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CONSUMER BEHAVIOUR IN BUYING FOOD PRODUCTS WITH NUTRITIONAL AND HEALTH CLAIMS

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List of abbreviations

AIC	Akaike Information Criteria
ANA	Attribute Non-Attendance
ANOVA	Analysis of Variance
AOI	Areas of Interest
BIC	Bayasian Information Criteria
BMI	Body Mass Index
DCE	Discrete Choice Experiment
EC	European Commission
EFSA	European Food Safety Authority
ELM	Elaboration Likelihood Model
ET	Eye Tracking
EU	European Union
FC	Fixation Count
FF	Functional Food
FOP	Front of Pack
FT	Fixation Time
GDA	Guideline Daily Amount
GHI	General Health Interest
GMXL	Generalized Mixed Logit model
HC	Health Claim
HP	Hedonic Price
INE	Spanish National Institute of Statistics
INFORMAS	International Network for Food and Obesity Research Monitoring and Action Supporting
LC	Latent Class model
MAO	Motivation Ability Opportunity
MAPAMA	Ministry of Agriculture and Fisheries, Food and Environment
MNL	Multinomial Logit model
NC	Nutritional claim
NCD	Non-Communicable Disease
OECD	Organisation for Economic Co-operation and Development
PREDIMED	Prevention with Mediterranean Diet
RO	Research Objective
RPL	Random Parameter Logit model
RQ	Research Question
RUT	Random Utility Theory

TTFF	Time To First Fixation
UHT	Ultra-High Temperature
UK	United Kingdom
US	United States
USA	United States of America
USDA	United States Department of Agriculture
WHO	World Health Organization
WTP	Willingness To Pay

Summary

Public interest in healthy eating issues has significantly increased in recent years due to the rising obesity rates and the heightening of consumer concerns about the way their food is produced. In this context, to improve product information and guide consumers towards healthy diets, the European Union (EU) has introduced several nutritional claims (NCs) and health claims (HCs) on food product packaging. This has led to a growth in the number of NCs and HCs used by food manufacturers to differentiate their products. Additionally, the incorporation of NCs and HCs on food products is gaining importance, and experts in alimentary now advise consumers to purchase healthy food with NCs and HCs. Healthier eating can be encouraged through information-oriented approaches such as food labelling, marketing and advertising campaigns, and educational programs, which educate, promote, and empower consumers to make healthy food choices. This dissertation focuses on NCs and HCs as information provision tools which allow for more informed food choices and encourage consumers to choose healthy food.

An issue with NCs and HCs is that they are credence attributes, which can be observed neither before nor after consumption; therefore, consumers need to be informed about these attributes to be able to make informed decisions. Then, whether consumers will use them depends on their understanding, knowledge, and general interest in healthy eating. Thus, the influence of NCs and HCs on food choices and consumer preferences towards a wide range of NCs and HCs are studied. Moreover, visual attention to NCs and HCs during food selection and its relation to choice behaviour are investigated. Visual attention was captured through the use of eye-tracking (ET) technology, and consumer eye movements were recorded inside the areas of interest (AOI). Eye-tracking technology is limitedly used in consumer behaviour, yet is considered one of the most powerful means to determine individual choices, especially when combined with discrete choice experiments (DCE).

While consumers care about the healthy properties of their food, they also increasingly consider other physical properties, such as the sensory aspects

and, more specifically, the taste of their food. Taste is considered to be one of the most important attributes that consumers consider when purchasing food. However, consumers tend to associate healthy food with a poorer taste, especially when the main nutrients that empower its taste (e.g. fat, sugar, or salt) have been altered. In this context, in addition to the visual attention and food choice, the assessment of whether and how taste influences consumer preferences for healthy food with NCs and HCs is investigated. In this thesis, we consider yoghurt as a product of reference for three reasons: first, yoghurt is a common item in the shopping baskets of Spanish households; second, it is considered to be a healthy food; and, finally, yoghurt is the product with the highest presence of NCs and HCs in the Spanish market.

From an empirical point of view, this dissertation contributes to a better understanding of consumer preferences for healthy food with NCs and HCs. A wide range of claims are included, and the effects that these claims have on real market prices are investigated. No previous research has examined the effects of NC and HC attributes on yoghurt prices. In this context, this dissertation fills this gap by assessing the market valuation of (among other attributes) specific NCs and HCs for yoghurts in Spain. Previous research that has investigated NCs has mainly examined consumer preferences for fewer than three claims; hence, an examination of consumer preferences, choice behaviour, and visual attention for multiple NCs is conducted. Another contribution in the literature is that, besides consumer preferences, this is the first study to examine visual attention to multiple NCs on yoghurts, which also segments consumers based on preferences. Thus, this dissertation contributes to the food literature by exploring the importance of visual attention to a selection of NCs, as well as highlights Spanish consumer segments. Moreover, besides discussing consumer segments based on NCs, the importance attributed to yoghurt attributes, and socio-demographic characteristics, this dissertation provides more detailed consumer segmentation based on multiple NCs and HCs, as well as examines the general health interest (GHI) of Spanish consumers, the use of nutritional information, purchase habits, and the importance attributed to NCs and HCs in general. This dissertation is the first to evaluate consumer

preferences simultaneously for multiple NCs and HCs. This is an important aspect to take into consideration, as it allows consumers to evaluate many different claims, similar to a real purchasing situation. Another contribution of this dissertation is the inclusion of taste in healthy food products. As the first of its kind, this dissertation examines four of the most important parts of the consumers' quality perception process research framework used: i) visual attention, ii) quality perception, iii) purchase behaviour, and iv) experienced attributes based on taste.

From a methodological point of view, this doctoral dissertation methodologically contributes to the literature on consumers' valuation and price effects of NCs and HCs in several ways. First, it uses a hedonic price (HP), which is a more realistic approach to analyse the effects of real product attributes on price in the real market. The approach used in this research examines what consumers already pay for, among other attributes, each type of NC and HC on yoghurts in the Spanish market. Second, it uses a DCE. Consumers are asked to make trade-offs between changes in attribute levels or a no-buy option. Compared to other methods (e.g. experimental auction) consumers are more familiar with DCEs, as they resemble the consumer purchasing decision process (e.g. at the supermarket). Third, the DCE is combined with observational data based on ET technology. This more advanced methodological approach incorporates visual attention based on ET measures into the choice model. The ET technology has not yet been applied to the assessment of the effect of visual attention to multiple NCs and HCs on food packages. This dissertation therefore presents a novel study addressing this research gap by studying visual attention to multiple NCs and HCs and its relation to choice behaviour. In addition to visual attention, which is a continuous measure of the degree to which a respondent evaluates the attribute, it also investigates visual attribute non-attendance (ANA), which is a discrete measure that indicates whether participants will be considered to have attended to an attribute. Hence, from a methodological point of view, this dissertation also contributes to the literature on ANA in DCEs by implementing visual ANA with the use of ET technology. Finally, in addition to measuring attention and choice behaviour, this dissertation includes the sensory aspects of the food

product. As the first of its kind to combine DCE and ET with sensory analysis, this dissertation examines the importance of taste in a healthy food product. The combination of these three methods is expected to provide new insights into the decision-making process and consumer behaviour, which allows for the examination of preferences for healthy foods. Based on the conceptual framework, as well as the empirical and methodological applications, a total of four main research objectives are identified.

The first objective was to examine the price effects of NCs and HCs on yoghurts in Spain. Findings indicate that yoghurt is a highly differentiated food product. Some of the NCs did not affect yoghurt market prices, while most of the HCs received significant positive premium prices. Compared to NCs, HCs received higher premium prices. The second objective assessed consumers' visual attention and choice decision for multiple NCs. Consumer heterogeneity was taken into account through consumer segmentation, which entailed the classification of the participants into two segments by consumer characteristics. Overall, the presence of NCs increased visual attention, which may be linked to an increased likelihood of affecting the final decision to purchase yoghurts with NCs. The third objective explored visual attention and choices for NCs and HCs on healthy food and the influence of taste in the final purchase decision. Results illustrated that there was a relationship between the most highly valued NCs and HCs from the stated preferences and visual attention. Tasting a healthy food product resulted in negative utility, but greater visual attention attached to NCs and HCs and a lower percentage of ANA. The fourth objective studied the relationship between choice behaviour, attitudes, and socio-demographic characteristics to predict Spanish consumer characteristics of healthy foods with NCs and HCs. Findings showed that consumers positively valued most claims; however, the valuation was heterogeneous, and three consumer segments were identified: 'health-claims oriented', 'nutritional- and health-claim oriented', and 'indifferent'.

Resumen

El interés público hacia una alimentación más saludable ha aumentado significativamente en los últimos años debido al ritmo de crecimiento de la pandemia de obesidad y a un aumento del interés en los consumidores sobre las formas en que se producen y se procesan sus alimentos. En este contexto, para comunicar mejor la información del producto y ayudar a los consumidores hacia una dieta más saludable, la Unión Europea (UE) ha introducido una serie de declaraciones nutricionales (DN) y de propiedades saludables (DS) en los envases de los productos alimenticios, lo cual ha llevado al aumento del número de DNs y DSs utilizadas por los fabricantes de alimentos como una manera para diferenciar sus productos. Este aumento de las DN y DS encontradas en los productos alimenticios hace que los expertos en alimentación aconsejen a los consumidores comprar alimentos saludables con DN y DS. Esta tesis doctoral se centra en el estudio de las DNs y DSs como una herramienta que proporciona información a los consumidores y les permite la elección de alimentos más saludables.

Las DNs y DSs son "*credence attributes*"[1], es decir atributos de confianza, lo que significa que son de difícil evaluación y determinación, incluso después de haber consumido el producto. Por lo tanto los consumidores deben ser informados sobre estos atributos para poder tomar decisiones más correctas. No obstante, el uso de estas declaraciones depende de su comprensión, conocimiento y el interés general por parte de los consumidores para seguir una alimentación más saludable. En este contexto, este trabajo de investigación estudia la influencia de las DNs y DSs en las elecciones de alimentos y las preferencias de los consumidores hacia una amplia gama de declaraciones. Finalmente, se investiga la atención visual a las DNs y DSs durante la elección de alimentos y su relación con el comportamiento en la elección. La atención visual se captura mediante el uso de la tecnología de eye-tracking (ET) la que nos permite capturar y grabar los movimientos oculares del consumidor dentro de las Áreas de interés (ADI). La tecnología del ET se ha utilizado de forma limitada en

[1] Mantenemos la terminología inglesa original al no encontrar una traducción convincente y tan ilustrativa de este término.

experimentos de comportamiento del consumidor, aun así, se considera uno de los medios más efectivos para determinar las elecciones de los consumidores, especialmente cuando se combina con experimentos de elección discreta (DCE).

Aunque existe una preocupación general por las propiedades saludables de los alimentos, los consumidores también consideran cada vez más otras propiedades en la hora de comprar, como los aspectos sensoriales, y más específicamente, el sabor. La literatura demuestra que el sabor es uno de los atributos más importantes para los consumidores al comprar alimentos. Sin embargo, los consumidores tienden a asociar alimentos saludables con menos sabrosos, especialmente aquellos alimentos en que los nutrientes principales que potencian su sabor (por ejemplo, grasa, azúcar, sal) se han alterado durante el proceso de producción. En este contexto, además de la atención visual y la elección de alimentos, esta tesis doctoral investiga si el sabor influye y cómo influye en las preferencias de los consumidores en alimentos saludables con DNs y DSs. El producto de referencia utilizado es el yogur ya que es un alimento importante en la cesta de la compra de los hogares españoles. Además se considera como un alimento saludable y es el producto con la mayor prevalencia de DNs y DSs en el mercado español.

Desde un enfoque empírico, esta tesis contribuye a una mejor comprensión de las preferencias de los consumidores por alimentos saludables con DNs y DSs. En primer lugar, se investigan los efectos que las DNs y DSs tienen sobre los precios reales del mercado. No existe ninguna investigación previa que examina los efectos de las declaraciones nutricionales y saludables en los precios del yogur en el mercado español. En segundo lugar, estudios previos han investigado principalmente las preferencias de los consumidores por un número limitado de DN y DS. Por lo tanto, teniendo en cuenta que en un mercado real los consumidores intercambian entre una diversidad de declaraciones nutricionales y saludables, esta tesis doctoral se enfoca en examinar el comportamiento hacia las elecciones y la atención visual de productos con múltiples DN y DS. Otra contribución a la literatura es que, además de las preferencias del consumidor, esta es la primera investigación que examina la atención visual para múltiples DNs y DSs en yogures segmentando a los consumidores en función de sus preferencias.

Por tanto, esta tesis doctoral contribuye a la literatura alimentaria al explorar la importancia de la atención visual en una selección de DNs y DSs y también muestra de manera detallada segmentos de consumidores españoles basados en el interés general hacia una alimentación saludable, el uso de información nutricional, los hábitos de compra y la importancia atribuida a las DNs y DSs en alimentos saludables. En tercer lugar, otra contribución de esta tesis doctoral es la inclusión del sabor en productos alimenticios saludables. Adicionalmente incluye cuatro de las partes más importantes del marco de investigación del proceso de percepción de calidad de los consumidores que son: i) atención visual, ii) percepción de calidad, iii) comportamiento de compra y iv) atributos experimentados basados en el sabor.

Desde un punto de vista metodológico, esta tesis doctoral contribuye a la literatura en los métodos de valoración de las preferencias de los consumidores y en los efectos de las DNs y DSs sobre los precios de yogures en el mercado español. En primer lugar, utiliza un precio hedónico, que se considera como un enfoque más real para analizar los efectos de los atributos del producto sobre el precio en el mercado real. Esta metodología examina lo que los consumidores actualmente pagan por cada tipo de DNs y DSs en los yogures en el mercado español. En segundo lugar, utiliza un experimento de elección (EE) para estimar las preferencias de los consumidores. En esta metodología se les pide a los consumidores que elijan el producto que comprarían entre diferentes productos con distintos niveles de atributos, o una opción de no comprar. En comparación con otras metodologías utilizadas (por ejemplo, subasta experimental), los consumidores están más familiarizados con un experimento de elección ya que esta metodología se asemeja al proceso de decisión de compra como por ejemplo, en un supermercado. En tercer lugar, el EE se combina con datos de observación basados en la tecnología de seguimiento ocular "*eye tracking*". Este enfoque metodológico más avanzado incorpora la atención visual basada en medidas de eye tracking en el experimento de elección. La tecnología de eye tracking aún no se ha aplicado a la evaluación del efecto de la atención visual a múltiples DNs y DSs en los paquetes de alimentos. Por tanto, esta tesis doctoral proporciona un primer estudio que examina si

hay relación entre la atención visual a múltiples DNs y DSs y la compra final del producto. Además de la atención visual en las DNs y DSs, que se considera como "una medida continua del grado en que un encuestado evalúa el atributo" también investiga la falta de la atención visual hacia los atributos incluidos en el estudio, denominado en la literatura inglesa como "*attribute non-attendance (ANA)*", que es una medida discreta que indica el porcentaje de los participantes que no se han fijado (o no han atendido visualmente "ANA visual") a un atributo durante el experimento de elección. Por tanto, desde un punto de vista metodológico, esta tesis doctoral también contribuye a la literatura sobre ANA en EE mediante la implementación de ANA visual con el uso de la tecnología de eye tracking. Finalmente, además de medir la atención visual y el comportamiento de elección, esta tesis también examina los aspectos sensoriales del producto alimenticio. Es la primera de su tipo en combinar un experimento de elección y la atención visual con análisis sensoriales, examinando la importancia del sabor en un producto alimenticio saludable. Basándose en el marco conceptual y en las aplicaciones empíricas y metodológicas, se fijaron un total de cuatro objetivos principales en la investigación.

El primer objetivo de esta investigación fue examinar los efectos de las DNs y DSs sobre el precio de los yogures en España. Los resultados ilustraron que el yogur es un producto alimenticio altamente diferenciado. Algunas de las DNs no afectaron a los precios del mercado de yogur, mientras que la mayoría de las DS recibieron precios premium positivos y significativos. El segundo objetivo evaluó la atención visual de los consumidores y la decisión de compra con múltiples DNs. Por ello se tuvo en cuenta la heterogeneidad del consumidor a través de la segmentación del mismo, que implicó la clasificación del participante en dos segmentos. En general, la presencia de las DNs generalmente aumenta la atención visual, lo que puede estar relacionado con una mayor probabilidad de afectar a la decisión final de comprar yogures con DNs. Dicho de otra manera, es más probable que prestemos atención a la información que estamos buscando y esa atención aumenta la probabilidad de compra. El tercer objetivo exploró la atención visual y las elecciones de DNs y DSs en un alimento saludable y la influencia del sabor en la decisión final de compra. Los resultados demostraron que

había una relación entre las DNs y DSs más valoradas y seleccionadas y la atención visual. El sabor de un producto alimenticio saludable dio como resultado una utilidad negativa, pero una mayor atención visual asociada a las DNs y DSs y un menor porcentaje de no asistir a los atributos (ANA visual). Finalmente el cuarto objetivo estudió la relación entre el comportamiento de elección, las actitudes y las características sociodemográficas para predecir las características del consumidor español de alimentos saludables con DNs y DSs. Los resultados mostraron que los consumidores valoraron positivamente la mayoría de las declaraciones, sin embargo, la valoración fue heterogénea, siendo identificados tres segmentos de consumidores: "orientados a las declaraciones de salud", "orientados a las declaraciones nutricionales y de salud" e "indiferentes".

Chapter 1

General introduction, objectives and thesis outline

1.1. General introduction

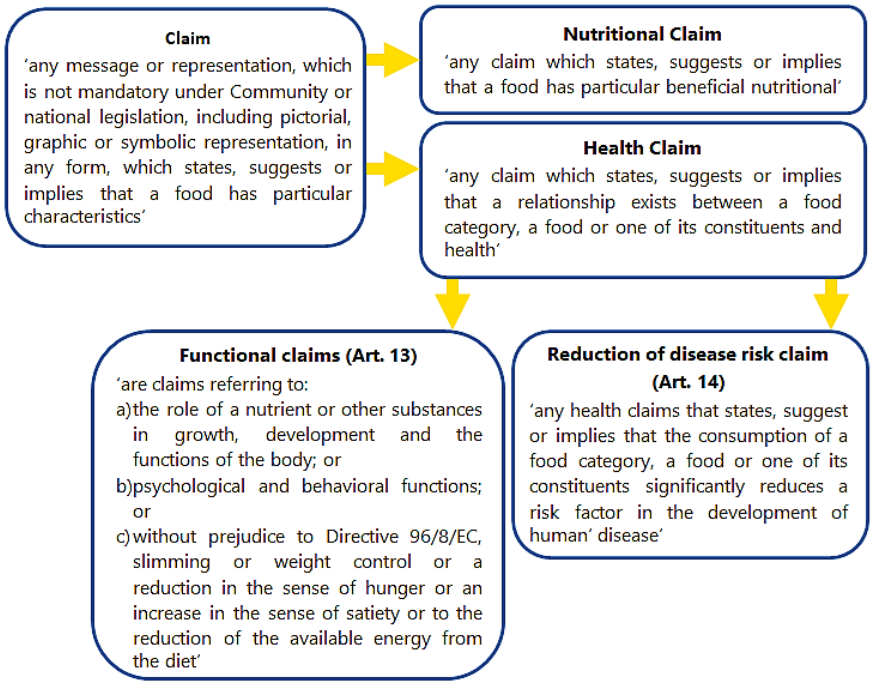
This dissertation focuses on exploring consumer behaviour on nutritional claims (NCs) and health claims (HCs). An increasing number of consumers are concerned about the food they consume and are willing to adopt healthier diets. While consumers care about the healthy physical properties of their food, they also increasingly consider the sensory aspects (i.e. taste) when determining which food to purchase and consume (Connors, Bisogni, Sobal, & Devine, 2001; Drewnowski & Rock, 1995; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Kearney, Kearney, Dunne, & Gibney, 2000; Kourouniotis et al., 2016; Mok, 2010). The influence of NCs and HCs on food choice and the consumer preferences towards a range of NCs and HCs are studied in this dissertation. In addition, visual attention during food choice and the sensory aspects of healthy food are studied.

Fernqvist and Ekelund (2014) use the quality perception process to explain the determinants of behaviour with respect to the attributes a product contains. Nutritional and health claims give consumers the opportunity to select healthier characteristics compared to conventional food without these claims but do not imply that consumers will use these claims (Grunert & Wills, 2007). Whether they will use these claims is influenced by their degree of motivation and ability to use the information (Grunert, Wills, & Fernández-Celemín, 2010), as well as the sensory characteristics (i.e. taste) that the product possesses. Before further elaboration on the use of NCs and HCs, the importance of sensory characteristics, and the quality perception process in consumer food choice (Section 1.3), this general introduction first describes NCs and HCs and their legal framework, as well as the availability and variability (i.e. type of claims) of these claims in the European Union (EU) food markets. Following this general introduction, the conceptual framework is discussed in detail (Section 1.3).

1.1.1. Defining nutritional and health claims

Nutritional and health claims are short messages concerning the nutritional content or healthy properties of a food product. In the EU, such claims are regulated to prevent misleading messages to consumers. Figure 1.1 provides the specific definitions for the various claims presented by the EU.

Figure 1.1. Claim, NC and HC definitions (based on EU Regulation No. 1924/2006)



These claims represent a simple and immediate tool that can contribute to making consumers more aware of the health properties that a food contains and favour high transparency in the market (Cavaliere, Ricci, & Banterle, 2015). The particular nutritional content of food products expressed by NCs (e.g. 'fat-free', 'source of calcium', etc.) may be of interest to a specific group of consumers particularly concerned with the nutritional aspects of their diet choices, while the health properties of food products which are highlighted with HCs could attract different consumers that are more interested in the direct link between food and health (e.g. 'Calcium is necessary for maintaining bones under normal conditions').

