THE ROLE OF LABELLING IN CONSUMERS' FUNCTIONAL FOOD CHOICES

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ABSTRACT:

Given the credence nature of functional food attributes labelling plays a key role in allowing consumers to make informed choices about foods with enhanced health attributes. The degree to which a particular jurisdiction permits health claims for food products and the type of allowable health claim influence the information set available to consumers. In Canada the regulatory environment governing health claims for functional food products is somewhat more restrictive than in other jurisdictions, including the United States. Food manufacturers therefore also use visual imagery to suggest a health benefit, such as the picture of a red heart to imply that a product has heart health benefits. The paper characterizes these labelling strategies as "partial labelling", while "full labelling'' refers to formal health claims on food labels, ranging from general (structure-function) claims, to risk reduction claims, to disease prevention claims. This paper explores the effect of labelling (full and partial) on consumers' functional food choices. How might different types of labelling information and the verification of health claims by different agencies affect consumers' preferences for functional foods? Using data from an online survey of 740 Canadians conducted in summer 2009 the paper uses discrete choice modelling to examine the responses of Canadian consumers to different product labelling strategies for milk enhanced with Omega-3. Conditional Logit and Latent Class models are estimated. Preliminary results suggest that full labelling is preferred over partial labelling, but primarily for risk reduction claims. There is no significant difference between a function claim, such as "good for your heart" and partial labelling in the form of a red heart symbol. The choice experiment included verification of health claims by a government agency (Health Canada) or by a third party (Heart and Stroke Foundation). The preliminary results suggest that consumers on average respond positively to verification of health claims, however, the latent class model reveals considerable heterogeneity in consumer attitudes toward the source of verification. Interactions between key-socio-demographic and attitudinal variables and the main effects variables in the choice experiment provide further insights into consumer responses.

KEYWORDS:

Discrete choice experiment; latent class model; health; labelling; Omega-3

JEL CODES: D12; Q13; Q18

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1. INTRODUCTION

A growing awareness of the link between diet and health has precipitated a rapid expansion in the market for functional foods. Given the credence nature of functional food attributes such as Omega-3, probiotics, lycopene, etc., labelling plays a key role in allowing consumers to make informed choices about foods with enhanced health attributes. The degree to which a particular jurisdiction permits health claims for food products, and the type of allowable health claim, influence the information set available to consumers.

In Canada, health claims for food products are regulated by Health Canada, a Federal government ministry. Currently Health Canada only allows five science-based risk reduction claims, compared with seventeen allowable health claims in the United States. Perhaps constrained by the limited scope of allowable health claims, food manufacturers use other means to convey health attributes, for example, the use of symbols or images to imply a health benefit (e.g. a red heart picture to imply heart health), or food companies may simply identify the functional ingredient on a label (e.g. "contains Omega-3", "high in lycopene", etc.). The paper characterizes these labelling strategies as "partial labelling". In contrast, "full labelling'' refers to formal health claims on food labels and ranges from general (structure-function) claims, to risk reduction claims, to disease prevention claims. While structure-function health claims and risk reduction claims are permissible on some food products in the Canadian market, disease prevention claims are reserved for drugs and are not used on food products.

This paper explores the effect of labelling (full and partial) on consumers' functional food choices. How might different types of labelling information and the verification of health claims by different agencies affect consumers' preferences for functional foods? Using a discrete choice experiment, the paper examines the responses of Canadian consumers to different product labelling strategies for a milk product containing Omega-3. In particular, the approach recognizes that different consumers make different choices depending on their current health status and health knowledge, the degree to which they tend to trust in health claims and food labels, and the extent to which they believe that there are benefits from consuming functional foods. Canadian consumers' responses to full health claims versus partial (implied) health claims, the credibility of verifying organizations and the effects of other factors (e.g. health risk, attitudinal and socio-demographic factors) are examined in the paper.

The following section examines the concept of 'partial' labelling in the context of functional food labelling in Canada. Section 3 outlines the research design and data collection methods used in the study. Section 4 describes the estimation methods for the conditional logit and latent class models used in the analysis, while section 5 presents the results. The paper concludes with a consideration of policy implications and suggestions for further research.

2. FUNCTIONAL FOOD LABELLING IN CANADA

A brief comparison of the regulatory framework for labelling health claims in the US and Canada provides some context for the analysis presented in this paper. The United States currently permits two types of health claims on functional food products. A health claim which links a nutrient to a particular disease is defined as a '*risk reduction claim*', for example, "diets rich in calcium may reduce the risk of osteoporosis". This type of health claim must be pre-approved by the U.S. Food and Drug Administration (FDA) and must be supported by significant scientific evidence. Currently seventeen different types of (risk reduction) health claims are allowed for functional food products in the United States. Second, a product may carry a function claim linking a substance to an effect on the functioning of the body, a so-called '*structure/function claim*', for example, "calcium builds strong bones". This type of health claims does not need FDA pre-approval (Federal Trade Commission, 2006).

In Canada, the regulatory framework for allowable health claims on functional foods is relatively more restrictive. As in the United States, disease risk reduction claims need to be pre-approved, however, there are also conditions governing the use of structure-function claims in Canada. Minimum levels and content requirements need to be reviewed by Health Canada before a structure-function claim is acceptable and can be used on a product label (Health Canada and CFIA, 2003). Health Canada currently allows five specific science-based disease risk reduction claims to be used on food labels or in advertisements, as follows (Health Canada and CFIA, 2003):

1. a healthy diet low in sodium and high in potassium and reduced risk of high blood pressure;

2. a healthy diet with adequate calcium and vitamin D and reduced risk of osteoporosis;

3. a healthy diet low in saturated and trans fat and reduced risk of heart disease;

4. a healthy diet rich in vegetables and fruit and reduced risk of some types of cancers;

5. the non-cariogenic benefits of non-fermentable carbohydrates in gums and hard candies;

The above five health claims are based on ten existing approved health claims by the United States under the Nutrition Labeling and Education Act (NLEA) in the 1990s. Health Canada reviewed the ten claims and determined that five of them would be allowed in Canada, while the other five risk reduction claims remain unapproved. The unapproved health claims include relationships between: "fat and cancer; folate and neural tube defects; fiber-containing grain products, fruits, and vegetables and cancer; fruits, vegetables, and grain products that contain fiber, particularly soluble fiber, and risk of coronary artery disease; soluble fiber and risk of coronary artery disease" (Fitzpatrick, 2004).

