthy and unhealthy items appeared in the second or fifth position to minimize primacy and recency exposure effects.

We evaluated participants' "threat appraisal perceptions" (i.e., severity plus vulnerability feelings) related to not eating healthy using the following scale (modified from Witte 1992): (a) severity dimension ($\alpha = .92$): "I believe that the health consequences of unhealthy eating can be severe," "I believe that unhealthy eating can have serious health consequences," and "I believe that unhealthy eating can be extremely harmful to a person's health"; (b) vulnerability dimension ($\alpha = .94$): "It is likely that I will experience unfavorable health consequences if I eat unhealthy," "I am at risk for experiencing negative health consequences if I eat unhealthy," and "It is possible that I will experience negative health consequences if I eat unhealthy" (anchored by 1 = "highly disagree," and 7 = "highly agree"). The correlation between the two threat appraisal dimensions in our study is .61 ($p < .01$).

We measured self-efficacy perceptions regarding participants' ability to eat a healthy diet as follows (modified from Witte 1992): "I am confident that I can adhere to the

USDA's nutritional guidelines for healthy eating," "I can easily adhere to the USDA's nutritional guidelines for healthy eating," and "I am able to adhere to the USDA's nutritional guidelines for healthy eating" (anchored by 1 = "highly disagree," and 7 = "highly agree"; $\alpha = .90$). Finally, we measured response efficacy with the following questions (modified from Witte 1992): "Following the USDA's nutritional guidelines for healthy eating reduces the likelihood of harmful health consequences"; "If I follow the USDA's nutritional guidelines for healthy eating, I am less likely to experience negative health consequences"; and "Following the USDA's nutritional guidelines for healthy eating works to lower my chances of experiencing serious health consequences (anchored by 1 = "highly disagree," and 7 = "highly agree"; $\alpha = .86$). The correlation between our self-efficacy and response efficacy measures is .41 ($p < .01$). Neither threat appraisal dimension is significantly correlated with self- or response-efficacy ($p > .1$).

Results (manipulation check). A manipulation check assessed the effectiveness of the fear and peer appeals with the following questions: "I am fearful of eating unhealthy," and "I am scared of eating unhealthy" (anchored by 1 = "highly disagree," and 7 = "highly agree") (r = .81; fear manipulation check: $M_{control} = 4.56$ vs. $M_{fear\ appeal} = 5.25$, $p = .01$; $M_{peer\ appeal} = 4.63$ vs. $M_{fear\ appeal} = 5.25$, $p < .05$); "I have access to social support for eating healthy," and "I have access to social backing for eating healthy" (anchored by 1 = "highly disagree," and 7 = highly agree) (r = .83; social network manipulation check: $M_{control} = 4.16$ vs. $M_{peer\ appeal} = 4.75$, $p < 05$; $M_{fear\ appeal} = 4.04$ vs. $M_{peer\ appeal} = 4.75$, $p < .01$).

Results (demand asymmetry). As we noted in the experimental survey, from a public policy perspective, it is desirable for δ_{kc} to exhibit positive or higher values for healthy food categories and negative or lower values for unhealthy food categories. As Table 4, Panel B, shows, the mean values of δ_{kc} for the control condition are significantly different than zero in the predicted directions ($\delta_{kc\ Healthy} = -.64$, $t(39) = 2.40$, $p < .05$; $\delta_{kc\ Unhealthy} = .59$, $t(39) = 2.15$, $p < .05$). Thus, H_1 and H_2 (i.e., undesirable patterns of demand asymmetry for unhealthy and healthy food) are also supported by the controlled experimental data.