1.1.2. Legal framework

The food labelling legislation in the EU was introduced in 1979 (Regulation European Commission [EC] No 1979/112, 1978). In 2000, the EC passed a new directive (Regulation [EC] No 2000/13, 2000) establishing the compulsory information to be reported on food labels, and the first regulation targeted at NCs and HCs was Regulation (EC) No 1924/2006, as defined in Figure 1.1. Regarding NCs, Regulation No.1924/2006 introduced fixed parameters for labels presented on the front of pack (FOP), proposing standard short messages with regard the nutritional content of products, such as fat, sugar, fibre, vitamins, etc. Concerning fat content, for example, two of the claims are 'low fat' and 'fat-free'.

Regulation No. 116/2010 (Regulation [EC] No 116/2010) amended Regulation No. 1924/2006, adding claims regarding omega-3 fatty acids, monounsaturated fats, polyunsaturated fats, and unsaturated fats to the list of NCs. Nutritional claims can be labelled on a product's FOP only if the product completes the specific quantitative indications reported in the Annex of Regulation No.1924/2006.

Nutritional information was first introduced voluntarily to correct asymmetric information, help consumers make more informed and more conscious food choices, improve the efficiency of the market for higher quality food products, and allow producers to differentiate the new healthier versions from the conventional food. EU Regulation No. 1169/2011 however, amended Regulations No. 1924/2006 and No. 116/2010 and repealed Commission Directive 2000/13/EC, introducing a new general legal framework for food product labelling by establishing rules in terms of mandatory information and specific characteristics of labels. A crucial aspect of this regulation regards the change from voluntary to mandatory nutrition information (Cavaliere et al., 2015).

This regulation specifies that pre-packaged food labels should include the nutritional declarations regarding energy value and the amounts expressed per 100 g/ml of fat, saturated fat, carbohydrate, sugar, protein, and salt, as well as a list of allergens. Nutritional claims, however, still remain voluntary. Regarding HCs, prior to the enactment of Regulation No. 1924/2006, HCs were regulated in 13 out of 26 EU member states (Hung, Grunert, Hoefkens, Hieke, & Verbeke, 2017). Commission Directive 2000/13/EC was used in some member states as a partial regulation by which 'any labelling, presentation and advertising of foodstuffs that could mislead consumers' was prohibited (Regulation [EC] No 2000/13, 2000). Aside from legislation on HCs, voluntary codes of practice that included pre-approval through national institutions were introduced on 12 EU member states. Owing to a considerable difference in practices, public opinions about HCs varied from favourable in some EU member states to disapproving in others (Williams, 2005). Therefore, to harmonize the regulation of HCs and to support scientifically approved claims on food products in all EU member states, EC Regulation No. 1924/2006 was introduced. This regulation prohibited any health-related message that was not previously authorized based on scientific evidence (see Hartmann et al. [2008] for an overview) and approved by the European Food Safety Authority (EFSA). Following Articles 13.2 and 13.3 of Regulation No. 1924/2006, between 2008 and 2010, the EC provided a list of HCs to be evaluated by the EFSA, which served as a basis for more precise future regulation. Member countries requested about 44,000 claims to be evaluated, which was reduced to 4,637 by the EC in 2008 and further reduced to 2,758 by the EFSA in 2010. In 2012, the final list of HCs permitted by the EFSA consisted of 222 claims, which was extended to 223 with Regulation No. 40/2014 (Regulation [EC] No 40/2014).

The approved claims were related to vitamins and minerals, omega 3s, beta-glucans, live cultures, and olive-oil polyphenols. This regulation induced many changes in the market – companies needed to remove about 95% of HCs from their products, as they were not included on the approved list. After the 14th of December 2012, all HCs intended to go on the market had to be on the approved list.

To further complicate matters, HCs needed to be accompanied by additional label information, such as the importance of a varied and balanced diet, the serving size needed to obtain the beneficial effect, health risks related to excess consumption, etc. Some studies have found that this may lead to information overloading issues (Hartmann, Hieke, Taper, & Siegrist, 2018; Wansink, Sonka, & Hasler, 2004); however, the intent is to avoid 'deception by omission'.

Nevertheless, the availability of NCs and HCs and corresponding legislative frameworks, regulations, and monitoring procedures do not always guarantee tangible benefits to consumers, as some consumers deliberately or unintentionally ignore the provided information (Rotfeld, 2010), while others may not have the motivation or knowledge, or they are uninterested in using the information in their decision making. Any effect of NCs and HCs will depend on consumers, their preferences, and their behaviour towards these claims (Grunert & Wills, 2007; Hieke & Taylor, 2012; Hung et al., 2017).

1.2. Prevalence of nutritional and health claims

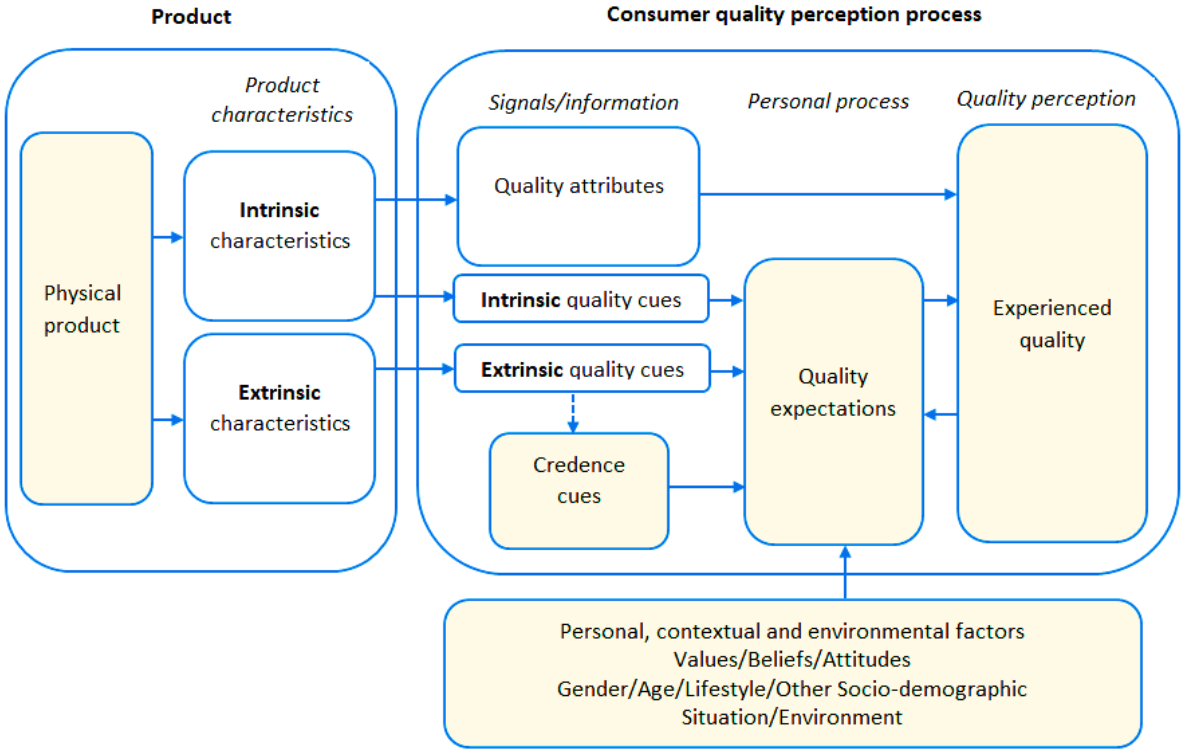
Nutritional and health claims are designed to inform consumers of the healthfulness of a product (Grebitus & Davis, 2017). It has been demonstrated that people who read them tend to have a healthier diet (Campos, Doxey, & Hammond, 2011). However, the difficulty of signalling NC and HC properties on food products is a major challenge, as NCs and HCs are credence attributes which can only be considered by consumers if those attributes are properly signalled at the point of purchase, for example, by means of claims. Since the introduction of the EU regulations, the increasing demand for NCs and HCs on food products has led to a growth in the number of claims used by food manufacturers to differentiate their products. It has been estimated that, within Europe, about 26% of pre-packaged foods carry an NC or HC (Hieke et al., 2016). In comparison to other EU countries, the availability of food products with NCs and HCs in Spain reached 95% (Prieto-Castillo, Royo-Bordonada, & Moya-Geromini, 2015) and was ranked second after the United Kingdom (UK) in terms of nutritional labelling (Hieke et al., 2016).

The most frequent type of NCs and HCs found were related to the fat content (24% NCs and 8% HCs), vitamins (22% NCs and 10% HCs), minerals (13% NCs and 6% HCs), sugars (12% NCs and 1% HCs), fibre (9% NCs and 4% HCs), calcium (6% NCs and 3% HCs), and sodium/salt content (4% NCs without any HC) (Hieke et al., 2016). Consumers need NC and HC information to guide healthy food choices. Ideally, this information should be clear, comprehensive, comparable, and credible so that consumers trust the information. While these claims provide information to consumers and aim towards making healthy food choices, the proliferation of these labels may have a negative impact. This is a challenge for the future, as these claims may lead to confusion. Consumers could become overwhelmed and uncertain about which information they can trust. The proliferation of these claims may thus lead to information overload and loss of credibility among consumers, rather than helping them.

1.3. Conceptual framework: Nutritional and health claims, sensory aspects and food choice

Giving consumers what they want and expect, based on the information provided on a product's FOP, is the primordial aim of food producers, and many efforts are made to satisfy consumers' requirements and ensure the success of a product in the marketplace. However, food choices depend on the interactions between the intrinsic and extrinsic characteristics, as well as sensory (i.e. taste) aspects, which are the principal factors that play a significant role in food choices (Kourouniotis et al., 2016; Mok, 2010). Food product characteristics can be divided into two main groups: intrinsic and extrinsic attributes (Figure 1.2). Extrinsic attributes are product attributes which are not a part of the physical product and can be changed without altering the physical product characteristics (Olson & Jacoby, 1972). Examples of extrinsic attributes that can influence the decision to purchase a food product include brand, price, and package layout, which can easily be evaluated by consumers during the purchase decision-making process, while others are unobservable (e.g. NCs and HCs, organic and sustainability claims) and must be provided (Fernqvist & Ekelund, 2014).

Figure 1.2. The consumer quality perception process (Fernqvist & Ekelund, 2014)



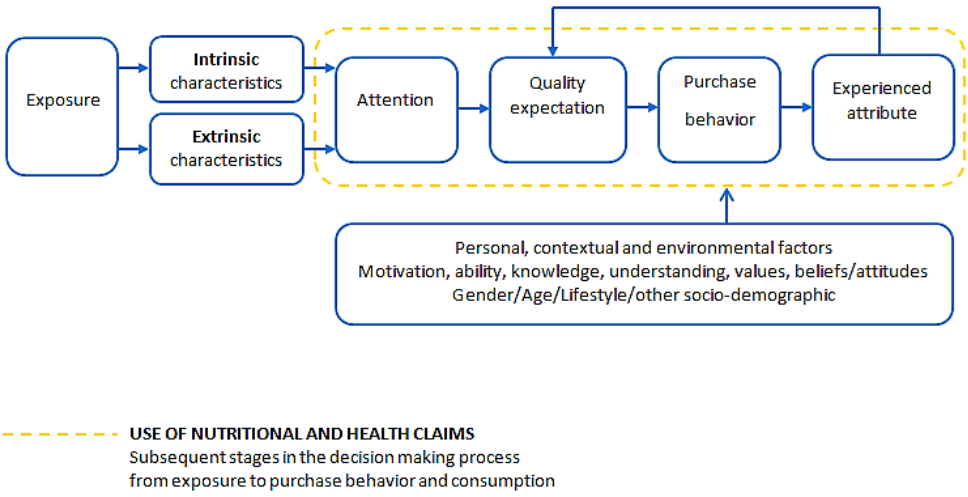
Intrinsic attributes, on the other hand, are product attributes that cannot be changed or manipulated without altering the physical characteristics of the product itself (Olson & Jacoby, 1972). Examples of intrinsic attributes include sensory properties (e.g. taste, appearance, texture, etc.) and chemical and physical properties of food, such as product composition (e.g. ingredients) (Olson & Jacoby, 1972). Sensory attributes are also known as experience attributes, because consumers must experience the food to evaluate them (Asioli et al., 2017).

Previous research has demonstrated that research that combines both intrinsic (sensory) and extrinsic attributes makes it possible to obtain more complete and realistic information about consumer behaviour in real-life purchase situations (De-Pelsmaeker, Schouteten, Lagast, Dewettinck, & Gellynck, 2017; Endrizzi et al., 2015; Grunert, 2015; Köster, 2009; Simeone & Marotta, 2010). For this reason, it is important not only to study the impact of NCs and HCs based on the expected quality before consumption, but also to conduct sensory evaluation for more accurate predictions of food choices (Grunert, 2015).

There is a hierarchy of effects (or stages) that the consumer should go through before making a purchasing decision, from NC and HC exposure and attention to purchase behaviour and consumption (or experienced attribute) (Figure 1.2). Fernqvist & Ekelund (2014) use the consumer quality perception framework to explain the determinants of how experienced food quality is influenced by intrinsic quality attributes of the physical product, which can only be ascertained through consumption and quality perceptions that are formed by the quality cues from the intrinsic and extrinsic characteristics of the product (Steenkamp, 1990). However, exposure to quality attributes and cues does not necessarily imply that the cues are attended to and therefore used in the decision-making process. Exposure will only have an effect if the individual attends to it and if the information is perceived. This point also illustrates the importance of visual attention. This consumer quality perception process can be further extended to also include attention (in this case, visual attention) and intrinsic characteristics (experienced attribute).

Building on Fernqvist & Ekelund's (2014) consumer quality perception process, Figure 1.3 represents an adapted conceptual framework underlying the methodology. In addition to the intrinsic and extrinsic evaluation stages, this theoretical framework incorporates attention (in this case, visual attention measured using eye tracking [ET]) which is followed by consumer quality expectations (e.g. expectations based on taste, previous experiences), purchase behaviour (i.e. purchase), and experienced attributes (i.e. consumption to confirm or reject the quality expectations formed from the intrinsic attributes, such as taste).

Figure 1.3. Hierarchical framework of the effects of exposure to NCs and HCs and the consumer quality perception process adopted from Fernqvist & Ekelund (2014); Steenkamp (1990)



Exposure forms a necessary but insufficient condition for attention; for example, only some of the available information may be attracting attention as a bias to be properly detected. The likelihood of exposure is increased if consumers are actually attracted by the intrinsic and extrinsic characteristics of the product, which will most likely lead to attention. Bialkova & Van Trijp (2011) define attention as the process mediating perceptual selectivity for further action. Attention leads to subsequent behaviour only when consumers are motivated towards healthy eating and have the sufficient knowledge to understand the information.

Once given meaning, a positive quality expectation may play a role in decision making. This most likely occurs in interaction and trade-off with other knowledge obtained from previous experiences, which leads to a purchase. After a purchase, consumers experience some of the credence attributes of the products (e.g. taste), which either confirm or reject the quality expectations formed prior to the purchase of the product. This is described in greater detail in the following sections.

1.3.1. Role of individual differences: Motivation, ability, knowledge, understanding, demographics

The principal factors that influence the quality perception process can be divided into person-, product-, and environmental-related factors. Kotler et al. (2013) mention four sets of consumer characteristics (i.e. personal-related factors) that influence the consumer decision-making process. These include personal (demographics, personality, lifestyle), psychological (knowledge, perceptions, motives, attitudes, involvement), cultural (social class, reference group), and social factors (family, reference groups). In addition to consumer characteristics, environmental factors (e.g. situational influences such as time and occasion) and product-related factors (e.g. price, place, promotion, product attributes) may influence the process (Kotler, Armstrong, Harris, & Piercy, 2013). This dissertation mainly focuses on the personal, psychological, and product-related factors.

The role of individual differences in terms of motivation, ability, knowledge, and understanding among claims in the literature mostly focuses on HCs, rather than NCs. Moorman (1990) defines motivation as the desire or readiness of consumers to process health-related information, influencing how consumers advance from health information exposure to processing, attitude formation, and purchasing (Mitchell, 1981). A lack of motivation decreases cognitive efforts consigned to health information. In addition, ability refers to skills in understanding information (MacInnis & Jaworski, 1989). A low degree of ability implies challenges in understanding HCs, even when attention has been attracted (Hung et al., 2017). Among others, two theoretical frameworks have been used in the literature to examine the role of motivation and ability in consumer information processing.

The motivation-ability-opportunity (MAO) framework used by MacInnis & Jaworski (1989) and Macinnis et al. (1991) suggests that the level of information processing depends on the opportunity, consumers' motivation, and their ability to process the information during or immediately after exposure. The opportunity part of this framework assumes that there are sufficient NCs and HCs available for exposure; the remaining determinants, then, are the motivation and ability of consumers to process these claims. In the elaboration likelihood model (ELM), motivation and ability are the main factors influencing the level of information processing with a stimulus message (e.g. NCs and HCs) (Petty & Cacioppo, 1986). In their study, Moorman & Matulich (1993) illustrate that the interaction of motivation and ability influences consumers' health behaviour. Likewise, the highest level of health information processing is the result of high motivation and ability (Petty & Cacioppo, 1986).

Aside from motivation and ability, health-related knowledge is an important cognitive aspect that reflects the ability to process NCs and HCs (Hung et al., 2017; Moorman & Matulich, 1993). Previous research has demonstrated that consumer knowledge is associated with the correct use of health-related information (Grunert & Wills, 2007; Hung et al., 2017; Moorman, 1990). Similarly, a review by Miller & Cassady (2015) suggests that prior knowledge is, indeed, significantly associated with food label use. Knowledge is also closely related to the level of consumer understanding of NCs and HCs (Grunert et al., 2010) and is related to the ability to process HCs (Lähteenmäki, 2013). Understanding NCs and, especially, HCs is an essential element that affects informed food choices (Hung & Verbeke, 2017). Although the EU regulation requires that HCs must be understood by 'average consumers', it remains a challenge for implication, as understanding an HC may depend on the use of scientific versus lay terms (e.g. normal homocysteine metabolism vs. normal function of the heart), the choice of words (e.g. is needed for vs. contributes to), and the length of the claim (Stancu, Grunert, & Lähteenmäki, 2017; Tan, van der Beek, Kuznesof, & Seal, 2016).

Finally, products with NCs and HCs have been considered to be part of nutritionally healthy diets, and the appeal of these claims is also positively linked to interest in healthy eating (Dean et al., 2012; Kaur, Scarborough, & Rayner, 2017). The General Health Interest (GHI) scale has demonstrated to effectively measure the interest in healthy food choice (Roininen, Lähteenmäki, & Tuorila, 1999). People with high GHI are more likely to purchase food products based on their health benefits (Lähteenmäki, 2013). Compared to the aforementioned individual differences of attitudinal and cognitive characteristics, socio-demographic characteristics are generally unalterable and play a relative minor role in consumers' processing of health-related information (Grunert et al., 2010) and reactions towards food products with HCs (Hung et al., 2017; Verbeke, 2005).

1.3.2. Factors influencing exposure and attention

Only labels to which consumers are exposed can be expected to have an effect (Grunert & Wills, 2007). Consequently, exposure to the label, followed by attention, are the first steps in information processing (Solomon, Bamossy, & Askegaard, 2013), possibly leading to informed healthy food choices. Likewise, the market potential for healthy foods is also affected by the attractiveness of NC and HC labels to consumers. However, when shopping for food, consumers may be overwhelmed with the provided information, and time constraints may prevent them from attending to the information made available on food products. Verbeke (2005) illustrates that overloading the package with information makes it more difficult to extract and process the information of interest and may even lead to confusion, as well as lack of interest. Milosavljevic & Cerf (2008) discovered that, when shopping, consumers make choice decisions within a few seconds, and they may not attend to all of the information provided on the product's FOP. Likewise, Verbeke (2008) suggests that consumers may apply heuristics to simplify their decision and, as a result, may not attend to all the product attributes when selecting food. Other studies have indicated that consumers only partially process food information, and they are sometimes unaware of its presence on the label (Oliveira et al., 2016; Wedel & Pieters, 2008a).

Taken together, this evidence indicates that visual attention plays a key role in the effectiveness of food labelling systems.

Attention is an important step in the consumer decision-making process, as it is a prerequisite for information processing. Solomon et al. (2013) define attention as 'the degree to which consumers focus on a stimulus within their range of exposure'. With ET technology, respondents' gaze, fixation time (FT), and fixation count (FC) can be recorded to observe their visual attention when making food choices. Researchers differentiate between two types of attention: goal-directed attention and stimulus-driven attention (Norman & Shallice, 2000; Yantis, 2000). Goal-directed attention is influenced by top-down factors, while stimulus-driven attention is mostly determined by bottom-up factors. Bottom-up factors refer to visual stimulus designed factors (e.g. number of images, complexity of images, colour, shape, and information level of images), whereas top-down factors refer to consumers and their individual preferences, goals, mood, or task instructions (Gere et al., 2016; Orquin & Mueller Loose, 2013). Bialkova & Van Trijp (2011) suggest that the effect of nutrition information on food products depends on whether consumers have a hedonic goal or a health goal when making choices. People with high GHI are more likely to purchase food products based on their health benefits, rather than hedonic benefits (Lähteenmäki, 2013), and are more likely to choose low-fat foods (e.g. an apple) over a chocolate snack (Roininen et al., 2001). Vyth et al. (2011) confirm these findings, similarly suggesting that, when shopping for food, people with high GHI pay more attention to health labels.

Bialkova et al. (2014) found that people with high GHI placed greater importance and visual attention on nutrition label information. Specifically, they report that consumers with interest in healthier eating (i.e. health goals) attached longer and more frequent fixations than consumers who aimed at hedonic eating (i.e. preference goals). In addition, findings suggest that the product fixated on most had the highest likelihood of being chosen. Similarly, it is likely that consumers who attach greater importance to healthy aspects of food are more motivated and will visually attend more to NCs and HCs during food selection.