Products claiming to treat, cure, mitigate or prevent a disease or illness are regulated as drugs. '*Disease prevention claims*', linking consumption of a food to the prevention of a specific disease, are not permitted on food products either in Canada or in the United States, although some scientific evidence (e.g. Bloch and Thomson, 1995) has showed supportive (not conclusive) indicators of the role functional food may play in preventing certain chronic diseases.

With the growing scientific evidence for the effectiveness of functional ingredients in enhancing health, reducing the risk of diseases and perhaps preventing some chronic diseases, it is timely to consider how consumers respond to different types of labelling for functional foods. In the absence of labelling, the health benefits from functional foods are a credence attribute since the differences between a functional food and a regular food cannot be detected by search or experience behaviours. Given the importance of labelling and information asymmetry in understanding the consumer decision-making process the interesting research questions lie in understanding the labelling context: how do consumers make decisions in environments of uncertainty; which sources of information are credible; how do different information environments (full versus partial labelling) affect willingness to pay; and how do consumers' attitudes and past consumption behaviours shape their response to the health benefits labelled or implied on a functional food product.

Kozup et al. (2003) found that when a heart-healthy logo was present, consumers generally believed that the food would reduce the likelihood of heart disease or stroke. While the regulatory environment for formal labelling of functional health claims in Canada may be relatively restrictive, food companies nevertheless use other strategies to imply a health benefit, such as the use of a symbol or visual cue. Figure 1 provides examples. In the paper we term this approach 'partial labelling', while 'full labelling' refers to health claims that are clearly stated on food labels, such as (structure) function claims, risk reduction claims and disease prevention claims. In Canada, none of the three types of 'full labelling' health claims are permissible for Omega-3 functional food products, while the US has allowed both structure-function claims and also risk reduction claims for Omega-3 fatty acids since 2004. However, a number of products on the Canadian market that are enriched with Omega-3 instead use red heart symbols on the packaging to imply heart health benefits.

Figure 1: Examples of 'Partial Labelling'

It is possible that partial labelling could convey the same amount of information, or even work better than full labelling to inform consumers about the health benefits of the products (perhaps because of the attractive design or if images are easier to understand than a written health claim which consumers may not take the time to read). Alternatively, food products may contain symbols or logos implying an endorsement or healthy diet recommendation by a third party, such as the Canadian Diabetic Association, or the 'Health Check' program of the Heart and Stroke Foundation. The effects of verifying organizations in establishing the credibility of health claims are also examined in this paper. A growing literature has examined consumer attitudes toward functional foods in various countries and has highlighted the importance of examining consumers' perceptions of the link between food and health, and the role of health and nutrition information in shaping consumers' acceptance of functional foods (see for example, West et al. 2002; Hailu et al. 2009; Verbeke, 2005; De Jong et al. 2003; Bech-Larsen and Grunert, 2003). Therefore the analysis in this paper also controls for consumer attitudes toward food and health, as well as current health status and health knowledge in examining reactions to different types of health labelling claim.

3. RESEARCH DESIGN AND DATA COLLECTION

The primary tool used in this study to assess Canadian consumer responses to different functional food labelling contexts is a discrete choice experiment. Data for the analysis is drawn from an Internet survey conducted in Canada in July 2009. The product chosen for analysis was milk containing enhanced levels of Omega-3 fatty acids. In addition to the discrete choice experiment, the survey gathered information on respondents' milk purchasing habits, attitudes toward and knowledge of a variety of related topics including food labelling, health information sources and functional food, as well socio-demographic and health information about each respondent. The survey was administered online by a professional market research company with a total of 740 useable responses received. Overall, the sample was reasonably representative of the Canadian population in terms of age, household size and number of children in the household. The proportion of female respondents (67.8%) is higher than the proportion of females in the Canadian population (51.5%), but this is to be expected given that the survey was targeted at the primary shopper(s) in a household through the use of screener question; females still tend to play a relatively larger role in household food purchase decisions. The sample also over-represents higher income groups and higher education groups relative to the Canadian population, which is fairly common with Internet surveys. Finally, the survey was conducted in English only for budgetary reasons, and therefore under-represents the Province of Quebec.

In the choice experiment, respondents were asked to imagine that they were in a grocery store buying a 2-litre carton of milk. They were presented with 10 choice sets containing different descriptions of a milk product with and without Omega-3 and with various combinations of partial labelling (heart symbol) and fully labelled health claims verified by different organizations[1]. Table 1 outlines the five attributes and levels used in the choice experiment. The labelling effects are captured by two attributes: 'health claims' which features three different types of health claims, corresponding to a general structure-function claim, a risk reduction claim, and a disease prevention claim. Partial labelling is captured by the presence of a red heart symbol. The role of verifying organizations in lending credibility to a health claims is explored through the 'Verification Organization' attribute, which features three levels: Health Canada (government) and the Heart and Stroke Foundation (a third party), and none. Four price levels were selected to capture a range of prices that are found for conventional and specialty milk products.

