

Processing and acting upon nutrition labeling on food: The state of knowledge and new directions for transformative consumer research

Klaus G. Grunert

MAPP Centre for Research on Customer Relations in the Food Sector, Aarhus University, Denmark

Lisa E. Bolton

Department of Marketing, Pennsylvania State University, USA

Monique M. Raats

Food, Consumer Behaviour and Health Research Centre, University of Surrey, UK

Introduction

Non-communicable diseases (i.e. cardiovascular diseases, diabetes, cancers and chronic respiratory diseases) are globally estimated to cause 60% of all deaths in 2005 (WHO, 2005). Five out of the ten leading causes of death are related to non-communicable diseases, an estimate expected to rise to eight out of ten by 2030 (WHO, 2008). Diet is a major modifiable risk factors underlying chronic diseases (WHO, 2005; World Cancer Research Fund and American Institute for Cancer Research, 2007).

Nutrition labeling is widely regarded as one of the most promising instruments for fighting unhealthy eating habits and rising obesity rates (Baltas, 2001). Nutrition labeling refers to a list of nutrients on a food label along with some means of quantification (Hawkes, 2004). From a policy

perspective, it holds the promise of furthering healthy eating while preserving freedom of choice. From a consumer perspective, it provides a means of reducing the information asymmetry that exists between producers and consumers by providing product specific information. From a producer or retailer perspective, it provides a means of exhibiting positive nutritional characteristics of products in a credible way.

In this chapter, we will give a brief introduction to the current practice of nutrition labeling in the USA and the EU. We will then address the question of how nutrition labeling affects consumer behavior, reviewing extant research and proposing an agenda for future research. Our discussion will focus on the effects of nutrition labeling that occur via their impact on consumer behavior. Labeling may also have effects on the supply side: For example, as labeling makes certain nutritional properties of a product more visible, new product development and product reformulation may take place to create positive nutritional profiles. Such effects, while potentially very important from a public health perspective, will not be addressed in this chapter (see Moorman, 1998 and Moorman, Du & Mela, 2005 for investigation of such effects).

Nutrition Labeling in the USA and EU: An Overview

When examining the history of nutrition labeling in the US, Golan and colleagues (2001) report the first explicit reports linking labels with the social goal of health of the nation to the White House Conference on Food, Nutrition, and Health in 1969. One of the major recommendations from this conference was that the Federal Government should consider developing a system for identifying the nutritional qualities of food to help address deficiencies in the U.S. diet (U.S. Food and Drug

Administration, 1998). Around the world regulation by transparency has become an important regulatory tool, of which nutritional labeling is one form (Weil, Fung, Graham and Fagotto 2006). The United States Nutrition Labeling and Education Act (NLEA), enacted in 1990, explicitly seeks to reduce heart disease, cancer, and other chronic diseases through changing consumers' habits and by encouraging companies to market healthier products. In their review of transparency policies, Weil et al. (2006) conclude that these policies are only effective when the information they produce becomes "embedded" in the everyday decision-making routines of information users and information disclosers.

Prior to the NLEA, nutrition labeling in the USA was voluntary. The NLEA mandated that packaged foods display a Nutrition Facts Panel, listing selected nutrients per food serving, as well as nutrients as a percentage of recommended Daily Values. An additional labeling requirement for trans-fat content went into effect in 2006. The US Department of Agriculture's Food Safety and Inspection Service (FSIS) adopted similar labeling rules for meat, poultry, and eggs. In contrast, labeling is not mandated for raw produce. A sample U.S. nutrition panel is shown in Figure 1. Usually, this panel appears on the side or back of pack (BOP). Although the FDA estimated the monetary value of the health benefits of the NLEA at \$4.4-26.5 billion (1991), compared against estimated costs of \$1.4-2.3 billion to implement, research is scant on whether these health benefits were achieved (Variyam & Cawley, 2008).

More recently, various voluntary labeling schemes, many of them appearing on the front of the pack (FOP), have been adopted by industry to augment the Nutrition Facts Panel in the U.S. Many of these are health logos, i.e., logos that are awarded to products regarded as nutritionally superior based on selected criteria (see Figure 1 for some examples). Some of these labels are awarded by

independent bodies, like the American Heart Association Heart-Check Mark for foods that meet certain fat, sodium, and other criteria. Others are run by firms, like Kraft's Sensible Solution program, which identifies products that are "better for you" among Kraft offerings with a green flag. Finally, a health logo effort of multiple firms (including Kraft, Kellogg, and Unilever) was voluntarily halted after a short period in 2009. The Smart Choices program featured a green checkmark label and labeling decisions were guided by a panel of food executives, academics, and health academics. However, the program was widely criticized when the Smart Choice label appeared on products like Fruit Loops and Fudgsicles. According to FDA Commissioner Margaret Hamburg, "There's a growing proliferation of forms and symbols, check marks, numerical ratings, stars, heart icons and the like...There's truly a cacophony of approaches, not unlike the tower of Babel" (<http://www.chicagotribune.com/business/chi-biz-food-labels-1020-,0,3674628.story>). The FDA has announced intentions to review voluntary FOP labels for misleading health claims and to research labeling that would help consumers make healthier choices, including the challenging question of realistic serving sizes. There have also been recent initiatives to institute nutrition labeling of restaurant menus, such as the Menu Education and Labeling (MEAL) Act (introduced but never passed at the federal level) and various state and city initiatives in the U.S.

Mandatory nutrition labeling legislation can also be found in other countries including Argentina, Australia, Canada, Israel, Malaysia and New Zealand (Hawkes, 2004). In the EU, giving nutrition information on food labels is voluntary, unless the product carries a nutrition or health claim, i.e., promotes certain nutritional or health-related properties (for overviews of the EU situation, see Cheftel, 2005 and Przyrembel, 2004). The EU Commission has presented a proposal for making such information compulsory, including easily legible FOP information. In addition, numerous voluntary schemes are in place in the E.U., some promoted by major food producers or retail chains.

BOP information is usually a table or list giving information on content of various nutrients in grams per 100 g, per serving, and/or per package, supplemented with information on calories. In addition, the per serving information may also be stated as a % of *guideline daily allowances* (GDA). (GDA are a guide to the amount of energy (calories) and maximum amount of some nutrients (e.g. fat, saturated fat/saturates, salt, sugars) a person should eat in a day, usually computed for an adult female with a moderate level of physical activity.)

