When more is less: the effect of multiple health and nutritional labels in food product choice

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Abstract— **Consumers are facing increasing information on health and nutritional aspects of foods, an important source of which is that presented in food packages. Prior research has identified that this information is positively valued, but the effect of multiple information items simultaneously is not so well understood. A choice experiment has been conducted to identify the effect of multiple health and nutrition information sources in two products which represent both a healthy and less-healthy food (pork Frankfurt sausages and plain yoghurt respectively). Results show that although highly heterogeneous, preferences seem to positively value individual information items and negatively value the presence of more than one item, specially if the item is a health claim. Premiums consumers are willing to pay represent a significant percentage of retail price, specially for the less healthy food product which also faces lower retails prices.**

Keywords— **Nutritional information, nutritional claims, health claims.**

I. INTRODUCTION

Of total preventable diseases a significant portion of ill health is due to a combination of poor diet and low levels of physical activity. In particular, within the European context, five of the six leading risk factors for ill health are linked to nutrition: the risk factors are blood pressure, cholesterol, high body mass index, (low) fruit and vegetable intake and alcohol [1]. Moreover, much of the incremental improvement in life span and quality is likely to derive from changes in lifestyle and habits than from improved medical care [2]. However, modifying individual's dietary habits is a challenging task in which multiple strategies such as increased scientific knowledge, education and information must be simultaneously and co-ordinately implemented [3]. This paper focus on the role of one of these strategies: information and how consumers use and value it when making purchase decisions.

Consumers are facing increasing information on health and nutritional aspects of foods, an important source of which is that presented in food packages. Current legislation allows for three different types of nutritional and health information to be included in food products: nutritional information, nutritional claims and health claims [4]. Nowadays, these types of information and claims are widespread in the EU context. For example, in a recent review of 250 packed products covering 72 types of foods in Spain, over 70% of all products carried nutritional information, 43% carried nutritional claims and 23% health claims [5].

The presence of multiple information items in food products is foreseen to increase in the future as nutritional content information has been set as compulsory if claims want to be inserted in food products. Previous research has shown that consumers do indeed consider beneficial the presence of nutritional and health information on food products improving their opinion on the product, their valuation or their purchase intention. Moreover, analysis of real market data has shown that claims do indeed shift consumption patterns towards healthier diets [6] and that a ban on their use in certain products can foster unhealthy habits [7].

The usefulness of labels in influencing purchase decision has been detected to be positively related to the importance given to nutritional and ingredients information [8], but not to claims [9]. Less studied has been the effect of multiple sources of health and nutrition information. Studies focusing on examining the ability of consumers to interpret nutrition label in the presence of a health and/or nutrition claim include [10], [11] and [12]. Evidence from these studies suggests that when consumers interpret nutrition label they are not influenced by the health claim present on the food product. Moreover, consumers rely on the nutrition labels to a greater extent than they do on nutrition claims. On the other hand, [13] show that nutritional labels can induce less healthy eating through increase in quantities, even when serving size is clearly indicated. These experimental findings have been checked with real consumption data too, with [14] reporting the impact of increasing media low-carbohydrate awareness on cholesterol consumption

using an revealed preference data at the aggregated level, showing that new information may lessen the concern for a previously relevant nutrient.

Therefore, in a context of increasing information availability and diet health relationship concerns, better understanding of consumer choice effects of multiple information options seems to be a research priority, this is precisely the objective of this paper. Using a choice experiment of Spanish consumers, preferences for nutritional and health information present in food products are assessed. The experimental design employed allows to estimate not only individual information items effect but also the potential interactions between the different strategies food industry has available. The empirical application is focused on fat-related information and claims, as this nutrient seems to be one of the most relevant for consumers. Over 50% of those who declare to have changed their eating habits at the EU level have done so to reduce their fat intake [15]. The effects of fat-related labels is tested on two different products (plain yoghurt and pork sausages) to see whether there are any differences with regards to their perceived healthiness.

The rest of the article begins with a brief presentation of choice modelling approach, followed by a more detailed description of the experimental design and the econometric specification. Second, a description of the survey design, sample selection and questionnaire construction is provided. Results are presented in section four, with conclusions and follow-up research needs closing the paper.

II. METHODOLOGY

To assess consumers' preferences for different nutrition and health information labels choice experiments (CE) are used because of its ability to value multiple attributes simultaneously, the consistency of CE with random utility theory, and the similarity of the hypothetical choice to real market decisions [16], [17].