Initial versions of the research design were pre-tested with the inclusion of the Omega-3 attribute, wherein the identification of "Omega-3" as a functional ingredient varied among the choice sets as with the other four attributes. However, its inclusion required that too many restrictions be imposed with respect to the relationship with the other attributes, which significantly reduced the efficiency of the design. Instead, the choice design was modified so as to include a partial constant alternative (regular/conventional milk) in each choice set. Respondents were presented with four alternatives in each choice set: two Omega-3 milk products, one conventional (i.e. non-functional) milk product, and a no-purchase option. Only the two functional milk products identified as containing Omega-3 feature health claims or verification sources. The partial constant alternative,

[1] The D-optimal efficient design resulted in 8 choice sets, blocked into 6 versions (48 in total). In addition, each respondent was presented with a further two choice sets that acted as a validity check. One was an identical repeat of a previous choice set to determine whether a respondent was consistent in his/her responses; the second was an asymmetrically dominated choice set with a logical answer (i.e. one alternative included superior attributes and the lowest price and was a logical answer if a respondent was answering rationally). A respondent failing either of these two 'trap' questions was excluded from the final data set (95 respondents or 10.3% of the initial 924 respondents). A pilot of the survey determined that the survey should take 15-20 minutes to complete; therefore also excluded from the final data set were any respondents completing the survey in less than ten minutes (47 respondents, or 5.1% of the initial sample of 924).

conventional milk, varied only in the price levels, with all other attributes set to 'none'. As Table 1 indicates, the lowest and highest price levels were reserved for the conventional and Omega-3 milk choices respectively. Pictures of labelled milk cartons were used to convey the non-price attributes, as can be seen in Figure 2 which presents an example of a choice set. As can be seen from Figure 2, options A and B in each choice set featured Omega-3 enhanced milk with various combinations of full and partial health claims, verification sources and prices, while Option C featured conventional milk at different price levels, and Option D was the No-Purchase option.

Table 1: Attributes and Levels in Choice Experiment

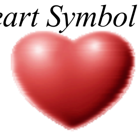
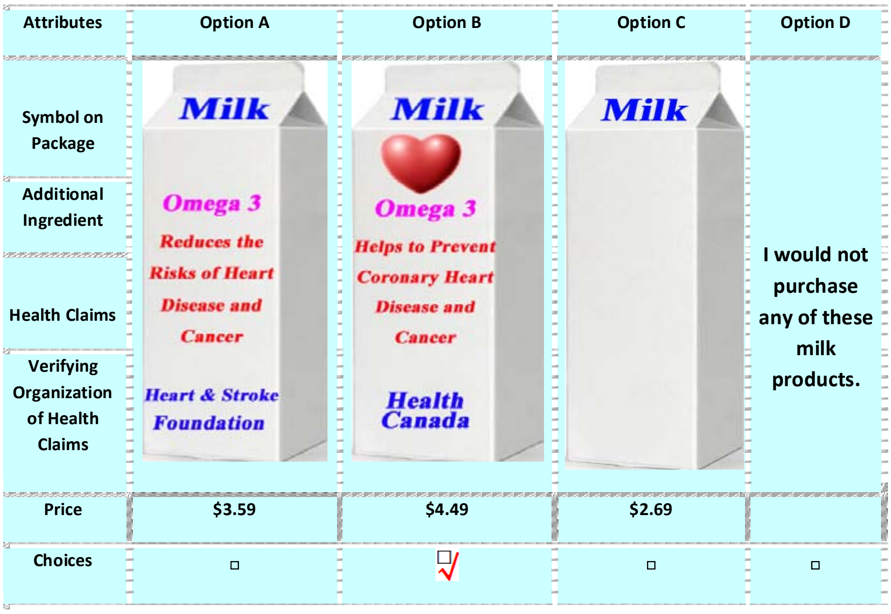
ATTRIBUTES	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1. Omega-3	Contains Omega-3	Regular milk (included as a partial constant alternative)		
2. Health Claims (full labelling)	*Function Claim:* "Good for your heart health"	*Risk Reduction Claim:* "Reduces the risk of heart disease and cancer"	*Disease Prevention Claims:* "Helps to prevent Coronary Heart Disease and Cancer"	None
3. Symbol (partial labelling)	*Heart Symbol* 	None		
4. Verification Organization	*Government:* Health Canada	*Third party:* Heart and Stroke Foundation of Canada	None	
5. Price	$1.99 (conventional)	$2.69 (conventional or Omega-3)	$3.59 (conventional or Omega-3)	$4.49 (Omega-3)

Figure 2: An Example of a Choice Set



Choice behaviour is modelled in a random utility framework where the indirect utility of consumer *i* choosing alternative *j* can be expressed as:

(1) $U_{ij} = X_{ij}\beta + e_{ij}$

where ß is a vector of estimated parameters, X_{ij} represents a vector of the attribute levels in the choice set, and e_{ij} is the error term which is associated with the assumed distributions in the discrete choice model. Given the specified attributes and levels of milk products in this study, the indirect utility function of consumer *i* choosing alternative *j* in one choice set in the base model is specified as:

(2) $U_{ij} = \beta_1 NoPurchase + e_j \quad (j = \text{no purchase})$

(3) $U_{ij} = (1\text{-}NoPurchase)*(\beta_2 FunctionClaim_j + \beta_3 RiskReductionClaim_j + \beta_4 DiseasePreventionClaim_j + \beta_5 Heart_j + \beta_6 Gov_j + \beta_7 ThirdParty_j + \beta_8 Omega3_j + \beta_9 Price_j) + e_j \quad (j \neq \text{no purchase})$

Equation 3 represents the base model which specifies the utility function with the main variables but no interaction effects. An extension to this model includes interactions between the health claims and verifying organization variables, as well as interactions with variables representing health knowledge, trust in health claims, and attitudes toward functional foods. These extensions are discussed further below. The main variables identified in equation 3 correspond to the attributes and levels identified in Table 1, for example, the health claims attribute (full labelling) is captured by four dummy variables: function claim (FC), risk reduction claim (RRC), disease prevention claim (DPC) and No health claim (base level). Heart is a dummy variable for partial labelling, equal to 1 if respondent *i* chooses an alternative with a red heart symbol, otherwise equal to 0. The verifying organization attribute is represented by three dummy variables, corresponding to government (GOV) (Health Canada), a Third Party (Heart & Stroke Foundation) and None (base level). Omega-3 is an alternative specific constant equal to 1 if the respondent chooses an alternative including Omega-3 (i.e. one of the functional milk products) and equal to 0 otherwise. NoPurchase is a dummy variable equal to 1 if the respondent chooses Option D in the choice set "I would not purchase any of these milk products", and equal to 0 otherwise. Variable definitions are provided in Table 2.