FOP information is more simplified and three types of FOP labeling are prevalent: GDA labels, traffic light labels, and health logos. GDA labels usually give information on calories, fat, saturated fat, sugar and salt both in grams per serving and in % of the GDA. GDA labels are promoted by parts of the food industry and have been adopted by several multinational food producers as well as some major retail chains. Traffic light labels also give information on calories and the four key nutrients fat, saturated fat, sugar and salt; instead of GDA percentages for nutrients and the calories, these labels are color-coded as red, yellow or green to reflect whether the nutrient and energy content is high, medium or low (based on some pre-established standards). Traffic light labels are used by some producers and retail chains in the UK, where the Food Standards Agency has set nutrition criteria for the red, amber and green colour coding that provides information on the level (i.e. whether high, medium or low) of individual nutrients in the product (Food Standards Agency, 2007). Traffic light labels are the type of label preferred by most European consumer associations, many of which look with some suspicion at GDA labels that they believe are too complicated for consumers to use and may be misleading (BEUC, 2006). Finally, health logos are used in Europe as well. The most well-known and oldest example in Europe is the Swedish *Keyhole* logo, which signals that a product contains less fat, less sugar, less salt and more fiber than similar products in the same category; a newer example is the *Choices* logo promoted by the Choices International Foundation

(<http://choicesprogramme.org/en>). Sometimes these three types of labels are designated as non-directive, semi-directive and directive, based on the extent to which they direct consumers to what to buy if they want to make a healthier choice (Hodgkins et al., 2009). Figure 2 shows examples of the major formats used in Europe.

Figures 1 and 2 here

A recent audit of almost 40,000 products in all 27 EU member states and Turkey (Storcksdieck et al., in press) showed that 85% of the products had BOP nutrition information, and 48% also had FOP nutrition information. GDA labels were the most common form of FOP nutrition information (25% of the products audited). In the USA, a 1995 survey indicated that 96% of processed foods had nutrition-facts labels (cited in French, Story & Jeffery, 2001). Thus, use of nutrition labeling is widespread—which begs the question whether (and how) it works.

Approaches to analyzing the effects of nutrition labeling

The effects of nutrition labeling on *consumer behavior* can be analyzed from a producer and from a public health perspective. While a food producer may have a genuine interest in contributing to public health, nutrition labeling is for the producer also a positioning and branding tool. For example, the mere presence of a FOP nutrition label on a range of products might be perceived by consumers as an indicator of overall healthiness of the product line. The major difference between a producer and a public health perspective, though, is that a producer perspective is primarily concerned with the effect of nutrition labeling on brand choice, whereas a public health perspective

is primarily concerned with a healthier overall dietary intake—goals that are not necessarily aligned and may frequently compete. When analyzing the effects of nutrition labeling on consumer behavior, it therefore makes sense to distinguish between effects on brand choice and effects on dietary intake.

In this chapter, and in line with the philosophy of transformative consumer research, we will look at the effects of nutrition labeling on consumer behavior both in terms of brand choice and in terms of effects on dietary intake.

Brand choice

To understand the impact of nutrition labeling on brand choice, a broad range of theoretical concepts may be invoked. One simple way of structuring the problem area is to use a dual processing hierarchy of effects framework, as illustrated in figure 3 (see also Balasubramanian & Cole, 2002; Grunert & Wills, 2007; Moorman, 1990). Consumers need to be exposed to the nutrition information. BOP nutrition information will mostly require intentional exposure inasmuch as consumers have to turn the package around and look at the back in order to see the information, whereas FOP nutrition information is more likely to result in incidental exposure. Perception of the BOP information is therefore most likely dependent on the consumer's motivation and ability to process nutrition information and to use nutritional content as a criterion in decision-making, whereas perception of FOP information also will be affected by the attention-getting properties of the label. If (part of) the nutrition label is indeed perceived, further processing can follow two paths.

Path 1 is cognitively dominated and involves conscious efforts to assign meaning to the labeling information. The process of assigning meaning can be subdivided into *understanding* and *inferences*. Understanding includes, for example, whether the consumer understands the concepts upon which the information is based, e.g. whether the information is per serving or per 100 grams, understands the definition of GDA, understands what a health logo stands for, and so on. Inferences are the conclusions about the healthiness of the product that the consumer draws from her understanding of the label; in addition, nutrition labels can also serve as the basis for inferring other product attributes, like the taste of the product. Both understanding and inferences depend on the nutritional competence of the consumer, i.e., their declarative (e.g. that too much saturated fat is not healthy) and procedural (e.g. how to choose a low sugar product) knowledge with regard to nutrition and healthy eating. This includes knowledge about expert recommendations (don't eat too much fat), about nutritional properties of certain products (alcohol is high in calories, fish is high in unsaturated fat), about principles of healthy eating (eat a varied diet), and about making trade-offs in choices (salt content is more important than calories or vice versa, depending on your health status). Health inferences may not be based on the nutrition label alone – perceptions of the healthiness of product categories differ considerably and consumers may infer healthiness also from a range of other indicators, like degree of processing, use of additives, organic production, or the brand. Nutrition and health will in most cases not be the only criterion in food choice, and hence the effect of the nutrition information on brand choice will depend on how the inferences made about healthiness will be integrated with or traded off against other criteria like taste, family liking, convenience and price.

Figure 3 here

Path 1 sketched above traces the cognitive effects of nutrition labeling and processing via this path will depend on the levels of both motivation and ability to process nutrition information when buying food. However, food is frequently bought, some product categories may be low involvement purchases for the consumer, and many brand choices may be habit-based. In addition, nutrition and health may not even be a prominent motive in some people's food choice. In such cases the nutrition label information may just be ignored, or it may have affective effects as described by path 2 in figure 3. We have already noted that the mere presence of a FOP nutrition label can be taken as a signal of healthiness, and our framework proposes that such labels may also elicit affective responses. For example, the presence of green or red traffic lights on the front of the pack may elicit positive or negative emotions that impact brand choice without further cognitive processing. The literature has typically not distinguished between these paths and has tended to focus on cognitive responses; research on affective response to nutritional labeling is scant.

Dietary intake

From a dietary intake perspective, nutritional labeling should result in healthier choices in a product category—which should, in turn, have a positive (albeit small) effect on the healthiness of overall dietary intake (Roodenburg et al., 2009). However, several important qualifiers affect whether this conclusion can be drawn. First, the nutrition label must have driven the healthier choice—hence, determining whether consumers are able to use labels correctly and whether such labels impact choice is an important precursor of effects on dietary intake. Second, the positive effect of healthier choices assumes that all other aspects of buying, preparing and eating food remain the same—an assumption that may be questionable. The label may affect the quantity eaten within the category (e.g., consumers may eat more of a product if they perceive it as low-fat), across categories (e.g.,

eating healthier during regular meals may lead consumers to think they can indulge more into snacking), and even changes in meal patterns and eating habits (e.g., substituting dining out for ready-made meals after realizing the latter are high in fat and salt). The single brand choice represents one of a large number of decisions that have an impact on dietary intake. In addition to the totality of brand choices in the food area, dietary impact will be influenced by decisions on menus, meal preparation methods, choice of recipes, eating in vs. eating out, meal patterns and snacking habits. While many of these may not be directly affected by nutrition labels, indirect effects may occur that either reinforce or counteract healthier brand choices. Given this complexity, the net effects of nutrition labeling on dietary intake at the aggregate level are probably not huge.

Compared to explaining brand choices, the body of consumer behavior theory we can draw upon is considerably sparser when it comes to explaining meal preparation, meal patterns, and other aspects of dietary intake at the aggregate level. Economic models of demand have possible substitutions between various product categories built in, and while relative prices are viewed as the primary determinant of demand in economics, effects of information (including health information) are being analyzed as part of demand models (see, e.g., Mazocchi, Traill & Shogren, 2009). Sociological approaches have also been employed to analyze changes in meal patterns in response to changes in society, and the introduction of nutrition labeling can be viewed as an aspect a changing societal discourse on health that impacts also on meal patterns (e.g., Mennel, Murcott & van Otterloo, 1992). The question of how nutrition labeling affects dietary intake remains, therefore, largely unanswered.

