Nutritional labelling information: Utilisation of new technologies

Ben Lowe[1]
Kent Business School
University of Kent
United Kingdom

Diogo de Souza-Monteiro
Kent Business School
University of Kent
United Kingdom

Iain Fraser
School of Economics
University of Kent
United Kingdom
and
School of Economics and Finance
La Trobe University
Australia

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[1] Address correspondence to Dr Ben Lowe, Kent Business School, University of Kent, Canterbury, CT2 7PE. Tel: +44 1227 824840. Email: B.Lowe@kent.ac.uk The authors wish to acknowledge support from the Faculty of Social Sciences at the University of Kent for supporting this research.

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Abstract

The increase in food related diseases in society has led to a variety of public policy and private sector initiatives, such as the use of nutritional labels. Although nutritional labels have been shown to be broadly effective in terms of informing food choice, their influence is moderated by a variety of factors, such as how information is conveyed and processed by consumers. Recent advances in technology might overcome these limitations. Using a choice experiment this paper examines consumer preferences for alternative technological devices that may aid consumer processing of nutritional information on food packaging. The results show which attributes of the technology consumers prefer, and identifies three distinct segments of consumers ("information hungry innovators", "active label readers" and "onlookers"), and differences between them in relation to their preferences, demographics and psychographic characteristics. The identification of segments is a novel aspect of this research and highlights the importance of finding more customised solutions to the communication of nutritional information; an issue which technology can contribute to.

Keywords: nutritional information, technology, segments, labelling

Exploring the Role of Technology in Consumer Processing of Nutritional Information

Introduction: Nutritional labels on food packaging

Obesity and other food related health issues are an increasing concern of modern societies and are associated with significant economic and social costs (Drichoutis, Lazaridis, & Nayga, 2005; Wansink, 2005; Mazzocchi, Traill, & Shogren, 2009; Winterman, 2011). Using nutritional labels to provide consumers with better information on the nutritional value of food has been an important element of public policy aimed at alleviating food related health problems because consumers can use the labels to make more informed choices about the food they purchase (Hughner & Maher, 2006). The use of nutritional labels also constitutes an aspect of social marketing as it provides consumers with more personally relevant/targeted information for the purposes of voluntary behaviour change (Gordon, McDermott, Stead & Angus, 2006), and represents an important aspect of a product's offering.

In general, nutrition labels have been shown to alter consumers' purchasing behaviour albeit less than desired (Cowburn & Stockley, 2005; Grunert & Wills, 2007). For example, low-literate consumers may not be able to fully understand nutritional labels (Viswanathan, Hastak & Gau, 2009). There have also been unintended consequences of the use of food labels as the way information is framed can affect consumer use (e.g., Mohr, Lichtenstein, & Janiszewski, 2012). These outcomes have led to a debate about consumer response to nutritional labels and their effectiveness (Mazzochi et al, 2009; Naylor, Droms & Haws, 2009), the format of labels (Grunert & Wills, 2007), the composition of labels (Bitzios, Fraser, & Haddock-Fraser, 2011) and individuals' characteristics which moderate label usage (Drichoutis et al., 2005). To date the empirical evidence on the effectiveness of conventional labels is mixed and recently some researchers have begun to call for new and innovative approaches to nutritional labelling (e.g., "one label may not fit all products" Grunert, Wills & Fernandez-Celemin, 2010, p. 187) due to the limitations of conventional approaches.

So far research has yet to examine consumer response to technology that *may* enhance how consumers interpret labelling information. The emergence and rapid expansion of RFID (Radio Frequency Identification) labels and matrix or 2D bar codes that can be read with an application (app) in a smart phone is becoming increasingly available and may enable such opportunities. In fact, recent retailing examples show how technology and labelling practices are beginning to converge. For example, one retailer in the US has been experimenting with an iPhone app to provide nutritional information direct to customers' mobile phones. Such technological developments have led to a number of exciting, yet under researched possibilities in regards to how technology can be used to communicate nutritional information.

We contend that technology may be able to assist consumers by providing a medium through which to provide more robust and customised information that is less likely to be biased by consumers' heuristics. As such this study is contributing to the literature on how to improve the delivery and use of information by consumers when undertaking a purchase (e.g., Salaün & Flores, 2001; Verbeke, 2005). We argue that the rapid diffusion and adoption of such technologies may facilitate the way in which consumers process information and perhaps facilitate healthier food choices, yet little is known about how technologies can assist consumers' use of nutritional labels. Thus, we aim to ascertain:

i) consumer preferences for different technological devices with different attributes

ii) whether or not different segments of consumers exist in relation to their preferences for the attributes of the technology

iii) the demographic and psychographic characteristics of these segments.

Using a choice experiment informed by extensive pilot testing of relevant attributes, we examine consumer preferences for different devices conveying nutritional information. Based on the estimation of a Latent Class Model (LCM), our results show that different segments exist within our sample, and they have different preferences for different possible permutations of the technology. These segments are identified as "information hungry innovators", "active label readers" and "onlookers", and they differ in terms of a variety of demographic and psychographic characteristics. These results also highlight the potential value of new technology in providing more customisable solutions to the communication of nutritional labels, in light of the largely unquestioned mass communications approach currently adopted by retailers and policy makers. Similar concerns about the effectiveness of current mass media approaches to communicating with consumers have been voiced elsewhere in the marketing literature (e.g., Brennan, Dahl & Lynne, 2010), where it is argued that more customised and tailored approaches should be used. It has also previously been observed that customisation can be very powerful in providing consumers with product outcomes they desire (Bardakci & Whitelock, 2004; Jiang, 2002). However, the customisation of nutritional information represents a new challenge.

This research should be viewed as an exploratory attempt to try to understand consumer preferences towards new technologies that can assist consumers in making more informed choices about the food they consume. With the increased diffusion and convergence of mobile technologies in the market place this research also has both marketing and public policy dimensions. Food marketers and retailers can take advantage of these technologies to create value and target specific consumer goods. For instance these technologies could be associated to loyalty cards and suggest promotions or packages consistent with consumer's special nutritional or dietary requirements. In terms of public health such technological devices may allow segments of the population with special needs to gain reliable access to more customised forms of nutritional information. Broadly, this research relates to work in the domain of social marketing by examining consumer preferences towards a tool that will enable greater customisation of nutritional labels, and the provision of more targeted nutritional information to consumers. As such this research broadly contributes to the literature on social marketing by examining consumer preferences towards a new technology that allows customised nutritional information. In doing so it begins to address some of the key environmental imperatives outlined by Kotler (2011), that marketing tools and techniques can begin to address more adequately.