1.3.3. Quality expectations related to experienced attributes

Once exposed to NCs and HCs and the remaining extrinsic and intrinsic characteristics, and having attached the required attention to the information on the FOP, consumers create quality expectations which affect their willingness to buy the product (see Piqueras-Fiszman & Spence, 2015 for an overview). Within the quality expectations based on the intrinsic characteristics, research exploring sensory analysis in food products has indicated that taste is perceived as one of the most influential factors that individuals consider when determining which food to purchase and consume (Connors et al., 2001; Drewnowski & Rock, 1995; Glanz et al., 1998; Kearney et al., 2000; Kourouniotis et al., 2016; Mok, 2010). This distinction is linked with the economic theory on product quality, which states that food products are classified into three characteristics: search, experience, and credence (Nelson, 1974).[2] When purchasing a product for the first time, consumers choose it by considering search and credence attributes and creating sensory expectations (e.g. taste, flavour). After consumption, these expectations are transformed into real experiences of the product's sensory characteristics. Therefore, in the case of satisfaction, the re-purchase stage summarizes the three characteristics (i.e. search, credence, and experience) (Ballco & Gracia, 2020). The relationship between product expectation and product experience is commonly believed to determine consumer satisfaction with the product and is, therefore, a strong determinant of repeated purchases (Bollinger, Leslie, & Sorensen, 2011; Elbel, Gyamfi, & Kersh, 2011; Holmquist, McCluskey, & Ross, 2012). When the food is subsequently consumed (i.e. when consumers experience the attributes in terms of flavour, aroma, and taste), there may, or may not, be a discrepancy between the expected experience and actual experience. These discrepancies, according to Kahneman and Tversky's (1979) prospect theory, are identified as subjective values of gain and loss.

[2] Search characteristics can be evaluated before purchasing the product (e.g., colour, size), experience characteristics can only be evaluated after the product is consumed (e.g., taste) and credence characteristics are those that cannot be evaluated by consumers unless additional information is provided (e.g., organic labels) (Nelson, 1974).

The subjective value of gain is smaller than the subjective value of an equivalent loss (Kahneman & Tversky, 1979). When a product tastes better than expected (gain), the evaluation of a labelled product will be closer to the expectations. Conversely, when a product is experienced as worse than expected (loss), the evaluation will be closer to the evaluation of an unlabelled product (see Piqueras-Fiszman & Spence, 2015 for an overview). The formation of quality expectations prior to purchase also highly depends on consumers' goals in purchasing a specific food. More specifically, when making food decisions, consumers are often challenged with the dilemma of self-control (Fishbach & Zhang, 2008; Wilcox, Vallen, Block, & Fitzsimons, 2009). They are forced to choose between the short-term hedonic goal of taste food intake and the long-term utilitarian goal of healthy nutrition.

The desire to consume tasty food often contradicts the desire to eat healthy, leading to a widespread assumption that unhealthy food tastes better than healthy food. Previous research has illustrated that consumers intuitively believe that the less healthy the food product, the better it will taste (Hamblin, 2018; Mai & Hoffmann, 2015; Raghunathan, Naylor, & Hoyer, 2006; Suzuki & Park, 2018). This may be partially true for food with NCs and HCs in which the fat, sugar, and salt contents, which are associated with the increased likability and palatability of foods, are altered (Drewnowski & Specter, 2004; Kourouniotis et al., 2016; McCrory, Saltzman, Rolls, & Roberts, 2006; Vadiveloo, Morwitz, & Chandon, 2013). Yet, although no previous research has directly investigated whether food pleasure diminishes the 'healthy = less tasty' intuition, indirect evidence seem to disapprove this intuition. More precisely, French people, who have been shown to be highly food pleasure oriented, consider healthy food to be tastier than unhealthy food (Jo, Lusk, Muller, & Ruffieux, 2016; Rozin, Fischler, Imada, Sarubin, & Wrzesniewski, 1999; Werle, Trendel, & Ardito, 2013). In addition, related to taste expectations based on NCs and HCs, it has been demonstrated that consumers often question the trustworthiness of health benefit information on FOPs, especially when it is communicated on unhealthy food products, due to their unfavourable overall nutrient density composition (Bialkova, Sasse, & Fenko, 2016).

Health information is often ignored when it is presented on unhealthy food, unlike when the product is believed to be healthy (Balasubramanian & Cole, 2002).

For these two reasons, a healthy food product (yoghurt), rather than an unhealthy one, is included as the product of reference to be further studied in this doctoral dissertation. Other main reasons of including yoghurt are i) because it is a common ingredient in the shopping baskets of Spanish households,[3] ii) because it is considered to be a healthy food product (Moore, Horti, & Fielding, 2018); and iii) because it is the product that carries the most NCs and HCs as defined by EU Regulation No. 1924/2006 in the Spanish market.

1.4. Research objectives and research questions

From an empirical point of view, this doctoral dissertation investigates the individual phases from the framework detailed in Figure 1.3. First, the availability of NCs and HCs in the Spanish market that is linked to exposure on different yoghurts is studied. Then, the implicit willingness to pay (WTP) estimates in terms of the value placed on each NC and HC attribute on a healthy food (yoghurt) are studied. Second, consumers' preferences and visual attention towards a wide range of NCs, focusing on socio-demographic characteristics, the importance attached to yoghurt attributes, and NCs attributes, are examined. Third, the consumer preferences, visual attention, and sensory evaluations for yoghurts with multiple NCs and their corresponding HCs are explored. This relates to the ability to use the information from the framework in the consumer decision–making process and gives an indication of the use of NCs and HCs without relying on self-reported measures.

[3]According to the Consumer Observatory in Spain, 89% of the per capita consumption of food consisted of liquid milk, processed meat, yoghurts, cheeses, industrial bread, and biscuits (Ministry of Agriculture and Fisheries, Food, and Environment (MAPAMA), 2014).

In addition, this dissertation explores the sensory evaluation (i.e. taste) of a healthy food (yoghurt) that is nutritionally altered (fat-free, low sugar, high fibre, etc.) and whether taste affects choice behaviour. Fourth, individual differences in food with NCs and HCs are examined. This gives greater emphasis to the GHI eating, use of food with NCs and HCs, importance placed on these claims, and preferences based on socio-demographic characteristics. From a methodological point of view, this doctoral dissertation studies the use of ET as a tool to evaluate visual attention, visual ANA, and sensory analysis, which are incorporated in the choice modelling. Consequently, four main research objectives are distinguished. Figure 1.4 relates the research objectives (RO) to the conceptual framework. An overview of the research objectives and corresponding research questions (RQ) is provided in Table 1.1. The empirical and methodological contributions are elaborated in greater detail in Section 1.6.

Figure 1.4. Research objectives in relation to the research framework

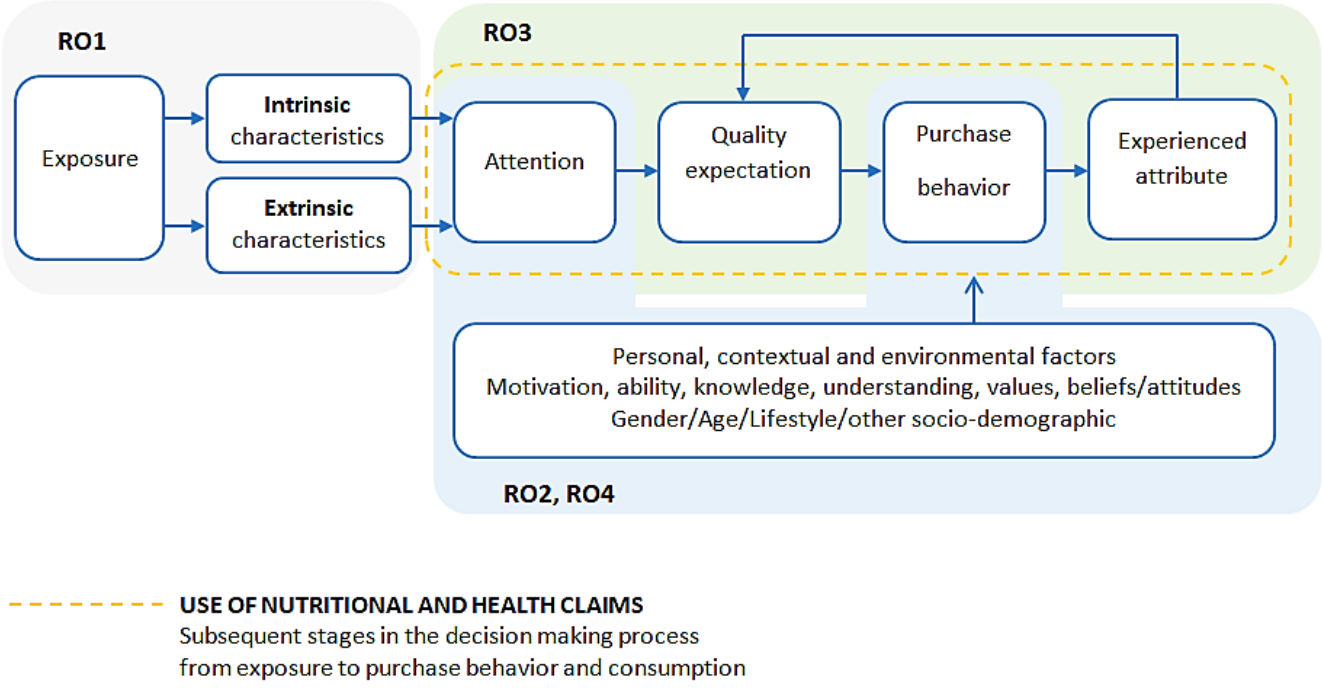


Table 1.1. Overview research objectives and corresponding research questions

Research Objectives	***Research questions***
RO1: Examine the price effects of NCs and HCs on yoghurts in Spain	***RQ1*** *Which attributes influence yoghurt prices in the market?* ***RQ2*** *What type of claims affect yoghurt market prices?* ***RQ3*** *Which claim (NCs vs. HCs) receives the highest premium price?*
RO2: Assess consumers' visual attention and choice decision for multiple NCs	***RQ4*** *Do NCs on yoghurts' FOP attract the visual attention of consumers, and which claims attract the most?* ***RQ5*** *What are the consumer preferences for NCs on yoghurts?* ***RQ6*** *Is there any relationship between the most visually attended and the chosen NCs?* ***RQ7*** *How do people with a different buying behaviour differ in terms of preferences towards NCs?*
RO3: Explore visual attention and choices for NCs and HCs on a healthy food and the influence of taste in the final purchase decision	***RQ8*** *Will consumers choose a healthy food (yoghurt) with NC and HC rather than an unlabelled one?* ***RQ9*** *Will HCs be considered an information overload on the food package and, thus, be less chosen compared to NCs which are short and concise?* ***RQ10*** *Will there be a relationship between the NCs and HCs with the highest visual attention and the claims that generated the highest utilities, and will this relationship affect the likelihood of the product being chosen?* ***RQ11*** *How will the taste of a healthy food with NCs and HCs affect visual attention and final choices?* ***RQ12*** *Does accounting for attribute non-attendance in food choice experiments using eye-tracking measures influence the model estimates?* ***RQ13*** *Does the taste of a food influence the attribute non-attendance in choice experiments?*
RO4: Study the relationship between choice behaviour, attitudes, and socio-demographic characteristics to predict Spanish consumer characteristics of healthy foods with NCs and HCs	***RQ14*** *Is there an association between attitudes (interest in healthy eating, importance and use of NCs and HCs) and choice behaviour?* ***RQ15*** *What consumer characteristics predict Spanish consumers' choice of healthy products with NCs and HCs?*

1.4.1. RO1: Price effects of NCs and HCs on yoghurts in Spain

The first objective aims to investigate the exposure of, among other intrinsic and extrinsic characteristics, NCs and HCs, as well as examine their effect on yoghurt market prices. In other words, it examines the price premiums that Spanish consumers pay when purchasing yoghurt with NCs and/or HCs on the FOP. There is much literature examining consumers' utility and the estimated WTPs for food with NCs and HCs (Barreiro-Hurlé, Gracia, & de-Magistris, 2010a; Barreiro-Hurle, Gracia, & De-Magistris, 2010b; de-Magistris & Lopéz-Galán, 2016; de-Magistris, López-Galán, & Caputo, 2016; Jurado & Gracia, 2017; López-Galán & de-Magistris, 2019; Van Wezemael, Caputo, Nayga, Chryssochoidis, & Verbeke, 2014); however, examining the effect that each attribute has on the products' price through the use of the hedonic price (HP) approach is more realistic, because it obtains information on what consumers are exposed to and what they pay on the attributes of a real product in a real market. Previous research using the HP approach on dairy food in Italy found premium prices for yoghurts with added fibre (+32.33%), probiotic (+24.45%), and calcium (+27.18%) attributes (Carlucci, Stasi, Nardone, & Seccia, 2013). In the same line, Bimbo et al. (2016) found premium prices for added fibre (0.183€/L) and added vitamins (0.044€/L) to ultra-high-temperature (UHT)-treated milk. Measuring the price effects of NCs and HCs in the market not only aims at identifying the premium prices that consumers pay on the attributes of a healthy food (yoghurt) but also guides the research towards a better identification of the type of attributes that affect yoghurt prices (RQ1) and the type of claims (NCs and/or HCs) (RQ2), as well as identify the type of claim (NCs vs. HCs) that receives the highest premiums (RQ3).

1.4.2. RO2: Consumers' visual attention and choice decision for multiple NCs

The aim of the second research objective is to investigate consumers' preferences for alternative NCs (fat-free, low sugar, high fibre, source of vitamin B6, and source of calcium) and explore the impact of consumers' visual attention on final choices.

It measures the attention to NCs, which might be related to the involvement towards their use (Wedel & Pieters, 2008b, 2008a). Instead of relying only on self-reports, visual attention to NCs is measured with ET technology. While past studies have evaluated consumers' visual attention to nutrition information during food selection with the use of ET, no studies have applied this method to NCs on the FOP, and on yoghurt. The current study contributes to this research gap by studying the visual attention paid to several NCs on yoghurt packages. Consequently, the research questions that this objective investigates aim to determine whether NCs attract consumers' attention on yoghurts' FOP and identify the claims that attract attention the most (*RQ4*). In addition, it investigates whether participants' degree of visual attention relates to their choice preference for that particular NC when needing to make trade-offs with other claims, aiming at the responses to two research questions (*RQ5 and RQ6*) reported in Table 1.1. Finally, based on the self-reported importance placed on NCs, attributes that influence the purchase decision, and socio-demographic characteristics, it identifies segments of consumers with homogeneous needs within groups and heterogeneous preferences between groups (*RQ7*).

1.4.3. RO3: Visual attention, sensory analysis and choice decisions for yoghurts with NCs and HCs

This objective aims to explore consumer preferences for multiple NCs and HCs on a healthy food (yoghurt), explore whether and how taste influences consumer preferences for NC and HC labels, and determine whether visual attention might lead to an increased likelihood of the product being purchased. Previous research has demonstrated that food products with NCs and HCs are regarded as health alternatives, for which Spanish consumers are willing to pay premium prices (Barreiro-Hurlé et al., 2010a; Barreiro-Hurle et al., 2010b; de-Magistris & Lopéz-Galán, 2016; de-Magistris et al., 2016; Jurado & Gracia, 2017; López-Galán & de-Magistris, 2019). However, although consumers express positive attitudes, their purchase intentions do not always match their stated views. One reason might be that HCs may result in an information overload on the food package (Barreiro-Hurle et al., 2010b).

This objective first aims to answer the question of whether *consumers will choose a healthy food (yoghurt) with NCs and HCs rather than an unlabelled food (RQ8),* and second, whether *HCs will be considered an information overload on the food package and, thus, be less chosen compared to NCs which are short and concise (RQ9)*. Another factor that might influence the choice of a healthy food with NCs and HCs is sensory expectations. Consumers tend to associate healthy food with an unpleasant taste (Hamblin, 2018; Raghunathan et al., 2006; Suzuki & Park, 2018). As previous research has demonstrated, taste is perceived as one of the most influential purchasing factors (Connors et al., 2001; Drewnowski & Rock, 1995; Glanz et al., 1998; Kearney et al., 2000; Kourouniotis et al., 2016; Mok, 2010). Hence, when evaluating the market potential of healthy products, it is important to evaluate whether, and how, taste influences consumer preferences for a healthy food with NCs and HCs. This point is linked to the tenth research question, which asks *whether the taste of a healthy food with NCs and HCs affects visual attention and final food choice (RQ11)*. Likewise, the market potential for healthy foods is also affected by the attractiveness of NCs and HCs to consumers. Previous research using ET to explore attention and choice behaviour has suggested that attention is strongly linked to the final purchase decision (Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Samant & HanSeok, 2016; Uggeldahl, Jacobsen, Lundhede, & Olsen, 2016; Van der Laan, Hooge, Ridder, Viergever, & Smeets, 2015; Van Loo et al., 2015; Vu, Tu, & Duerrschmid, 2016). Based on these findings, *RQ10* has been developed, which asks, *Will there be a relationship between the NCs and HCs with the highest visual attention and the claims that generated the highest utilities, and will this relationship affect the likelihood of the product being chosen?*

In relation to the visual attention, this objective also helps to address attribute non-attendance (ANA) in choice experiments (CEs). In a discrete choice experiment (DCE), respondents are asked to select their preferred alternative from a given task, in which each alternative is described by attributes of varying levels. Respondents are then asked to make selections from a series of choice tasks.

The analysis of DCE data is based on the economic theory of consumer behaviour (Lancaster, 1966; McFadden, 1973), which assumes continuous preferences and, thus, unlimited substitutability between the attributes employed (Hoyos, 2010). This continuity axiom implies that respondents consider all of the attributes presented to them when choosing their most preferred alternative (Hensher, Rose, & Greene, 2005). However, previous research has questioned the assumption of compensatory behaviour, because respondents may ignore some of the attributes presented to them in a choice task (Campbell, Hensher, & Scarpa, 2011; Carlsson, Kataria, & Lampi, 2010; Hensher, 2006; Hensher, Rose, & Li, 2012; Hole, 2011; Kragt, 2013; Scarpa, Gilbride, Campbell, & Hensher, 2009; Scarpa, Thiene, & Hensher, 2010; Van Loo, Nayga, Campbell, Seo, & Verbeke, 2017). Not accounting for ANA has been found to affect coefficient estimates and model performance (Campbell et al., 2011; Carlsson et al., 2010; Hensher & Rose, 2009; Scarpa et al., 2009, 2010; Van Loo et al., 2017).

Traditionally, ANA in DCEs is identified by asking the respondents additional questions about which attributes they ignored (i.e. stated ANA), identifying ANA based on the observed choices (i.e. inferred ANA), or visual ANA, which is measured through ET while respondents are answering the DCE questions. Visual ANA is defined as visually ignoring information about attribute levels. This method uses eye fixation, which is an ET measure that can be used as an indicator of visual attention (Balcombe, Fraser, & McSorley, 2015; Balcombe, Fraser, Williams, & McSorley, 2017; Van Loo et al., 2017). Specifically, eye FCs are used to develop a discrete measure of visual attendance to determine whether a respondent visually attends to an attribute. To detect whether a specific attribute is ignored during a choice task, the specific attribute in the choice set is considered as a whole, instead of in each of the alternatives within each choice task.

Two FCs of cut-off points were used (FC one and FC two). This resulted in a total of two models to account for visual ANA. The research question investigates *whether accounting for visual ANA in food choice experiments using ET measures influences the model estimates (RQ12)*.

In addition, in relation to the sensory aspects, it asks *whether the taste of a healthy food product influences the visual ANA in choice experiments (RQ13).*

1.4.4. RO4: Spanish consumer characteristics of healthy foods with NCs and HCs

The aim of this objective is to study the relationship between choice behaviour, attitudes, and socio-demographic characteristics to predict Spanish consumers' choice of healthy food with NCs and HCs. In other words, this final objective aims to provide the private and public agro-food sector with a profile of Spanish consumers with different individual characteristics that are interested in consuming healthy food with NCs and HCs. The characterization of consumers based on categories would allow food companies and public authorities to tailor strategies and promote healthy food choices. Two research questions are identified in this research objective: i) *Is there an association between consumers' attitudes (GHI eating, importance and use of NCs and HCs) and choice behaviour? (RQ14);* and ii) *What consumer characteristics predict Spanish consumers' choice of healthy products with NCs and HCs? (RQ15).*

1.5. Research design and data collection

Data required to meet the research objectives and to explore the research questions were collected through quantitative research procedures (surveys), sensory analysis, and observational procedures (ET). Table 1.2 provides an overview of the empirical application, the type of data, and the methodology applied for the four chapters in this dissertation. More detailed description are included in each of the research chapters.

The experiment was conducted in 2016 in Zaragoza (Spain), which is widely used by food marketers and consulting companies, since the socio-demographics of this town are representative of the Spanish Census of Population. A total of 218 participants older than 18 years, and without any eye problems, participated in the experiment.

Participants were recruited via email by a recruiting agency and were selected through random stratification with proportional allocation for age, gender, and education to avoid under/overrepresentation of consumer profiles.