Previous research on nutrition labeling

Consumer research on the effects of nutrition labeling has been conducted for decades (for previous reviews, see Cowburn & Stockley, 2005; Drichoutis, Lazaridis & Nayga, 2006; Grunert & Wills, 2007). Such research has tended to ‘drill deep’ on certain effects of nutrition labeling—for example, focusing only on one or few dependent variables, like self-reported use of the label or liking of different label formats. The following section highlights some of the results that have been obtained in existing research.

Motivation to process nutrition labels

In their review of European research on the topic, Grunert and Wills (2007) concluded that there is “a surprising degree of consistency in the conclusions about consumer interest in nutrition information and in their interest in getting this information from nutrition labels on food products.” Their review suggested that consumers were generally aware of the link between food and health, indicated an interest in nutrition and also expressed an interest in getting information about the nutritional properties of the food they eat. It was also clear, however, that nutrition information was not the top interest with regard to food, even in those countries where nutrition issues are of higher interest. In a Dutch study, for example, informants would rather talk about tasty food, food safety or issues like GMO than nutrition (van Dillen et al., 2003). In a Swedish study, respondents ranked health and nutrition sixth in importance after food safety, freshness, taste, lack of pesticides, and animal welfare (Svederberg et al., 2002). In a study on what kind of information consumers would like to see on meat labels in Europe, nutrition information was rated as of medium importance, lower than information on origin and best before date (Bernues, Olaizola & Corcoran, 2003). Demographic differences exist: women have a higher interest in nutrition than men, interest in health and nutrition increases with age, and there is more interest in Northern compared to Southern

Europe. Interest in getting nutritional information was also higher for products with a higher degree of processing, and less for products that are regarded as a treat; it was also higher when products were bought for the first time. Across a range of studies, the nutrition information that respondents were most interested in were calories and fat, followed by sugar, salt, carbohydrates, vitamins and calcium. As expected, motivation to process nutrition information is related to actually processing of label information, both in a lab setting (Moorman, 1990) and in the real world (Grunert et al., 2010). That is, motivation drives consumers to process nutrition labels along path 1 in figure 3.

Nutrition knowledge

Knowledge or ability is an important driver of behavior, although the influence of nutrition knowledge on food-related behaviors has not received consistent support from the scientific literature (Worseley, 2002). In his review, Worseley (2002) draws on the distinction between (1) declarative knowledge, i.e. knowledge of ‘what is’, awareness of things and processes (e.g. good sources of particular nutrients or diet-disease relationships) and (2) procedural knowledge, i.e. knowledge about how to do things (e.g. how to choose a low salt product). There is some evidence of a relationship between higher nutrition knowledge and 'healthier' food intakes (e.g., Wardle, Parmenter & Waller, 2000). Overall, however, Worseley (2002) suggests that the lack of significant evidence for nutrition knowledge improving dietary behaviors is a result of (1) poor conceptualization of nutrition knowledge, (2) lack of relevance (e.g. saturated fat knowledge may be more relevant to middle aged consumers than to teenagers), (3) poor measurement (i.e., lack of well validated questionnaires), (4) poor matching of knowledge and outcome variables, and (5) small studies, (i.e. no statistical power to detect any influence, see also Obayashi et al. (2003)). Turning to the processing of nutrition labels, Elbon and colleagues (2000) found that high nutrition

knowledge and positive nutrition-related health seeking behaviors (i.e. interest) were strongly associated with the reading of nutrition information panels on food products. However, such effects may not be forthcoming if consumers with higher levels of nutrition knowledge feel that processing of nutrition labels is unnecessary. Hence, nutrition knowledge may be a second factor (beyond motivation) that affects path 1 processing in figure 3—but support for this relationship is weaker (compared to motivation) in the literature.

Self-reported perception and use in decision-making

By far most research carried out on perception and use of nutrition information on food labels is based on self-reported measures, i.e., respondents are asked *how often do you read...or how often do you use...when buying....* Reading and use is often treated as synonymous in this type of research (and it may indeed be difficult to ask consumers whether they read, but did not use, nutrition information). However, these processes are conceptually distinct and reading may not imply use. In their review of nutrition labeling research conducted until 2002, Cowburn and Stockley (2005) concluded that “most consumers claimed to look at nutrition labels often or at least sometimes.” The review of research after 2002 by Grunert and Wills (2007) comes to a similar conclusion, finding that usually about 50% of the sample claim that they read or use nutrition information always or often. Women report more use than men, and people with higher levels of education and with higher incomes report more frequent use, as do people with higher levels of interest in health and nutrition and/or with a health status that implies special dietary needs. Higher levels of nutritional knowledge also correlate with higher self-reported use. When asked for reasons for not using nutrition labels, factors mentioned include lack of time, small print, lack of understanding and concerns about accuracy of the information. Other information available on the food package, like

the presence of a health claim, may also impact the likelihood of reported label use (Roe, Levy & Derby, 1999).

Measures of self-reported retrospective behavior can lead to considerable over reporting with regard to behaviors that are regarded as socially desirable (Podsakoff et al, 2003), and as we will note below, more direct evidence on reading and use of nutrition information in the shops suggests that actual reading and usage rates may be considerably lower. A recent study conducted in six European countries (Grunert et al., 2010) that employed both observation of purchases and measures of self-reported use when buying the same product category found levels of over reporting varying between 0 and 100% and suggested that some of these differences may be attributable to differences in how much health and nutrition have been prominent in the public discourse in those countries. Also, self-reported use does not distinguish whether processing followed the cognitive path 1 or the affective path 2 (figure 3).

Liking of different labeling formats

A range of studies has looked at consumer liking or preferences for different label types and formats. However, most of these studies (though sometimes highly cited in the public debate on nutrition labeling) are not specific about the theoretical status of ‘liking’. In our framework, ‘liking’ is an affective reaction (path 2 in figure 3) whereby nutrition labels can affect choice with minimal cognitive processing. Grunert and Wills (2007), in reviewing the evidence on consumer liking of different labeling formats, suggest three underlying dimensions (see also Levy, Fein & Schucker, 1996). First, consumers like simplification. They know that in a real shopping situation they have limited time and opportunity to look at comprehensive (especially BOP) nutrition information. They

also find it difficult to interpret various nutrients, compare numbers, and are generally wary about the cognitive load that comes with trying to make use of nutrient tables. Second, consumers may be wary of simplification and respond negatively. When presented with simplified information like traffic lights or health logos, consumers want to know what the simplified information stands for (e.g., how the red light or the health logo was determined) and are wary of letting even credible others make these judgments for them. Third, nutrition information can create resistance in consumers when they feel coerced or pushed to make choices that they do not want. Obviously, these three responses may conflict, and consumers may differ in the weight with which these responses determine their liking for various labeling formats.