Social marketing and the role of nutritional labels

Broadly speaking social marketing advocates the use of marketing tools for social problems (Hastings and Saren, 2003) and can be linked to problems where voluntary behaviour change is the key objective. Comprehensive social marketing interventions are few and far between in practice, and though the use of nutritional labelling may not itself be classed as a comprehensive social marketing initiative (e.g., social marketing is more than just advertising with a social cause McDermott et al., 2005), nutritional labelling issues have been an aspect of a larger social marketing initiative by government departments such as the Food Standards Agency (FSA) in the UK, to help individuals make healthier food choices. The use of new formats for nutritional labels (e.g., the Guideline Daily Amount or the Traffic Light System), have been initiated in light of policy concerns centred around encouraging individuals to eat healthier diets to overcome a variety of health concerns (e.g., obesity, diabetes etc.) which are on the rise in many countries. Specifically the use of technology to provide more customised nutritional information can be closely linked to a more comprehensive programme of social marketing designed to induce voluntary behaviour change. Firstly, we draw this connection because labelling is an important aspect of product packaging, and secondly because more customised forms of nutritional information may improve over existing mass marketed labelling approaches by providing the consumer with more flexible formats of nutritional information closely associated to their own individual needs (e.g., when a customer goes to a retailer such as Tesco and views their nutritional labels, all customers see the same label regardless of differing needs). This relates closely to targeting and the benefits that more tailored information will bring to consumers (Brennan et al., 2010). Increasingly such themes are being echoed in other literature where researchers are examining the use of technology to highlight allergens more easily for consumers with allergies (Cornelisse-Vermaat et al., 2008; Voordouw et al., 2011). Therefore, as the technology to enable mass customisation becomes more scalable, marketers and policy makers are increasingly able to satisfy differing consumer needs in relation to the provision of nutritional information. We now examine the consumer behaviour effects of customisation.

Nutritional labelling and new technologies: Research issues

Customisation of nutritional information

Little research so far has examined more customised approaches to labelling. However, some research in the marketing literature has begun to examine consumers' response to customised products and services more generally. It is thought that customisation leads to customer empowerment and more active participation in the value creation process (Alba et al., 1997; Hoffmann and Novak, 1996). However, the empirical literature so far remains sparse, and the results between studies sometimes provide conflicting findings. For example, so far research is unclear in terms of whether or not consumers are willing to pay for customisation. Jiang (2002) notes, in a study based around consumer perceptions of an online service, that consumers are not willing to pay extra for having more customised information. However, Bardakci and Whitelock (2004) observe that over 59% of their sample are willing to pay more to have a customised car design service when purchasing a new car. On the other hand these two studies are rather more consistent in terms of illustrating more favourable consumer reactions to customisation in general. For example, Huffman and Kahn (1998) illustrate that consumer input into products in the form of providing their preferences for product attributes leads to greater customer satisfaction. Likewise Jiang (2002) tests a variety of other consumer behaviour outcome variables and concludes that consumers who are able to customise product offerings are more likely to exhibit customer satisfaction, and are more likely to revisit the provider of the customised offering. Jiang also illustrates that consumers have more confidence in the purchase decisions they make. Bardakci and Whitelock (2004) extend these consumer behaviour findings by showing that customers are willing to engage in customisation processes for a reasonable amount of time at retail outlets, and that customers appreciate customised products because they don't have to pay for unnecessary attributes.

Therefore, as a way to overcome some of the limitations of conventional labels, an alternative approach would be one where each consumer would be able to record their nutritional purchase profile and compare this to their own specific needs. Wansink (2003, p. 306) highlights the importance of this possibility by stating "Effective nutrition labels should take both these less involved and more involved shoppers into account", having acknowledged differences in usage behaviour between nutrition conscious individuals and consumers who are less involved. To accommodate these issues, Wansink (2003) suggests providing convergent forms of nutritional information to appeal to the different segments of consumers (e.g., back panel information that provides comprehensive nutritional details for nutrition conscious consumers and front panel summary information for less nutrition conscious consumers). Grunert et al. (2010) also argue for different labelling approaches for different product categories. Technology can provide a seamless solution to these challenges by providing accessible information that might be communicated in a variety of ways based on each individual's needs or based upon product category. For example, a consumer may wish to see the nutritional information for the *basket* of goods they are purchasing, rather than for each individual product. The widespread diffusion of mobile technologies and the creation of app markets make the customisation of nutritional information more feasible.

Mediums to convey nutritional information

Such technologies are becoming increasingly common as retailers experiment with new labelling practices. For instance, one emerging technology known as MediaCart (http://www.mediacart.com/) allows the user to scan a product's barcode on a unit attached to the shopping trolley. This enables detailed product information about the purchase to be displayed on a screen. Another way in which nutritional information can be provided is through the use of new mobile technologies. For example, some retailers such as Marks & Spencer have been experimenting with 2D barcodes which can be scanned with a user's web enabled mobile phone using the camera. After scanning the 2D barcode product information is provided on the phone. In this case the technology has been used to provide promotional and other product information. US retailer Hannaford has adopted the Guiding Stars labelling system and recently introduced a technological innovation to allow its integration with an iPhone or iPad using an app (Supermarket News, 2009). With this application iPhone/iPad users can easily access and compare products labelled with the Guiding stars system. Namely they can browse and compare across products, add rated items to shopping lists or create multiple shopping lists based on store, occasions or recipes (Guiding Stars, 2009). Similar examples of apps, enabling users to keep track of the amount of salt in foods added to shopping baskets have been reported in the UK (Food Standards Agency, 2009).

An analysis of current technologies on the market reveals that nutritional information may be provided to consumers in a variety of ways, including via a screen mounted on a shopping trolley (like with MediaCart), via a mobile device (like M&S and Hannaford's) or at the checkout when paying for one's shopping. Each of these technologies has the potential to enable detailed customised nutritional information to be presented to consumers in a variety of flexible formats. However, as yet the literature is unclear on whether or not consumers value such technology, and what consumer preferences are for the device on which the information is conveyed.

Aggregating nutritional information

Another issue that has been largely ignored in the literature is how consumers determine the nutritional value of a *basket* (or trolley) of food, and whether or not such a function provides any value to the consumer. Most studies have analysed consumers' use of different label formats for a single product, yet shoppers typically buy a range of products at any given time. Moreover, food related health problems emerge from poor diets rather than occasional consumption of certain products (Jetter & Cassady, 2006). A pressing question is therefore: would consumers prefer nutritional information to be aggregated for their basket of goods or presented product-by-product? Some notable exceptions of studies which consider nutritional information presented to consumers as a basket include Jetter & Cassady (2006) and Balcombe, Fraser & Di Falco (2010). Jetter & Cassady (2006) use a basket of food items to evaluate the nutrition value of the US Thrifty Food Plan diet guide, and Balcombe et al. (2010) use the traffic lights labelling format, proposed by the FSA in the UK, to evaluate baskets of goods with different nutritional values. Assessing the overall nutrition value of a basket of goods on a diet is a complex task and most consumers will not check the nutrition labels for all the products they purchase (Balcombe et al., 2010). Borgmeier & Westenhoefer (2009), in a study undertaken in Germany asked survey participants to select several food items so as to compose a single day's consumption. This was a virtual grocery task in that only pictures were presented to participants. This task did not directly ask participants to make healthy choices. They found that the resulting levels of all nutrients (i.e., fat, saturated fat, sugar and sodium) were above the existing recommendations, regardless of the type of nutrition label employed. This was despite the fact that at the single product level participants can differentiate between healthy and less healthy food items. However, when confronted with making use of the labels to construct a basket of goods they do not aggregate healthy food choices which would be expected if nutritional labels are to have the desired public health effect. Indeed we should not be surprised by these results as there already exists a large literature explaining why consumers frequently fail to make rational choices (de Palma, Myers & Papageorgiou, 1994; Swait & Adamowicz, 2001).