Choice modelling is based on Lancastrian consumer theory of utility maximization [18] and consumers' preferences over food attributes are modelled in a random utility framework [19]. In the choice modelling approach consumers choose between alternative products that contain a number of attributes with different levels. Individuals choose the alternative that provides the greatest utility and the probability of selecting an alternative increases as the utility associated with it increases. The utility function is known by the individual but some of its components are unobserved by the researcher. Thus, utility is taken as a random variable where utility from the n^{th} individual facing a choice among *j* alternatives within choice set *J* can be represented as,

$$U_{nijt} = v_{njt} + \varepsilon_{njt} \qquad [1]$$

Where *n* is the number of respondents; *j the* number of alternatives within choice set *J, t the* number of choice occasions, v_{njt} utility determined by the attributes and their values for alternative *j* in *t* choice occasions and ε_{njt} an extreme value error term $(0,\sigma^2)$, i.i.d. over alternatives and independent of v_{njt}.

Different choice models can be derived contingent on the specification of the density of unobserved factors $f(\varepsilon_{njt})$. The selection of this function will depend on the assumptions underling the consumer's preferences. If preference heterogeneity across consumers is expected, a general specification such as the Randon Parameters (RPL) or mixed logit model can be used. Assuming that v_{njt} is linear in parameters ($v_{njt} = \beta_n' x_{njt}$), each consumer has his own vector of parameters β_n [1] which deviates from the population mean β by the deviation parameters η_n. The β_n is random across individuals with a density function f(β). In the RPL model, the conditional probability that individual *n* chooses alternative *j* in a particular choice occasion *t*, is represented as:

$$L_{njt}(\beta_n) = \frac{\exp(\beta'_n x_{njt})}{\sum_i \exp(\beta'_n x_{nit})} \qquad [2]$$

For the maximum likelihood estimation, the conditional probability of the sequence of choices made by each respondent is obtained according to the following expression:

$$S_n(\beta_n) = \prod_t L_{nj(n,t)t}(\beta_n) \qquad [3]$$

where *nj(n,t)* represents the alternative chosen by person n in choice occasion t. The unconditional probability for this sequence is given by:

[1] β_n does not carry the subscript *t* as taste is assumed to vary over respondents but not over choices.

$$P_n(\theta) = \int S_n(\beta_n) f(\beta_n \mid \theta) d\beta_n. \qquad [4]$$

Since the integral in [4] does not have a close form, the probabilities have to be simulated by summing over R random draws of β, which are taken from the probability density function $f(\beta_n \mid \theta)$ [20-22]. For the estimation of the RPL, Halton draws rather than random draws are used since they provide a more efficient simulation for the RPL.

III. DATA

Data were collected from a survey conducted in two medium-sized Spanish towns, Cordoba and Zaragoza, during March and April 2007. These towns were selected to be representative of both, the North and the South of the Country while having socio-demographics similar to the Spanish Census of Population. Two food products with different health perceptions were chosen, plain yoghurt (healthy product) and pork Frankfurt sausages (less healthy product). Both products fulfil three conditions *i)* consumers are very familiar with both products which may reduce bias; ii) they are frequently consumed; and *iii)* they are non luxury products as most consumers can afford them.

In the questionnaire consumers were asked questions related to health, diet and food safety attitudes, nutritional knowledge, food label use and pork Frankfurt sausages and yoghurt consumption patterns. The questionnaire also contained questions on socio-demographic characteristics (i.e. sex, family size and composition, age, education level, income). A description of the experiment was presented to participants, indicating the selected attributes for each of the products: price per package, nutrition facts panel, nutrition claim and health claim. The level of the attributes for the two products are presented in table 1. Choice sets include three alternatives: two unlabeled alternatives [23] and a no-buy scenario and was presented using mock packages as shown in figure 1.

The price vector selected reflects the current price levels found in supermarkets with the upper bound including a 50% premium. The basic nutrition facts panel option contains only the four nutrients that EU regulation considered as basic [24] while the detailed one presented additional information consumers could value and that is currently presented in the analysed products. The nutrition claim considered is "low fat content". For yoghurt a 0% fat content was considered while sausages a 30% fat reduction was considered in order to comply with the EU regulation on nutrition and health claims made on foods while being feasible [25]. The health claim is related to cardiovascular diseases. There is sufficient scientific evidence relating the relationship between fat intake and this type of diseases as to consider that this claim could be approved by the European Food Safety Authority [26].