Such heterogeneity may explain why results on liking of different formats are not always clear, especially when comparisons are made across the three major formats of FOP labeling (GDA labels, traffic light labels, and health logos). Health logos are simple, but consumers may be suspicious about the underlying criteria. GDA labels are much more complete in the information provided, but are more complex. Traffic light labels are somewhere in between, with the color coding reducing the complexity, but at the same time possibly adding an element of perceived coerciveness that could lead to reactance. Results on liking are considerably more clear-cut when the basic type of label is held constant and only presentational elements are changed, with a higher liking for bigger fonts, use of colors, and use of whole numbers instead of decimals.

Understanding and health inferences

Understanding has two distinct dimensions: subjective understanding (whether consumers believe themselves that they understand the label information) and objective understanding (whether the

consumer interprets the information correctly based on some external standard). Subjective understanding is usually high, especially for the simplified FOP formats. Objective understanding, not surprisingly, depends upon the design of the task. Usually, a majority of respondents can correctly recall information given on one nutrient, though the percentage of correct answers may depend on the format in which the information is given. For example, a study commissioned by the Food Standards Agency in the United Kingdom (Food Standards Agency, 2005) asked respondents to evaluate whether a product was high, medium or low on two key nutrients. Of four formats tested, the multiple traffic light format led to most correct answers, ahead of the color-coded GDA information—presumably because the multiple traffic light provided exactly this information. When, however, respondents were asked which of two products was higher on these two key nutrients, the color-coded GDA outperformed the traffic light system. In another study (Which 2006), the multiple traffic light system clearly outperformed various versions of a GDA-based system when the task was to find out whether the level of four nutrients in the product was low, medium or high. A U.S. study (Levy, Fein & Schucker, 1996) showed that the format where respondents performed best in comparing nutrient content across products was different from the format that best facilitated computing overall daily intakes of a particular nutrient, which again was different from the format best for find out how to balance a diet across nutrients. Most of these results can be interpreted on the background of the simple hypothesis that share of correct answers increases in line with a decrease in the requirements for processing of the information provided in order to give a correct answer. That is, objective understanding improves when the measure ‘matches’ the label. Such measurement artifact makes it difficult to determine whether label formats actually affect true comprehension.

Research on inference-making from nutrition labeling is more limited and, again, results depend upon characteristics of the study design. When respondents are asked to compare or rank two or three products from the same product category in terms of overall healthiness, based on some kind of FOP labeling format, most respondents are able to do so correctly and the percentages of correct answers do not differ considerably between the various formats of FOP labels (see Grunert et al., 2010; Malam et al., 2009; Which, 2006). That is, any structured and legible presentation of key nutrient and energy information, regardless of FOP format, is sufficient to enable consumers to detect the healthier alternative. For more difficult tasks (i.e., monadic and product comparisons), however, objective understanding declines—and label format appears to matter (e.g., Malam et al. 2009, Barone et al. 1996).

Health inferences may of course be based on other information than the nutrition label. A recent European study (Grunert et al., 2010) indicated that level of processing is the most commonly used information when making inferences about healthiness; information on ingredients and additives are also commonly used. While the presence of health and nutrition claims affects the likelihood of reading the BOP information (Roe, Levy & Derby, 1999), their presence does not appear to interact with nutrition information when judging overall healthiness of a product (Keller et al., 1997; Kozup, Creyer & Burton, 2003; Mitra et al., 1999). Given the recent interest in adding FOP nutrition and health claims to food products, the issue of how such claims combine with standard nutrition labeling affect consumer response is important to investigate.

Actual use in decision-making

The high levels of self-reported use, coupled with the evidence for accurate health inferences, could suggest that the impact of nutrition labels on food choice and dietary intake is considerable. However, as already noted, self-reported use probably reflects an over reporting bias. The limited evidence that is available based on observational methods or verbal protocol analysis suggests that actual levels of usage may be a good deal lower, and/or that consumers may merely look at the label but not process the information further (Cowburn & Stockley, 2005). A recent study conducted in six European countries (Grunert et al., 2010) provides the most accurate picture of actual label use to date. Shoppers were observed at six different aisles in supermarkets (breakfast cereal, soft drinks, yoghurts, savory snacks, confectionary, ready meals), and time spent, products handled and selections made were recorded. Upon leaving the aisle, shoppers were intercepted and interviewed about the selection just made. When respondents answered the question ‘Did you look for any nutrition information when selecting this product’ affirmatively, they were asked to name the nutrient(s) on which they sought information, to characterize the product as high or low on that nutrient, and to show the interviewer where on the package they had found this information. Respondents who answered these questions were classified as having processed nutrition information. From 9% (in France) to 27% (in the UK) of shoppers appeared to process nutrition information, with considerable variation across product categories (from 11% for confectionary to 25% for breakfast cereal).

It should be noted that this methodology only taps explicit knowledge of nutrition information on the package. Research on price knowledge (Dickson & Sawyer, 1990; Vanhuele & Dreeze, 2002) suggests that shoppers may also have implicit knowledge on the products they buy, which could be measured by a recognition task, but not by a recall task as above. Explicit knowledge is more likely to result from cognitive processing of the label information (path 1) than from affective processing

(path 2), and it is thus conceivable that this type of methodology underestimates cognitive and affective processing of nutrition labels.

Dietary intake

Processing of nutrition information does not necessarily imply that the information will have an impact on the choice made, or that the impact results in an objectively healthier choice. Moreover, even if individual choices improved, an impact on overall dietary intake may not emerge at the aggregate level. —and, indeed, the empirical evidence is rather weak. Three types of studies have been conducted to address the effects of nutritional labeling on dietary intake. The first type of study is based on survey data and relates people’s self-reported food intake to the same people’s self-reported use of nutrition labels (e.g., Coulson, 2000; Kim, Mayga & Capps, 2001; Kristal et al., 2001; Lin et al., 2004; Neuhouser, Kristal & Patterson, 1999; Weaver & Finke, 2003), finding that there is indeed a positive relationship. Apart from potential biases resulting from social desirability and consistency, correlational evidence cannot provide evidence of causality. (The interpretation that people with a healthier lifestyle consult nutrition labels more often is at least as plausible as the hypothesis that use of nutrition labels results in a healthier lifestyle.) The causality problem is less severe in longitudinal studies, and a recent analysis using National Health Interview Survey data pre- and post-NLEA finds that self-reported use of nutrition labeling reduced BMI for only one demographic group (non-Hispanic white women; Variyam & Cawley, 2008). The second type of study consists of econometric studies using household budget data, where researchers attempt to incorporate health information as a potential predictor of demand for product categories that involve a health issue (e.g., eggs, animal fat). Usually, an index of health information is constructed based, for example, by counting media appearances of a certain issue (e.g., cholesterol) or counting

appearances of the issue in the scientific press, based on the argument that this information eventually will trickle down to consumers. Indeed, such an association can be found in a number of US studies (e.g., Brown & Schrader, 1990; Chern, Loehman & Yen, 1995). While such studies show that the presence of a food-and-health issue in the public discourse has an effect on consumer demand, they do not shed much light on the effect of nutrition labeling. The closest we come to real evidence on how nutrition labeling affects consumer choices are some studies comparing purchase patterns before and after changes in the US legislation on nutrition labeling, with mixed evidence (e.g., Mathios, 1998; Mojduszka, Caswell & Harris, 2001). Finally, the third type of study refers to experimental work where the focus is not on brand choice, but on consumption decisions. For example, Wansink and Chandon (2006) demonstrate that providing information on low fat content led to increased calorie intake by adjusting the perception of the appropriate serving size upwards and decreasing consumption guilt. Although this approach provides stronger evidence of causality, it remains focused on a single consumption episode rather than the totality of consumption that, in the aggregate, determines dietary intake.