The base model was modified in three ways: through the inclusion of interaction effects between the main variables, the inclusion of interactions between the main variables and socio-demographic variables, and through the inclusion of three variables derived from factor analysis that captured relevant attitudinal and behavioural traits of the respondents. Each of these modifications is discussed in turn. While the base model enables an examination of the main effects, it is quite possible that interaction effects exist between some of these variables. Interaction effects exist if a consumer's preferences for levels of one attribute depend on the levels of the other (Louviere, et al. 2000). In the context of the present study, it is entirely plausible that interactions exist between the type of health claim and the verifying organization, as well as between full labelling (a specific health claim) and partial labelling (a visual image), for instance if one method of communicating a health benefit reinforces the other. First order interactions between these main effects were added to the model, for example, RRC_j*GOV_j, RRC*TP, DPC*Heart, etc. in equation 4.

Table 2: Variable Definitions

Variable	*Abbreviation*	Description
Price	***Price***	Price of a 2-litre carton of milk: $1.99 to $4.49.
Function Claim	***FC***	= 1 if the milk product has a function claim ('Good for your heart'), otherwise 0.
Risk Reduction Claim	***RRC***	=1 if the milk product has a risk reduction claim ('Reduces the risk of heart disease and cancer'), otherwise 0.
Disease Prevention Claim	***DPC***	=1 if the milk product has a disease prevention claim ('Helps prevent heart disease and cancer'), otherwise 0.
Heart Symbol	***Heart***	= 1 if the milk product has a red heart symbol, otherwise 0.
Government Verification	***GOV***	= 1 if the health claim is verified by a government organization (Health Canada), otherwise 0.
Third Party Verification	***TP***	= 1 if health claim is verified by a third party (Heart and Stroke Foundation), otherwise 0.
Omega3	***OMG3***	= 1 if the milk product is contains Omega3, otherwise 0.
Heart Disease	***HeartDisease***	=1 if a respondent self-reports having heart disease, otherwise 0
Income	***Income***	Annual household income before taxes (8 categories).
Education	***Edu***	Education level of respondent (High school, College, Bachelors degree, Graduate degree)
Gender	***Gender***	=1 if the respondent is female, otherwise 0.
Attitudes toward functional food	***Factor 1***	Factor capturing respondents with positive attitudes toward and experience consuming functional food (see Appendix A)
Health knowledge	***Factor 2***	Factor capturing respondents with more awareness of health and healthy diet behaviours (see Appendix A)
Trust in health claims and nutrition labels	***Factor 3***	Factor capturing respondents indicating higher levels of trust in health claims and nutrition labels (see Appendix A)
No Purchase	***No Purchase***	=1 if a respondent chose not to purchase a milk product in the choice set, otherwise 0.

Interactions between four additional variables (income, education, gender and heart disease) and a number of the main variables are also included in equation 4; for example, $Edu_i\&RRC_j$ captures interactions between the education level of the respondent and preferences for risk reduction claims, while $Gender_i*Omg3_j$ would pick up any differences in preferences for Omega-3 milk among female versus male respondents. Finally, the survey collected detailed information on respondents' food purchasing habits, attitudes toward and experience with functional foods, trust in food labels, health status and level of health awareness/knowledge. Factor analysis was used to examine the relationships between these variables and identify key factors that defined specific attitudes or behaviours among the respondents. Three key factors were identified: attitudes and past consumption behaviour pertaining to functional food (Factor 1), health knowledge and healthy diet behaviours (Factor 2), and trust in health claims and nutrition labels (Factor 3). Interaction effects between the three factors and several of the main variables were also included in the model, as indicated in equation 4, for example, $RRC_j*Factor1_i$., etc. Appendix A provides more information on the factor analysis that underlies these variables.

(4) $U_{ij} = (1\text{-NoPurchase})*(ß_2FC_j + ß_3RRC_j + ß_4DPC_j + ß_5Heart_j + ß_6GOV_j + ß_7TP_j + ß_8Omega3_j + ß_9Price_j + ß_{10}HeartDisease_i *RRC_j + ß_{11}HeartDisease_i *DPC_j + ß_{12}Income_i*Omg3_j + ß_{13}Edu_i*RRC_j + ß_{14}Gender_i *Omg3_j + ß_{15}\ Factor1_i *RRC_j + ß_{16}\ Factor1_i*Omega\text{-}3_j + ß_{17}\ Factor2_i *Omega\text{-}3_j + ß_{18}Factor3*RRC_i + ß_{19}Factor3_{i*}\ GOV_j) + e_j$

4. ESTIMATION METHODS

A number of discrete choice models are available that differ in their assumptions about the distributions of the error terms (Train, 2003). For the purposes of this study, the Conditional Logit model and the Latent Class Model were estimated. Following McFadden (1974) and Train (2003), an individual (i) receives utility (U) when choosing an alternative (j) with a group of attributes (X_{ij}) from a choice set. Utility is modelled with two components: an observed deterministic component (V_{ij}) and an unobserved stochastic component (ε_{ij}). The utility received from alternative j is represented by:

(5) $U_{ij} = V_{ij} + \varepsilon_{ij}$

Where V_{ij} = $f(X_{ij})$, the deterministic component, depends on the attributes of the alternative. In the choice model, individual (*i*) faces a choice of one alternative from a finite choice set (*C*). The probability (P_{ij}) that alternative *j* will be chosen equals the probability that the utility gained from this choice is no less than the utility of choosing another alternative in the finite choice set. The probability of individual *i* choosing alternative *j* is expressed as:

(6) $P_{ij} = Prob\ \{V_{ij}+\ \varepsilon_{ij} \geq V_{ik}\ \varepsilon_{ik}\}$ for all $j \neq k$, $k \in C$

Applied to this study, consumer *i* faces the choice of one alternative among Omega-3 milk, conventional (non-functional) milk and the no-purchase option, given various attribute level combinations in each choice set. The probability of consumer *i* choosing alternative *j* is equal to the probability that the utility received from alternative *j* is greater than or equal to the utility received when choosing any other milk alternative or the no-purchase option.