Fig. 1 Sample choice card

Table 1 Attributes and levels used in the experimental design

Attribute	Levels	
	Pork Frankfurt sausages	***Plain yoghurt***
Price	0.20 € per pack 0.40 € per pack 0.60 € per pack 0.80 € per pack	0.75 € per pack 1.00 € per pack 1.25 € per pack 1.75 € per pack
Nutritional facts panel	Basic (energy, fat, protein carbohydrate)	
	Detailed (basic plus sugar, type of fat, cholesterol and sodium)	Detailed (basic plus vitamins with quantities and DRI %)
Nutrition claim	None Low fat content	
Health claim	None Reduces the risk of cardiovascular diseases	

The choice set design was created following [27]. As the research objective is to allow for the estimation of main effects and two-way factor interactions, we generated a full factorial design. The complete factorial design results in 32 runs. We then used these 32 profiles to obtain suitable pairs. The optimal design consists of choice set in which the number of attributes that differ between any pair of profiles in the choice set is *(k/2)+1* where k is the number of attributes [28]. Thus, the levels of three attributes in each element of

the choice set (32) were systematically changed for three times (k=4), and left the level of fourth attribute unchanged. 92 pairs were obtained, which resulted in a final number of 80 after removing repeated choice sets. This design is 97.5% efficient. To avoid fatigue effects associated with multiple valuation tasks, the 80 choice sets were randomly split into 20 blocks and each respondent was asked to choice one block of four choice sets per product.

In each town 400 consumers were interviewed. For a infinite population and assuming a confidence level of 95.5% (k=2) and p=0.5 the error is 5%. The final sample in each town was selected using a stratified random sample of consumers on the basis of town district and age . The questionnaire was administrated face to face and target respondents were the primary food buyers in the household. Interviewers approached randomly selected individuals asking them two screening questions: whether they were the main household food shopper and whether they consumed pork Frankfurt sausages and plain yoghurt. In the case of a negative response to either the first or the second screening questions, the interviewer selected randomly another customer belonging to a given age group, until finding a participant matching both requirements. Summary statistics for the characteristics of the full sample are presented in Table 2.

Table 2 Socio-Demographic Characteristics of the Sample (%)

Gender	
Male	28.0
Female	72.0
Age (average of total sample)	45.5
Education of respondent	
Elementary school.	29.5
High School	34.0
University	36.5
Average household income	
< 600 €	02.1
> 600 € and < 1.500 €	15.5
> 1.500 € and < 2.500 €	32.5
> 2.500 € and < 3.500 €	19.5
> 3.500 € and < 4.500 €	10.1
>4.500 €	06.3
Household size (sample average)	03.1
Households with children below 6	19.0

IV. MODEL SPECIFICATION AND ESTIMATION

In the final specification of the utility function, an alternative-specific constant representing the A and B choice option was introduced (ASC). It is expected that this constant would be positive and significant, indicating that consumers will get higher utility from alternative A and B than from the no-buy option C. The nutritional panel (NPANEL), nutritional claim (NCLAIM) and health claim (HCLAIM) variables are effect coded and the price (PRICE) represents the price levels given to consumers for each food product. Interactions between the three nutrition and health attributes (NPANEL&NCLAIM; NPANEL&HCLAIM and NCLAIM&HCLAIM) have also been included. Price is expected to have a negative impact on utility while, the effects of the other variables are the posed questions in the paper.

In the RPL, the researcher has to specified the distribution for the random coefficients that satisfied his expectations about consumer behaviour (Train, 2003). Since consumers may either like or dislike the nutrition and health information attributes considered in the experimental design, a normal distribution is used. The estimation of the RPL was conducted using NLOGIT 3.0 keeping price fixed and letting the coefficients of the other three attributes and of the interaction between them random (Table 3).

The final specification of the utility function relies on statistical tests that support the significance of the included coefficients[2]. With respect to the overall fit, both models are statistically significant with a chi-square statistics of 2,635.97 and 2,285.82, respectively which are higher that the critical value, suggesting that attributes by themselves and their interactions are jointly significant, affecting consumers' utility. As expected, the alternative specific constants are positive and statistically significant, indicating that consumer utility for purchase alternatives is higher than non-purchase option for both products.