Table 1.2. Research design and data collection

Empirical application	Type of data	Number of participants	Chapter	Methodology applied
Study 1: NCs and HCs effects on yoghurt prices	Market observation	-	Chapter 2	Linear regression
Study 2: Nutritional claims on yoghurts, visual attention and choice	Survey and observational (ET)	n=100	Chapter 3	DCE, including visual attention and segmentation
Study 3: Nutritional and health claims, sensory analysis, choice behaviour, visual attention, and visual ANA	Sensory analysis and observational (ET)	n=218	Chapter 4	DCE, visual attention, sensory analysis, visual ANA
Study 4: Involvement in healthy eating of food with NCs and HCs	Survey	n=218	Chapter 5	DCE, segmentation

1.6. Research contributions

1.6.1. Empirical contributions

The empirical contributions of this dissertation lie in each of the studies investigated. Scant literature exists on the effects of dairy/yoghurt attributes on real market prices (Annunziata & Vecchio, 2013; Bimbo et al., 2016; Bonanno, 2016; Carlucci et al., 2013). In Spain, the effects of food attributes on Spanish market prices have mainly been examined on extra virgin olive oil (Cabrera, Arriaza, & Rodríguez-Entrena, 2015), veal (Gracia & Perez y Perez, 2004), and saffron (Sanjuán-López, Resano-Ezcaray, & Camarena-Gómez, 2009), and no previous research has examined the effects of NC and HC attributes on yoghurt prices. In this context, the first research objective (Study 1) of this dissertation fills this gap by assessing the market valuation of (among other attributes) specific NCs and HCs for yoghurts in Spain. Regarding the second research objective (Study 2), while most previous literature has focused on consumer preferences for fewer than three NCs (Barreiro-Hurle et al., 2010b; Carrillo, Varela, & Fiszman, 2012; de-Magistris

& Lopéz-Galán, 2016; de-Magistris et al., 2016; Jurado & Gracia, 2017), Study 2 analyses consumer preferences, choice behaviour, and visual attention for multiple NCs by considering that, in a real market, consumers trade off between a variety of claims. Another contribution of Study 2 to the literature is that, aside from consumer preferences, this is the first research to examine visual attention for multiple NCs on yoghurts, which also segments consumers based on preferences. Previous research exploring consumer preferences and visual attention has mainly focused on various formats of nutritional labels (e.g. choice logos, monochrome guidelines, daily amount nutritional labels, colour-coded nutritional labels, the traffic light system, and information tables showing nutritional facts, organic, and sustainability-related labels) displayed on the FOP (Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Mawad, Trías, Giménez, Maiche, & Ares, 2015; Samant & HanSeok, 2016; Van Loo et al., 2015; Van Loo et al., 2010). Thus, this research objective contributes to the food literature by exploring the importance of visual attention to a selection of NCs, as well as highlights Spanish consumer segments, which can be considered by producers and retailers in the agro-food industry.

Consequently, while Study 2 highlights consumer segments based on NCs, the importance attached to yoghurt attributes, and socio-demographic characteristics, Study 4 provides a more detailed consumer segmentation based on multiple NCs and HCs, the GHI of Spanish consumers in healthy eating, the use of nutritional information in healthy eating, purchase habits and the importance placed on NCs and HCs when purchasing food, body mass index (BMI), self-reported health problems, and their socio-demographic characteristics. Previous research exploring consumer preferences through choice behaviour has mainly used a limited set of NCs and HCs (Barreiro-Hurle et al., 2010b; Benson et al., 2018; Bialkova et al., 2016; Carrillo, Fiszman, Lähteenmäki, & Varela, 2014; Iglesia et al., 2018; Jurado & Gracia, 2017; Van Wezemael et al., 2014). Studies 3 and 4 are the first to evaluate consumer preferences for multiple NCs and HCs. (13 in total). This is an important aspect to consider, as it allows consumers to compare and evaluate many different claims, similar to a real purchasing situation.

Another contribution of this dissertation offered by Study 3 is the inclusion of taste in healthy food products. As previously mentioned, in some countries, consumers associate healthy food with an unpleasant taste (Hamblin, 2018; Raghunathan et al., 2006; Suzuki & Park, 2018); thus, as the first of its kind, the contribution of Study 3 is the examination of four of the most important parts of our research framework (i.e. consumers' quality perception process): i) visual attention, ii) quality perception, iii) purchase behaviour, and iv) experienced attribute based on taste. Empirically, this dissertation not only contributes to the literature exploring consumer preferences for healthy food, but it also provides policymakers and the agro-food sector with relevant information about consumer preferences for NC and HC labels, assisting them in designing new policies and marketing strategies while promoting healthy food choices.

1.6.2. Methodological contribution

This dissertation methodologically contributes to the literature on consumer behaviour towards food products with NCs and HCs in several ways. First, while previous research has estimated consumers' WTP for NCs and HCs using various stated preference methods (e.g. contingent valuation and choice modelling), an HP analysis evaluated the effects of, among other attributes, NCs and HCs on yoghurt prices (Study 1). This is a more realistic approach, as it analyses the effects of real product attributes on price in the real market. In other words, the HP approach specifies what consumers already pay for each type of NC and HC on yoghurts in the market.

Second, in this dissertation (Studies 2, 3, and 4), a DCE was employed due to its ability to value multiple attributes simultaneously, its consistency with the random utility theory (RUT), and its similarity to real purchase decisions (Ballco & Gracia, 2020). Moreover, the DCE method is the most commonly used valuation technique in the food marketing literature. In the choice modelling approach, consumers must choose between alternative products that contain a number of attributes with different levels, which closely resemble the consumer purchasing decision process (e.g. in supermarkets).

Consumers' familiarity with the task is the main advantage of the DCE method with respect to the other commonly used valuation methods (e.g. experimental auctions). In experimental auctions, participants are asked to submit bids for the product, and the price is determined by the highest bid, which is an unfamiliar mechanism for most consumers (Alfnes, Guttormsen, Steine, & Kolstad, 2006). Consumers are asked to make trade-offs between changes in attribute levels. A no-buy alternative is also included in each set of alternatives, which indicates that participants would not buy any of the presented product alternatives.

Third, the DCE was combined with observational data based on ET technology (Study 2 and 3). Eye-tracking data were recorded during the performance of the DCE. This more advanced methodological approach incorporates visual attention based on ET measures into the choice model. The use of ET in agriculture economic research is an innovative approach, as only a limited number of previous studies have incorporated it in choice modelling (Balcombe et al., 2015, 2017; Bialkova et al., 2014; Van Loo et al., 2015, 2017). Eye-tracking technology has led to useful insights into consumers' use of nutritional information and sustainability labels on food packages (Antúnez, Giménez, Maiche, & Ares, 2015; Antúnez et al., 2013; Ares, Mawad, Giménez, & Maiche, 2014; Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Van Herpen & Van Trijp, 2011; Van Loo et al., 2015, 2017; Visschers, Hess, & Siegrist, 2010). However, ET technology has not yet been applied to the assessment of the effect of visual attention to multiple NCs and HCs on food packages. With an increasing number of NCs and HCs, it is important to improve our understanding of consumers' visual attention to NCs and HCs. This dissertation thus provides an initial study addressing this research gap by studying visual attention to multiple NCs and HCs and its relation to choice behaviour.

In addition to visual attention to NCs and HCs, which is 'a continuous measure of the degree to which a respondent evaluates the attribute' (Balcombe et al., 2015), this dissertation also investigates visual ANA, which is a discrete measure that indicates whether participants will be considered

to have attended to an attribute (Balcombe et al., 2015, 2017; Van Loo et al., 2017). Thus, from a methodological point of view, this dissertation also contributes to the literature on ANA in CEs by implementing visual ANA through the use of ET technology.

Fourth, besides measuring attention and choice behaviour, this dissertation also includes the sensory aspects of the food product. As previous sensory research has indicated, taste is perceived to be one of the most influential purchase factors (Connors et al., 2001; Drewnowski & Rock, 1995; Glanz et al., 1998; Kearney et al., 2000; Kourouniotis et al., 2016; Mok, 2010), and consumers tend to associate healthy food with an unpleasant taste. Thus, it is important to evaluate the market potential of healthy products to assess whether, and how, taste influences consumer preferences for NCs and HCs. As the first of its kind to combine DCE and ET with sensory analysis, this dissertation examines the importance of taste in a healthy food product. The combination of these three methods provides novel insights into the decision-making process and consumer behaviour, which facilitates the examination of preferences for healthy food.

1.7. Thesis outline

This dissertation is a compilation of four studies, resulting in four research chapters in line with the four scientific research papers which have been published to national and international peer-reviewed journals, covering the scientific disciplines of agricultural economics, food marketing, consumer behaviour, and food choice. As also illustrated in Table 1.2, the studies (Studies 1 through 4) are related to the chapters (Chapters 2 through 5), and the specific research questions (RQ1 to RQ15) in each chapter are covered. In addition to the four chapters, a general introduction and a general conclusion are included, resulting in a total of six chapters.

Chapter 1 presents the general introduction, objectives, and thesis outline. More precisely, it explains the definitions of NCs and HCs and their legal framework, as well as the availability and variability (i.e. type of claims) of these claims in the EU food markets.

In addition, it illustrates the use of NCs and HCs, the importance of sensory characteristics and the quality perception process in consumer food choice, and the conceptual framework, which is discussed in detail (Section 1.3).

Chapter 2 investigates the exposure of (among other intrinsic and extrinsic characteristics) NCs and HCs and examines their effect on yoghurt prices. In other words, it examines the price premiums that Spanish consumers pay for each type of NC and HC when purchasing yoghurt.

Chapters 3 and 4 focus on consumers' valuation of NCs and HCs on healthy foods (yoghurt). More specifically, Chapter 3 examines consumers' visual attention and choice decision for multiple NCs and identifies consumer segments with different preferences based on importance given to yoghurt attributes, as well as socio-demographic characteristics. Chapter 4 investigates consumer preferences for NCs and HCs on a healthy food and provides insight into visual attention and visual ANA in CEs towards these claims. Preferences based on the sensory aspects of a healthy food are also given emphasis in relation to visual attention and food choice.

Chapter 5 examines the relationship between choice behaviour, attitudes, and socio-demographic characteristics to predict Spanish consumer characteristics of healthy foods with NCs and HCs. This chapter looks at consumer GHI eating and use of food with NCs and HCs from a consumer's point of view.

Finally, Chapter 6 provides a general conclusion based on the aforementioned research objectives. Limitations, suggestions for further research, and policy and industry implications are reported. Since the research chapters (Chapters 2 through 5) are a collection of published articles, they can be read independently, but they may overlap to some extent with the introduction (Chapter 1) and conclusions (Chapter 6).

1.8. References

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Chapter 2

Nutritional and health claim effects on yoghurt prices

This chapter is based on:

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Abstract

This article investigates price effects of NCs and HCs, in addition to other attributes, on yoghurts in the Spanish market. Prices and product characteristics are collected from yoghurt label references found on the shelves of the main representative retail shops in the capital city of Aragón (Zaragoza) Spain. The total sample included 508 yoghurts. Nutritional claims and HCs are selected based on the official definitions of the (EC) Regulation No 1924/2006 and No 432/2012. Premium prices of the claims and other attributes included are assessed through a HP approach. Results show that yoghurt is a highly differentiated food product. NCs related to fat-free, low in sugar and fibre content do not affect yoghurt prices while most of the HCs receive significant positive effects. Health claims outperform NCs leading to higher premium prices. These findings are a useful source in a better understanding of the evolution of NCs and HCs in the Spanish market. Our findings suggest that NCs accompanied by the corresponding HC, which exactly define the benefits of that nutrient in our health may be a promising strategy for product differentiation.

RQ1: Which attributes influence yoghurt prices in the market?

RQ2: What type of claims affect yoghurt market prices?

RQ3: Which claim (NCs vs. HCs) receives the highest premium price?

2.1. Introduction

Developing functional food with increased health benefits and acceptable sensory properties has been one of the main objectives of the food industry for the past 20 years. In Europe, consumers' demand for healthier food products is rising continuously with special concern toward nutritional aspects. Increased awareness in health issues has led to an increase consumption of functional dairy products, and more specifically yoghurts enriched with nutrients. Yoghurt is obtained through a fermentation process of milk active bacterial cultures and by-products (Serafeimidou, Zlatanos, Laskaridis, & Sagredos, 2012) that can be used as a vehicle for probiotic cultures (Lourens-Hattingh & Viljoen, 2001), and it is associated with a healthy dietary pattern (Cormier et al., 2016). The consumption of sufficient amounts of yoghurt live microorganisms[4] promotes health benefits (WHO/FAO, 2001). Such benefits include a reduction risk of type 2 diabetes (Díaz-López et al., 2016), reduction in weight gain (Mozaffarian, Hao, Rimm, Willett, & Hu, 2011) and prevention of certain cardiovascular diseases (Astrup, 2014).

Commercial yoghurt has created a widely segmented market offering a variety of functional products whose nutritional and health benefits are reported in NC and HC. One of the hurdles in the success of these products is that a nutritional or/and a health benefit delivered by a functional food is a credence attribute[5] which cannot be easily recognized even after repeated consumption. Products that are characterized by credence attributes may result to asymmetric information.

[4] Live and active culture yoghurts must contain an amount of ≥ 108 organisms/g live Lactic Acid Bacteria (LAB) (Desobry-Banon, Vetier, & Hardy, 1999). According to the United States Department of Agriculture (USDA)'s ChooseMyPlate website, for anyone over the age of 9, the recommended dairy product intake is 3 cups (735 g) per day, out of which, 1 cup (245 g) is yoghurt (USDA-The Food Guide Pyramid, 1992).

[5] Credence attributes of a good are quality aspects difficult, or in some cases, impossible to detect by consumers, but that play an important role for them (*e.g.*, organic) (Caswell, 1998).

In order to fill this gap, the EU has introduced regulations[6] with a main objective to reduce the asymmetric information, guarantee truthful and understandable claims by the 'average consumer' and aim in healthier informed food choices. Within the European context, recent studies on consumer preferences and WTP report distinct preferences among consumers from different countries for NCs and HCs. More specifically, a study of Van Wezemael et al. (2014) investigates consumer preferences for NCs and HCs on lean beef steak in four EU countries (Belgium, France, the Netherlands and UK) found that in Belgium, the Netherlands and France, NCs and HCs on saturated fat yielded higher utilities than claims on protein and/or iron, while the opposite was found among consumers in the UK. On the other hand, studies conducted in different countries covering a broad range of issues including consumers' attitudes and perceptions (Masson, Debucquet, Fischler, & Merdji, 2016; Urala & Lahteenmaki, 2007), preferences (Annunziata, Vecchio, & Kraus, 2016; Bechtold & Abdulai, 2014) and WTP for functional food (FF) products with NCs and HCs (Cavaliere, Ricci, & Banterle, 2015; de-Magistris & Lopéz-Galán, 2016; Hellyer, Fraser, & Haddock-Fraser, 2012; Hirogaki, 2013; Jurado & Gracia, 2017; Lopez-Galán & De-Magistris, 2017) found that health-conscious consumers have positive perception and are willing to pay premium prices for food products with NCs and HCs. Others indicate that healthier perceptions and acceptance of FFs with NCs and HCs depend on the ingredients and their combination within the product.

[6] Regulation (EC) No 1924/2006 defines a nutritional claim as '*…any claim which states, suggests or implies that a food has particular beneficial nutritional properties…*' In other words, NCs are the simplest type of claim about the nutrients (protein, carbohydrate, fat, fiber, vitamin and minerals) a food contains (*e.g.*, a yoghurt containing vitamin B6). Regulation 1924/2006 and the updated Regulation No 432/2012 define a health claim as '*… any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health…*' There are four types of HCs: (i) Article 14 health claims are those related to the reduction of disease risk claims, (ii) and claims regarding children's development and health; (iii) Article 13(5) health claims are based on newly developed scientific evidence and may include a request for the protection of proprietary data and (iv) Article 13 health claims also known as ´General health claims´ are those that describe the effect of a substance on a body function.

More specifically, Landström et al. (2009) and Cox et al. (2011) found that consumers have healthier perceptions and positive acceptance for food products when the bioactive ingredient is 'naturally added' or inherited. Results are also confirmed by previous studies (Chase et al., 2009; Krutulyte et al., 2011) who found that consumers have negative perceptions toward yoghurts enriched with omega 3 because the combination of this ingredient is perceived to be artificial. On the other hand, Krutulyte et al. (2011) and Ares & Gámbaro (2007) found positive attitudes on dairy products enriched with calcium rather than antioxidants and iron since the functional component (calcium) is 'naturally' inherited to this product category. Thus, not all type of functional nutrients within the same product category may be perceived positively and generate premiums.

Concerns for healthier food choices have also derived consumers to pay premium prices for FF with NCs and HCs. In the case of the Italian yoghurts, Carlucci et al. (2013) found premium prices for the added fibre (+32.33%), probiotic (+24.45%) and calcium (+27.18%) attributes. In the case of fruit beverages, Szathvary & Trestini (2014) found positive effects for NCs (5.7%) and for HCs (20.6%), respectively. In the same line, Bimbo et al. (2015) found premium prices for added fibre (0.183€/L) and added vitamins (0.044€/L) to the UHT-treated milk. Barreiro-Hurle et al. (2010) found higher WTP for HCs related to health risks. This result was also confirmed by Annunziata & Vecchio (2013) and Ares et al. (2010) who reported that in the case of dairy products, consumers mostly prefer those HCs that reduce the risk of osteoporosis and cardiovascular diseases. In spite of the fact that there are many studies focused on consumer acceptance of NCs and HCs, to the best of our knowledge, there is a scant literature assessing (among other attributes) the analysis of specific NCs and HC premium prices on food products in Spain. Hence, the main objective of this work is to fill these gaps and assess the market valuation of (among other attributes) specific NCs and HCs for yoghurts in Spain. This is the first contribution of this paper. To achieve this objective, we used the HP approach as the most appropriate analytical tool due to high range of yoghurts retail prices in the Spanish market. Moreover, HP approach has the advantage to explain how yoghurt prices vary depending on NCs and HCs.

In Spain, the HP approach has been used by Cabrera et al. (2015) on the extra virgin olive oil, Gracia & Perez y Perez (2004) on veal and Sanjuán-López et al. (2009) on saffron. Nevertheless, the present study is the first that analyses NCs and HCs on yoghurt in Spain, while using the HP methodology on yoghurt attributes is the second contribution of our paper. Finally, through an identification of the individual effect of each NC and HC on the overall price of yoghurt, our results will provide guidance for food manufactures and distribution presenting investment opportunities in the development and marketing of FF.

2.2. Material and methods

2.2.1. Data collection

Results from the most recent studies focused on yoghurts (Bonanno, 2015; Carlucci et al., 2013) have determined that extrinsic attributes best explain the final product price although in the markets with experienced consumers, some intrinsic attributes are significant. To determine the presence of NC and HC and the rest of yoghurt attributes, we created a database that collects information regarding yoghurt products available between July and September 2015. The creation of the database was based on the standardized protocols established by the International Network for Food and Obesity Research, Monitoring and Action Supporting the (INFORMAS) of Pravst & Kušar (2015) and Rayner et al. (2013). The final sample included yoghurts that contained one nutritional and/or health claim in the package and were in accordance to the official EU definitions[7]. The sample included 508 yoghurts in total marketed in three types of stores present in the national territory. To guarantee the representativeness of the sample, the data were collected in the online stores and were validated with visits to the physical stores of 'Carrefour', 'Mercadona' and 'Dia' food distribution

[7] (EC) No 1924/2006 and (EC) No 432/2012 for NCs and HCs.

chains, which account for 40% of the sector's market share[8] (Kantar Worldpanel, 2017).

Natural yoghurts were a selection of all plain yoghurts with no fruits / flavours but from different textures (*e.g.,* liquid). The database was created in Microsoft Excel 2010 that allowed the collection of the following information: Name of the distribution chain, product category, product name, brand, price, presence or absence of NCs, and the HCs (if any). This study only includes nutritional statements expressed in text and not as symbols unlike the study of Pravst & Kušar (2015). Table 2.1 summarizes the attributes included in this study and the descriptive statistics of variables.

As shown in Table 2.1, yoghurt prices varied depending on quantity from a minimum of €0.89 to a maximum of €6.75 with an average price of €3.07/kg. The quantity content varied between 100 g and 2 kg, with an average weight of 607 g. The most common size found was 400-500 g (46%), mainly in plastic Quattro pack of 125 g (500 g) followed by 600-1000 g (17%) and containers of 500-600 g (12%). The hypermarket provided around 52% of the total number of references followed by the discount store with about 26% of yoghurts. Neighbourhood store had lower number of references compared to the hypermarket distribution chain and slightly lower (22%) compared with the discount store.

Records imply that yoghurts were mostly marketed with the own distributor's private brands (51%) in comparison to processor's leader brands (49%). In terms of sensory characteristics, the majority of yoghurts were marketed with fruits and flavours (86%) followed by natural plain yoghurts (27%) and drinkable yoghurts (23%), in comparison to the rest (*e.g.,* Bifidus and Greek yoghurts). Yoghurts baring the 'fat-free' NC (31%) followed by yoghurts with 'source of calcium' (15%), 'no added sugar' (9%) and the ones with 'source of vitamin B6' (8%) had the highest presence in the local market, while, yoghurts with the 'source of fibre' (1%) and 'high in protein' (2%) type of claims had the lowest presence.

[8] It is worth to mention that while in countries like UK a handful of large operators control more than 80% of the market, in Spain the local chains and small distribution companies still distribute about 45% of the pie.

Table 2.1. Characteristics of the sample

Attributes	Attribute levels	Observations (%)
Price	€/kg	508 (100)
Retail channel	Hypermarket (Carrefour)	266 (52.36)
	Discount (Dia)	130 (25.59)
	Neighbourhood store (Mercadona)	112 (22.05)
Brand	Leader	259 (50.98)
	Private	249 (49.02)
Sensory characteristics	Drinkable	116 (22.83)
	Bifidus	51 (10.04)
	Natural	137 (26.97)
	Greek	49 (9.65)
	Fruity / Flavours	434 (85.93)
Nutritional claims	Fat / Free fat	157 (30.91)
	Sugar / No added sugar	44 (8.66)
	Fibber / Source of fibre	4 (0.79)
	Protein / High source of protein	8 (1.57)
	Vitamin B6 / Source of vitamin B6	39 (7.68)
	Calcium / Enriched with calcium (%)	78 (15.35)
Health claims	Vitamin B6 contributes to the normal functioning of the immune system.	21 (4.13)
	Plant sterols/stanols contribute to the maintenance of normal blood cholesterol levels.	22 (4.33)
	Fibber contributes to an acceleration of intestinal transit	7 (1.38)
	Lactase enzyme improves lactose digestion in individuals who have difficulty digesting lactose	64 (12.59)
	Calcium is needed for the maintenance of normal bones	4 (0.79)

	No. cases (%)	Minimum price	Maximum price	Average price	*SD*
Total sample	508 (100)	0.89	6.75	3.07	1.06
	Package size mean 607 (g)				
100-250 (g)	61 (12)	0.89	4.79	1.01	0.63
250-400 (g)	23 (4.53)	0.90	1.89	1.39	0.31
400-500 (g)	232 (45.67)	0.52	3.80	1.38	0.63
500-600 (g)	63 (12.40)	1.37	3.92	2.50	0.91
600-1000 (g)	84 (16.54)	0.71	4.74	1.69	0.97
>1000 (g)	45 (8.86)	0.79	6.75	3.17	1.66

Source: Own elaboration

Records implied that the HCs that dominate the yoghurt market were the ones that described the effects of 'lactose digestion' (12%), the ones that 'control cholesterol levels' (4%) followed by those that contain 'vitamin B6 that contributes to the normal functioning of the immune system' (4%).