Since there is evidence that, for a large number of consumers, the use of conventional labels to provide nutrition information for a single product is already a daunting task (Cowburn & Stockley, 2005), it may be near an impossible task for consumers to make an accurate assessment of nutritional content for a basket of products, without the use of technology. For example, consider the difficulty of keeping track of the nutritional content for twenty different products, without the use of a facilitating technology to summarise the appropriate information. Thus, the task of evaluating the nutritional content of a basket of goods is much more complex for consumers because they need to mentally keep track of their purchases. By presenting nutritional information to consumers for their basket of goods, rather than each individual product, this could potentially reduce the consumer's cognitive burden, identified by Grunert & Wills (2007, p. 391) as a key concern regarding the use of labels. Again technology may provide a solution here because information can be presented in a variety of ways (e.g., per product, by the basket etc.). As such it would be useful for retailers, policy makers and researchers to understand how consumers respond to different levels of information aggregation. With new technologies, even the ability to present a consolidated list of purchases in one place holds promise in terms of helping consumers make better decisions about their purchases (rather than relying on memory and other heuristics which may bias their decisions).

Presentation of nutritional information: Labelling format

A further research issue involves understanding the most effective way by which nutritional information should be presented to consumers. In the UK there are two main forms of front of packaging nutritional labels: the Traffic Light System (TLS) and the Guideline Daily amount (GDA). In 2006 the FSA published a voluntary nutritional front of pack label guideline based on a signpost (commonly known as the TLS system) and suggested its adoption to all food manufacturers. This label provides simplified information in terms of nutrient (fat, sugar, saturates and salt) and energy content. The usability of the TLS has been noted by many researchers (e.g., Lang, 2006) as well as many organisations and businesses including The British Heart Foundation, Which? magazine, the British Medical Association and various large retailers such as Sainsbury's. However, other groups in the food industry have advocated the use of a percentage GDA system that relates food intake to a total daily target. The European Union is proposing new regulation on nutrition labels. The last draft of the regulation suggests that nutrition labelling will become mandatory for pre-packaged foods and will include information on content of energy, fat, sugar and salt. As long as the information is consistent and easy to spot on a package, operators can choose whether to place it in the front or back of packs, as well as their preferred format (European Council, 2011). There has been ongoing debate about the preferred format to be used to present nutritional information to consumers in the UK so further evidence on consumers' preferences would be useful.

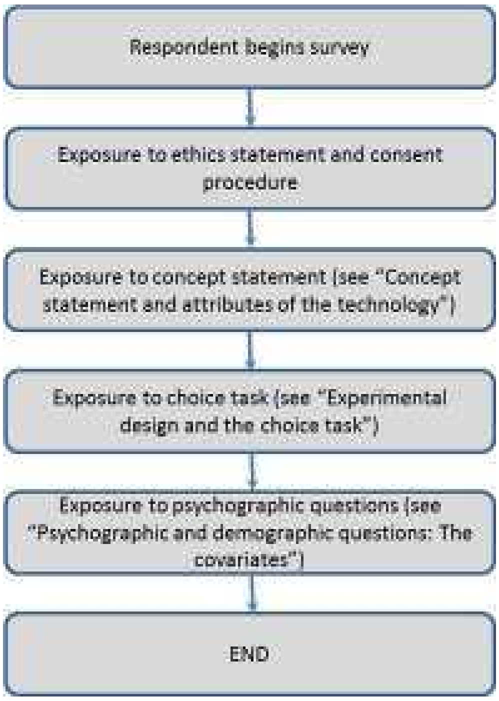
To date and the best of our knowledge no research has examined how consumers might respond to and evaluate new technologies which can simplify information processing of nutritional labels, yet integration of labels with new technologies may provide a number of benefits to consumers. Though retailers are increasingly experimenting with new technologies that enable different forms of information to be communicated to the consumer, there has been no research about i) whether or not consumers would respond positively to such a technology, and ii) how consumers would prefer to engage with such a technology. This research contributes to the literature by examining consumer preferences for such a technology, and heterogeneity among consumers.

Method

Procedure

To evaluate consumers' preferences towards different attributes of the new technology a choice experiment was developed. Choice experiments present bundles of attributes to consumers who then choose their most preferred options. This information allows researchers to estimate respondents' underlying preferences for the attributes within the bundle based on the trade-offs made. Respondents were initially exposed to the innovation via a concept statement developed based upon typical prescriptions for writing a concept statement (Crawford & Di Benedetto, 2008), following other studies which have examined consumers' reactions to innovative products (e.g., Carpenter & Nakamoto, 1989). After exposure to the concept statement respondents then completed the choice experiment by choosing their most preferred profiles. Upon completion of the choice task respondents then answered a series of questions based on their psychographic and demographic characteristics (see Figure 1 for a summary of the procedure that was implemented). The concept statement, the choice task and the questions were refined through a series of in-depth interviews and focus groups. After several iterations the instrument was amended and clarified to resolve ambiguity in interpretation, and, after consensus in interpretation the instrument was pilot tested on a further independent sample of 12 respondents.

FIGURE 1 Summary of procedure



Concept statement and attributes of the technology

The concept statement included text with a concept description, outlining the concept's general benefits and the uses which one might have for the product, and a picture of certain aspects of the product to enhance realism of the task. Greater realism of the choice task leads to greater predictive validity. The concept statement also contained a clear description of the way in which the attributes of the technology varied in the subsequent choice experiment (a copy of the concept statement can be seen in the Appendix).

We identified five attributes to characterise a technology that would facilitate access to nutritional information. One attribute of importance to consumers was how the nutritional information was received. Therefore, consumers were asked to evaluate how they wanted the information provided to them; either on the shopping trolley, using their mobile phone, or at the checkout. We call this attribute Device. A second attribute in the choice experiment that respondents evaluated was the way in which the information was aggregated. In particular, given the flexibility of technology in presenting nutritional information to consumers, we wanted to examine whether or not consumers valued the information presented for their basket of goods or for each individual product in their basket of goods. We call this attribute Basket. A third attribute, consistent with past research, relates to the format with which the information is conveyed to consumers. Therefore, we decided to ask respondents about their preferences for seeing the information using the TLS or the GDA (Food Standards Agency, 2007). Both of these labelling systems are widely used in practice. We call this attribute Format. Further incorporating the flexibility of technology in providing nutritional information, a fourth attribute was whether or not the technology provided an alert for certain dietary conditions (e.g., once the product is scanned the device may alert the shopper to the presence of nuts). Therefore, consumers with certain health conditions (e.g., a nut allergy or diabetes) might value an alert to simplify and speed up the purchase decision and also to act as an alarm when they have mistakenly overlooked the nutritional contents of some products. We call this attribute Alert. Finally, respondents also evaluated price as an attribute of each of the profiles. Because this service was new, price levels were set in a pilot study (n=52) using Monroe's (2003) price sensitivity meter for estimating thresholds of consumer price acceptability. The price sensitivity meter was used to estimate the most acceptable price (£1.40), the lowest acceptable price (£1.00) and the highest acceptable price (£1.80) on a per use basis. While price could have been set based on a monthly subscription, because of the nature of the product and because of consumer responses to an earlier pilot study a pay per use price was implemented. These attributes and their levels are presented in Table 1, and sample choice tasks showing how the levels of the attributes were operationalised are presented in Figure 2.

In summary the final selection of attributes was based on the recent literature on nutritional labelling (e.g., Nayga, 2008), an investigation of current technologies in the market place, and a series of pilot studies designed to elicit attributes of importance to consumers. While a variety of other plausible attributes could have been included for testing in the choice experiment using many attributes would make the choice task far more complex and may introduce attributes that may be irrelevant for some respondents (Kivitz & Simonson, 2000).