The Wald test for the non-random parameters (PRICE) is significant different from zero at the 5% of significance level. The expected negative parameter estimates for the price indicate that increments on the price decrease the associated utility level provided by the choice of each food product. In the case of sausages, the mean of the three main random parameters (NPANEL, NCLAIM and HCLAIM) and

[2] Only those attributes and attributes interactions which mean of estimate parameters were statistically significant have been maintained in the final model.

two attribute interactions (NPANEL&NCLAIM and NCLAIM&HCLAIM) are statistically significant explaining consumers' utility. Moreover, if we compare this model with two interactions with the same one only considering the main effects, the joint insignificance of the two interactions is rejected using the likelihood ratio test (LR=86, for a χ^2_4 at 5%) suggesting non-linear responses to bundles of alternatives including nutrition and health information. The pattern changes in the case of yoghurts, the nutrition claim attribute is no longer significant and only one interaction between the nutrition facts panel and the health claim (NPANEL&HCLAIM) is statistically significant different from zero.

Table 3 Random parameter model results

	Pork Frankfurt sausages		**Plain yoghurt**	
	Coef.	***Coef./StD***	***Coef.***	***Coef./StD***
Mean Values				
ASC	3.8420	22.68	4.4879	23.87
PRICE	-1.5322	-9.95	-1.4557	-11.68
NPANEL	0.1259	2.76	0.2254	4.27
NCLAIM	0.3848	5.75	---	---
HCLAIM	0.5887	10.45	0.2340	5.086
NPANEL&NCLAIM	0.1697	2.81	---	---
NPANEL&HCLAIM	---	---	-0.1793	-2.197
NCLAIM&HCLAIM	-0.3779	-3.979	---	---
Standard Deviations				
PRICE	0.3675	4.34	0.3153	3.59
NPANEL	0.1391	1.03	---	---
NCLAIM	0.3588	6.01	0.4466	8.53
HCLAIM	0.0239	0.23	---	---
NPANEL&NCLAIM	---	---	0.4344	4.49
NPANEL&HCLAIM	0.9027	9.78	---	---
N	9,600.00		9,600.00	
Log-Likelihood	-2,197.57		-2,372.64	
χ^2	2,635.97		2,285.82	
Pseudo R^2	0.37		0.32	

Turning to homogeneity in preference, the Wald statistics for the derived standard deviation parameters indicates that the dispersion around the mean is statistically different from zero for the nutrition facts panel (NPANEL) and the health claim (HCLAIM) for both products, although, only the interaction between the nutrition claim and health claim (NCLAIM&HCLAIM) in the case of sausages and, the interaction between the nutrition facts panel and the health claim (NPANEL&HCLAIM) in the case of yoghurt. In other words, the main effect of the nutrition facts panel (NPANEL) and the health claim (HCLAIM) in the utility function differs across consumers.

For sausages, the positive value of the mean parameter estimates for the main attributes (NPANEL, NCLAIM and HCLAIM) indicates that utility for the packages with detailed nutrition facts panel, nutrition claim and health claim is higher. Moreover, the mean parameter estimate for the interaction between the nutrition facts panel and the nutrition claim (NPANEL&NCLAIM) is positive indicating an increasing marginal utility when both nutrition information labels appear together in the package. However, the mean parameter estimate for the interaction between the nutrition claim and the health claim (NCLAIM&HCLAIM) is negative which means that the inclusion of both claims in the package yields a decrease in consumers' utility. This last result may be due in part to an information repetition effect. In fact, both claims give the same information with two different verbal compositions. However, in the case of NPANEL&NCLAIM, the information provided by each of the labels differs. While nutrition facts panels provide detailed information of the amount of different nutrients, nutrition claims focus on giving short and concise information on a single nutrient (fats in this application), therefore, they are seen as complementary.

In the case of yoghurt, the parameter estimates for NPANEL and HCLAIM indicates that the utility for the yoghurt-pack with detailed nutrition facts panel and health claim is higher than when these labels are not included. The presence of a 0% fat claim has no impact on consumers' utility. This result might be explained because it is straightforward to identify the extra information provided by the nutritional claim in the nutrition facts panel, so the nutritional claim might be worthless to them. However, the mean parameter estimate for NPANEL&HCLAIM is negative which means that the inclusion of both sets of information in yoghurts decreases consumers' utility. In other words, consumers experience a decreasing marginal utility from increasing the amount of information about nutrition and health.