2.2.2. Hedonic price approach

The basis of the HP theory comes from two formative studies of Lancaster (1966) and Rosen (1974), who question the traditional utility function and suggest that consumers' utility increases based on the attributes a product possess instead of the product itself. Following Rosen (1974) the HP function undertakes that market goods are made of a set of characteristics that can be represented by a vector *k* of attributes:

$$z = (z_{1,} z_{2,\ldots,} z_k) \tag{1}$$

The utility function for a representative consumer is then expressed as:

$$\mathrm{U} = \mathrm{U}\ (z_{1,}\ z_{2,\ldots,} z_k\ ;\ \alpha) \tag{2}$$

where z_k is the quantity of the k^{th} attribute contained in market goods and α is a parameter of consumer preferences. The level of the n^{th} attribute achieved by a consumer will depend on the number of quantity (Qi) of different goods consumed. Units are related to z_k through the variable x_{jk} that represents the amount of the k^{th} attribute contained in one quantity of the j^{th} product. Under this assumption:

$$Z_k = \mathrm{f}_n(\mathrm{Q}_{1,} \mathrm{Q}_{2,\ldots,} \mathrm{Q}_{n,} x_{1k,} x_{2k,\ldots,} x_{nk}) \tag{3}$$

Taking into consideration equation (2) and (3), an individual´s level of utility is based on the level of attribute per quantity of product and the number of products consumed:

$$\mathrm{U} = \mathrm{U}\ (\mathrm{Q}_{1,} \mathrm{Q}_{2,\ldots,} \mathrm{Q}_{n,} x_{1t,\ldots,} x_{nk}; \alpha) \tag{4}$$

As the economic theory states, consumers will maximize utility (4) subject to a budget constraint, defined as:

$$\mathrm{M} = \sum_{j=1}^{n} \mathrm{P}_j \times \mathrm{Q}_j \quad (5)$$

where P_j is the price of the market good j^{th}. As result the maximization issue is given as:

$$\mathrm{P}_j = \mathrm{f}\,(x_{j1}, x_{j2,\ldots,} x_{jk}) \quad (6)$$

where, x_{jk} is the quantity of attribute *k* associated with a unit of Q_j. Expression (6) can adopt different functional forms. A linear function implies that implicit prices are constant while a non-linear function implies that the prices of an additional unit of a characteristic will depend on the quantity. Few studies in Table 2.2 have mainly used linear functions and have adopted different methodological solutions.

Table 2.2. Hedonic price applications

Topic	Authors	Functional form
Nutritional composition of fruit beverages	Leschewski et al. (2016)	Log-lin
Do HCs add value?	Bimbo et al. (2016)	Log-lin
Examination of the olive oil price structure	Cabrera et al. (2015)	Log-log
Hedonic analysis on the UHT milk prices	Bimbo et al. (2015)	Log-lin
NCs and HCs valuation on fruit beverages	Szathvary & Trestini (2014)	Log-lin
Valuation of yoghurt HCs	Bimbo et al. (2014)	Log-lin
Values of olive oil	Muñoz et al. (2015)	Log-lin
Price variability in the Italian yoghurt market	Carlucci et al. (2013)	Log-log
Developing strategies for Jiloca saffron	Sanjuán-López et al. (2009)	Log-log
Determinant factors of veal price	Gracia & Perez y Perez (2004)	Log-lin

Source: Own elaboration

2.2.3. Model specification

As in most cases of HP applications, a dependent price model was specified. The '*Price*' and '*Quantity*' variables were measured in €/kg and grams, respectively and were introduced to the model as continuous variables. The rest were exploratory variables which explained the characteristics of the currently marketed product. Each possible level was specified as a dummy variable. Table 2.3 presents the description of variables used in the estimation of the HP function.

Table 2.3. Description of variables used in the estimation of the hedonic price function.

Attributes	Attribute levels	Variable	Value
Price	-	Price	Continuous (€/kg)
Quantity	-	Quantity	Continuous (g)
Retail channel	Hypermarket	Hyper	1= hypermarket; 0= otherwise
	Discount store	Disc	1= discount store; 0= otherwise
	Neighbourhood	Neigh	(α) is expressed as constant
Brand	Leader / Private	Brand	1= leader; 0= private (supermarket)
Sensory characteristics	Drinkable	Drink	1= liquid; 0= otherwise
	Bifidus	Bifidus	1= bifidus; 0= otherwise
	Natural	Natural	1= plaint (natural); 0= otherwise
	Greek	Greek	1= Greek yoghurt texture; 0= otherwise
	Fruity / Flavours	Fruit_Flav	1= fruits or flavours; 0= otherwise
Nutritional claims	Fat-free	N_FatFree	1= fat-free; 0= otherwise
	No added sugar	N_NoSugar	1= no added sugar; 0= otherwise
	Source of fibre	N_Fiber	1= source of fibre; 0= otherwise
	High source of protein	N_Protein	1= high source of protein; 0= otherwise
	Source of vitamin B6	N_VitB6	1= enriched with vitamin B6; 0= otherwise
	Enriched with calcium (%)	N_Calcium	1= enriched with calcium; 0= otherwise
Health claims	Vitamin B6 contributes to the normal functioning of the immune system.	H_VitB6	1 if the product contains this HC; 0= otherwise
	Plant sterols/stanols contribute to the maintenance of normal blood cholesterol levels.	H_Cholesterol	1 if the products contains this HC; 0= otherwise
	Fiber contributes to an acceleration of intestinal transit	H_Fiber	1 if the product contains this HC; 0= otherwise
	Lactase enzyme improves lactose digestion in individuals who have difficulty digesting lactose	H_Lactase	1 if the product contains this HC; 0= otherwise
	Calcium is needed for the maintenance of normal bones	H_Calcium	1 if the product contains this HC; 0= otherwise

2.2.4. Box-Cox transformation

The most frequently functional forms applied in the literature are the semi-logarithmic (log-lin), the logarithmic (lin-log) and the double-logarithmic (log-log). Since the economic theory does not solve the problem as to which is the most suitable functional form of the HP function, it is a decision that researchers have to make empirically. The Box-Cox transformation approach (Box & Cox, 1964) has usually been applied for this purpose. The approach nests alternative functional forms, by adding non-linear parameters, θ and λ on the dependent and independent variables, respectively expressed as:

$$P_k^{(\theta)} = \begin{cases} \frac{P^{\theta}-1}{\theta} if\ \theta \neq 0 \\ \ln\theta\ \ if\ \theta = 0 \end{cases} \quad z_k^{(\lambda)} = \begin{cases} \frac{Z^{\lambda}-1}{\lambda} if\ \lambda \neq 0 \\ \ln\lambda\ \ if\ \lambda = 0 \end{cases} \tag{7}$$

The Box-Cox transformation provides four possible functional outcomes: (i) linear, when θ=λ=1; (ii) semi-logarithmic, when θ=0 and λ=1; (iii) double-logarithmic, θ=λ=0 and (iv) liner-logarithmic, θ=1 and λ=1. However, individual and joint tests on the Box-Cox parameters may lead to un-conclusive results. According to previous literature (Cabrera et al., 2015; Sanjuán-López et al., 2009) the Vuong test (Vuong, 1989) may be applied in order to select the functional form that best fits the data. The Vuong test determines the predicted probabilities of two models, choosing the best values in terms of log-likelihood and the variance estimate of their difference. For each functional form *i,* the likelihood ratio is expressed as:

$$LR^i = \left(\lambda_{\mathrm{j}}\ \theta_j, \lambda_{\mathrm{k}}\ \theta_k\right) = ll_j^i - \ ll_k^i \tag{8}$$

where *j, k* are one of any of the four models (*m*) defined by the Box-Cox transformation and the ll_m is the log-likelihood function for observation *i* evaluated at the parameter estimates of the model *m*. The Vuong test than is given by:

$$Vuong = \frac{\sqrt{n}\left[\frac{1}{n}\Sigma_{i=1}^{n} LR_i\right]}{\sqrt{\frac{1}{n}\Sigma_{i=1}^{n}\left(LR_i - \overline{LR_i}\right)^2}} \tag{9}$$

where, n is the number of observations. The test is normally distributed, thus, values larger than the critical $N_{\alpha/2}$ (with α the significance level) favor model *j*; negative values $-N_{\alpha/2}$ are in favor of model *k* and Vuong ≤ $N_{\alpha/2}$ indicates no significant differences between the two models.

2.3. Results

The first step includes the estimation of the Box-Cox regression. Table 2.4 provides the results indicating that two possible functional forms are not rejected. If we consider that that a joint linear transformation is always rejected then we choose the semi-logarithmic log-lin functional form for further analysis.

Table 2.4. Box-Cox transformation

Functional form	θ value	λ value	Statistic (*p*-value)	Result
Log-lin	0	1	0.05 (0.83)	Not rejected
Lin-log	1	0	56.76 (0.00)	Rejected
Lin-lin	1	1	1.29 (0.26)	Not rejected
Log-log	0	0	34.21 (0.00)	Rejected

Source: Own elaboration

Since the Box-Cox transformation might lead to un-conclusive results, very common in the HP empirical literature, in addition, Vuong´s test was applied (Table 2.5). Likewise, the results of the Vuong test indicate that the semi-logarithmic (log-lin) functional form is suitable.

Table 2.5. Vuong's test results

Ho:	Vuong statistic	Accepted form
Log-lin *vs.* lin-log	-15.296*	Log-lin
Log-lin *vs.* lin-lin	-0.016	-
Log-lin *vs.* log-log	-0.004	-
Lin-log *vs.* lin-lin	0.001	-
Lin-log *vs.* log-log	0.002	-
Lin-lin *vs.* log-log	0.001	-

* indicates the values were higher or lower than the critical values of 1.96 and -1.96 respectively, rejecting the null hypothesis of no-differences among functional forms.
Source: Own elaboration

In line with Muñoz *et al.* (2014) and Cabrera *et al.* (2015) additional statistical parameters have been performed to verify the functional form that best fits the model. Two likelihood ratio statistics were performed to verify if the semi-logarithmic (log-lin) functional form was significantly preferred to a semi-logarithmic (lin-log) or a double-logarithmic (log-log) specification, respectively. Results clearly indicated that the adopted functional form was superior to the other two alternatives. Goodness-of-fit (R^2 = 0.66) and the adjusted R^2 = 0.64 were higher and significant (F-statistic < 0.01) while the Akaike and Schwarz information criterion was lower than those of the log-lin and log-log model, respectively. Moreover, the model showed no problem with the normality of residuals (probability of Jarque-Bera statistic of 0.00). The heteroscedasticity was tested by the Breusch-Pagan-Godfrey and White test statistic and the null hypothesis of the homoscedasticity in the error term was rejected (probability F-statistic 0.00), that indicates homoscedasticity problems. White's robust estimation strategy to obtain the parameter standard errors was used to solve this problem. The estimated hedonic price function parameters are shown in Table 2.6.

When analysing, the magnitude of the coefficients must be understood as the percentage change of the price variable in view of the change in a unit of the independent variable. In the case of a continuous variable this percentage change can be determined as:

$$(\partial P/\partial Z_K)\,(1/P) = (\partial LnP/\partial Z_K) = \beta_m \tag{10}$$

That can be expressed as a percentage $100 \times \beta_m$. Percentage variation for the rest variables were calculated according to Kennedy (1981):

$$100 \times (\exp[\beta_m - 0.5Var(\beta_m)] - 1) \tag{11}$$

where $Var\,(\beta_m)$ is the estimated variance of parameter *m*.

All the percentage variations for each of the attributes used in the estimation model are shown in the fourth column of Table 2.6 (percentage impact that each dummy variable has over price).

Table 2.6. Parameters estimates of the hedonic price equation

	Semi-logarithmic (log-lin)				
	Coefficient	**(SE)**	***p*-value[a]**	**PI[b] (%)**	**IP[c] (€/kg)**
Constant (α)	1.6358	0.11	0.000***	-	-
Quantity	-0.0007	0.00	0.000***	-0.07	-0.002
Brand	-0.5493	0.05	0.000***	-43.66	-1.340
Hyper	-0.0772	0.05	0.103*	-9.59	-0.294
Disc	-0.0528	0.05	0.295	-7.50	-0.230
Drink	0.1408	0.05	0.011***	12.00	0.368
Bifidus	0.0774	0.05	0.158	5.13	0.158
Natural	-0.0733	0.05	0.113	-9.18	-0.282
Greek	0.2181	0.05	0.000***	21.54	0.661
Fruit_flav	-0.0302	0.06	0.594	-5.69	-0.175
N_FatFree	-0.0428	0.04	-1.16	-5.94	-0.182
N_NoSugar	0.0076	0.06	0.892	-2.01	-0.062
N_Fiber	0.0249	0.06	0.697	-0.71	-0.022
N_Protein	0.2609	0.04	0.000***	27.19	0.835
N_Vitb6	0.5263	0.09	0.000***	62.19	1.909
N_Calcium	-0.0904	0.04	0.033***	-10.55	-0.324
H_Vitb6	0.1898	0.10	0.051**	15.19	0.466
H_Cholesterol	0.5885	0.08	0.000***	73.18	2.247
H_Fiber	0.0750	0.15	0.612	0.11	0.003
H_Calcium	0.1781	0.05	0.000***	16.84	0.517
H_Lactase	0.4346	0.08	0.000***	48.65	1.494
R^2	0.6565				
Adjusted R^2	0.6424				
F-test	14.82 (0.00)				

[a] *p*-values calculated with robust HC3 standard errors. [b] PI: percentage impact over price. [c] IP: implicit price. Average price of the sample: €3.07/kg. ***,**,*: significant at 1%, 5% and 10% level, respectively. *Source:* Own elaboration

Values appearing in the fifth column were the result of applying the percentage impact on a reference price. In this case the average price of the sample is €3.07/kg, so implicit prices were calculated. Observations from table 2.6 show that the '*Quantity*' variable was statistically significant and negative at 1% with a coefficient equal to -0.0007.

Taking into account the logarithmic form of the equation, the coefficient of a continuous variable such as '*Quantity*' can be directly interpreted in terms of elasticity. Therefore, a negative but less than one coefficient means that an increase in the total amount of product contained in the package leads to a less-than-proportional decrease in its price. This is an expected result since discount on a unit price is usually given when a larger quantity of product is purchased. Regarding the two types of brands the model gives a negative impact of -43.66% for the '*Leading*' brands in comparison to '*Private*' (supermarket) brand. The different type of retail channels where the product is sold significantly affects product prices and in particular, in comparison with '*Neigh*' store, the price decreases at -9.59% for '*Hyper*'. The '*Disc*' store was not statistically significant therefore did not receive any premium or price discount compared to the other type of stores. With respect to the different types of sensory characteristics, '*Greek*' yoghurt is found to be the most valued type of yoghurt with a positive impact price of 21.54%. '*Drink*' yoghurts have lately become very popular in the local market for being enriched with different types of vitamins (*e.g.*, B6, B12 etc.) and perceived as healthier yoghurts. In our case, this type of yoghurt is the second mostly valued with a positive impact of 12.00%. In particular, Spanish consumers pay an additional price of €0.66/kg for '*Greek*' yoghurts and an additional of €0.37/kg/l for '*Drink*' type of yoghurts. '*Bifidus*' '*Natural*' and '*Fruit_flav*' yoghurts are not statistically significant therefore these types of yoghurts do not receive premium or price discounts.

Unexpectedly, three most familiar NCs with the highest presence in the market ('*N_FatFree*', '*N_NoSugar*' and '*N_Fiber*') did not seem to affect yoghurt prices. In contrary, two NCs '*N_VitB6*' and '*N_Protein*' that were introduced later in the market received positive impact prices of 62.19% and 27.19% and were valued with additional implicit prices of €1.91/kg/l and €0.84/kg, respectively. On the other hand, the coefficient of '*N_Calcium*' was negative with a percentage impact change over price of -10.55 and an implicit price of €-0.32/kg. By contrast, HCs seemed to better respond and affected yoghurt prices in the local market in comparison to NCs.

In particular, the highest premium price was received by yoghurts that bared the '*H_Cholesterol*' claim (€2.25/kg) with a positive impact on price of 73.18 %. The HC related to lactose digestion was the second most valued type of claims. More specifically, '*H_Lactase*' claim received 48.65% positive impact and a premium price of €1.49/kg. In contradiction to the negative valuation of the '*N_Calcium*' nutritional claim, the HC that explains the effect of 'H_Calcium' in our body, revealed to have a positive percentage impact change over price of 16.84% and received a premium of €0.52/kg. This means that when the '*Calcium*' nutritional and health claim appeared jointly the estimation effect was positive. Yoghurts baring the HC of '*H_VitB6*' also had a positive impact of 21.12% over price and were valued with an additional price premium of €0.65/kg/l. Lastly, '*H_Fiber*' HC was totally neglected therefore this attribute did not have a premium of discount price.

2.4. Discussion

The main objective of this study was to measure the market value in terms of implicit prices given to yoghurts with nutritional and health claims in the Spanish market. Results show that yoghurt is a highly differentiated food product. The quality attributes that the market competition is based are related to quantity, brand, type of retailer, the type of yoghurt (*e.g.*, natural, with fruits-flavours, bifidus, Greek etc.) and nutritional and health claims. The applied hedonic function provides a measure of the market value of these attributes and investigates some important features of the Spanish yoghurt industry to offer insights on certain competitive strategies.

Results showed that yoghurt prices are positively affected by private brands purchased at neighbourhood stores in comparison to leader brands purchased at hypermarkets. This is an expected result because in the Spanish market the neighbourhood store ('Mercadona') has the highest market share (23.6%) in comparison to the rest of supermarkets, including also the hypermarket of 'Carrefour' (8.5%) (Berengueras, 2017). In addition, while in the rest of super-hypermarkets the presence of private brand did not exceed 34.1%, the percentage of private brands in the neighbourhood store ascended to 56.6% in 2017 (San Esteban, 2017).

With respect to the different types of yoghurts present in the Spanish market, the Greek type received the highest premium price followed by drinking yoghurts. Drinking yoghurts have lately become very popular in the local market for being enriched with different types of vitamins (*e.g.*, B6, B12 etc.) and are perceived as healthier yoghurts. Consistent with Bonanno's (2013) findings in the Italian yoghurt market, consumers seem to prefer drinking yoghurts over regular ones, in particular with regard to functional alternatives. Bifidus, natural and yoghurts with fruits and flavours have negligible effects on the Spanish yoghurt prices.

Surprisingly, negligible effects on yoghurt prices are seen for the nutritional claims related to fat-free, no added sugar and fibre contents. These results are in contrary to consumers' preference growth for low-calorie and free-fat food products, and in contradiction to previous studies who state that consumers have stronger preferences for simple (Bitzios et al., 2011) and more familiar claims (Lähteenmäki et al., 2010). The neglected valuation of the free-fat nutritional claim is partially in line with Bimbo et al. (2016) who found negative marginal price for zero-fat (-1.9%) yoghurt attributes in Italy and in line with Carlucci et al. (2013) who found negative but not significant relationship between the low-fat attribute and yoghurt's prices in Italy. In general, our results are consistent with Van Wezemael et al. (2014) and Krystallis & Chrysochou (2011) who found that consumers across five different countries have very heterogeneous preferences on nutritional claims. More precisely, consumers from Belgium, the Netherlands, France and Greece give higher value on NCs related to fat content and saturated fat while it is the opposite for consumers in the UK. With respect to the fibre content nutritional claim our result is in line with Ares & Gambaro (2007) who found that fibre added to yoghurt are perceived as interfering with the naturalness and healthiness of the product, and this may reduce consumers' acceptance and price. Another reason that might influence the negative and not significant impact of the three most present NCs (*'N_FreeFat', N_NoSugar'* and *'N_Fiber'*) in the yoghurt Spanish market is that since these types of claims have been introduced long time ago they might be in the maturity stage of the product lifecycle.

To the contrary, two nutritional claims related vitamin B6 and protein contents that were later introduced in the national yoghurt market have positive influence on price and receive premiums. This outcome seems understandable since both claims are considered to be innovative, are still in the growth stage of the product lifecycle, are perceived as healthy attributes on yoghurts and have a limited competition in the local market (only 'Danone'). On the other hand, findings report that health claims, outperform nutritional claims leading to higher premium prices in the Spanish market. In particular, the highest premium price is received by yoghurts that bare the cholesterol claim. These estimates are consistent with other studies who found that product claiming to prevent cardiovascular diseases by lowering or controlling cholesterol levels are well accepted by dairy product consumers (Ares & Gámbaro, 2007; Landström, Hursti, Becker, & Magnusson, 2007). Moreover, Marette et al. (2010) found positive WTP for cholesterol HCs even for participants without high cholesterol problems. HCs regarding lactose digestion receive positive valuation being the second mostly valued after the cholesterol claim. This is an expected result due to the fact that in 2015 the Spanish Society of Digestive Pathology in collaboration with the Spanish Society of General and Family Physicians found that between 30 and 50% of the Spanish population suffers from lactose intolerance (Argüelles-Arias et al., 2015).