Experimental design and the choice task

In the choice experiment there were five attributes, leading to a 2x3x2x2x3 choice experiment (the profiles presented to respondents varied based on the attributes and levels presented in Table 1). To reduce the number of choices respondents had to make, an orthogonal design was implemented, leading to 16 possible choice tasks. In choice experiments orthogonality allows for a parsimonious research design where attribute coefficients can be estimated efficiently, without the need to have respondents assess each “product” or combination of attributes (e.g., if respondents were to provide evaluations for all possible attribute combinations they would have to make 72 choices). Thus an orthogonal design allows enough variation in the choice sets to cover the entire parameter space with a sufficient number of combinations of attributes. Practically, this reduces respondents’ fatigue and the possibility of acquiescence bias, whilst preserving model efficiency. Such designs are common in choice experiments with large numbers of attributes and levels (Hair et al., 2006). In the pilot studies no respondents complained that the number of choice tasks was burdensome, and other literature suggests fatigue is not an issue until more than 20 or even more than 40 choice sets are presented to respondents (Louviere, Hensher & Swait, 2001).

TABLE 1 Attributes and levels used in the choice experiment

Attribute	Description	Levels
Basket	How nutritional information is presented. For a whole basket of goods or for each product individually.	Basket = 0, Individual = 1
Device	How the information is accessed. Either through a screen at the counter, a screen on your trolley or through a mobile phone	Device 1 = Trolley, Device 2 = Mobile, Device 3 = Checkout
Format	The information could either be presented in the form of Guideline Daily Amounts (GDAs) or the Traffic Light System (TLS).	GDA = 0, TLS = 1
Alert	A service to alert the buyers to ingredients that they might need to avoid when shopping.	No = 0, Yes = 1
Price	The price of the information provision service.	£1.00, £1.40, and £1.80

In the choice task respondents could choose one of the two product profiles presented to them, or could select an option indicating that the choice was too close to call. A “too close to call” option is often referred to as a “no opinion” option (Fenichel, Lupi, Hoehn, & Kaplowitz, 2009). Including “no opinion” options makes choice sets more realistic and is widespread within the choice experiment literature (Brazell et al., 2006). Although a “no opinion” option may reduce statistical power in some circumstances (because it means losing information on the trade-offs that respondents would have made had they been forced to choose), only 8% of respondents in our study selected this option, and this is well below the threshold of 15% suggested by Brazell et al. (2006). Sample choice tasks are shown in Figure 2 for reference.

FIGURE 2 Sample choice tasks

Choice 1

Attribute	Service A	Service B
Basket	Basket of goods	Basket of goods
Device	Mobile	Mobile
Format	Guideline Daily Amount	Traffic Light System
Diet Alert	No alert	No alert
Price	£1.80	£1.40

Which of these services do you prefer?
O I prefer Service A O I prefer Service B O Too close to call

Choice 2

Attribute	Service A	Service B
Basket	Individual products	Individual products
Device	Mobile	Trolley
Format	Guideline Daily Amount	Traffic Light System
Diet Alert	Alert	Alert
Price	£1.00	£1.80

Which of these services do you prefer?
O I prefer Service A O I prefer Service B O Too close to call

The number of levels for each of the attributes was kept relatively constant so that respondents did not place too much emphasis on any one attribute as a result of greater salience from greater variation in levels within the task.

Psychographic and demographic questions: The covariates

To provide segmentation information, and more precise estimates of the relevant coefficients, measures of individual characteristics were taken and used as covariates, based around key dimensions highlighted in the nutritional labelling literature. We used and adapted existing measures of Nutritional Information Interest and Usage, Consumer Innovativeness, Health Behaviour and health related conditions. We also measured respondents' demographic characteristics. The measures of Nutritional Information Interest and Nutritional Information Usage were five-item and four-item, seven point Likert scales adapted from Moorman (1998). Acknowledging the category specific nature of Consumer Innovativeness, a measure of Consumer Innovativeness was adapted from Goldsmith and Hofacker (1991) using a six item, seven point Likert scale. A measure of Health Behaviour was adapted from the scale used in Moorman and Matulich (1993). This consisted of fifteen items measured on seven point rating scales to describe dietary behaviour and life balance behaviour. Respondents were also asked whether or not they, or a relative, had any existing health conditions.

Data collection method

The survey was conducted online and promoted through a mailing list to a convenience sample of staff and students at a university within the UK. After deleting 8 unusable responses the final sample size was 388. Participants ranged in age from 18 to 65. The median level of education was university educated and 74% of the sample were female. While the participation rate of females in our sample is slightly higher than in other studies on nutritional labelling, it is only marginally higher. A large proportion of the sample (77%) had an existing health condition or had a relative that did. As such, though this may be a higher proportion than in the population, the sample reflects the characteristics of those most likely to be interested in this type of product (e.g., Nayga et al. 1998, show that a special diet moderates nutrition labelling usage), and is also substantial enough to examine whether or not those who do not have an existing health condition, or a relative that do, are a different cohort. Though the sample is slightly biased to those who have been shown to have most interest in reading nutritional labels (e.g., females and people with an existing health condition, or had friends of relatives who had), the primary purpose of this study was to understand what preferences likely users of this technology may have for different combinations of its attributes. As such a focus on likely users is appropriate. Also, while some groups are not as highly represented as others (e.g., males), there are sufficient numbers within the sample to make statistically generalisable conclusions. Therefore, while we make no claims as to the sample's generalisability to the general population, it is appropriate for an exploratory study of this nature and its characteristics do share a number of commonalities with samples used in prior research (e.g., Godwin, Speller-Henderson, & Thompson, 2006). A summary of the data collected from the survey instrument and employed in our analysis is presented in Table 2, along with descriptions of the coding procedures employed with the analysis.

TABLE 2 Descriptive statistics and regression variables

Variable Definition	Survey Returns (%)	Regression Variable
Gender (%)	Female = 74; Male = 26	Dummy Variable Female = 0, Male = 1
Age (Years)	18-25 = 62; 26-35 = 16; 36-45 = 11; 46-55 = 6; > 56 = 4	Ordered Variable 1,2,3,4,5
Marital Status	Married = 35; Single = 61; Other = 4	Dummy Variable Single = 1, Other = 0
Children (Number)	0 = 80; 1 = 8; 2 = 7; 3 = 3; >4 = 1	Continuous Variable 0, 1, 2, 3, 4
Education	0 = 2; 1 = 37; 2 = 9; 3 = 37; 4 = 15	Ordered Variable 0, 1, 2, 3, 4
Income (£ per month)	<500 = 54; 501-1000 = 10; 1001-1500 = 11; 1501-2000 = 6; 2001-2500 = 7; 2501-3000 = 4; 3001-3500 = 4; 3501-4000 = 1; >4001 = 3	Ordered Variable

Analysis

Scale reliability and validity

Before commencing the main analysis the psychometric properties of the covariates were examined. The scales for Nutrition Information Interest (Moorman, 1998), Nutrition Information Usage (Moorman, 1998), and Consumer Innovativeness (Goldsmith & Hofacker, 1991) were unidimensional and had Cronbach's alpha values higher than .7, indicating good internal consistency (Nunnally & Bernstein, 1994). The Health Behaviour scale (Moorman & Matulich, 1993) was more problematic and the items did not load on the factors in the way intended. As such a modified and reduced version of the scale was used, where items with low communalities were removed. The final scale was unidimensional and had a high reliability above .7.