Theoretical and Methodological Challenges

A review of the existing research on nutrition labeling is not easily summarized. A large proportion of consumers are aware of the link between food and health and have a basic interest in obtaining and using information that could help them eat healthily. When making food choices, using nutrition labeling information is regarded as good and desirable behavior. Still, evidence is limited for actual use of such information in the shop. To explain this gap, the discussion has for a long time focused mainly on problems with availability of labels, understandability of labels, and comparability of information. But much progress has been made on these fronts: Availability is

now improved due to legislation and retailer and producer initiatives. Understandability has also improved inasmuch as FOP labels help consumers, when prompted, to identify healthier options. Nonetheless, actual usage of nutrition labels remains low—which raises two major questions for future research: 1) Why is the current level of usage of nutrition labeling information not higher than it is? Answering this question may require a shift from the information processing approach of prior research on nutrition labels, to an approach that emphasizes motivational issues, goal setting and self-regulation. And 2) When nutrition labeling information indeed is used, does it have a positive effect on healthy product choice and dietary intake? Answering this question may require a shift from the study of individual brand choice to an approach that emphasizes actual consumption and, in the aggregate, dietary intake. Providing answers to these questions would provide help in designing nutrition labeling schemes that indeed will be used and inform the regulatory debate on nutrition labeling.

To encourage real progress in addressing these questions, we focus on three theoretical and methodological challenges: the need to do research in-store and in-home, the challenge of analyzing consumer choices that are not discrete but form a continuous pattern, and the difficulty of analyzing the link from food choice to dietary intake.

In-store and in-home research

Given the large amount of research that has been done on brand choice, it is astonishing how little has been conducted where most such choices are made – in the shop or restaurant. Of course there are good reasons for moving studies into the lab (where the information-overloaded supermarket environment can be replaced with a controlled environment), and for relying on retrospective

accounts of own behavior instead of observations of the actual behavior (given the cost and time needed to conduct observational studies in the field, along with the challenge of finding retailers with which to partner). Nonetheless, it seems imperative to consider the effects that nutrition labeling has at the place where it occurs. Observations at the aisle, combined with interviews conducted with close temporal proximity to the observed behavior, can help researchers to determine whether consumers did look at the label, how long, what they looked for, whether they found what they looked for, and how consumers themselves believe that the information has entered their decision. Mobile eye-trackers may be another way of measuring processing at the micro level in a real-world setting, despite concerns about reactivity. Conducting in-store experiments with different forms of labeling may ultimately be the gold standard for investigating how different forms of labeling can affect perception, understanding, health inferences and use in decision-making, especially when combined with the scanner data automatically generated in retail outlets.

Another location that may merit greater research is the home. Exposure to nutrition labels continues at home, with both the shopper and other family members potentially being exposed, and nutrition may become an element in the family discourse that shapes the next shopping trip. Unfortunately, the home is at least as difficult to access as the shop. Unobtrusive observation is not easy, and input from different family members may be needed in order to get a more complete picture of family interactions.

Ongoing choice and consumption

For decades the bulk of brand choice research has explicitly or implicitly followed a paradigm focusing on individual brand choices rather than a continuing process of interrelated choices. In fact

moving consumer goods, it has of course been recognized that category purchases are made frequently, and that specific instances of brand choice therefore are part of an ongoing process in which choices are interrelated. Food choice is probably the most extreme form of such interrelated choices. Most people eat several times every day, and the process of planning meals, buying food, preparing meals and eating is therefore an ongoing process that pervades much of daily life. What people eat is the result of many small decisions triggered by events like experiences with current meals, remarks by family members, remembering the need to pack lunches school, looking into the fridge to find out what is there and what is missing, etc. (Khare & Inman, 2006). To illustrate this issue, figure 3 depicts the results of a network analysis of all food-related thoughts that 10 respondents recorded during a one week period (Scholderer, 2005).

Ideally, the role of nutrition labeling needs to be related to this ongoing decision-making process, not just to the brand choice of the product on which the label appears. The challenge, of course, is that very little is currently known about this ongoing decision-making process, about which decisions are made when, triggered by which environmental events, and with what outcome. When was the decision made to have steak for dinner tonight? When was the subsequent decision made to combine them with creamy potato gratin instead of baked potato, and what triggered that decision? Was the decision to buy reduced-fat crème fraiche made in the shop, with the potato gratin in mind, or was reduced-fat crème fraiche only used because it had been bought earlier as part of some stocking-up? And did the label on the bottle of olive oil standing in the kitchen trigger the decision to fry the steaks in oil instead of butter? It seems difficult to make claims about a possible role of nutrition labeling when so little groundwork has been done on ongoing choice and consumption in the food domain. More generally, we expect that cultural and social norms will play an important

role in food-related decisions and so may shape the role that nutrition labeling does—and could—play.

Figure 4 here

Food choice versus dietary intake

Personal health is affected by overall dietary intake, not by individual brand choices—which represents a final challenge for nutrition labeling research. First, effects of nutrition labeling have to be held up against some objective standard of what constitutes a healthy diet. Second, since nutrition labeling is developed to aid consumer decision-making at the product level, we need to analyze and understand the link between product decisions and the overall dietary intake. This link may be straightforward: for example, if nutrition labeling encourages consumers to substitute fat-rich ready meals with less fat-rich ready meals, and the rest of the diet remain mostly unchanged, then overall dietary intake should improve in healthiness. However, the link may also be more complex and less direct: for example, nutrition labeling that encourages consumers to substitute butter with margarine and olive oil may lead to changes in recipes and to substitutions between categories that eventually lead to shifts in eating style. In such cases, the relationships between product choice and overall dietary intake are much more intricate and require a more holistic understanding of ongoing consumption patterns.

Importantly, researchers should also consider whether nutrition labeling may have unintended consequences on dietary intake. Prior research suggests that exposure to weight management drug

marketing increases consumption of high-fat foods (Bhattacharjee, Reed & Bolton, 2009) and undermines healthy lifestyle intentions (Bolton, Reed, Volpp & Armstrong, 2008) - consistent with the notion that remedies may serve as ‘get-out-of-jail-free cards’ that encourage risky behavior (Bolton, Cohen & Bloom, 2006). In the food domain, research by Wansink and Chandon (2006) finds that low-fat labels increase consumption of such food—consumers appear to compensate for the improved healthfulness of the item by consuming greater quantities. Preliminary research also suggests that functional foods can boomerang on subsequent eating intentions (Garvey & Bolton 2010), perhaps because consumers infer progress on a health goal and then switch to other goals like indulgence (cf. Fishbach & Dhar, 2005). These findings point to the importance of investigating not just brand choice but the impact of nutritional labeling on consumption and dietary intake.