In contradiction to the calcium content nutritional claim who negatively affects yoghurt prices, the calcium type of HC was found to have a positive impact and received an important premium. This result is in contrast with Barreiro-Hurle et al. (2010) and Szathvary & Trestini (2014), who found negative interaction effects when nutritional and health claims are labelled together. Premium prices were also received by yoghurts bearing the vitamin B6 joint NCs and HCs. Lastly, the fibre health claim was totally neglected, therefore the attribute did not receive any premium price. This result was similar to Ares & Gámbaro (2007) who found that consumers show positive attitudes on dairy products enriched with calcium rather than fibre since the functional component (fibre) is 'artificially' inherited to this product category.

Our finding imply that NC and HC matters in determining a yoghurt's premium price due to a differentiation strategy of processors or manufacturers which should take into account the growing consumer concerns on healthier food products and heterogeneous preferences. Especially in the yoghurt market, health enhancing product differentiated by functional food ingredients seems to be the most profitable way of product differentiation. Even though, certain nutritional claims had no effect on yoghurt product prices, a profitable strategy may be to introduce them accompanied by the corresponding health claim that exactly defines the benefits of that nutrient on our health (*e.g.*, the case of enriched with calcium nutritional and health claim). Further research is needed in the future to better understand Spanish consumer preferences towards yoghurts with nutritional and health claims. Future research may analyse to what extent consumer preferences and WTP for these specific attributes are related to price structures and provide guidance to food manufacturers in deciding whether or not to invest in the development of marketing strategies. This constitutes our future research. Even though this study's interest is more limited to Spanish market, the methodology used can be replicated in other countries.

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Chapter 3

Consumers' visual attention and choice decision for nutritional claims

This chapter is based on:

Ballco, P., de-Magistris, T., & Caputo, V. (2019). Consumer preferences for nutritional claims: An exploration of attention and choice based on an eye-tracking choice experiment. *Food Research International*, *116*, 37–48. https://doi.org/10.1016/j.foodres.2018.12.031

Abstract

Nutritional claim requirements on food packages are among the most important and influential EU policy measures related to diet and have the capacity to promote healthy eating. This study combines a DCE method with ET technology to assess consumer preferences for multiple NCs in yoghurt selection and explores the relationships between the NC preferences and the visual attention paid to these claims and the visual attention and choice decisions. The results indicate that the low-sugar NC was the least-preferred claim in all the models. Overall, the presence of NCs generally increases visual attention in terms of FC, which may be linked to an increased likelihood of affecting the final decision to purchase yoghurts with NCs.

RQ4: Do NCs on yoghurts' FOP attract the visual attention of consumers, and which claims attract the most?

RQ5: What are the consumer preferences for NCs on yoghurts?

RQ6: Is there any relationship between the most visually attended and the chosen NCs?

RQ7: How do people with a different buying behaviour differ in terms of preferences towards NCs?

3.1. Introduction

Poor dietary patterns, high-energy intake, and malnutrition are some of the major triggers of non-communicable diseases (NCDs), such as obesity, diabetes, cardiovascular disease, and some types of cancer. According to the World Health Organization (WHO, 2018), NCDs cause 70% of deaths every year worldwide. Of the six WHO regions, Europe is the most affected by NCDs, and they are increasing. The impact of NCDs in Europe has accounted for an estimated 86% of the deaths and 77% of the disease burden in the last decade (WHO/Europe, 2018). Given the current situation, policy makers, such as the EU and the United States Department of Agriculture (USDA), have called for transitions toward healthier diets and more informed food choices (Burlingame, Dernini, & FAO, 2010; Dötsch-Klerk, Mela, & Kearney, 2015; UNEP, 2010). Healthiness, though, typically needs to be encouraged in consumers through trustworthy information that is based on scientific evidence.

In this regard, the EU has introduced European Council (EC) Regulation No. 1924/2006 (Smith, 2015), which requires NCs[9] in food products to be based only on scientific evidence. The positive impact of this regulation is that it identifies lawful claims and thereby makes it possible for authorities to take action if other NCs are used in the marketplace. Partly due to this EU labelling requirement, on average 85% of all packaged food products in Europe have NCs (Prieto-Castillo, Royo-Bordonada, & Moya-Geromini, 2015). In Spain, the availability of NCs reached 95%, making Spain one of the top countries in terms of nutritional labelling (Prieto-Castillo et al., 2015). In particular, a recent study that explored the presence of nutritional and health claims in five EU countries (the UK, Slovenia, the Netherlands, Germany, and Spain) ranked Spain second, after the UK, regarding the pres-

[9] This regulation defines an NC as 'any statement that suggests or implies that a food has specific beneficial nutritional properties.' This definition distinguishes two types of NCs. The first group refers to the content of nutrients or substances (e.g., a source of vitamin B_6), while the second group compares the product with its conventional version in terms of the content (high or low) of a nutrient or substance (e.g., high in calcium).

-ence of NCs (Hieke et al., 2016). Studies of consumers' understanding and use of nutritional information have shown considerable interest in NCs, but, in the case of Spain, of the 52% who reported a full understanding, only 21% reported using them (Prieto-Castillo et al., 2015). Hence, there is a need to investigate and identify the attributes that motivate the use of NCs and their influence on the decision to purchase.

Previous literature has indicated that NCs help consumers to compare the healthfulness of food products (Grunert, Wills, & Fernández-Celemín, 2010) and that generally they are willing to pay premium prices for food products bearing NCs (Ballco & de-Magistris, 2018; Barreiro-Hurle, Gracia, & De-Magistris, 2010; de-Magistris, López-Galán, & Caputo, 2016; Jurado & Gracia, 2017; Van Wezemael, Caputo, Nayga, Chryssochoidis, & Verbeke, 2014). However, despite these findings, there is increasing evidence that what consumers say about their preferences regarding NCs is not actually reflected in what they purchase in the marketplace. To illustrate, in the last few decades, the consumer demand for healthier FF products offering NCs has grown rapidly (Santeramo et al., 2018). Attracted by such market growth, companies have invested in and developed new FF products (Khan, Grigor, Win, & Boland, 2014). Nevertheless, 70 to 90% of these new FF products exited the market within the first two years from their launch (Bimbo et al., 2017). This high failure rate suggests that a deeper understanding of the main motives underlying consumer preferences and the heterogeneity in the demand for NCs is needed. For this reason, understanding how consumers make trade-offs among multiple FOP NCs is an important issue for marketing and public policy purposes.

Recent studies have focused on exploring new approaches to investigating consumer food choice behaviour based on consumers' visual attention.[10] These approaches use ET technology to analyse consumers' purchase decisions by tracking the visual attention paid to areas of interest (AOIs).

[10] By definition, 'attention' is the 'degree to which consumers focus on a stimulus within their range of exposure' (Solomon, Bamossy, Askegaard, & Hogg, 2006).

ET technology is considered to be one of the most powerful means to determine individual choices (Balcombe, Fraser, & McSorley, 2015), especially when combined with DCEs (Scarpa, Zanoli, Bruschi, & Naspetti, 2013).

This study investigates consumers' preferences for alternative NCs (fat free, low sugar, high fibre, source of vitamin B_6, and source of calcium) and explores the impact of consumers' visual attention on their final choice. To elicit consumers' preferences for alternative NCs, we conducted a DCE, because its ability to evaluate multiple attributes simultaneously is consistent with random utility theory (RUT) and very similar to the purchase decision process (Lusk, 2003). Visual attention was measured in terms of FT (milliseconds) and FC[11] using ET. The FT was used due to its frequency of use in the extended literature analysing visual attention to food products (Antúnez et al., 2013; Ares et al., 2013; Ares, Mawad, Giménez, & Maiche, 2014; Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Fenko, Nicolaas, & Galetzka, 2018; Gere et al., 2016; Grebitus & Davis, 2017; Hummel, Zerweck, Ehret, Winter, & Stroebele-Benschop, 2017; Samant & HanSeok, 2016; Spinks & Mortimer, 2016; Torrico et al., 2018; Uggeldahl, Jacobsen, Lundhede, & Olsen, 2016; Van Loo et al., 2015; Vu, Tu, & Duerrschmid, 2016). However, the recent research by Orquin and Holmqvist (2018) suggested that the total fixation duration is not recommended because it often involves inappropriate aggregation data. Therefore, in our research, we also included the FC to compare results across ET measures. This study focuses on NCs because they are a simpler way to present information than nutritional tables. NCs do not list the amount of a nutrient but rather summarize the information concerning a specific nutrient and communicate it to consumers in simple, easy-to-process language (e.g., fat free). We chose to study yoghurt claims because yoghurt is recommended as part of a healthy diet in many countries (Eržen, Kač, & Pravst, 2014). Most notably, in a market study that we conducted on food products with NCs in Spain, yoghurt was found to be a product that commonly contained NCs.

[11] The fixation time is respondents' fixation duration within an AOI, and the fixation count measures participants' fixation frequency within an AOI (Duchowski, 2017).

This study contributes to the existing literature on consumer food choice behaviour in several ways. First, while most previous literature has focused on consumer preferences for fewer than three NCs, this study analyses consumer preferences and choice behaviour for multiple NCs. Second, this is the first study to combine ET and a DCE to investigate whether consumers pay attention to alternative NCs when making food choice decisions and how their attention affects their final food choices. Most researchers utilizing DCE and ET methods have explored consumer preferences for different formats of nutritional labels (e.g., choice logos, monochrome guidelines, daily amount nutritional labels, colour coded nutritional labels, the traffic light system, and information tables showing nutritional facts) displayed on the FOP (Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Mawad, Trías, Giménez, Maiche, & Ares, 2015) and the effect of sustainability-related labels on consumers' purchase behaviour (Samant & HanSeok, 2016; Van Loo et al., 2015). Hence, this research contributes to the food choice literature by exploring the importance of visual attention to a selection of NCs. Finally, this study offers new insights into the combination of DCEs and ET, a novel methodological approach that has not yet been applied to food products in a European country such as Spain. The findings from this research can be informative for producers, processors, and retailers. In addition, the results can provide new insights for policy makers, assisting them in designing strategies to promote healthy food choices.

3.1.1. Consumer attention and food choices: Background

During a purchase decision, consumers are exposed to multiple food attributes, such as symbols, health-related label messages, health claims, nutritional claims, and others (Carrillo, Fiszman, Lähteenmäki, & Varela, 2014; Miraballes, Fiszman, Gámbaro, & Varela, 2014). As documented by Milosavljevic & Cerf (2008), consumers typically make choice decisions within a few seconds; thus, they may not attend to all the information available on the food package. Generally, some information is selected to be processed further while the rest is lost, and, in most cases, consumers are not even aware of its presence on the label (Oliveira et al., 2016).

For this reason, studying consumers' attention to food labels is becoming a key aspect of the design of food labels that successfully attract attention.

In this regard, a rapidly growing body of literature has examined the relationship between visual attention and stated preference in the food sector. Table 3.1 contains a review of previous studies using ET and DCEs and their key findings. We focus on these particular studies because they combine DCEs with ET and centre on consumer valuation for food-labelling programs.[12] The results of these studies are mixed regarding the extent to which the degree of visual attention paid to specific attributes correlates with the actual choices. For example, Balcombe et al. (2015) examined visual attention in a multi-attribute DCE using ET and found little evidence that visual attention in terms of fixation duration on the attributes indicates the level of importance. In other words, looking longer or more often at an attribute does not necessarily mean that it is of higher value to the consumer. A more recent study by Balcombe et al. (2017) again examined the combination of visual attention and stated preferences and found weak relationships between them. These results differ significantly from those reported by Uggeldahl et al. (2016), who, through a DCE combined with ET on the selection of ground beef minced meat, found that visual attention paid to the alternatives in a choice task does reflect participants' stated choices. Similarly, Bialkova and Van Trijp (2011) indicated that the combination of ET with a DCE is a promising tool for consumer research on attention to nutrition labelling information and its effect on informed healthy food choices.

[12] Although we limited our literature review to food choice studies, we acknowledge that ET technology is widely used in other fields, such as psychology (Orquin & Lagerkvist, 2015; Orquin & Mueller Loose, 2013; Peschel & Orquin, 2013), marketing (Meißner, Musalem, & Huber, 2016; Pieters & Warlop, 1999; Wedel & Pieters, 2008b), and health economics (Ryan, Krucien, & Hermens, 2017), among others. Recently, ET has also increasingly been used to explore methodological issues related to survey design, organizational research (Meißner & Oll, 2017; Meißner, Pfeiffer, Pfeiffer, & Oppewal, 2017), visual biases, and threats (Orquin, Ashby, & Clarke, 2016; Orquin, Bagger, & Loose, 2013; Orquin, Chrobot, & Grunert, 2018; Orquin, Perkovic, & Grunert, 2018).

Table 3.1. Summary of studies that have combined ET with stated preferences and DCEs

No.	Authors	Country	Products	Methodology	Key findings
1	Balcombe et al. (2015)	UK	A basket of goods containing a mix of foods	DCE and ET	No compelling evidence that higher- or lower-value attributes receive more or less attention.
2	Balcombe et al. (2017)	UK	A basket of goods containing a mix of foods	DCE and ET	Although respondents with higher levels of visual attendance valued specific attributes more, the results reveal weak relationships between ET and stated preference data.
3	Bialkova et al. (2014)	Netherlands	Yoghurt	A combination of an experimental choice task with ET	Results suggest that attention mediates the effect of nutrition labels on choice. The longer the fixation, the higher the likelihood of being chosen.
4	Bialkova and Van Trijp (2011)	Netherlands	Yoghurt	Integration of the visual search paradigm (ET) with a DCE	ET was found to be a promising tool for consumer research on attention to nutrition labelling information and its effect on informed healthy choices.
5	Graham & Jeffery (2011)	USA	Pizza, soup, yoghurt, snacks, fruits, and vegetables	Self-reported online grocery shopping DCE and ET	Participants spent longer looking at labels for foods they decided to purchase compared with foods they decided not to purchase.
6	Samant & HanSeok (2016)	USA	Chicken products	Stated preference and ET	Findings suggest that enhanced label knowledge increases consumers' visual attention to labels with a possibility of positive purchase behaviour.

Continuation table 3.1. Summary of studies that have combined ET with stated preferences and DCEs

No.	Authors	Country	Products	Methodology	Key findings
7	Uggeldahl et al. (2016)	Denmark	Ground beef minced meat	DCE and ET	Eye movements are related to stated choice certainty.
8	Van Herpen & Van Trijp (2011)	Turkey and Netherlands	Breakfast cereals	Self-reported use, recognition, ET, and DCE	Although a nutrition table was evaluated most positively, it received little attention and did not stimulate healthy choices. Other types of labels enhanced healthy product choices.
9	Van der Laan et al. (2015)	Netherlands	Different food images	Choice screens and ET	Results show that for both the most-wanted and the least-wanted decision types, the total fixation duration was longest for the product of choice.
10	Van Loo et al. (2015)	USA	Coffee	DCE and ET	Results suggest that consumers who spend more time attending to and fixate more on sustainability attributes value them more.
11	Vu et al. (2016)	Austria	Different food images	Stated preference under time pressure, test design complexity, and ET	Highlights the importance of understanding the factors influencing gazing behaviour in an ET test for better future application.

Other explanatory studies that have combined visual attention with actual choices have found a positive association. More specifically, in the US, Graham and Jeffery (2011) examined visual attention to nutritional labels (e.g., a nutritional fact table) for sixty-four different food products in an online shopping scenario. Consumers were found to spend more time looking at the nutrients in food products that they ultimately chose to purchase. Another study using an online shopping purchase scenario, by Van der Laan et al. (2015), tested the effect of healthy food choices and changes in visual attention on purchases. This study showed that health goals increase the attention to goal-congruent items and increase the likelihood of the consumer choosing them.

Van Herpen and Van Trijp (2011) examined consumer attention and the use of three different types of nutrition labelling (a logo, a traffic-light label, and a nutritional table) in Turkey and the Netherlands to investigate whether the type of label influences consumers to make healthier food choices. The results in both countries suggested that, although consumers evaluated the nutritional table positively, it received little visual attention and did not stimulate healthy choices. However, the traffic light and especially the logo labels enhanced healthy product choices. Bialkova et al. (2014) used yoghurt selection in a DCE to explore whether and how attention to nutritional information (a health logo, a monochrome Guideline Daily Amount (GDA) label, or a color-coded GDA label) affects consumer choice. The results suggested that products with long FTs have the highest likelihood of being chosen.

Regarding sustainability-related label claims, Samant and HanSeok (2016) determined the effect of label education on consumers' purchase behaviour by combining visual attention and sustainability label claims on chicken products. The findings provided empirical evidence that enhanced label knowledge increases consumers' visual attention to labels, with the possibility of positive purchase behaviour. Lastly, Van Loo et al. (2015) analyzed the importance of sustainability labels on coffee (e.g., Fairtrade, Rainforest Alliance, USDA Organic, and carbon footprint) by combining the visual attention paid to these labels with a DCE.

Their results indicated that greater importance associated with sustainability labels results in increased visual attention and WTP for coffee with these labels. Based on the findings of earlier studies, we hypothesize the following:

(H1). Providing NCs on yoghurt packages may provide a signal detection assumption that an increase in participants' visual attention may result in an increased probability of the product being purchased.

Because consumers have raised concerns about their health and are shifting toward food products that are low in calories (Carrillo, Varela, & Fiszman, 2012; de-Magistris & Gracia, 2016; Jurado & Gracia, 2017), we also hypothesize that:

(H2). Low-calorie[13] yoghurts (e.g., fat free and low sugar) will generate greater utility in participants than other nutritional claims.

3.2. Materials and methods

3.2.1. Choice experiment: Product and attribute selection

The product for the experiment was selected based on market research on food products bearing NCs sold in local supermarkets between July and September 2015. The foods were included in the database according to their importance in the shopping basket of Spanish families.[14] An examination of the products showed that yoghurt carried the most NCs. In total, 251 yoghurts that contained 1 NC on the FOP that corresponded to the official EU definitions (Regulation (EC) No 1924/2006) were considered for further analysis as well as a full-fat unlabelled yoghurt.

[13] According to the previous literature, low-calorie yoghurts are mostly low fat, fat free (i.e., skimmed or semi-skimmed), and low in sugar (Peres, Esmerino, da Silva, Racowski, & Bolini, 2018; Pinheiro, Oliveira, Penna, & Tamime, 2005).

[14] According to the Ministry of Agriculture and Fisheries, Food and Environment's (MAPAMA, 2014) consumer survey in Spain, 89 percent of the per capita consumption of packaged food was liquid milk, processed meat, yoghurt, cheese, industrial bread, and biscuits.

We used the 500 g package (4 containers, each with 125 g), because it is the size with the greatest presence in the market. All the products used were natural yoghurts (no added flavour), with no fruits, except the one with fibre, which contained several types of cereal (oats, barley, wheat, and wheat bran). We included the high-in-fibre yoghurt because of the high demand and the large variety of cereal-fibre-source yoghurt in the local market (Cuevas, 2012; Fontecha, Recio, & Pilosof, 2009; Sah, Vasiljevic, McKechnie, & Donkor, 2016). The NCs included in the study are shown in Table 3.2.

Table 3.2. Nutritional claims used in the study

Nº	Natural yoghurts with NCs	Frequency of NC
1º	Fat free	42.78%
2º	Source of calcium	21.25%
3º	Full-fat unlabelled (reference)[a]	12.26%
4º	Low sugar	11.99%
5º	Source of vitamin B_6	10.63%
6º	High fibre	1.09%

Note: [a] The unlabelled product is a full-fat natural yoghurt with no added flavour and no NC on the FOP.

Following Bialkova and Van Trijp (2011), Bialkova et al. (2014), and Carlsson et al. (2007), we excluded the price attribute by asking consumers to assume that the price was the same as the yoghurt that they regularly consume, since yoghurt is regularly consumed in Spanish households (Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), 2014) and individuals are aware of the price variations (which are not large except for the reference full-fat, no-NC yoghurt) among different types of yoghurt. Following the experimental design of Bialkova and Van Trijp (2011) and Bialkova et al. (2014), a full factorial design (i.e., nutritional claims in our case) resulted in a combination of 15 choice questions (or choice tasks), each with 2 alternatives. To each choice task, we also added a non-buy option. The product location (either left or right in the two-alternative choice set) of the two products was systematically varied. A computer program (Tobii X2-30 ET) randomized the sequence of appearance of the 15 choice tasks.

The participants had 15 seconds[15] to observe the 2 products in each task and then were asked to choose their preferred yoghurt. Oral answers were recorded through an evaluation form that appeared on the screen after 15 seconds. Then, the moderator, using a parallel screen, selected the preferred alternative defined by the participant (A, B, or no buy). See the evaluation form in Appendix A (Figure A1).

3.2.2. Eye-tracking procedure and measures

To capture the visual attention during the DCE, we replicated the work of Van Loo et al. (2015) using a totally different product, yoghurt, and measured preferences without considering the price attribute. For the analysis of the eye movement data, we defined a set of AOIs to capture the eye fixations, in terms of FT and FC, on the NCs (see Figure 3.1).