Model specification

It is common practice to begin by estimating a Conditional Logit model when dealing with data generated by a choice experiment. Next a decision is made with respect to how to take account of respondent heterogeneity. There are two approaches available: the Random Parameter Logit (RPL) and the Latent Class (logit) Model (LCM). The choice of method is generally determined by how the researcher wishes to model respondent heterogeneity. Since the use and comprehension of nutrition labels seem to vary within different segments of the population, in this paper we employ the LCM. The LCM assumes that respondent preferences are not specific to the individual but rather unique for a number of respondents for a finite number of classes. Thus, all respondents are assumed to be a member of a specific segment or class. With the LCM the researcher is able to allow market segment probabilities to be explained by individual demographic and psychographic characteristics.

There are a growing number of papers in the literature that have employed the LCM. Examples include, Greene and Hensher (2003), Hu et al. (2004), Kontoleon and Yabe (2006), Chalak, Balcombe, Bailey and Fraser (2008), Cui and Wang (2010) and Bitzios et al. (2011). In this paper we follow Greene and Hensher (2003) and employ a standard LCM specification which assumes a random utility model. This model has two parts, an observable deterministic component and an unobservable random component. Thus, the utility an individual *n* obtains from selecting alternative *j* in the t^{th} choice set is:

(1) $$U_{njt|s} = \beta_s X_{njt} + \varepsilon_{njt|s}$$

where *U* is the utility obtained by individual, *β* is a vector of parameters of segment *s*, *X* is a vector of attributes from the choice experiment and *ε* is a random component assumed to be a Type 1 extreme distribution. As in Swait (1994) we assume that the deterministic component of Equation (1) can be decomposed into two parts. The first relates to the specific attributes of the choice made. The second captures individual specific characteristics (i.e., the demographic and psychographic variables).

It then follows that the choice probability for an individual *n*, given that they belong to *s*, will select an alternative *i* from a choice set of *j* alternatives, for a specific choice activity is as follows:

(2) $$\Pr_{nit|s} = \left(\frac{e^{\beta_s' X_{nit}}}{\sum_{i=1}^{I} e^{\beta_s' X_{njt}}} \right)$$

Next we follow Greene and Hensher (2003) and employ a Multinomial Logit so as to distribute an individual *n* to a given class *s* as follows:

(3) $$\Pr_{ns} = \left(\frac{e^{\alpha_s' Z_n}}{\sum_{s=1}^{S} e^{\alpha_s' Z_n}} \right)$$

where Z_n is a vector of individual-specific variables and α_s a vector of segment specific utility parameters to be estimated. Then we assume that conditional on an individual respondent being allocated to a specific segment, that the t^{th} choice activities are independent. This then implies that conditional on a specific segment membership, the probability that a respondent n selects an alternative i from a set of j alternatives can be shown as follows:

(4) $$\Pr_{ni|s} = \prod_{t=1}^{T} \Pr_{nit|s}$$

Finally, to estimate the LCM so as to simultaneously take account of the choice made by a respondent and the segment to which they belong we combine equations (3) and (4) as follows:

(5) $$\Pr_{ni} = \sum_{s=1}^{S} \left(\frac{e^{\alpha_s' Z_n}}{\sum_{s=1}^{S} e^{\alpha_s' Z_n}} \prod_{t=1}^{T} \left(\frac{e^{\beta_s' X_{njt}}}{\sum_{j=1}^{J} e^{\beta_s' X_{njt}}} \right) \right)$$

The term in the first bracket on the right hand side is the probability of observing any individual in segment s. The second bracket is the probability of selecting alternative i given membership of segment s. Note that if $\alpha_s = 0$ then the LCM becomes the standard MNL.

The parameters in Equation (5) are estimated using maximum likelihood estimation. Importantly, estimation requires that the number of segments S be known in advance. This means that it is necessary to estimate this model S times and employ various statistical criteria to select the optimal number of segments. Within the literature a number of criteria are employed, in particular the minimum Akaike Information Criterion (AIC), and the minimum Bayesian

Information Criterion (BIC). We employ both of these in helping to determine the number of segments.

Choice set design

Table 1 describes the attributes of the new technology and how the choices were converted to suit the LCM analysis. For most attributes the design only had two levels and therefore data coding was straight forward, and price was treated as a continuous variable.

Estimation

To estimate the LCM described by Equation (5) we need to delineate those variables which enter the utility function and those used to explain segment membership. Specifically, within the utility function we include all attributes used within the choice experiment– that is Price, Basket, Format, Device, Diet Alert. We also include one alternative specific constant (ASC) that is used to capture the choice of either option A or B as opposed to the no preference option. Thus, we anticipate that the ASC will be positively signed (and statistically significant) indicating utility has been obtained from the choice of either option in the choice experiment. In terms of segment membership we employ a number of demographic and psychographic covariates.

Results

We begin by examining how our model performs as we increase the number of segments. These results are reported in Table 3.

TABLE 3 Summary statistics to determine optimal number of segments

Number of Segments	Number of Parameters	Log-likelihood (LL)	Akaike Information Criterion (AIC)	Bayesian Information Criterion (BIC)
1	7	-5240.314	1.6905	1.6981
2	25	-5128.534	1.6603	1.6874
3	43	-5035.499	1.6361	1.6827
4	61	-5004.817	1.6320	1.6981
5	79	-4980.710	1.6301	1.7157

The first thing to observe is that as the number of segments increases both the LL and AIC decrease which is what we would expect. However, the most telling result is for the BIC. The BIC more heavily penalises models as the number of parameters increases compared to the AIC. As we can see the BIC reaches a minimum at three segments. On the other hand increases on the AIC are only marginal for more than 3 segments. Thus, based on these criteria and also the interpretability of the resulting parameter estimates we present results for a three segment LCM.

We now present our model estimates. These are reported in Table 4, with statistically significant coefficients (at the 10 percent level of significance) highlighted in bold. Let us begin by examining the MNL. The signs on the estimates' coefficients can be interpreted as follows. The ASC is positive which indicates that the choice of options A or B, has yielded positive utility which is as we would expect. Although, the sign on Basket is positive which indicates a preference for information on individual products as opposed to a basket of goods, this coefficient is not statistically significant. What this means is that there appears to be no preference on the part of survey participants in relation to how the nutritional information is presented (i.e., no preference for information presented as a basket of goods or by individual product).

Next consider the estimates on Device 1 (Trolley) and Device 2 (Mobile Phone). These estimates need to be interpreted relative to Device 3 (Checkout). We see that for Trolley the estimate is positive and for Mobile Phone it is negative, and both are statistically significant. The positive sign on Trolley shows a strong preference for this device relative to Checkout, whereas the negative sign on Mobile Phone indicates that survey respondents obtain a lower level of utility from this device relative to receiving the information at the checkout. In other words, the preferred device was a technological tool based on a shopping trolley, followed by information provided at the checkout and then a mobile phone. Importantly, respondents obtain positive utility as the sum of the ASC plus the coefficient for Mobile Phone is positive.

The next attribute we consider is Format. The negative sign on the Format coefficient indicates that respondents have a preference for the GDA system of labelling compared to the TLS. This is an interesting result relative to earlier findings in the literature, which indicate many consumers prefer the TLS to the GDA (e.g., Balcombe et al., 2010).