Next, the results also demonstrate that the fear and peer appeals exhibit the same capacity to attenuate the undesirable asymmetry of demand sensitivity for unhealthy and healthy food as the primes we used in the experimental survey (Study 2a). For healthy food, an ANOVA shows a significant difference across values of δ_{kc} for the three conditions ($F(2, 117) = 4.25$, $p < .05$). Furthermore, Dunnett tests show that compared with the control condition ($\delta_{kc} = -.64$), the value of δ_{kc} is higher for both the fear appeal ($\delta_{kc} = .15$, $p < .1$) and the peer appeal ($\delta_{kc} = .53$, $p < .01$). For unhealthy food, an ANOVA also shows a significant difference across values of δ_{kc} for the three conditions ($F(2, 117) = 4.64$, $p < .05$). Moreover, Dunnett tests again show that compared with the control condition ($\delta_{kc} = .59$), the value of δ_{kc} is lower for both the fear appeal ($\delta_{kc} = -.30$, $p < .05$) and the peer appeal ($\delta_{kc} = -.38$, $p < .05$). Thus, H_{6a} and H_{6b} are again supported, this time using controlled experimental data (for a summary of results, see Table 4, Panel B).

Results (age and income). We also found that the undesirable patterns of demand response for healthy and unhealthy food are magnified as age and income decrease. We found that the relationships hold across all three conditions. Thus, H_4 and H_5 are supported. We report the results from the control group condition here (for a full summary of age and income effects for all conditions, see Table 5). The control group results are as follows: Age: $\beta_{Healthy} = .081$, $F(1, 38) = 7.03$, $p < .05$; $\beta_{Unhealthy} = -.089$, $F(1, 38) = 9.28$, $p < .01$; Income: $\beta_{Healthy} = .032$, $F(1, 38) = 5.29$, $p < .05$; and $\beta_{Unhealthy} = -.042$, $F(1, 38) = 11.10$, $p < .01$.

Results (process). We conducted mediation analyses using recent bootstrapping techniques (Hayes 2009), and we report our results in accordance with recent recommendations for mediation reporting best practices (Zhao, Lynch and Chen 2010) (for a full summary of mediation analysis results, see Table 6). Specifically, we perform a multipath analysis (appeal vs. control). The positive β values for path A indicate that the appeals (i.e., fear and peer) influence their mediators in the same direction (i.e., threat appraisal and self-efficacy). For paths B and C, in the case of healthy food, positive β values represent attenuation of the undesirable demand response asymmetry; in contrast, for unhealthy food, negative β values represent attenuation of the undesirable demand response asymmetry. Finally, for path A × B, as the confidence intervals indicate, the undesirable patterns of demand response asymmetry are mediated by threat appraisal for a fear appeal (unhealthy food) and self-efficacy for a peer (social network) appeal (unhealthy and healthy food). Thus, the process hypotheses, H_{7a} and H_{7b}, are supported.

TABLE 5
Income and Age Results (Study 2b)

	Healthy			Unhealthy		
	Control	**Fear Appeal**	**Peer Appeal**	**Control**	**Fear Appeal**	**Peer Appeal**
β income	.032*	.041*	.034*	–.042**	–.031*	–.028*
β age	.081*	.070*	.102**	–.089**	–.065*	–.069**

*$p < .05$.
**$p < .01$.
Notes: For healthy food, positive β values represent attenuation of the undesirable demand response asymmetry; for unhealthy food, negative β values represent attenuation of the undesirable demand response asymmetry. Thus, as age and income increase, the undesirable patterns of demand response asymmetry are attenuated.

TABLE 6
Mediation Results (Study 2b)

	Path A (Independent Variable–Mediator)	Path B (Mediator–Dependent Variable)	Path A × B (Indirect Effect)	Path C (Direct Effect)
β fear appeal (healthy food)	.55	.09	.01 95% CI: –.32 to .35	.83
β fear appeal (unhealthy food)	.55	–.65	–.60** 95% CI: –.88 to –.32	–.90
β peer appeal (healthy food)	.80	.56	.46* 95% CI: .11 to .81	1.21
β peer appeal (unhealthy food)	.80	–.61	–.54** 95% CI: –.81 to –.27	–.98

*$p < .05$.
**$p < .01$.
Notes: For healthy food, positive β values represent attenuation of the undesirable demand response asymmetry; for unhealthy food, negative β values represent attenuation of the undesirable demand response asymmetry. Thus, both appeals attenuate the undesirable patterns of demand response asymmetry, and this effect is mediated by threat appraisal for a fear appeal and self-efficacy for a peer (social network) appeal. CI = confidence interval.