However, the interpretation of direct estimate parameters is not enough to fully understand the consumers' valuation. Therefore, we calculate the marginal values or willingness to pay for the main effects of the attributes (NPANEL, NCLAIM and HCLAIM) and for the total effects that include the

interaction factors terms (table 4). The WTP is calculated by determining the price difference that generates utility equivalence between food products with nutrition and health information and without this information. Mean WTP values are calculated by taking the ratio of mean of nutrition and health attributes to the price parameter multiplied by minus one.

Table 4 Consumers' willingness to pay for nutrition and health information

	Pork Frankfurt sausages	**Plain yoghurt**
Mean WTP		
ASC	0.086 €	0.155 €
PRICE	0.251 €	---
NPANEL	0.386 €	0.162 €
Total WTP		
PRICE	0.445 €	0.155 €
NPANEL	0.472 €	0.197 €
NCLAIM	0.380 €	0.162 €

The mean WTP estimates indicate that premiums consumers are willing to pay for nutrition and health information on the product itself are higher for the "less healthy product" (sausages) than for the healthy one (yoghurt). This result indicates that although nutrition facts panel and claims have more prevalence in the dairy sector, the value that consumers attached to these labels is lower compared to products considered less healthy. Thus, companies in the processed pork sector may use these labels to reach consumers segments more concerned about health and food intake.

Total WTP for information on sausages indicates that consumers are willing to pay 0.46€ for the presence of both, detailed nutrition facts panel and a nutritional claim. This total WTP is higher than the sum of the willingness to pay for each of the labels because consumers gains utility for the joint presence of both nutrition and health information. However, total WTP for the presence of both types of claims is 0.38, lower than the sum of WTP for each of the claims and also lower that the WTP for the presence of a detailed nutrition facts panel and a nutritional claim. However, the total WTP for the presence of both, a detailed nutrition facts panel and a health claim, which is the sum of the individual WTP because the interaction was not statistically significant, is also higher. Results indicate that companies in the pork sausages industry should use either a nutrition or health claim and to complement this verbal information with detailed nutrient information in the facts panel. As expected, the presence of two different claims, nutrition and health in a package of sausages is not the most appropriate strategy. However, results also show that health claims will be more beneficial and in this case, providing information content on more nutrients than the basics mandate by the EU regulation would be recommended. In the case of yoghurt, total WTP indicates that the best strategy for companies is also to provide a health claims and to include additional information on nutrients such as different vitamins and the percentage of daily recommended intake.

V. CONCLUSIONS AND FURTHER RESEARCH

Providing nutritional and health related information on food labels is currently one of the most important trend in food marketing. Using a stated preference valuation methodology this paper has presented estimates of how consumers value these attributes in products with varying perceived healthiness. The presented results lead to several conclusions. The most straightforward one is that consumers do indeed value this additional information when free to choose between different products. However, this valuation is heterogeneous both among consumers and between products. As far as individual heterogeneity is concerned the existence of a single valuation of nutritional and health information can be discarded. All attributes, and relevant interactions, are best described as random and therefore different individuals can have even sign reversals, negatively valuing some of the attributes which in mean are increasing in utility.

With regards to product heterogeneity, information seem to be more valued in healthy products while claims are more effective for less healthy products. Consumers seem to disregard nutritional claims when the product is already perceived as healthy while valuing them as the most important attribute in less healthy products. Moreover, the interaction between different sources of information changes also with the product. Answering to the title of the paper, it seems that more information is only more valued when reinforcing information not obviously positive for consumers (i.e. nutritional claims when nutritional information is not straightforward as in the case of sausages with reduced fat content). What is more surprising is that additional information can mean less

utility when two claims are made simultaneously (sausages) or when additional information on nutrition and health claims coincide (yoghurts). In the first case consumers might distrust too much positive promotion of a product perceived as not very healthy and in the second consumers may consider additional information is not relevant.

Further research should be aimed at better understanding the sources of preference heterogeneity among consumers using latent class choice models. This would allow reinforcing the reported results based on existing information processing and valuation theory (i.e. impact of knowledge and attitudes on individual values) and identifying homogenous groups to which this types of information sources should be targeted.

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