McFadden (1974) developed the Conditional Logit model to estimate these probabilities assuming the stochastic error term is independent and follows a Type-I extreme value distribution. Assume the observed deterministic component (V_{ij}) is a linear function of the perceived product attributes (X_j), so $V_{ij} = \beta' X_j$. The choice probability of consumer *i* choosing alternative *j* in the Conditional Logit Model is defined as:

$$P_{ij} = \frac{\exp(\mu\beta' X_j)}{\sum_{k=1}^{K} \exp(\mu\beta' X_k)} \qquad \textbf{(7)}$$

where μ is a scale parameter which is assumed to be 1, β is a vector of parameters, and *k* is an index representing the chosen product by consumers from the choice set (*k* =1,…,K, where K = 4 in this study). Parameters in this model can be estimated by the maximum likelihood estimation method.

The Conditional Logit (CL) model is generally the starting point for the analysis of discrete choice models, however its limitations are well recognized; for example, the estimated coefficients are fixed to be the mean values of all respondents, and as such it ignores the variation of the estimated coefficients and cannot handle preference heterogeneity among consumers. Consumer heterogeneity is an important issue in food markets, especially when dealing with highly differentiated products such as functional food where we might expect to find a wide variety of consumer preferences. The second major limitation of the CL model is its IIA assumption (independence of irrelevant alternatives). The IIA property assumes that the ratio of the probability for any two alternatives is completely independent of the existence and attributes of any other alternatives (see Ben-Akiva and Lerman, 1985). It assumes that the errors are independently distributed across alternatives even for repeated choices, which is unrealistic (Louviere et al, 2000). It is often necessary to relax the IIA assumption in practice. Nevertheless, it is common in the literature to begin by estimating the CL model and then proceed to other models if heterogeneity is present or if the IIA assumption cannot be maintained.

Although there are several different approaches to address the limitations of the CL model, this paper focuses on the Latent Class Model (LCM) and the insights that it provides into consumer heterogeneity. The LCM assumes that a discrete number of classes or segments of respondents are sufficient to account for preference heterogeneity among classes (see McFadden, 1986; Boxall and Adamowicz, 2002; Shen, 2009). The LCM allows the choice attribute data and an individual consumer's personal characteristics to simultaneously explain choice behaviour (Boxall and Adamowicz, 2002).

The latent classes capture the unobserved heterogeneity in the population, and each class is estimated with a different parameter vector. While in the CL model the vector β is not specific to an individual or segment, the LC model assumes the existence of S segments in the population, with the choice probability of individual i in class s choosing alternative j given by:

$$P_{ij|s} = \frac{\exp(\mu_s \beta_s X_j)}{\sum_{k=1}^{K} \exp(\mu_s \beta_s X_k)} \quad \textbf{(8)}$$

The LCM simultaneously estimates the above probability equation and predicts the latent class probability H_{ij} of individual i being in class s. Following Boxall and Adamowicz (2002) the unconditional probability equation of the LCM is expressed as:

$$P_{ij} = \sum_{s}^{S} P_{ij|s} H_{ij} \quad \textbf{(9)}$$

The number of classes, *S*, were chosen using the Akaike Information Criterion and (AIC) Bayesian Information Criterion (BIC), where the values of AIC and BIC are minimized (Louviere et al, 2000; Boxall and Adamowicz, 2002). Finally, willingness-to-pay (WTP) estimates provide a means of comparing parameter coefficients on a common basis and are estimates of the ratios of the marginal utility of attributes over the marginal utility of money: - β_k / β_{price} where k=1,...18, are conditional marginal utilities estimated at the mean of the population for the attribute of interest, and β_{price} is the parameter estimate for price (Louviere et al., 2002).

5. RESULTS

The base model (equation 3), which is limited to the main effects, was first examined before proceeding to the extended model (equation 4) which considers interaction effects between the main choice set variables and key socio-demographic variables and behavioural factors. For the purposes of this paper only results for the extended model are reported, beginning with the conditional logit model. The results reported in this paper are preliminary and further analysis is ongoing. Table 3 reports the CL parameter estimates and WTP estimates for the extended model. Willingness-to-pay estimates are expressed as dollars per two-litre carton of milk and provide a useful basis on which to compare the relative strength of preferences for these attributes. Variables are as previously defined in Table 2.

From Table 3 it can be seen that coefficients and WTP estimates for the main effects (full labelling health claims, partial labelling, and verification source) are all positive and highly significant. These results suggest that, on average, the risk reduction health claim elicited a higher WTP than the disease prevention claim, with the functional claim having a relatively smaller WTP. That a risk reduction claim is stronger than a function claim is perhaps to be expected; the relatively lower WTP for a disease prevention claim (in essence a stronger health claim) is interesting. The interaction effects and latent class analysis (discussed below) allow us to explore attitudes toward these health claims in more detail. The presence of a heart symbol (partial labelling) on a package tended to increase WTP, although not as strongly as a full health claim. Further analysis reveals that there is no statistically significant difference between the WTP for a function claim, "good for your heart", and a heart symbol that implies heart health.

Table 3: Results and WTP Estimates: Conditional Logit Model

VARIABLE	COEFFICIENT	T-RATIO	WTP	T-RATIO
Price	-1.555***	-47.882	-	-
Function Claim	.293***	2.782	.189***	2.780
Risk Reduction Claim	.789***	6.561	.508***	6.598
Disease Prevention Claim	.520***	4.983	.334***	4.983
Heart Symbol	.183***	3.945	.118***	3.949
Government verification	.376***	5.595	.242***	5.587
Third Party verification	.362***	5.420	.233***	5.438
Omega3	.311***	2.263	.200**	2.275
RRC*HeartDisease	.518***	2.620	.333***	2.619
DPC*HeartDisease	.595***	2.941	.383***	2.946
Omega3*Income	4.790***	5.452	3.079***	5.441
RRC*Edu	-.159***	-2.706	-.102***	-2.706
Omega3*Gender	.160**	2.344	.103***	2.343
RRC*Factor1	.141**	2.327	.090**	2.330
Omega3*Factor1	.741***	19.251	.476***	18.764
Omega3*Factor2	.077**	2.386	.049**	2.385
RRC*Factor3	.183***	3.412	.118***	3.412
GOV*Factor3	.259***	4.691	.167***	4.709
No Purchase	-6.400***	-58.504	-4.115***	-69.574

Log Likelihood Function = -4912.471;

*,** and *** indicate significant at the 10%, 5% and 1% significance level, respectively.