Discussion. Using participants' own estimates of demand and specifically constructed appeals, Study 2b corroborates the findings on demand response patterns from Studies 1 and 2a. Study 2b also demonstrates that the undesirable demand patterns are magnified for younger and lower-income participants—groups that have shown a tendency to consume more impulsively than older and higher-income consumers. Moreover, we find supporting evidence for the cognition process by which the appeals are predicted to attenuate the undesirable patterns of demand response—that is, through a threat appraisal for a fear appeal and self-efficacy for a peer appeal.

General Discussion

Theoretical Implications

Our study, employing an integrative framework and using multiple data sources and analysis approaches, demonstrates and explains important and novel aspects of consumers' demand response patterns for unhealthy and healthy food. Specifically, using research on impulsivity as well as standard economic theory, we predict and show that not only do consumers exhibit asymmetric patterns of demand sensitivity to price changes for both healthy and unhealthy food, but they do so in opposite and undesirable directions. This is a unique insight, which runs counter to the conventional premise of symmetric patterns of demand response. This finding was supported across both supermarket scanner data and primary experimental data.

From a nomological standpoint, the research further highlights the interplay of the impulsive and reflective regulatory systems (i.e., Systems 1 and 2; Kahneman 2011) and shows that several policy-relevant variables that either exacerbate or regulate impulsive consumption also magnify or mitigate the undesirable patterns of demand response, respectively. Of particular note, while recent research has explored the effect of social network modification on intentions/behaviors (e.g., Christakis and Fowler 2008), the current study demonstrates that in certain cases, food demand response can be nudged in a healthier direction by merely making the peer support aspect of social networks salient. This salience can be operationalized through either environmental primes or specifically constructed appeals. Along these same lines, our research is also one of the first to investigate the influence of fear salience in the nutritional domain.

In a broader sense, our research contributes to the ongoing interdisciplinary effort to meld research streams from economics and psychology to better understand how and when human behavior deviates from the standard rational economic model (Kahneman 2011). It also contributes to the recent call for marketing scholars to be more responsive to addressing ongoing public policy issues (Talukdar 2008; Wansink and Huckabee 2005). In this context, given that obesity is now a health epidemic in the United States on par with cigarette smoking, food consumption behavior is a key contemporary public policy issue (Seiders and Petty 2004).

Substantive Implications

For public policy makers, our findings imply that the efficacy of economic policy interventions in inducing healthier food consumption behavior will be much more limited than what is expected under the conventional premise of symmetric patterns of demand response. This may warrant that public policy officials lower their level of expectations regarding the effectiveness of so-called sin tax initiatives in curbing demand for unhealthy food. By the same token, our findings suggest that such food-based sin taxes are thus likely to generate more public revenues than expected. For example, given the observed higher-than-expected resistance of consumers to reduce consumption of unhealthy food in the face of a price increase, such measures are likely to extract still more consumer surplus (e.g., by charging extra for unhealthy food in some contexts such as school vending machines).

From a managerial standpoint, understanding the patterns of demand sensitivities highlighted here with respect to price increases and decreases across healthy and unhealthy food items should allow for more effective pricing decisions at both the SKU and category management level (especially for hi-lo grocers). For example, if the goal is short-term revenue generation, coupons and discounts are likely to be more effective when offered in conjunction with unhealthy food items. At the same time, our finding that food demand response patterns may be nudged in a healthier direction by merely priming participants to think about the enabling peer support aspects of social networks implies that investing in "virtual community" programs holds more promise for not only public policy makers but firms that aim to promote healthy lifestyles. Such firms may include supermarket chains (e.g., Whole Foods) and companies promoting consumer and employee wellness programs. Given the changing nature of communication and the influence of virtual communities (Chan and Li 2010), this appears to be a high-yield area in terms of influencing healthier food selection and consumption.