Agenda for research

Based on our discussion of the challenges in this domain, we would like to propose five problem areas that are in need of research in order to provide a better basis for the design of nutrition labeling that can improve public health.

First, we are in urgent need of studies of *peripheral processing of labels*, both in the shop and at home – studies that take into account principles of low involvement learning and subconscious processing and that therefore do not put respondents into a forced exposure situation (Grunert 1996). Label processing in the shop, if it occurs at all, will be mostly in situations of time pressure and as part of decisions in which habitual behavior and the use of heuristics play a large role. Label perception in the shop can be studied by observational methods and by at-the-shelf interviewing

methods analogous to those that have been used in price perception research (e.g. Dickson and Sawyer 1990). Such studies can be complemented by eye-tracking experiments in the laboratory (Pieters & Warlop, 1999) and by choice experiments that do not involve forced exposure to labels. Developing insight into low-involvement and real-world label processing would allow the formulation of realistic expectations about the impact of nutrition labels on brand choice and dietary intake. Moreover, such insights could also give important guidance to improve label exposure, to design and identify label formats that encourage processing, and perhaps even to develop accompanying measures in the shop that encourage label usage.

A second area that needs more attention is the *inferences that consumers make from label information*, including how the label information *interacts with other information* and with consumers' prior beliefs about what makes a food product healthy. Consumers may draw inferences from information about nutrients, from ways of presenting the information, and from patterns of information across the key nutrients. In addition, consumers may infer healthiness from the product category, from the brand, from the list of ingredients and additives, from the degree and type of processing (e.g., freezing vs. canning vs. high pressure treatment), from organic and natural attributes, and from a range of other factors that together constitute their personal set of meta-beliefs for what constitutes healthy food. Such research, which should also incorporate differences in consumer motivation and ability to process nutritional information, would yield insight into how consumers' personal health theories affect the way in which they interpret nutrition labels and how label information interacts with other cues used for health inferences. This insight, in turn, could be used to improve the design of labels and perhaps more importantly for calibrating the way in which labels are integrated into comprehensive systems for conveying nutrition information.

Third, we need more insight into *whether and how labels actually are used in guiding buying decisions and with what effect*. This is a difficult problem and requires a combination of approaches. An obvious starting point is to analyze scanner data from retailers. For product categories that are labeled or partly labeled, a hedonic pricing approach (Rosen, 1974) would allow researchers to detect whether certain patterns of labeling information carry a positive hedonic price (and evidence that consumers appreciate this information). Another analytic approach, using sales as the dependent variable, would attempt to examine whether label information, controlling for other important determinants like price, promotions, and shelf space, influences sales. This approach would be complemented by research that looks more closely at the way consumers use labeling in their decision-making, distinguishing different forms of processing corresponding to the two paths in figure 3. Research methods might include think-aloud studies and choice experiments to understand the ways in which nutritional labeling information is (or is not) used in decision-making.

Fourth, recent research on *goal setting and balancing* seems relevant to understanding how consumers make food and consumption choices—and also raises the question whether and how goals interact with labeling. Research suggests that making some progress towards a goal frees consumers to pursue other goals, implying that ordering a healthy main course in a restaurant may be viewed as a license to indulge with the dessert (akin to the boomerang effect discussed earlier). Nutrition labeling could not only facilitate choices when a health goal is dominant but could also affect goal balancing. Indeed, labeling (and packaging) may make salient healthful goals that improve consumer choice, consumption, and ultimately dietary intake.

A final research issue has to do with the *personalization/customization of nutrition information*. Nutrigenomics has established that people's different genomic make-ups lead to different

nutritional needs, and that there hence is a need for personalized diets, personalized nutrition information or even personalized food products. While these ideas are still in their infancy and neither producers nor consumers may be ready for them (Ronteltap, van Trijp & Renes, 2007, 2009), it is clear that nutrition labeling in its current form is still very standardized. How do consumers interpret nutritional info and adapt it to their personal needs – both to their personal physiological profile (bodyweight, age, level of physical activity) and their more specific health needs (diabetes, obesity, bone loss etc.)? How do consumers with competing health goals (reduce for losing weight, increase polyunsaturated fat for preventing heart disease) balance these personal goals, as well as goals of family members, when shopping and using labeling information. Current nutrition labels are standardized and do not address such individualized needs—which may represent one potential future direction for nutritional labeling in society.

Epilogue

As we noted at the beginning of this chapter, nutrition labeling is widely regarded as one of the most promising instruments for fighting unhealthy eating habits and rising obesity rates. But as this chapter has shown, numerous questions regarding the effects of nutrition labeling are as yet unanswered. From the evidence already at hand, it seems fair to warn against exaggerated hopes with regard to the effects of nutrition labeling. Dietary intake is a complex matter affected by a multitude of factors (see also Grier & Moore, this volume), and nutrition labeling is only one among many other factors having an influence. More importantly, while nutrition labeling can be viewed as one among many instruments aimed at increasing consumer resilience (Maddi, this volume), we should also note that most arguments advanced for nutrition labeling assume that consumers are both motivated and able to cognitively process the information. Peripheral processing, including

affective responses, is largely uninvestigated in the area of nutrition labeling, and it is unclear whether such processing would move dietary intake in a healthy direction. Just as partial, biased beliefs about what constitutes a healthy diet may cause more harm than good (Rozin et al., 1999), so may a partial, biased understanding of nutrition labeling.

References

- Balasubramanian, S. K., & Cole, C. (2002). Consumers' search and use of nutrition information: The challenge and promise of the Nutrition Labeling and Education Act. *Journal of Marketing*, 66(3), 112-127.
- Baltas, G. (2001). Nutrition labeling: issues and policies. *European Journal of Marketing*, 35, 708-721.
- Barone, M. J., Rose, R.R., Manning, K.C. & Miniard, P.W. (1996). Another look at the impact of reference information on consumer impressions of nutrition information. *Journal of Public Policy & Marketing*, 15, 55-62.
- Bernues, A., Olaizola, A. & Corcoran, K. (2003). Labelling information demanded by European consumers and relationships with purchasing motives, quality and safety of meat. *Meat Science*, 65, 1095–1106.
- BEUC (2006). The European Consumers' Organisation. Discussion Group on Simplified Labelling: Simpler labelling for healthier choices. <http://www.spismest.dk/NR/rdonlyres/CA725337-D4FE-4049-952C-14274B355DBF/0/20060053201E.pdf>. Final Report BEUC/X/044/2006.
- Bhattacharjee, A., Bolton, L.E. & Reed, A. (2009). License to lapse: The effects of weight management product marketing on a healthy lifestyle. Working paper.