The positive parameter estimate and WTP for the Omega-3 variable indicates that, holding all else constant, respondents preferred milk enriched with Omega-3 over regular (non-enriched) milk, while the negative and significant coefficient on the 'NoPurchase' option indicates that respondents preferred to choose a milk product in the choice experiment rather than Option D, the no purchase option[2].The presence of verification by Health Canada (government) or the Heart and Stroke Foundation (third party) tended to increase WTP; however, there is no significant difference between these two WTP estimates, indicating that on average respondents appeared to view verification by these two organizational types similarly. Interestingly, a positive and significant interaction effect is evident between government verification and respondents who were more likely to trust food labels and health claims (Factor 3).

Turning to the other interaction effects reported in Table 3, interactions between the risk reduction claim and four other variables were explored: the factor capturing respondents with positive attitudes towards and past consumption experience with functional foods (Factor 1), the factor capturing respondents who tend to be more trusting with respect to health claims, nutrition labels and new food products (Factor 3), respondents with heart disease problems, and the education level of the respondent. These interaction effects allow a more detailed examination of the type of respondent who tended to respond positively to a risk reduction claim. Parameter and WTP estimates for all four of these interaction effects are positive and significant; thus, respondents who self-report suffering from heart disease are more likely to prefer a risk reduction claim relative to those who do not have heart disease. Note that this is also the case for a disease prevention claim, as indicated by the significant and positive WTP on the HeartDisease*DPC variable. Respondents with more experience of consuming functional foods and positive attitudes toward these types of foods are more likely to respond positively to a risk reduction claim, as shown by the positive but relatively small WTP estimate for the Factor1*RRC interaction effect, while the effect is somewhat larger for those consumers who tend to be more trusting of health claims and nutrition labels (Factor3*RRC). Finally, respondents with higher levels of education are less likely to respond to a risk reduction claim, as indicated by the significant negative WTP estimate for this interaction effect. The reasons for this result are not clear but could reflect greater levels of scepticism of a risk reduction claim from this demographic.

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[2] This is consistent with expectations; milk is a regularly purchased item in most households and the survey included a screener question so that only respondents who purchased cow's milk at least once a month proceeded with the questionniare.

Interactions between the presence of Omega-3 and four other variables were also explored: the factor capturing respondents with positive attitudes towards and consumption experience with functional foods (Factor 1), the factor capturing respondents who self-declared higher levels of health knowledge and healthier diet behaviours (Factor 2), and two socio-economic variables - respondents' income levels and gender. In general, those respondents who have more experience with functional foods and are more engaged in terms of health knowledge and healthy diet behaviours responded more positively to the Omega-3 milk products, as shown by the positive and significant WTP estimates for the Factor1*Omega-3 and Factor2*Omega-3 interaction effects, respectively. The WTP results show that this effect is much stronger for Factor 1: those consumers with consumption experience of and positive attitudes toward functional foods. Consumers with higher incomes responded positively to Omega-3 milk products, although given the extremely large size of this WTP estimate this result should be treated with caution, while female respondents were also more likely to choose a functional milk product.

Recognizing the limitations of the CL model that were discussed earlier, Mixed Logit and Latent Class models were used to explore unobserved heterogeneity in choices, with a significant improvement in model fit compared with the CL results discussed above. Table 4 presents the WTP estimates for the latent class analysis for the extended model including the interaction effects between key socio-demographic, behavioural and attitudinal variables. Given the hypothetical nature of the choice experiment, the WTP estimates are most usefully interpreted as *relative* measures of the strength of preferences. The underlying parameter estimates can be found in Table A2 in the Appendix.

Four latent classes were identified, and have been named for ease of exposition; the average class probabilities indicate the probability that a randomly chosen respondent falls into a particular class. The "No Purchase" option yields a negative and statistically significant across all four classes, indicating that respondents in each segment preferred to purchase a milk product when presented with the choice sets. Class 1 represents respondents who were relatively uninterested in Omega-3 milk and did not respond to any of the full health claims or to partial labelling (the presence of a heart symbol on a milk carton). This class is termed *conventional milk consumers*, with a 49% probability of respondents falling into this group.

Table 4: Willingness-to-Pay Estimates: Latent Class Model

Variables	Class 1: Conventional Milk Consumers	Class 2: Functional Food Believers	Class 3: Functional Milk Lovers	Class 4: Health Claim Challengers
Function Claim	0.037 (0.487)	**0.158**** (1.992)	**0.485***** (2.583)	0.006 (0.033)
Risk Reduction Claim	0.056 (0.584)	**0.372***** (4.057)	**1.827***** (8.287)	-0.048 (-0.222)
Disease Prevention Claim	-0.007 (-0.099)	**0.458***** (5.359)	**1.744***** (9.666)	0.183 (1.010)
Government Verification	-0.045 (-0.729)	**0.174***** (2.596)	**0.978***** (9.545)	**0.365***** (3.551)
Third Party Verification	0.017 (0.322)	**0.333***** (5.126)	**0.701***** (6.729)	0.168 (1.363)
Heart Symbol	0.001 (0.024)	0.042 (1.238)	**0.306***** (5.412)	**0.270***** (3.532)
Omega3	-0.010 (-0.113)	**0.249*** (1.956)	**1.641***** (4.706)	**0.285*** (1.723)
RRC*Factor1	0.009 (0.159)	-0.139* (-1.804)	**0.359***** (4.533)	**0.257*** (1.955)
Omega3*Factor1	**0.110***** (3.868)	**4.841***** (19.833)	**0.476***** (3.932)	**0.744***** (10.168)
Omega3*Factor2	0.007 (0.300)	**-0.25***** (-4.541)	0.153 (1.082)	**-0.23***** (-5.224)
RRC*Factor3	-0.047 (-0.994)	0.045 (0.946)	**0.358***** (3.873)	-0.100 (-1.002)
GOV*Factor3	-0.012 (-0.266)	**0.093*** (1.738)	**0.254***** (3.192)	**0.334***** (4.377)
RRC*HeartDisease	0.127 (0.706)	0.066 (0.378)	**-0.580*** (-1.867)	8.779 (0.086)
DPC*HeartDisease	-0.031 (-0.179)	-0.045 (-0.230)	0.017 (0.057)	8.085 (0.079)
Omega3*Income	**1.394**** (2.176)	**3.848***** (2.969)	**8.942**** (2.092)	**-4.37***** (-3.628)
RRC*Edu	-0.023 (-0.418)	0.008 (0.128)	**-0.29***** (-2.776)	0.083 (0.738)
Omega3*Gender	**0.115**** (2.158)	**3.085***** (18.573)	**0.964***** (3.135)	**0.964***** (10.107)
No Purchase	**-4.0***** (-43.98)	**-3.81***** (-92.289)	**-5.77***** (-9.169)	**-1.95***** (-39.433)
Average Class Probabilities	0.489	0.217	0.221	0.073