Further Research

Although our study replicates findings across multiple product categories using actual market as well as experimental data, its geographic scope was limited to the northeastern United States. Thus, a useful avenue for further research would be to investigate other generalizations of our findings across other geographic areas and product categories. In this context, one worthwhile direction would be to explore cross-country, cross-cultural differences pertaining to our key findings on demand response. From a theoretical standpoint, a related literature stream suggests that because vice products are driven by emotion, they are thus best regulated by viscerally painful cues (e.g., Metcalfe and Mischel 1999; Thomas, Desai, and Seenivasan 2011). We use this notion when discussing the effects of some of the moderating variables in our conceptual framework. As such, visceral regulation of vice theory remains an area for future research exploration to identify additional moderators in the domain of food consumption and nutrition.

Further research would also benefit from a more in-depth focus on stimuli typology and manipulation of salience. In terms of stimuli type, the current research examines the effects of fear and social networks. Further research should investigate additional types of stimuli such as those that are purely educational and those that rely on positive affect (e.g., humor). In addition, while the current research manipulates salience through primes and appeals and investigates their effect on demand response independently, another useful direction would be to directly compare the relative efficacy of primes versus appeals. For example, literature shows that unlike environmental primes (e.g., actual articles), advertisements/appeals are more open to counterarguing (e.g., Obermiller and Spangenberg 2000). Thus, priming methods may prove a more effective avenue than traditional media, in some cases, for inducing behavior change (see studies on priming theory; e.g., Dahlen 2005). Individual characteristics are an area in which such differences in efficacy between primes and appeals are likely to manifest. For example, while generation Y features the most educated and technologically savvy consumers as a group, they are also extremely distrusting of advertising and "canned messages" (Acquino 2012). Thus, it may be that the relative efficacy of primes versus appeals will vary across educational levels and life stages.

Finally, while Study 1 uses actual consumer behavior data from supermarkets, both our experimental studies rely on behavioral intention data in an effort to gauge the impact of the focal public policy levers (primes in Study 2a and appeals in Study 2b) on consumers' demand response. Therefore, another fruitful direction for further research would be to test the impact of such policy initiatives on demand response by employing actual or simulated behavioral data. Some possible options (from more to less artificial, but more costly) in this regard are computer-simulated shopping experiments, test markets in laboratory-based stores, and/or natural test-market field-based studies (Burke 1996).

APPENDIX
Study 2b: Controlled Experiment

A: Fear Appeal

Eating Can Be a Dangerous Experience …

Did you know that an overwhelming majority of Americans' diets do not meet Federal Food Guide Pyramid recommendations?

The unhealthy diets of a majority of Americans result in more deaths each year than smoking, drug-use, and firearms combined and is one of the two leading causes of premature death in the United States (American Medical Association).

Such a diet contributes to four of the six leading causes of death:

- Heart disease.
- Diabetes.
- Stroke.
- Many cancers (colon, prostate, mouth, throat, esophagus, lung, stomach).

Please follow the USDA's nutritional guidelines for healthy eating.

B: Peer Appeal

Eating Can Be a Social Experience …

Did you know that an overwhelming majority of Americans belong to one or more social networking sites?

The unhealthy diets of a majority of Americans have resulted in the development of various nutrition-related sites which feature social networks and user groups.

Such sites foster social interaction on nutrition-related topics, and include the following:

- The Daily Plate—Connect with others.
- MD Junction—Find online support groups.
- Food Fan—A social network for anyone who wants to connect with others for support with food-related issues. It includes lots of community-based stuff like groups, message boards and blogs.
- Foodzy—The website provides a social network.

Please follow the USDA's nutritional guidelines for healthy eating.

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