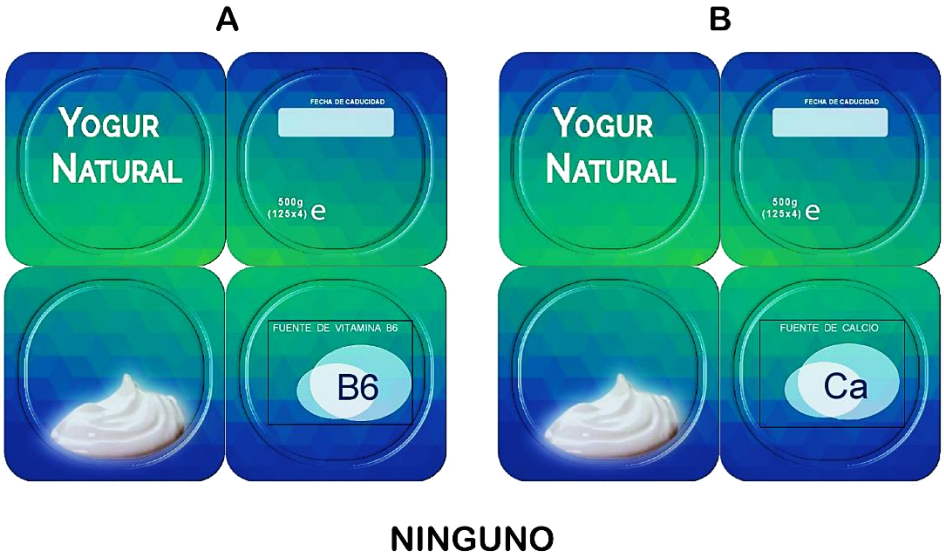
The FOPs were consistent in terms of AOI size (width and height). For each of these AOIs, we calculated the mean of the FT spent and the FC. The combination of images was presented in full colour on a 24" computer screen with 1920×1080 pixel resolution. Eye positions were sampled at 50 Hz with a remote ET device (Tobii X2-30 ET) positioned under the computer screen on which the stimuli were displayed.

Before recording the eye movements, we ran a 9-point calibration procedure and familiarized the participants with the process using an example of a 2-alternative choice task in which they were asked to choose

[15] We used a fixed exposure time to measure the fatigue effect from the 15 choice tasks and to examine the fixation process through the 15-second exposure time. However, due to the main focus of this paper, the results from this analysis are not included here. As for the set-up time, we considered studies in which the times varied from short periods of 2.5 seconds (Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013) to 10 seconds (Orquin & Scholderer, 2011) and up to 30 seconds (Strasser, Tang, Romer, Jepson, & Cappella, 2012). In addition, from a pretest of 20 participants, we observed that participants needed an average exposure time of 13 seconds to choose between alternatives. Therefore, based on the previous research and the results from the pretest, we decided to use an exposure time of 15 seconds.

'out loud' [16] A, B, or no buy. Then, we ran another calibration procedure before recording their eye movement for the experiment. The distance between the ET device and the participants' eyes was 58–60 cm.

Figure 3.1. An example of the areas of interest



Note: Option A refers to the Spanish version of a yoghurt with a *source of vitamin B6*, and option B refers to the yoghurt with *a source of calcium*. AOIs were not marked in black in the original evaluation choice task. 'Ninguno' is the 'non-buy' option.

3.2.3. The experiment

The experiment consisted of three stages: (i) recruiting and sampling, (ii) ET in combination with the DCE, and (iii) a follow-up questionnaire aimed at capturing yoghurt purchase behaviour, consumption habits, attribute importance, general attitudes toward yoghurts with NCs and HCs, GHI, and socio-demographic consumer characteristics.

[16] The choice of the product was indicated orally based on the applied methodology from two previous studies (Bialkova & Van Trijp, 2011; Bialkova et al., 2014). In addition, since we followed a stratified sample approach, we used the oral choice to avoid any possible choice mistake due to a lack of computer skills (almost 10 percent of the sample was older than 70 years).

The experiment was carried out in different periods of time (morning and afternoon) and on different days (from Monday to Saturday). The sessions consisted of 1 participant at a time. Upon their arrival at the lab, the respondents received information about the main purpose of the experiment (stage 1). A 9-point calibration procedure was used to calibrate participants' eye vision with the ET device before the example warm-up task and after starting the data collection. The respondents faced 15 choice tasks (stage 2). For each task, they were asked to choose their most-preferred option (A, B, or neither). They were reminded each time to imagine that they were in a supermarket to buy yoghurt and that the price reference was the price of the yoghurt that they habitually purchase. Finally, the participants completed a follow-up questionnaire capturing their yoghurt purchase behaviour, consumption habits, attribute importance, general attitudes toward yoghurts with NCs and HCs, GHI, and socio-demographic consumer characteristics (stage 3).

3.2.4. Recruitment and sample characteristics

The experiment was conducted from September to November 2016 in a medium-sized town in Spain that is widely used by food marketers and consulting companies because the socio-demographic characteristics are representative of the Spanish Census of Population (see Appendix B (Table B1)). The participants were recruited via email by a recruiting agency and were selected by random stratification with proportional allocation for age, gender, and education to avoid under/overrepresentation of consumer profiles. To discover distinctive groups with similar preferences, we performed a cluster analysis (Section 3.3.1). Table 3.3 shows the characteristics of the final sample of respondents and the segments from the cluster analysis.

Table 3.3. Descriptive analysis of the sample and socio-demographic characteristics (percentages)

	Reference population, Spain[a]	Sample	Segment1	Segment 2
Sample size	-	n = 100	n = 39	N = 61
Gender				
Female	51.00	52.00	46.15	55.74
Male	49.00	48.00	53.85	44.26
Age groups				
18–34**	22.24	18.00	15.38	26.23
35–44**	19.55	23.00	10.26	21.13
45–54	18.28	19.00	17.95	16.39
More than 54	39.93	40.00	56.41	36.07
Educational level[b]				
Primary	24.88	27.00	33.33	22.95
Secondary*	47.64	42.00	51.28	39.34
University**	27.48	31.00	15.38	37.70
Household income				
Less than €900–€1500*	-	9.00	51.28	26.23
€1501–€3500**	-	55.00	43.59	62.30
€3501–more than €4500	-	36.00	5.13	11.48

Note: [a] Data obtained from the Register (INE, 2017) on January 1, 2017 (www.ine.es). [b] OECD (2014). * The correlation is significant at the 0.05 level based on the χ^2 test between segments. ** The correlation is significant at the 0.01 level based on the χ^2 test between segments.

The final sample consisted of 100[17] adults out of 113[18] in total, who were older than 18 years and without eye problems (see the classification questionnaire for the eligibility of participants to be included in the study in Appendix C (C1) – this appendix was not included in this published article).

[17] For an ET study, this is a rather large sample, taking into account that past ET studies employed far fewer subjects (e.g., 53 in Ares et al., 2013; 71 in Ares et al., 2014; 40 in Balcombe et al., 2015; 99 in Balcombe et al., 2017; 10 in Bialkova & Van Trijp, 2011; 24 in Bialkova et al., 2014; 48 in Fenko, et al., 2018; 59 in Gere et al., 2016; 29 in Samant & HanSeok, 2016; 32 in Spinks & Mortimer, 2016; 22 in Van der Laan et al., 2015; 81 in Van Loo et al., 2015; 81 in Van Loo, Nayga, Campbell, Seo, & Verbeke, 2017; 50 in Varela, Antúnez, Cadena, Giménez, & Ares, 2014; and 39 in Zhang & Seo, 2015).

[18] It should be noted that 13 participants were not able to complete the entire experiment due to problems with their vision.

Compared with previous ET studies, this sample is rather large. Most respondents were female (51%). With respect to age and education, our sample is similar to the population in Spain, with approximately one-quarter of the respondents being between 35 and 44 years old and 40% being more than 55 years old. Around half of the sample had completed secondary studies.

3.2.5. Importance of yoghurt attributes and nutritional claims

After completing the DCE and ET study, the respondents answered a set of questions aimed at capturing the importance that they attach to the following eight yoghurt attributes: price, taste, brand, healthiness, convenience, health claims, nutritional claims, and natural ingredients. Food choice motives and the related importance that consumers attach to product attributes are valuable bases for segmentation (Haley, 1968; Jadczaková, 2013), because they determine to a large extent the food choices that consumers make and the arguments and information to which they are sensitive (Bellows & Hallman, 2010). Therefore, the insights gained by segmenting consumers based on these importance ratings can help to identify effective marketing strategies aimed at promoting healthy food consumption (Verain, Sijtsema, & Antonides, 2016).

The eight yoghurt attributes were included based on previous studies on different food categories (Grunert, Hieke, & Wills, 2014; Van Loo et al., 2015). The importance of yoghurt attributes was scored on a 5-point scale ranging from 'not at all important' (1) to 'extremely important' (5), and the attributes were merged into one construct (Cronbach's $\alpha = 0.70$). In addition to measuring the importance of yoghurt attributes, we asked the participants to rate how important it is to them that the yoghurt that they usually purchase contains one of the following NCs: low sugar, fat free, source of calcium, source of vitamin B_6, and high in fibre. The importance of each NC was scored on a 5-point scale ranging from 'not at all important' (1) to 'extremely important' (5), and the NCs were merged into 1 construct (Cronbach's $\alpha = 0.69$).

3.2.6. Data analysis

3.2.6.1. Statistical analysis of yoghurt attributes and eye-tracking variables

The yoghurt attributes and ET variables were analyzed using STATA 12 (StataCorp., Texas, TX). The scale construct reliability was tested with Cronbach's α, while the correlations between the attributes and the ET variables were tested with Spearman's correlation coefficients. The yoghurt attributes were used as segmentation variables in cluster analysis. Cluster analysis allows the grouping of observations into segments in which the preferences within the same segment are similar while the preferences between segments are dissimilar (Wedel & Kamakura, 2000). As suggested by Van Loo et al. (2015) and Verain et al. (2016), we applied a two-step procedure. First, a hierarchical agglomerative clustering procedure defined the number of clusters and the cluster centroid (Ketchen & Shook, 1996). Second, a non-hierarchical (k-means) approach was used to group the respondents into the optimal number of clusters using the centroids of the sub-clusters found in the first step as initial starting points (Ketchen & Shook, 1996). Two distinct segments with relatively homogeneous importance ratings were identified as the optimal solution. Cross-tabulations with student t-test statistics were used to determine the associations between the categorical variables, while an Anova F-test and Bonferroni post hoc test were used for the comparison of mean scores.

3.2.6.2. Econometric analysis

The DCE method is consistent with the RUT and the theory of consumer demand (Lancaster, 1966). A random utility function may be defined as follows:

$$\mathrm{U_{njt}} = V_{\mathrm{njt}} + \varepsilon_{\mathrm{njt}} \quad (1)$$

where U_{nj} is the n^{th} utility from the consumer's choice of alternative *j*; V_{nj} is the systematic or representative portion of the utility function, which depends on the product attributes and their values for alternative *j*; and ε_{nj} is the stochastic Gumbel distributed error term (unobserved and treated as random).

To estimate the consumer preferences for the multiple NCs, we used a random parameter logit (RPL) model (Train, 2003). More specifically, we estimated an RPL model, named RPL1, which accounts for both random taste variation and correlation patterns across random parameters. Given our choice experiment, the utility function that individual *n* derives from alternative *j* in choice situation *t* is defined as follows:

$$\mathrm{U_{njt}} = OptOut + \beta_1 Ffat_{\mathrm{njt}} + \beta_2 \mathrm{Lsugar_{njt}} + \beta_3 Hfiber_{\mathrm{njt}} + \beta_4 SvitB6_{\mathrm{njt}} + \beta_5 Scalcium_{\mathrm{njt}} + \varepsilon_{\mathrm{njt}} \quad (2)$$

where *n* is the number of respondents, *j* represents the available choices in the choice tasks (two experimentally designed yoghurt profiles and the opt-out option), and *t* is the number of choice situations. $OptOut$ is the alternative-specific constant representing the opt-out option. The variables related to the five NCs (fat free, *Ffat*; low sugar, *Lsugar*; high fibre, *Hfiber*; source of vitamin B_6, $SvitB_6$; and source of calcium, *Scalcium*) enter the model as dummy variables, and 'full fat – unlabelled' yoghurt represents the product of reference.

To investigate the effects of visual attention on consumer choice behaviour and preferences, we estimated two additional RPL models that incorporate the visual attention data into the utility function. In particular, RPL2 adds to RPL1 by including visual attention in terms of FT expressed in milliseconds, and RPL3 adds to RPL1 by including visual attention in terms of FC. In line with Grebitus, Roosen, and Seitz Carolin (2015) and Van Loo et al. (2015), we rescaled the FT spent and FC to have a zero mean. For RPL2 and RPL3, the utility function specified for individual *n*, alternative *j*, in choice situation *t*, is defined as follows:

$$\mathrm{U_{njt}} = OptOut + \beta_1 Ffat_{\mathrm{njt}} + \beta_2 \mathrm{Lsugar_{njt}} + \beta_3 Hfiber_{\mathrm{njt}} + \beta_4 SvitB6_{\mathrm{njt}} + \beta_5 Scalcium_{\mathrm{njt}} + \gamma_{\mathrm{Ffat}}(FtFfat * Ffat_{\mathrm{njt}}) + \gamma_{\mathrm{Lsugar}}(FtLsugar * Lsugar_{\mathrm{njt}}) + \gamma_{\mathrm{Hfiber}}(FtHfiber * Hfiber_{\mathrm{njt}}) + \gamma_{\mathrm{SvitB6}}(FtSvitB6 * SvitB6_{\mathrm{njt}}) + \gamma_{\mathrm{Scalcium}}(FtScalcium * Scalcium_{\mathrm{njt}}) + \varepsilon_{\mathrm{njt}} \quad (3)$$

where γ_{Ffat} is the coefficient of the interaction term between the fat-free attribute and the FT *FtFfat* for the fat-free attribute and so on for the other attributes.

Thus, in RPL2, the *FtFfat* variable is the mean-centred FT spent on the fat-free nutritional claim, whereas, in RPL3, $FcFfat$ is the mean-centered FC. Similarly, the other γs are the coefficients of the interaction terms between the attribute and the visual attention mean-centred variables. The remaining variables are as specified in (2).

In all the models, it is assumed that the coefficients of the five NCs (*Ffat*, *Lsugar*, *Hfiber*, *SvitB6*, and *Scalcium*) are random and follow a normal distribution. In the RPL2 and RPL3 models, the interaction terms are also assumed to be random and to follow a normal distribution.

3.3. Results

3.3.1. Segmentation and stated importance of yoghurt attributes

The results from the questionnaire reveal that, when evaluating yoghurt attributes, participants attach the highest level of importance to the health aspect of the product, followed by taste and nutritional and health claim labels (Table 3.4).

Table 3.4. Importance of yoghurt attributes

No.		Mean	Standard deviation
1	Health[a]	4.16	0.81
2	Taste	4.12	0.91
3	NC labels	4.11	0.91
4	HC labels	3.95	1.11
5	Natural ingredients	3.85	0.99
6	Price	3.66	1.01
7	Brand	3.09	1.04
8	Convenience[b]	2.72	1.16

Note: Measured on a 5-point scale from 1 (not at all important) to 5 (extremely important). [a] Health means that consumers might choose the product because of the health properties that it holds. [b] Convenience means that it can be found easily, there is a large variety, and it can be combined easily with other food.

This result suggests that NCs are perceived as being less important than health and taste and more important than health claims, natural ingredients, price, brand, and convenience. From the cluster analysis using the importance of yoghurt attributes, we obtained two distinct consumer segments.

The segment sizes and scores are reported in Table 3.5.

Table 3.5. Two-cluster solution and profiling of consumer segments (n = 100)

	Segment 1	Segment 2	
Segment size (n)	39 (39.00%)	61 (61.00%)	
Importance of yoghurt attributes[b]			
Taste	4.23 (0.78) [a]	Health	4.23 (0.76)
Health claims	4.10 (0.99)	Nutritional claims	4.11 (0.95)
Nutritional claims	4.10 (0.85)	Taste	4.05 (0.99)
Health	4.05 (0.89)	Health claims	3.85 (1.18)
Natural ingredients	3.85 (1.01)	Natural ingredients	3.85 (0.98)
Price	3.72 (0.94)	Price	3.62 (1.05)
Brand	3.00 (1.10)	Brand	3.15 (1.00)
Convenience	2.64 (1.20)	Convenience	2.77 (1.13)
Importance of NCs' attributes[b]			
Fat free*	3.69 (1.30)	Source of calcium*	3. 64 (1.20)
Low sugar	3.54 (1.39)	Low sugar	3.57 (1.16)
Source of calcium*	3.31 (1.16)	Fat free*	3.33 (1.22)
Source of vitamin B_6**	3.15 (1.16)	Source of vitamin B_6**	2.72 (1.29)
High fibre	2.92 (1.35)	High fibre	2.64 (1.08)

Note: * The correlation is significant at the 0.05 level based on the student t-test between segments. ** The correlation is significant at the 0.01 level based on the student t-test between segments. [a] Mean (standard deviation). [b] Measured on a 5-point scale from 1 (not at all important) to 5 (extremely important).

Segment 1 (39% of the sample) attaches the greatest importance to the *fat-free* type of claim followed by the *source of calcium* and *source of vitamin B_6* types of NCs when purchasing yoghurt. Segment 2 (61% of the sample), on the other hand, attaches the greatest importance to the *source of calcium* NC followed by the *fat-free* and *source of vitamin B_6* types of claims. The *high in fibre* type of claim is the least valued claim by both segments. With respect to the importance attached to yoghurt attributes, both segments do not attach importance to any of the yoghurt attributes mentioned in Table 3.5. The χ^2 test revealed no significant differences across the segments in terms of the socio-demographic variables gender, age group (45–54 and older than 54), education (primary), and income (from €3501 and above €4500) (Table 3.3).

To describe the segments further, the importance of NCs on the yoghurt packaging (Table 3.5) was compared with the visual attention data (Sections 3.3.2, 3.3.3, and 3.3.4).

3.3.2. Visual attention to NCs based on eye-tracking measures

The participants had the highest FC on the *low-sugar* NC with an average of 9 fixations and 2146 milliseconds of FT, suggesting that *low sugar* is the most important attribute when customers make their choices. On average, *source of calcium* and *high fibre* received fewer fixations than the other NCs. The FT and FC are reported in Table 3.6.

Table 3.6. Average eye-tracking measures for the total of 5 stimuli (n = 100)

	Fixation time (ms)[a]				Fixation count			
AOIs	Mean	Std Dev.	Min.	Max.	Mean	Std Dev.	Min.	Max.
Fat free	2057.15	1630.92	118	8544	8.30	5.20	1	26
High fibre	1314.83	1046.70	113	4665	5.37	3.63	1	18
Low sugar	2145.85	1555.14	101	7826	8.96	5.29	1	25
Source of calcium	1787.37	1245.8	129	4978	7.85	4.68	1	18
Source of vitamin B_6	1957.87	1257.26	116	5405	8.75	4.58	1	21

Note: [a] Milliseconds.

3.3.3. Relationship between visual attention and nutritional claims' importance

The results show several relationships between the total FC and FT within an AOI and the stated importance of the NCs (Table 3.7). There is a positive significant relationship between the stated importance and the FC or FT for two NCs: *source of calcium* and *source of vitamin B_6*. This finding suggests that those stating that they attach a high degree of importance to these two NCs when purchasing yoghurt truly do pay more attention to these attributes when making choices. With respect to the rest of the visual attention and NC attributes, we observe a small positive correlation (e.g., low sugar fixation time and high fibre (0.053), high fibre fixation count and source of vitamin B_6 (0.052)); however, this correlation is weak and is not significant at the 5 percent level.

Table 3.7. Pearson correlation coefficients between stated importance and visual attention to yoghurts with NCs

	Fixation time (ms)[a]					Fixation count				
Stated importance[b]	**Fat free**	**High fibre**	**Low sugar**	**Source of calcium**	**Source of vitamin B_6**	**Fat free**	**High fibre**	**Low sugar**	**Source of calcium**	**Source of vitamin B_6**
Fat free	0.141	0.178	0.176	0.239	0.182	0.153	0.145	0.165	0.218	0.171
(p-values)	(0.161)	(0.076)	(0.079)	(0.017)	(0.070)	(0.130)	(0.151)	(0.101)	(0.029)	(0.089)
High fibre	0.086	0.138	0.195	0.201	0.186	0.061	0.139	0.170	0.218	0.140
(p-values)	(0.393)	(0.172)	(0.053)	(0.045)	(0.064)	(0.546)	(0.167)	(0.091)	(0.030)	(0.165)
Low sugar	-0.002	0.075	0.057	0.090	0.074	0.021	0.101	0.066	0.010	0.060
(p-values)	(0.984)	(0.461)	(0.573)	(0.373)	(0.467)	(0.839)	(0.317)	(0.514)	(0.339)	(0.554)
Source of calcium	0.172	0.159	0.240	0.202	0.215	0.164	0.157	0.269	0.211	0.209
(p-values)	(0.087)	(0.114)	(0.016)	(0.044)	(0.032)	(0.103)	(0.120)	(0.007)	(0.035)	(0.037)
Source of vitamin B_6	0.138	0.162	0.279	0.231	0.199	0.168	0.195	0.310	0.292	0.211
(p-values)	(0.171)	(0.107)	(0.005)	(0.021)	(0.048)	(0.094)	(0.052)	(0.002)	(0.003)	(0.035)

Note: [a] Milliseconds. [b] The stated importance attributes are measured on a 5-point scale from 1 (not at all important) to 5 (extremely important).

This suggests that the relationship suggested by the correlation between these variables could have happened by chance. Therefore, we accept the null hypothesis and conclude that there is no correlation between these and the rest of the variables above the 5 percent significance level.

3.3.4. Differences in visual attention across segments

The differences in visual attention across segments that attach different degrees of importance to NC attributes for yoghurt are reported in Table 3.8. The FT and FC for the various attributes are indicators of their relevance to participants' purchase decisions. Therefore, we expect the segments that attach greater importance to various attributes also to have stronger visual attention in terms of FT and FC.