- Biehal, G. & Chakravarti, D. (1983). Information accessibility as a moderator of consumer choice. *Journal of Consumer Research*, 10, 1–14.
- Bolton, L. E., Reed, A. II, Volpp, K.G. & Armstrong, K. (2008). How does drug and supplement marketing affect a healthy lifestyle? *Journal of Consumer Research*, 34, 713-26.
- Bolton, L. E., Cohen, J.B. & Bloom, P.N. (2006). Does marketing products as remedies create “get out of jail free cards”? *Journal of Consumer Research*, 33, 71-81.
- Brown, D. J., & Schrader, L. F. (1990). Cholesterol information and shell egg consumption. *American Journal of Agricultural Economics*, 72, 548-555.
- Cheftel, J.C. (2005). Food and nutrition labeling in the European Union. *Food Chemistry*, 93, 531-550.
- Chern, W. S., Loehman, E. T., & Yen, S. T. (1995). Information, health risk beliefs and the demand for fats and oils. *Review of Economics and Statistics*, 77, 555-564.
- Coulson, N. S. (2000). An application of the stages of change model to consumer use of food labels. *British Food Journal*, 10, 661-668.
- Cowburn, G. & Stockley, L. (2005). Consumer understanding and use of nutrition labeling: a systematic review. *Public Health Nutrition*, 8, 21–28.
- Dickson, P. R. & Sawyer, A.G. (1990). The price knowledge and search of supermarket shoppers. *Journal of Marketing*, 54(3), 42-53.
- Drichoutis, A., Lazaridis, P., & Nayga, R.M. (2006). Consumers’ use of nutritional labels: a review of research studies and issues. *Academy of Marketing Science Review*, available online at <http://www.amsreview.org/articles/drichoutis09-2006.pdf>
- Elbon, S.M., Johnson, M.A., Fischer, J.G., Searcy, C.A. (2000) Demographic factors, nutrition knowledge, and health seeking behaviors influence nutrition label reading behaviors among older American adults. *Journal of Nutrition for the Elderly*, 19, 31–48.

- FDA (1998). Good reading for good eating. Washington, DC: U.S. Food and Drug Administration.
- Fishbach, A. & Dhar, R. (2005). Goals as excuses or guides: the liberating effect of perceived goal progress on choice. *Journal of Consumer Research*, 34, 370-377.
- Food Standards Agency (2005) Quantitative evaluation of alternative food signposting concepts. London: Synovate.
- Food Standards Agency (2007) Front of pack nutritional labelling technical guidance Issue 2: Published November 2007 [<http://www.food.gov.uk/multimedia/pdfs/frontofpackguidance2.pdf>].
- French, S. A., Story, M. & Jeffery, M. (2001). Environmental influences on eating and physical activity. *Annual Review of Public Health*, 22, 309-335.
- Garvey, A. & Bolton, L.E. (2010). Hedonic-utilitarian goal balancing as the result of functional food consumption. Paper presented at the Society for Consumer Psychology, St. Petersburg, FL.
- Golan E., Kuchler F., Mitchell L., Greene C. & Amber J. (2001) Economics of food labeling. *Journal of Consumer Policy*, 24, 117–184
- Grunert, K. G. (1996). Automatic and strategic processes in advertising effects. *Journal of Marketing*, 60(4), 88-101.
- Grunert, K.G., Fernandez-Celemin, L., Wills, J.C., Storcksdieck genannt Bonsmann, S. & Nureeva, L. (2010). Use and understanding of nutrition information on food labels in six European countries. *Journal of Public Health*, 18, 261-277.
- Grunert, K.G. & Wills, J.M. (2007). A review of European research on consumer response to nutrition information on food labels. *Journal of Public Health*, 15, 385-399
- Hawkes C. (2004) Nutrition labels and health claims: The global regulatory environment. World Health Organization.

- Hodgkins, C., Raats, M., Barnett, J., Wasowicz-Kirylo, G., Stysko-Kunkowska, M., Gulcan Y., Kustepeli Hodgkins, C., Raats, M., Barnett, J., Wasowicz-Kirylo, G., Stysko-Kunkowska, M., Gulcan Y., Kustepeli Hodgkins, C., Raats, M., Barnett, J., Wasowicz-Kirylo, G., Stysko-Kunkowska, M., Gulcan Y., Kustepeli, Y., Akgungor, S., Brebion, B. and Chryssochoidis, G., Fernandez L.& Storcksdieck, S. (2009). Derivation of a typology for nutritional labelling. Reported prepared for the EC. Brussels: EUFIC.
- Kardes, F.R., Posavac, S.S. & Cronley, M.L. (2004) Consumer inference: A review of processes, bases, and judgment contexts. *Journal of Consumer Psychology*, 14, 230-256.
- Keller, S. B., Landry, M., Olson, J., Velliquette, A.M., Burton, S. & Andrews, J.C. (1997). The effects of nutrition package claims, nutrition facts panels, and motivation to process nutrition information on consumer product evaluations. *Journal of Public Policy & Marketing*, 16, 256-269.
- Khare, A. & Inman, J.J. (2006). Habitual behavior in American eating patterns: The role of meal occasions. *Journal of Consumer Research*, 32, 567-75.
- Kim, S.-Y., Nayga, R. M., Jr., and Capps, O., Jr. (2001). Food label use, self-selectivity, and diet quality. *The Journal of Consumer Affairs*, 35, 346-363.
- Kozup, J. C., Creyer, E.H. & Burton, S. (2003). Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items. *Journal of Marketing*, 67(2), 19-34.
- Levy, A. S., Fein, S.B. & Shucker, R.E. (1996). Performance characteristics of seven nutrition label formats. *Journal of Public Policy & Marketing*, 15, 1-15.
- Lin, C.T.J., Lee, J.Y. & Yen, S.T. (2004). Do dietary intakes affect search for nutrient information on food labels? *Social Science and Medicine*, 59, 1955–1967.

- Malam, S., Clegg, S., Kirwan, S., McGinival, S., in association with Raats, M., Barnett, J., Senior, V., Hodgkins, C., Dean, M. (2009) Comprehension and use of UK nutrition signpost labelling schemes. London: British Market Research Bureau
- Mathios, A. D. (1998). The importance of nutrition labeling and health claim regulation on product choice: An analysis of the cooking oils market. *Agricultural and Resource Economics Review*, 27, 159-168.
- Mazzocchi, M., Traill, W.B. & Shogren, J. (2009). *Fat economics: Nutrition, health and economic policy*. Oxford: Oxford University Press.
- Mennel, S., Murcott, A., & van Otterloo, A.H. (1992) *The sociology of food: eating, diet and culture*. London: Sage Publications.
- Mitra, A., Hastak, M., Ford, G.T. & Ringold, D.J. (1999). Can the educationally disadvantaged interpret the fda-mandated nutrition facts panel in the presence of an implied health claim. *Journal of Public Policy & Marketing*, 18, 106-117.
- Mojduszka, E.M., Caswell, J.A. & Harris, J.M. (2001). Consumer choice of food products and the implications for price competition and government policy. *Agribusiness*, 17, 81-104.
- Moorman, C. (1990). The effects of stimulus and consumer characteristics on the utilization of nutrition information. *Journal of Consumer Research*, 17, 362-374.
- Moorman, C. (1998). Market-level effects of information: Competitive responses and consumer dynamics. *Journal of Marketing Research* 35, 82-98.
- Moorman, C., R. Du, C. F. Mela. (2005). The effect of standardized information on firm survival and marketing strategies. *Marketing Science*, 24, 263-274.
- Neuhouser, M. L., Kristal, A. R., & Patterson, R. E. (1999). Use of food nutrition labels is associated with lower fat intake. *Journal of the American Dietetic Association*, 99, 45-53.