As might be expected, with the Diet Alert attribute the coefficient is positive which indicates that respondents would be happy to receive messages about food ingredients that may have to be avoided as part of a diet or health condition. With a growing number of the population suffering from food related allergies this attribute is likely to be positively received. For example, it is reported (NHS, 2011) that since 1990 there has been a 700 percent increase of the number of children admitted to hospital as a result of food related allergies. Finally, the coefficient on Price is negative as we would expect, indicating that, everything else equal, the higher the price the lower the preference.

However, we are aware from the results presented in Table 3 that the statistically preferred model specification is the three segment LCM. An examination of the results for this model reveals a more complex set of responses than that provided by the MNL, and one which allows for heterogeneity in preferences, and thus the ability to provide information about possible segments for this kind of technology. The first thing to note is the proportion of responses attributed to each segment. These are respectively .515, .118 and .366. In addition, we have the segment equations which help provide insights into the makeup of the respondents allocated to a specific segment. These segments and their characteristics (e.g., preferences for attributes of the model, psychographic characteristics and demographic characteristics) are now labelled and described.

TABLE 4 LCM model estimates

	Multinomial Logit (MNL)		Segment 1		Segment 2		Segment 3	
Variable	**Coeff**	**t-ratio**	**Coeff**	**t-ratio**	**Coeff**	**t-ratio**	**Coeff**	**t-ratio**
ASC	**3.159**	***29.689***	**4.303**	***13.342***	**-.447**	***-1.853***	**12.283**	***2.034***
Basket	.044	.719	.080	.498	**.530**	***4.311***	.012	.101
Device 1 (Trolley)	**.509**	***16.664***	**.902**	***11.358***	**.339**	***4.417***	**.112**	***2.260***
Device 2 (Mobile)	**-.077**	***-3.048***	-.015	-.263	**-.322**	***-4.341***	**-.170**	***-4.340***
Format	**-.138**	***-4.064***	**-1.225**	***-10.098***	**.609**	***5.813***	**1.206**	***16.591***
Diet Alert	**.351**	***8.580***	**.478**	***4.390***	-.154	-1.418	**.798**	***10.573***
Price	**-1.191**	***-19.536***	**-1.459**	***-9.421***	**-.378**	***-2.237***	**-1.991**	***-18.884***

Segment Functions			**Coeff**	**t-ratio**	**Coeff**	**t-ratio**		
Constant			**-1.512**	***-2.890***	**-2.082**	***-3.252***		
Age			**-.166**	***-1.763***	.149	1.269		
Wage			.049	.930	.034	.533		
Gender			.250	1.489	-.354	-1.481		
Single			-.157	-.815	.389	1.447		
Education			-.029	-.414	-.026	-.283		
Children			**-.254**	***-2.599***	**.260**	***2.768***		
Health Behaviour			-.020	-.226	**.235**	***2.027***		
Information Interest			**.229**	***3.007***	-.122	-1.339		
Consumer Innovativeness			**.131**	***1.706***	-.146	-1.484		
Food Condition			**.668**	***4.039***	**.802**	***3.467***		
Class Probability			.515		.118		.366	

Note: Figures in bold indicate statistical significance at the 10 percent level.

Segment 1: Information hungry innovators (52%)

Let us begin by examining the segment utility functions. Taking each segment in turn, for segment one (i.e., S1) the signs and statistical significance of the coefficients are similar to that reported for the MNL. The main difference with the MNL and S1 is that the coefficient for Mobile Phone is not statistically significant. In addition, the contribution of Trolley relative to Mobile Phone is much greater for S1 compared to the MNL. Interestingly, the relative magnitude of the Format coefficient is much greater for S1 compared to the MNL. This would suggest that S1 is identifying respondents based on their preference for the use of the GDA and indicates that half of the sample have a positive preference for the GDA relative to the TLS.

We now consider the segment membership functions. These allow us to examine if there are any specific demographic or psychographic characteristics that can be used to understand the segmentation of the data. Beginning with S1 and focusing only on the statistically significant coefficients we can see that Age is negatively related to being in this segment. This result is reinforced by the coefficient on the number of children in the house which is also negative. However, respondents in this segment have a positive coefficient on Nutritional Information Interest, Consumer Innovativeness and Food Condition. These results indicate that these respondents have a general interest in information about food nutrition. The respondents in this segment also appear to consider and adopt new products and technology. Finally, the respondents in this segment have a positive awareness of food related health issues as reflected in the Food Condition coefficient.

Segment 2: Active label readers (12%)

Now consider segment two (i.e., S2). For this segment we begin to see a different picture emerge. First, the ASC has a negative sign which suggests that these respondents do not attain positive utility from the choice of option A or B, and may well be indifferent to the use of technology in this context, although the magnitude of this coefficient is relatively small. This implies that respondents within this segment do not derive positive utility from use of such a technology and may well be indifferent. Another significant difference is that S2 respondents yield a Basket coefficient that is positive and statistically significant. This indicates a clear preference on the part of these respondents for information about individual products as opposed to aggregate information for a whole basket of goods. This finding suggests that these respondents prefer nutritional information to be presented for each individual product, rather than for the whole basket. Therefore, it seems such respondents are likely to want to understand about the contribution of each product being purchased and not only the aggregate impact on their diet. This is not to say that they do not care about their whole diet, but rather they are concerned about understanding the contribution of each and every element when it comes to the provision of nutritional information.

We also find that respondents in S2 have a positive coefficient on Format which is statistically significant. Thus, they prefer the TLS to the GDA. Also another significant difference is found in relation to Diet Alert. In S2 we have a negative but statistically insignificant estimate. This implies that this part of the population do not require this type of information. This result is probably capturing behaviour related to that revealed by the Basket estimate, in that these respondents wish to consider each item being bought individually and as such they will already be aware of the likely dietary implications associated with any specific food item.

Overall, there are some very significant differences between S2 and S1 (and the MNL). These differences highlight the benefit of employing the LCM to capture preference heterogeneity in the population. Without using this approach differences between segments in relation to how the information is presented (e.g., respondents' preferred device), as well as the form of the nutritional label (e.g., format of the label) would have been missed.

At the same time the relative magnitude of the estimates for Trolley and Mobile Phone are similar within S2, and Price estimates are in keeping with S1 and the MNL. However, the Price coefficient estimate is much smaller for S2 compared to S1 indicating a smaller willingness to pay for the services being offered. This attitude to price may reflect a segment of the population who believe that this type of service and information is a public good, and as such are less willing to pay for it compared to other segments of the population.

The respondents in S2 have no obvious defining demographic characteristics apart from the number of children which is statistically significant. Unlike S1 the coefficient on the number of children is positive. Another important difference for this segment is that the Health Behaviour coefficient is positive. This indicates that members of this segment are likely to be concerned with how diet relates to health. As with S1 respondents in this segment have a positive awareness of food related health issues as reflected in the Food Condition coefficient.

Segment 3: Onlookers (37%)

Finally, segment three (i.e., S3) has a relatively large positive ASC coefficient which is statistically significant, indicating a positive utility for the technology. In common with S1 Basket is positive but statistically insignificant. Next we see that Trolley and Mobile Phone are both statistically significant but have opposite signs. The main difference between S3 and S1 (and the MNL) relates to Format. For S3, as with S2, the coefficient on Format is positive and statistically significant indicating a clear preference for the TLS. Overall our results indicate that the choice of Format for nutritional information is roughly equally split between the segments, which is in contrast to the finding that emerges from the MNL. Once, again these results highlight the importance of estimating a model that takes account of preference heterogeneity.