Log Likelihood Function = -3082.497.
*,** and *** indicate significant at the 10%, 5% and 1% significance level, respectively.

Class 2, *functional food believers,* represents a group of respondents who weakly prefer Omega-3 milk products, as shown by the positive WTP on the Omega-3 attribute. However, respondents in this class tended to have a significantly higher WTP for Omega-3 milk if they had experience with and positive attitudes toward functional foods, as shown by the interaction between Omega-3 and Factor 1. Another interesting feature about this class is that full health claims were preferred over partial labelling, as indicated by the positive WTP on the three full labelling health claims (function, risk reduction and disease prevention claims) while the coefficient and WTP estimates for partial labelling (the heart symbol) are not significant. The WTP estimates show that these consumers preferred a disease prevention claim over a risk reduction claim, with a lower but still positive WTP for a function claim, while those with higher levels of self-declared health and nutrition knowledge (Factor 2) tended discount the Omega-3 milk products. Verification of a health claim by government or a third party was valued by this segment, with a relatively higher WTP for third party (Heart and Stroke Foundation) verification, unlike the other classes who displayed a relative preference for verification by the government agency Health Canada. Females and respondents with higher incomes in this group exhibited markedly stronger preferences towards Omega-3 milk[3]. There was a 21.7% probability of respondents falling into this class.

A third segment of respondents, represented by Class 3, exhibited relatively strong preferences for Omega-3 milk and to the presence of a health claim. This class is termed *functional milk lovers*, with a 22% probability of a randomly chosen respondent falling into this segment. Of the four classes, they exhibit the strongest WTP for Omega-3 milk. Relative to class 2, preferences for the full health claims are reversed, with respondents in this class revealing a slightly higher WTP for a risk reduction over a disease prevention claim, with this effect magnified for those respondents with higher levels of trust in health and nutrition labels (Factor 3). However, respondents in this group who have actually experienced heart disease tend to discount risk reduction claims, which may reveal some scepticism among these consumers with respect to this type of health claim. Both

[3] The extremely high positive/negative WTP estimates for the interaction between Omega-3 and Income across all three classes, and between Gender and Omega-3 in class 2 is suspect and therefore should be treated with caution. Further analysis is needed to explore the nature of the relationship between these socio-demographic variables and the Omega-3 attribute.

government and third party verification engender a positive WTP but more so for government. The effect of government verification is magnified for respondents declaring higher levels of trust in health claims and food labels (Factor 3), which is true of all classes with the exception of class 1. Unlike Class 2, consumers in this class also responded positively to the presence of a red heart symbol on the milk package.

Finally, a relatively small segment of respondents (7.3%) is evident in class 4, *health claim challengers*, who exhibit a positive WTP for milk identified as Omega-3 as well as to partial labelling (the presence of a red heart symbol on the package), but who were indifferent toward the three full labelling claims. This class preferred government verification over third party or no verification, as already noted an influence that was magnified for those consumers who were more likely to trust health claims or nutrition labels. This is curious given the insignificant coefficients for any of the health claim variables for this segment and is a topic for further analysis.

6. CONCLUSIONS

With the growing interest among consumers in the link between diet and health and the credence nature of most health attributes, labelling plays a key role in consumers' decision making. The regulatory environment governing the types of health claims that are permissible is critical, both for protecting consumers from fraudulent or misleading health claims, and for providing information that allows informed choices about foods with enhanced health attributes. This paper began by observing that the regulatory environment in Canada is somewhat more restrictive with respect to allowable health claims for functional foods than is the case in the United States and that, the type of permissible health claim notwithstanding, food companies often also resort to visual imagery to imply a health benefit. The research question of interest therefore was to explore how different types of labelling information and the verification of health claims by different agencies might affect Canadian consumers' preferences for functional foods.

The research results discussed in this paper are preliminary and further analysis is ongoing. Nevertheless, a number of findings emerge from this preliminary analysis. First, 'full labelling' – in the form of a specific health claim – is preferred over partial labelling (e.g. a heart symbol) for all but a small segment of respondents. Across the entire sample the CL results indicate a preference ordering for health claims showing that a risk reduction claim, such as ‘reduces the risk of heart disease and cancer’ is preferred relative to a disease prevention claim, and that a disease prevention claim is preferred relative to a function claim. While risk reduction claims are permissible on food products in Canada and the United States, disease prevention claims are not. These preliminary results suggest that risk reduction claims may be adequate to convey a health benefit to consumers.