- Pieters, R. & Warlop, L. (1999). Visual attention during brand choice: the impact of time pressure and task motivation. *International Journal of Research in Marketing*, 16, 1–16.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioural research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903.
- Przyrembel, H. (2004). Food labeling legislation in the EU and consumer information. *Trends in Food Science and Technology*, 15, 360-365.
- Roe, B., Levy, A.S.& Derby, B.M. (1999). The impact of health claims on consumer search and product evaluation outcomes: results from FDA experimental data. *Journal of Public Policy & Marketing*, 18, 89-105.
- Ronteltap, A., van Trijp, J.C.M. & Renes, R.J. (2007). Expert views on critical success and failure factors for nutrigenomics. *Trends in Food Science and Technology*, 18, 189-200.
- Ronteltap, A., van Trijp, J.C.M. & Renes, R.J. (2009). Consumer acceptance of nutrigenomics-based personalised nutrition. *British Journal of Nutrition*, 101, 132-144.
- Roodenburg, A.J.C., Temme, E.H.M., Howell, D.O. & Seidell, J.C. (2009). Potential impact of the Choices Programme on nutrient intakes in the Dutch population. *Nutrition Bulletin*, 34, 318-323.
- Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*, 82, 34-55.
- Rozin, Paul, Fischler, C., Imada, S., Sarubin, A. & Wrzesniewski, A. (1999). Attitudes to food and the role of food in life in the U.S.A., Japan, Flemish Belgium and France: Possible implications for the diet-health debate. *Appetite*, 33, 163-80.
- Scholderer, J. (2005). Traps and pitfalls in research on healthy food choices: On selective accessibility, assimilation and contrast, and the look-in-the-fridge heuristic. Paper presented at International Conference on Food Choice and Healthy Eating, Helsinki.

- Storcksdieck, S., Fernández-Celemín, L., Larrañaga, A., Egger, S., Wills, J.M., Hodgkins, C. & Raats, M.M. (in press). Penetration of nutrition information on food labels across the EU-27 plus Turkey. *European Journal of Clinical Nutrition*.
- Svederberg, E. (2002). Consumers' views regarding health claims on two food packages. Lund: Department of Education, Lund University.
- van Dillen, S.M.E., Hiddink, G.J., Koelen, M.A., de Graaf, C. & van Woerkum, C.M.J. (2003). Understanding nutrition communication between health professionals and consumers: development of a model for nutrition awareness based on qualitative consumer research. *American Journal of Clinical Nutrition*, 77, 1065S–1072S.
- Vanhuele, M. & Drèze, X. (2002). Measuring the price knowledge shoppers bring to the store. *Journal of Marketing*, 66, 72-85.
- Variyam, J.N. & Cawley, J. (2006). Nutrition labels and obesity. Working paper. Cambridge, MA: National Bureau of Economic Research.
- Wardle J, Parmenter K, & Waller J. (2000) Nutrition knowledge and food intake. *Appetite*, 34, 269-75.
- Weil D., Fung A., Graham M. & Fagotto E. (2006) The effectiveness of regulatory disclosure policies. *Journal of Policy Analysis and Management*, 25, 155-181.
- Wansink, B. (2003). How do front and back package labels influence beliefs about health claims. *Journal of Consumer Affairs*, 37, 305-316.
- Wansink, B. & Chandon, P. (2006). Can “low-fat” nutrition labels lead to obesity?” *Journal of Marketing Research*, 43, 605-617.
- Wansink, B., Sonka, S.T. & Hasler, C.M. (2004). Front-label health claims: when less is more. *Food Policy*, 29, 659-667.

- Weaver, D. & Finke, M. (2003). The relationship between the use of sugar content information on nutrition labels and the consumption of added sugars. *Food Policy*, 28, 213–219.
- Which (2006). Food labelling study. Conquest Research.
- WHO. (2005). Preventing chronic diseases: a vital investment. Geneva: World Health Organization;.
- WHO (2008). World Health Statistics 2008. Geneva: World Health Organization.
- World Cancer Research Fund and American Institute for Cancer Research (2007). Food, nutrition, physical activity, and prevention of cancer: a global perspective. Washington DC: American Institute for Cancer Research, 2007. Available at www.dietandcancerreport.org.
- Worsley A. (2002) Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition*, 11 (Suppl.), S579–S585.

Figure 1: Examples of nutrition labels in the USA

Nutrition Facts			
Serving Size 1 cup (228g)			
Servings Per Container 2			
Amount Per Serving			
Calories 260		Calories from Fat 120	
		% Daily Value*	
Total Fat 13g			20%
Saturated Fat 5g			25%
Trans Fat 2g			
Cholesterol 30mg			10%
Sodium 660mg			28%
Total Carbohydrate 31g			10%
Dietary Fiber 0g			0%
Sugars 5g			
Protein 5g			
Vitamin A 4%	•	Vitamin C 2%	
Calcium 15%	•	Iron 4%	
* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g
Calories per gram:			
Fat 9	•	Carbohydrate 4	• Protein 4



Figure 2: Examples of nutrition labels in Europe

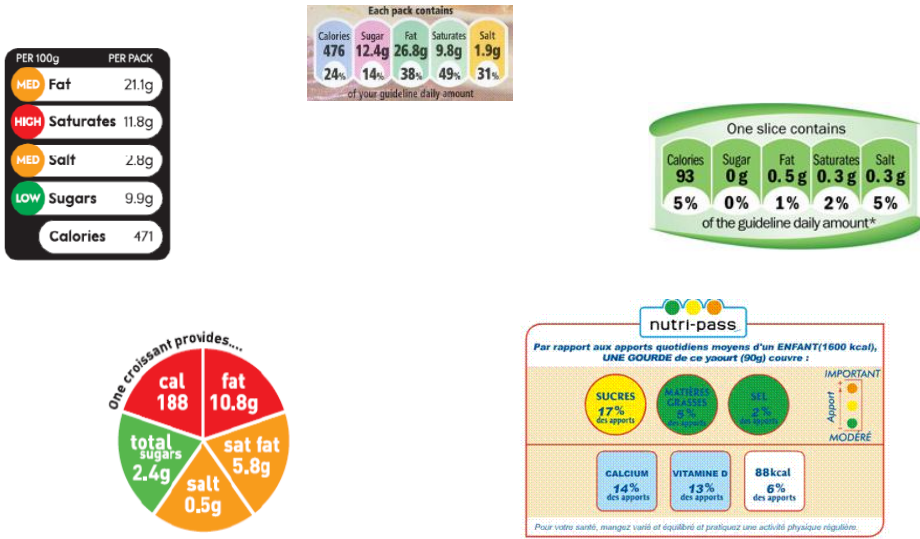


Figure 3: Hierarchy of effects model of nutrition labelling