To end, we work out the signs on the estimates for segment three. Although the segment coefficients cannot be estimated directly we can infer these coefficients given the estimates in the other two segments as long as they are the same sign. Thus, the main piece of information we can recover relates to Food Condition. For respondents who have been placed in S3 we can infer that the coefficient for Food Condition is negative. This would imply that this segment has identified those respondents who have not been exposed to health issues that are related directly or indirectly with food.

In summary, comparing the three segments from the LCM we find there is generally positive utility obtained from Trolley and negative utility for Mobile Phone, both relative to the provision of information at the checkout. As such we can conclude there is preliminary evidence that most consumers prefer to use a technological tool based on a shopping trolley to aid purchase of healthier food, rather than on a mobile or at the checkout. Moreover we can conclude that one of the main features of the device is a diet alert attribute. However, our results also indicate that the technology will need to allow for differences in nutritional information format as well as in some cases providing information at the individual product level. Clearly, what these results reveal is that any technology that is introduced to satisfy the demand for improved health informed shopping will need to cater for a variety of different consumer needs, and some of the important ones have been presented here.

We find preliminary evidence of utility for technological devices to aid nutritional decisions. Furthermore we identified three segments with clear differences in relation to the type of information preferred (see Table 5 for a summary of the segments and their characteristics) as well as how it is provided. We have found that there are some demographic differences between the segments in terms of explaining membership, in particular Age and Number of Children. However, consistent with other segmentation research in marketing, psychographic constructs tend to be more powerful segmentation variables than demographic characteristics (e.g., see Lin, 2002; Roberts, 1996; Straughan & Roberts, 1999). Overall, segment 1 (information hungry innovators) appears to describe younger respondents who are happy to embrace technology, and who are highly interested in nutritional information. Segment 2 (active label readers) seems to capture older respondents who seek out nutrition information, but who are less motivated to employ technology to aid food choice, and who are more than happy to read the minutiae on conventional nutritional labels. Finally segment 3 (onlookers), prefer nutritional information provided in a different format**,** but seem to be rather indifferent to a variety of attributes and cannot be easily distinguished in terms of their composition by demographic or psychographic factors.

TABLE 5 Consumer segments identified from the LCM

	Information hungry innovators (Segment 1, 52%)	**Active label readers (Segment 2, 12%)**	**Onlookers (Segment 3, 37%)**
Preferences towards attributes of technology	Exhibits positive utility towards such a technology, indifferent to whether information is presented individually or as a basket, prefers Trolley, prefers GDA, preference for diet alert, higher willingness to pay	Does not exhibit positive utility to such a technology, prefers information for individual products, prefers TLS to GDA, no preference for diet alert, lower willingness to pay, does not mind about the device	Exhibits positive utility towards such a technology, indifferent to whether information is presented individually or as a basket, prefers TLS to GDA, preference for diet alert
Demographic and psychographic characteristics	Younger, less likely to have children, interested in nutritional information, high on consumer innovativeness, more likely to have a food related condition	More likely to have children, more positive health behaviours, more likely to have a food related condition	Less likely to have a food related condition

General discussion

In the literature on nutrition and labelling this is the first study to examine how consumers evaluate different potential attributes of a new technology in relation to food choice and dietary information. It was also one of the first studies to examine how consumers evaluate nutritional information presented for a basket of goods rather than individually. As technology advances and converges it is important to further understand how consumers evaluate new technologies with greater possibility for customised and personally relevant information. Indeed the results presented here clearly indicate the need for a labelling technology that is customisable and flexible. Such calls for new and innovative labelling practices based upon the ineffectiveness of conventional labelling have begun to emerge in the literature (e.g., see Cornelisse-Vermaat et al., 2008; Grunert et al., 2010; Voordouw et al., 2011).

Implications for marketers, retailers and public policy

Consistent with prior studies, clear identifiable segments emerged from this research, and these segments had distinct preferences for the different attributes of the technology, highlighting the importance of more targeted forms of communication, and reflecting other similar calls in the literature for more targeted media (e.g., Brennan et al. 2010). This is particularly relevant given that conventional forms of nutritional labelling are communicated to shoppers using a mass marketing approach (e.g., an assumption that shoppers are all the same and can interpret nutritional labels, which are generally standardised within retailers and different across retailers). With advances in technology and the proliferation of smart phone devices and the app market, there is scope to provide customers with better alternatives that can meet their particular needs. Such customisation is becoming more common in other industries and the results here suggest it could be usefully applied in a nutritional labelling context. Customisation offers a number of benefits to consumers who tend to be willing to engage with technology in order to achieve more customisation (Bardakci and Whitelock, 2004).

This research is a preliminary study aimed at examining how consumers might evaluate different attributes for such a technology. Though prior research has examined differences in labelling effectiveness among different segments of the population, so far the results have largely called for different approaches to labelling, rather than more customisable solutions. However, practically speaking, only one labelling approach is possible at any given time, and for any given retailer, and the more information provided on any one label, the greater the chances of confusing consumers further. Thus, the literature has been constrained by practical considerations, including an industry focus on mass communication methods of providing nutritional information to consumers. While the implementation of the research here does not allow for a comprehensive understanding of consumers' responses to technologies, which may allow for customised information to be provided, it does show how such a technology might take shape. For example, the results here revealed, for S1, the largest of the three segments, that consumers would prefer information provided on a product-by-product basis, rather than for the basket. Likewise these consumers prefer to have the information sent to their shopping trolley, rather than through some other medium such as the mobile phone or a screen at the cashier's. These findings thus provide marketers and policy makers with useful information on how this service might manifest itself within the market place.

Retailers may well consider the provision of technology to enhance the consumer experience a sensible course of action to pursue in order to attract customers into their outlets. Indeed other research suggests customers who are able to engage in customisation processes are more likely to be satisfied and are more likely to be repeat customers (Jiang, 2002). It is also the case, as we have already seen with the different forms of nutritional information format, that retailers may take different approaches to the form and extent of technology provision offered. As such it could be that retailers might see this kind of technology as a way to enhance their value proposition through the provision of different services to their target markets. For example, for retailers who have a consumer profile similar to that of segment 1, providing this technology might be one way of doing this (either at a fee or for free).

This research has interesting implications for public policy makers who are attempting to change consumer attitudes and behaviour toward food so as to improve health and well-being. There appears to be a willingness on the part of consumers to embrace the use of technology in an effort to better understand their shopping outcomes in relation to health. Technology may enable greater understanding of nutrition information within a shopping basket. In addition, this information can be adjusted to consumer preferences. However, at the point of purchase the consumer is interacting with a private retailer and there is no reason *a priori* why retailers will provide the technology considered in this paper free of charge.