Furthermore, the conditional logit model results reveal that there is no significant difference between a function claim, such as “good for your heart” and partial labelling in the form of a red heart symbol. The rules surrounding the use of structure-function claims in Canada are somewhat more onerous than in the United States, which does not require pre-approval of the use of a structure-function claim. These results suggest that the use of a heart symbol on functional food products in the Canadian market may be just as effective as a structure-function claim. Thus, while consumers (and obviously functional food manufacturers) in Canada might benefit from the extension of risk reduction claims to a wider range of food products (albeit only where these claims are scientifically justifiable), it is not clear that there is as much to be gained from a consumer’s perspective by a relaxation of the rules around the use of a structure-function claim since the same information can be conveyed through the use of a symbol. Two caveats are important, however: first the analysis only examines heart health claims and the use of a heart symbol – the connection between the two being fairly self-evident – structure-function claims pertaining to other health conditions (such as digestive health) may be more difficult to convey clearly through the use of visual imagery. Second, the issue of consumer protection from fraudulent or misleading health claims has not been addressed in this paper. The use of structure-function health claims, or indeed visual imagery, to imply a health benefit that is not present in a product obviously would not assist consumers in making informed decisions about (genuinely) functional foods.

Verification of health claims appears to be important to those consumers for whom health claims matter. The CL model shows that, on average, consumers responded positively to verification of a health claim by either a government agency or a credible third party. The LC model results reveal a more nuanced picture, with evidence of heterogeneity in consumer attitudes toward the source of verification, as has been found in other recent studies (see for example, Innes and Hobbs, 2010; Uzea et al., 2010). In general though, verification by a government agency (Health Canada) appears to be important to those respondents who also tended to value the presence of Omega-3 in a milk product (classes 2, 3, and 4), while reactions to third party verification (Heart and Stroke Foundation) are less consistent. Further analysis of the interaction between the type of health claim and the source of verification is needed to explore this issue fully.

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APPENDIX

Table A.1 below provides details of the factor loadings for various survey questions that underlie the three factors used in the analysis[4]. Following Hair et al (1992), factor loadings greater than +0.5 are considered very significant and were selected as the key components underlying the factors.

Table A.1 The Key/Component Factors in the Factor Analysis

	Factor1: Positive Attitudes toward Functional Food	Factor 2:Health Knowledge	Factor 3: Trust in Health Claims and Nutrition Labels
Q19B: I trust nutrition labels on food products.	.126	.171	**.827*** **
Q19C: The health claims on food products are accurate.	.272	.030	**.833*** **
Q19D: I trust new food products.	.170	.032	**.797*** **
SUMQ23: Please indicate how often you consume the following functional foods: Omega-3 milk, Omega-3 Eggs, probiotic Yogurt, etc.	**.507*** **	.368	.058
Q24A: Functional foods can maintain overall wellbeing and improve long-term health.	**.883*** **	.103	.234
Q24B: Functional foods may reduce the risk of certain chronic diseases.	**.897*** **	.137	.204
Q24C: Functional foods may prevent certain diseases.	**.870*** **	.107	.199
Q24D: Functional foods are necessary for a healthy diet and should be consumed regularly.	**.872*** **	.065	.136
Q24F: I am knowledgeable about health and nutrition.	.023	**.830*** **	.178
Q24G: My friends/relatives ask me for health or nutrition advice.	-.020	**.811*** **	.091
SUMQ25: Healthy diet behaviours: eating healthy.	.298	**.630*** **	.064
SUMQ18: Dietary source of Omega-3 other than omega-3 milk.	.145	**.542*** **	-.045

[4] A copy of the survey instrument is available from the authors upon request.

Table A2: Latent Class Model Parameter Estimates (t statistics)

Variables	Class 1: Conventional Milk Consumers	Class 2: Functional Food Believers	Class 3: Functional Milk Lovers	Class 4: Health Claim Challengers
Price	-3.213*** (-27.555)	-4.327*** (-17.443)	-0.866*** (-22.921)	-2.067*** (-16.120)
Function Claim	0.120 (0.487)	0.686** (2.005)	0.420*** (2.603)	0.012 (0.033)
Risk Reduction Claim	0.179 (0.584)	1.611*** (3.923)	1.582*** (8.417)	-0.099 (-0.222)
Disease Prevention Claim	-0.024 (-0.099)	1.984*** (5.147)	1.511*** (9.650)	0.378 (1.010)
Government Verification	-0.144 (-0.723)	0.754** (2.465)	0.847*** (9.049)	0.754*** (3.422)
Third Party Verification	0.056 (0.322)	1.442*** (4.597)	0.607*** (6.859)	0.348 (1.355)
Heart Symbol	0.004 (0.024)	0.182 (1.226)	0.265*** (5.362)	0.557*** (3.349)
Omega3	-0.033 (-0.113)	1.076** (1.986)	1.422*** (4.739)	0.590* (1.714)
RRC*Factor1	0.028 (0.159)	-0.600* (-1.792)	0.311*** (4.568)	0.532* (1.936)
Omega3*Factor1	0.355*** (3.818)	20.948*** (13.794)	0.412*** (3.948)	1.539*** (11.587)
Omega3*Factor2	0.022 (0.300)	-1.060*** (-4.376)	0.133 (1.083)	-0.467*** (-5.214)
RRC*Factor3	-0.149 (-0.992)	0.195 (0.943)	0.310*** (3.849)	-0.207 (-1.001)
GOV*Factor3	-0.040 (-0.265)	0.402* (1.716)	0.220*** (3.243)	0.691*** (4.351)
RRC*HeartDisease	0.407 (0.705)	0.287 (0.378)	-0.502* (-1.856)	18.148 (0.086)
DPC*HeartDisease	-0.100 (-0.179)	-0.197 (-0.230)	0.015 (0.057)	16.713 (0.079)
Omega3*Income	4.479** (2.168)	16.654*** (2.911)	7.746** (2.095)	-9.027*** (-3.692)
RRC*Edu	-0.073 (-0.418)	0.033 (0.128)	-0.253*** (-2.782)	0.172 (0.740)
Omega3*Gender	0.370** (2.150)	13.351*** (12.649)	0.835*** (3.175)	1.993** (10.594)
No Purchase	-12.90*** (-33.515)	-16.48*** (-18.511)	-5.001*** (-9.285)	-4.028*** (-13.844)
Average Class Probabilities	0.489	0.217	0.221	0.073

Log Likelihood Function = -3082.497.
*,** and *** indicate significant at the 10%, 5% and 1% significance level, respectively.