An important question affecting the public policy value of nutritional information technologies arises with the issue of equity and how effective new technologies can be in helping segments of the population with higher food health related risks. Andrews, Netemeyer and Burton (2009) argue that the success of nutrition education campaigns is moderated by segmentation. Viswanathan et al. (2009) note that less educated segments in the population may require simpler messages. Similarly, it may be the case that those that would most benefit from these technologies are not able to use them. Indeed the research presented here identifies three clear segments of consumers and they differ in terms of their preferences for label format, the degree to which a technology provides positive utility and their preferences for how information is presented to them. Following other segmentation research in marketing this research also finds that psychographic factors provide a clearer interpretation of the segments than demographic factors (e.g., Lin, 2002; Roberts, 1996; Straughan & Roberts, 1999). Contingent on the confirmation and extension of our results, we envision two policy issues. The first relates to how to stimulate the adoption of these technologies by retailers and use by consumers, and the second concerns how to be sure that groups who will most benefit from this service actually have access to it.

Public agencies have a variety of options to induce adoption of welfare enhancing technologies. Since retailers are already experimenting with some of the technologies analysed in the study, perhaps the best strategy is to encourage voluntary schemes. The possibility of voluntary adoption is illustrated by the TLS front of package labelling scheme in the UK by retailers such as Asda, Boots, Sainsburys and Marks & Spencer.

While the use of a voluntary scheme may suffice to make these technologies available, the issue of paying to use technology may alienate some segments of the population, leading to the second policy issue above. Indeed, charging consumers for the use of the technology may well act as a constraint on the adoption of the technology. This would be counter-productive given the public policy objective of improving dietary intake in an effort to address wider public health concerns. If this is the case then government may have to consider offering the use of payments to retailers to introduce the technology or alternatively introduce legislation. Another possibility is that governments could consider subsidising groups of the population that would most likely benefit from this technology. More research is required to address these questions and it is likely it would involve some form of benefit cost analysis. As such there are issues of equity that will need to be addressed if this type of technology is to be widely implemented.

This research may also have important implications in terms of attracting segments of the population who are typically less concerned with reading nutritional labels (e.g., males). Although the coefficients for gender were not statistically significant at the 5% level of significance for segments 1 and 2, they were significant at the 10% level and indicated segment 1 was somewhat more likely to be male, and that segment 2 was somewhat more likely to be female. Therefore, females are not likely to be put off by the technology (e.g., see segment 2) and males may even become more attracted to a technology which provides nutritional information. This would be somewhat consistent with research on technology acceptance which shows males may have a higher propensity to accept new technologies than females (Venkatesh et al., 2000). As such, a new technology of this nature might be useful in redressing gender imbalances based upon the use of nutritional labels, and responding to the needs of groups who are more disadvantaged (e.g., those who are less literate).

Therefore, there are issues of equity that will need to be addressed if this type of technology is to be widely implemented. There is also the issue of what extent or use can we expect with this type of technology. Will only larger retailers at larger outlets provide this service? These are questions that require a wider analysis than that provided in this paper.

Future research and limitations

Given the emerging nature of mass customisation, and increasing societal need for healthier eating habits, customisable nutritional labels hold much promise for social marketers and our understanding of consumer behaviour. This research was an initial attempt at understanding consumer preferences for such a device but opens many other questions. Future research could determine i) whether such a technology enables consumers to make better choices, ii) whether or not customers are willing to pay for such a technology, and iii) how such a technology may assist disadvantaged groups to make more informed diet choices. Further research in this area at the confluence of social marketing, technology acceptance and food consumption would have many benefits to retailers, policy makers and consumers.

This study was exploratory in nature and the results should be interpreted as such. While we do not claim the sample is representative of the population in general its characteristics were relatively varied, consistent with other research in the area of nutritional labelling and its bias towards females is consistent with current research that shows that females are more likely to use labels than males (e.g., Balcombe et al., 2010; Drichoutis et al., 2005; Grunert & Wills, 2007; Wansink, 2003). There may also have been some degree of selection bias in the sample such that those with certain health conditions and an interest in technology were more likely to respond. However, our interest in this research was to examine how individuals reacted to, evaluated, and traded off attributes of a new technology. Therefore, we think the sample, which seems to exhibit a high interest in reading nutritional labelling information, is appropriate given the objectives of the research. Furthermore, with a large sample size of nearly 400 we can be quite confident that statistically generalizable conclusions can be drawn for under-represented groups (e.g., even though the sample was 26% male this still means that over 100 people in the sample were male). However, further research should replicate the study on more representative samples to increase the confidence in our findings.

Conclusion

In conclusion this study extends existing research in the area of nutritional labelling by examining consumer response to a new technology that may facilitate consumer processing of nutritional information. While previous approaches to labelling have shown some positive outcomes, the effectiveness of nutritional labels is largely dependent upon individual factors and the format of the labels themselves, which are notably fragmented. Recent advances in technology can overcome the limitations of a mass communications approach to conveying nutritional information and this research explores consumers' reactions to such a technology. As an initial exploratory study in this area, we aimed to determine consumer preferences for attributes of a technology to facilitate the interpretation of nutritional information, and to determine the nature of heterogeneity among different segments. While caution should be taken in generalising the results presented here, they provide interesting insights into the attributes of such a technology that consumers are likely to prefer, and identify three distinct segments with different preference structures, and psychographic characteristics. A number of questions have emerged with this work and they define a new research agenda in the area of labelling and point to the need to explore the feasibility and usefulness of such a technology in more depth.

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Appendix: Concept Statement

Please read the following concept statement carefully.

Concept: A supermarket chain is considering launching a new service to aid customers in making healthier food choices. This service will enable customers to keep a tally of the main nutritional components for the foods they are purchasing (e.g., the amount of sugar or fat being consumed). Using newly developed wireless technology an electronic label, sends nutritional information about the food being purchased to some other device close by (for instance, your mobile, a screen by the shopping counter or a screen attached to your shopping trolley). This service *not only* displays information contained on food labels but presents the information in an easy to read format.

Suppose you are doing your weekly shopping in a supermarket and you have the following products in your basket:

- ✓ Pasta (2 x 500 g packages)
- ✓ Lemon curd tart (400g)
- ✓ Raw lamb chops
- ✓ Bottle of extra virgin olive oil (500 ml)
- ✓ 2 cans of tuna in water
- ✓ Chicken curry with rice (400g pack)
- ✓ Battered cod fish (400g pack)
- ✓ Corn flakes (500 g)
- ✓ Tomato soup (2 pints)
- ✓ 12 inch pizza

If you wanted to find out the nutritional value of these products, currently you would need to read the labels on the packages. Alternatively, you can use this new service which will allow you to conveniently store and access the nutritional information in a simpler way, displaying it onto a screen while you do your shopping. This new service has 5 features and each feature may vary in the ways described below:

1. The nutritional information could be presented for a whole basket of goods or for each product individually. This feature is called "**Products**".
2. You can access the information either through your mobile, at a screen by the shopping counter or on a screen attached to your shopping trolley. This feature is called "**Device**".
3. The information is either presented using the Traffic Light System (TLS – see Figure 1) or as a Guideline Daily Amount (GDA – see Figure 2). This feature is called "**Format**".
4. The service can potentially alert you if you are purchasing something you need to avoid in your diet (e.g., traces of nuts if you have a nut allergy, or high sugar content if you have diabetes). So it can come with an alert or no alert. This feature is called "**Diet alerts**".
5. The product will also vary on price *per use*. This feature is called "**Price**".

Figure 1

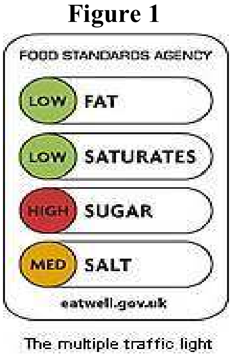

Figure 2