Table 3.8. Visual attention degree of importance to NC attributes for yoghurt

	Segment 1	**Segment 2**	
Segment size (n)	39 (39.00%)	61 (61.00%)	
Fixation count			
Low sugar***	13.97 (4.16)	Source of vitamin B_6***	6.15 (2.87)
Fat free***	12.90 (4.72)	Low sugar***	5.75 (2.90)
Source of vitamin B_6***	12.82 (3.72)	Fat free***	5.36 (2.83)
Source of calcium***	12.28 (3.55)	High fibre***	3.46 (1.75)
High fibre***	8.36 (3.81)	Source of calcium***	4.97 (2.66)
Fixation time (ms) [a]			
Low sugar***	3671.33 (1305.22)	Source of vitamin B_6***	1204.89 (649.66)
Fat free***	3500.28 (1620.93)	Low sugar***	1170.54 (657.13)
Source of vitamin B_6***	3135.62 (1057.34)	Fat free***	1134.49 (711.06)
Source of calcium***	3004.97 (974.11)	Source of calcium***	995.95 (608.50)
High fibre***	2255.28 (1031.71)	High fibre***	713.55 (437.16)

Note: * The correlation is significant at the 0.05 level based on the student t-test. ** The correlation is significant at the 0.01 level based on the student t-test.
[a] Milliseconds.

We find significant differences in the FT and FC for the various NCs between S1 and S2 (Table 3.8). Although there are differences in the visual attention between the two segments, S1, albeit smaller, has greater visual attention in terms of FT and FC for all the NCs than S2. The participants in this segment showed the strongest visual attention in terms of FT to the *fat-free* and *low-*

sugar NCs followed by the *source of vitamin B_6* claim. On the other hand, in terms of the FC, the participants paid the most attention to the *low-sugar* and *fat-free* NCs, followed by the *source of vitamin B_6* claim. The visual preferences in S2 seem to be slightly different from those in S1; however, they are consistent in terms of FT and FC visual attention. More specifically, regarding both FT and FC, the participants paid the most attention to the *source of vitamin B_6* and *low-sugar* NCs followed by the *fat-free* claim. Overall, the *high-fibre* NC is the least-valued NC for both eye-tracking measures.

3.3.5. Effect of visual attention on choice behaviour

RPL1, the baseline model, assumes random taste heterogeneity and correlation patterns across random parameters, while RPL2 and RPL3 add the interaction terms between the NCs and the visual attention measures FT and FC[19] to RPL1. Hence, RPL2 and RPL3 allowed us to determine whether consumers who pay more attention to an attribute value it more. Table 3.9 reports the coefficient estimates from the three RPL models.[20]

As expected, the results show that the coefficient of the opt-out option is negative and statistically significant in all the models, indicating that consumers gain more utility from choosing one of the experimentally designed yoghurt profiles rather than the opt-out choice. The coefficients of the five NCs (i.e., *fat free*, *low sugar*, *high fibre*, *source of vitamin B_6*, and *source of calcium*) are also all positive and statistically significant at the 1 percent and 5 percent significance levels in all the models, indicating that consumer utility increases when these claims are reported on yoghurt packages. The corresponding standard deviations are also statistically significant, suggesting that consumers' preferences for these five attributes are heterogeneous.

[19] The FT and FC are in the utility model as dummy variables. They take the value of 1 when the individuals' FT (milliseconds) or FC is equal to or higher than the centered mean of each attribute and 0 otherwise (e.g. the fat-free yoghurt takes the value of 1 if the time fixation is equal to or higher than 2057 ms or 0 otherwise).

[20] The results from the Cholesky matrix are available on request.

Table 3.9. Results of three random-parameter logit model specifications

	RPL 1	**RPL 2**	**RPL 3**
	-	Fixation time	Fixation count
Parameters	*β* (z)	*β* (z)	*β* (z)
Opt-out	-1.34 (-8.06)***	-1.38 (-7.98)***	-1.37 (-7.93)***
Fat free	**3.13 (8.57)*** **	**3.30 (8.46)*** **	**3.44 (7.93)*** **
Standard deviation	4.01 (9.56)***	4.20 (8.17)***	4.26 (8.08)***
Low sugar	**0.76 (2.08)** **	**1.07 (2.49)** **	**1.15 (2.24)** **
Standard deviation	2.71 (8.37)***	4.14 (5.54)***	3.84 (4.65)***
High fibre	**2.39 (7.08)*** **	**2.42 (6.84)*** **	**2.76 (6.77)*** **
Standard deviation	2.99 (8.38)***	3.68 (7.42)***	3.57 (7.85)***
Source of vitamin B_6	**1.22 (3.94)*** **	**1.12 (3.50)*** **	**0.77 (2.14)** **
Standard deviation	3.04 (8.8)***	3.46 (5.08)***	1.96 (4.79)***
Source of calcium	**2.09 (4.82)*** **	**0.93 (2.75)*** **	**1.00 (2.77)*** **
Standard deviation	2.12 (6.15)***	1.56 (4.36)***	2.02 (4.53)***
Int. 1 – Fat	**-**	**2.55 (2.81)*** **	**2.66 (4.23)*** **
Standard deviation		1.56 (4.36)***	2.02 (4.53)***
Int. 2 – Sugar	**-**	**-0.41 (-0.77)**	**-0.25 (-0.42)**
Standard deviation		1.22 (2.41)**	0.17 (0.39)
Int. 3 – Fibre	**-**	**2.35 (3.76)*** **	**1.43 (2.46)** **
Standard deviation		1.15 (2.11)**	0.91 (1.89)*
Int. 4 – Vitamin B6	**-**	**0.64 (1.70)***	**1.33 (2.96)*** **
Standard deviation		1.23 (2.43)**	1.12 (3.09)***
Int. 5 – Calcium	**-**	**2.61 (5.22)*** **	**3.36 (6.83)*** **
Standard deviation		1.53 (3.40)***	1.23 (3.09)***
N	4500	4500	4500
Log likelihood	-934.08	-895.10	-868.14
AIC	1.274	1.282	1.246

Note: Significance levels at *** 1%, ** 5%, and * 10%.

According to the results from RPL1, consumer utility is greater when a yoghurt bears the *fat-free* NC, followed by the *high-fibre* and *source of calcium* claims, in comparison with the unlabelled yoghurt. On the other hand, yoghurt that bears the *source of vitamin B_6* or the *low-sugar* claim is the least preferred. Participants' utility changes when we look at the visual attention results. In both models (RPL2 and RPL3), four of the five interaction terms are statistically significant: those related to *calcium*, *fat*, *fibre*, and vita-

vitamin B_6 contents. This result indicates that a longer FT or higher FC is related to greater utility for these attributes. In other words, people who visually attend more to these types of NCs are more likely to choose yoghurt that carries them.

A model fit comparison of the information criteria shows that RPL1 and RPL3 improve the model performance. This result suggests that the incorporation of visual attention in terms of FC information as covariates improves the model fit (see the model fit comparison in Appendix D (Table D1)).

3.4. Discussion and final remarks

This study combined a DCE and ET regarding yoghurt selection to assess consumers' valuation of multiple NCs and to investigate whether attention is related to food choice decisions in one European country (Spain). Consumer heterogeneity was taken into account through consumer segmentation, which entailed the classification of the participants into two segments by consumer characteristics. Those in segment 1, compared with those in segment 2, are more likely to be male, to be between 18 and 34 years old, to have completed secondary studies, and to have a low income. This segment attached a high level of importance to the *fat-free* NC followed by a *source of calcium and a source of vitamin B_6*. Segment 2 is characterized by females aged between 18 and 34 years with a higher income than segment 1 who had completed secondary education. For this segment, the most important NCs considered when purchasing yoghurts were the *source of calcium* type of claim followed by the *fat-free* and *source of vitamin B_6* claims. The preferences of segment 2 are consistent with the interaction terms (i.e., FC visual attention and choice) of the RPL 3 model, which also had the best model fit.

In terms of the importance attached to yoghurt attributes, we did not find any statistically significant differences between segments. This result suggests that there is homogeneity in the importance given to these attributes between our two segments.

The first four most important attributes to the participants of both segments when purchasing yoghurt were taste, nutritional claims, health claims, and health. These findings are consistent with the results of previous studies that defined taste as one of the most important attributes in the decision to purchase food products (Carrillo et al., 2014; Insch & Jackson, 2014; Markovina et al., 2015; Sautron et al., 2015). Moreover, the results are consistent with a previous study by Rebollar et al. (2017), who found healthfulness to be one of the most important attributes in yoghurt for Spanish consumers.

Taking the aforementioned into consideration, food companies should be willing to differentiate their products according to these preferences. These results can be informative and challenging to producers and processors: informative in terms of promoting the *source of calcium*, *fat-free*, and *source of vitamin* B_6 types of NCs as a differentiation strategy and challenging in terms of combining taste and health (i.e., two intrinsic attributes) to reduce the 'halo' effect of the common belief that 'healthy' in most cases equals less tasty food products. Since taste has been found to be one of the most important determinants of repeated purchases (Elbel, Gyamfi, & Kersh, 2011; Holmquist, McCluskey, & Ross, 2012), a strategy that would allow consumers to taste the food product before purchasing it may generate repurchases in the case of satisfaction and may be seen as a form of differentiation. This strategy is common in some stores in the US (e.g., Costco) and has proven to be effective in increasing sales (Pinsker, 2014).

In terms of the extent to which providing NCs on yoghurt packages may provide a signal detection assumption that increasing participants' visual attention may result in increasing the probability of the product being purchased (H1), we showed that visual attention in terms of fixation count may increase the likelihood of a product being purchased. This finding is in line with the overall results of previous studies that suggest that visual attention plays a role in explaining choice behaviour (Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Samant & HanSeok, 2016; Uggeldahl et al., 2016; Van der Laan et al., 2015; Van Loo et al., 2015; Van Loo, Nayga, Campbell, Seo, & Verbeke, 2017; Vu et al., 2016).

This finding is consistent with Orquin & Holmqvist (2018), who suggested that the total dwell time may threaten the external validity of the study. Our results partially confirm that greater utility is generated when the *fat-free* and *low-sugar* claims (H2) are present on the yoghurt package compared with the other claims. Overall, the results from the interactions of the DCE and ET suggest that the *fat-free* claim received the second-strongest visual attention, after *source of calcium*, and was the most chosen among the claims. This result is consistent with the attribute preferences from the cluster analysis (segment 2) and is in line with the previous studies by Krystallis & Chrysochou (2012) and Van Wezemael et al. (2014), who found that consumers have positive perceptions of and attach higher values to NCs related to fat content and saturated fat. The *low-sugar* NC, on the other hand, was the least-preferred claim in all the models. This result also confirms the increasing evidence that what consumers say about their preferences regarding NCs is not actually reflected in what they finally purchase in the marketplace. One reason for rejecting the *low-sugar* NC may be that consumers reject sugar-reduced products that do not meet their sensory preferences, even if they are more healthful than regular products (Civille & Oftedal, 2012). Therefore, emphasizing sugar reduction may create negative sensory effects and decrease the value of a product (e.g., yoghurt) (Brunner, Horst, & Siegrist, 2010; Lähteenmäki et al., 2010; Raghunathan, Naylor, & Hoyer, 2006). Although the *fat-free* NC was the most valued by both clusters and produced the greatest utility in terms of visual attention and final choice in yoghurt, producers, processors, and retailers should carefully consider the type of food product and modify the sensory characteristics related to the NCs accordingly (e.g., fat reduction in meat products, in general, reduces the sensory quality, the texture, and the acceptance of the final product; Méndez-Zamora et al., 2015).

This study has some limitations that constitute areas for further research. The first limitation is that, even though we found that the presence of NCs on yoghurts' FOP increases attention, we cannot prove this with certainty but can only assume that attention might be linked to an increased likelihood of affecting the final decision to purchase yoghurts with NCs.

As defined by Orquin and Holmqvist (2018), it is difficult to support an eye–mind assumption, because researchers cannot know whether the presence of fixation implies that the object has been processed or not and vice versa. Therefore, whilst we maintain that ET is useful, we argue that more research is needed to understand the extent to which ET data can be used to improve stated preference research. The second limitation is that this research was carried out in only one European country due to the limitation in funding; hence, it should be replicated in other countries to provide more evidence. Future research using ET should be developed not only in lab conditions but also in a real supermarket context using ET glasses to test the consumers' attention in terms of preferences and decision making in different contexts. Finally, since each NC has its own effect on people's health, it would also be interesting to explore groups of consumers with similar shopping goals (e.g., fat-free products for consumers who are concerned about reducing their cholesterol level) and discover whether their taste preference is more important than their health goals.

3.5. References

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Chapter 4

Visual attention, choice decision and sensory analysis for nutritional and health claims

This chapter is based on:

Ballco, P., Caputo, V., & de-Magistris, T. (2020). Consumer valuation of European nutritional and health claims: Do taste and attention matter? *Food Quality and Preference*, *79*, 103–793. https://doi.org/10.1016/j.foodqual.2019.103793

Abstract

Healthier eating and convenience are two important and often divergent aspects of contemporary diet patterns. With the intention of guiding consumers to make more informed food purchase decisions, policy makers, such as the EU, emphasize the need to shift dietary patterns toward healthier food by introducing NCs and HCs. The purpose of this study is to (i) explore the impact of NCs and HCs on a healthy food product (yoghurt), (ii) investigate consumer choices through a DCE, (iii) examine the role of taste as a key food attribute influencing the purchase decision process, and (iv) explore the visual attention that consumers pay to NCs and HCs. The results from a generalized mixed logit model (GMXL) suggest that there is a relationship between the most highly valued NCs and HCs from the stated preferences and visual attention in terms of FC. This relationship affirms that the final product selection is based not only on the type of labelling on the package but also on the visual attention that consumers pay to it. Tasting a healthy food product resulted in negative utility, but greater visual attention attached to NCs and HCs and a lower percentage of ANA.

RQ8 Will consumers choose a healthy food (yoghurt) with NC and HC rather than an unlabelled one?

RQ9 Will HCs be considered as an information overload on the food package and thus be less chosen compared to NCs which are short and concise?

RQ10 Will there be a relationship between the NCs and HCs with the highest visual attention and the claims that generated the highest utilities, and will this relationship affect the likelihood of the product being chosen?

RQ11 How will the taste of a healthy food with NCs and HCs affect visual attention and final choices?

RQ12 Does accounting for attribute non-attendance in food choice experiments using eye-tracking measures influence the model estimates?

RQ13 Does the taste of a food influences the attribute non-attendance in choice experiments?

4.1. Introduction

Obesity and the development of chronic diseases, also known as NCDs, have become some of the most common causes of death, not only in developed countries but also in developing ones (Bravo, 2016; WHO, 2018). As a result, dietary guidelines worldwide advise consumers to reduce their intake of saturated fat, sugar, and salt and increase their consumption of fresh fruit and vegetables. Various policy makers have introduced a number of food labelling systems to help consumers make more informed and healthier food choices. For example, the EU has introduced a number of NCs and HCs, which can be displayed on the FOP for food products (Regulation (EC) No 1924/2006).

Evidence from previous studies has shown that food products bearing NCs and HCs are seen as healthy alternatives for which consumers are willing to pay a premium (Ballco & de-Magistris, 2018; Barreiro-Hurlé, Gracia, & de-Magistris, 2010; de-Magistris & Gracia, 2014; de-Magistris & Lopéz-Galán, 2016; Jurado & Gracia, 2017; Van Wezemael, Caputo, Nayga, Chryssochoidis, & Verbeke, 2014). Yet, although consumers express positive attitudes towards food with NCs and HCs, their purchase intentions do not always match their stated views. One potential reason for this mismatch is that NC and HC products, although healthier, do not always meet consumers' sensory expectations (i.e., taste) (Civille & Oftedal, 2012); consumers tend to associate healthy food with an unpleasant taste (Hamblin, 2018; Raghunathan, Naylor, & Hoyer, 2006; Suzuki & Park, 2018). As previous sensory studies have indicated, taste is perceived as one of the most influential purchasing factors (Connors, Bisogni, Sobal, & Devine, 2001; Drewnowski & Rock, 1995; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Kearney, Kearney, Dunne, & Gibney, 2000; Kourouniotis et al., 2016; Mok, 2010). Therefore, when evaluating the market potential of healthy products, it is crucial to assess whether, and how, taste influences consumer preferences for NC and HC labels.

Likewise, the market potential for healthy foods is also affected by the attractiveness of NC and HC labels to consumers.

Previous studies have shown that consumers make choice decisions within a few seconds, and that they may not pay attention to all the information available on the FOP (Milosavljevic & Cerf, 2008). Other studies indicate that consumers only partially process food information, and are sometimes unconscious of its presence on the label (Oliveira et al., 2016; Wedel & Pieters, 2008). Taken together, this evidence indicates that visual attention plays a key role in the effectiveness of food labelling systems. Thus, new technologies, such as ET, can be a helpful aid in understanding the decision-making process, and specifically the link between healthy food product purchase and visual attention. This is also confirmed by several studies, indicating that ET is a promising tool that effectively captures visual attention (Lewis, Grebitus, & Nayga, 2016; Muñoz-Leiva, Hernández-Méndez, Liébana-Cabanillas, & Marchitto, 2016; Scott, Green, & Fairley, 2016; Wedel & Pieters, 2008).

Given the aforementioned framework, the main objectives of this research are to assess consumer preferences for NCs and HCs on a healthy food product (yoghurt), explore whether and how taste influences consumer preferences for NC and HC labels, and determine whether visual attention might lead to the increased likelihood of a product being purchased. To achieve these objectives, this study combines a DCE, ET technology, and sensory analysis. To explore how taste influences consumer choices, two between-subject experiments were utilized: a control (no-taste), where respondents were asked to answer repeated DCE questions displaying yoghurts bearing different NC and HC claims, and a taste treatment in which respondents were first asked to participate in a taste test before being exposed to the DCE questions. In both experiments, participants' eye movements were recorded using ET.

By using ET, we are also able to take ANA into consideration. In the analysis of DCE, it is commonly assumed that respondents pay attention to all the proposed stimuli and attributes presented to them. However, recent studies have shown that during experiments consumers may not attend to all of the attribute information presented to them due to different food product evaluation strategies and other factors that are unknown to the researcher

(Caputo, Van Loo, Scarpa, Nayga, & Verbeke, 2017; Van Loo et al., 2018, 2017). This decision heuristic is referred to as ANA in the choice modelling literature. Results from previous applications indicate that not considering ANA may affect model choice outcomes and lead to biased estimates (Campbell, Hensher, & Scarpa, 2011; Hensher, Rose, & Greene, 2012; Hole, 2011; Kragt, 2013; Scarpa, Gilbride, Campbell, & Hensher, 2009; Scarpa, Thiene, & Hensher, 2010). Therefore, to account for all aspects of the decision-making process we also incorporate ANA into our analysis.

This study contributes to the literature on consumer valuation of nutritional and health claims in several ways. First, while previous studies have used a limited set of NCs and HCs (Benson et al., 2018; Bialkova, Sasse, & Fenko, 2016; Carrillo, Fiszman, Lähteenmäki, & Varela, 2014; Iglesia et al., 2018; Jurado & Gracia, 2017; Van Wezemael, Caputo, Nayga, Chryssochoidis, & Verbeke, 2014), this study is the first to evaluate consumer preferences for multiple NCs and HCs. This is an important aspect to take into consideration, as it allows consumers to evaluate many different claims, similar to a real purchasing situation.

Second, as the first of its kind to combine DCEs and ET with sensory analysis, this study examines the importance of taste in healthy food products. The combination of these three methods provides new insights into the decision-making process and consumer behaviour, which allow us to examine preferences for healthy food products. For instance, while the use of DCE and sensory analysis mirror what consumers experience pre- and post-purchase, the ET technology allows us to measure ANA behaviour and observe the attention consumers devote to the NC and HC labels. Finally, findings from this study provide policy makers and the agro-food sector with relevant information about consumer preferences for NC and HC labels, assisting them in designing new policies and marketing strategies, while promoting healthy food choices.

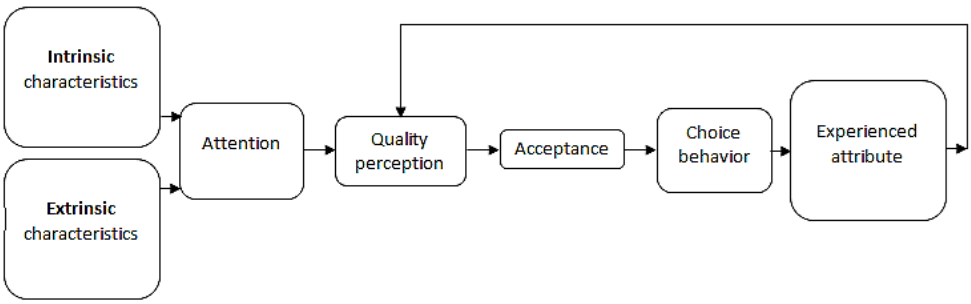
The rest of the article is structured as follows. The next section summarizes the previous research using DCE, ET, and sensory analysis, followed by the experimental procedures used and a description of the empirical and data

analysis. We then report our results before presenting the discussion and conclusions in the final section.

4.2. Theoretical Background

Consumer food purchase behaviour is influenced by the quality inferred based on product characteristics, which can be differentiated into extrinsic (e.g., price, claims, and labels) and intrinsic (e.g., taste) quality cues (see Fernqvist & Ekelund (2014); Steenkamp, (1990)). Extrinsic characteristics such as labels and claims, also known in the literature as credence attributes (Caswell & Mojduszka, 1996), are those product characteristics whose quality cannot be discerned neither before nor after purchase and consumption. Thus, consumers use them as cue to form their quality expectation (Caputo, Scarpa, & Nayga, 2016) and predict benefit perceptions. Intrinsic characteristics such as taste, on the other hand, can be evaluated by consumers through experience and thus only after purchase and consumption. Figure 4.1 depicts the role of extrinsic and intrinsic characteristics in repeated food choice behaviour.

Figure 4.1. Product characteristics and the consumer quality perception process adopted from Fernqvist & Ekelund (2014), Grunert & Wills (2007) and Steenkamp (1990).



In addition to the intrinsic and extrinsic evaluation stages, the theoretical framework in Figure 4.1 incorporates attention (i.e., in our case visual attention measured using ET) product acceptance and, finally, the choice be-

-aviour which, in our case, is measured using the DCE method. As shown in Figure 4.1, in order to impact pre-consumption, consumers must pay attention to the quality characteristics. For example, the effectiveness of NCs and HCs depends on whether, and how, consumers process their presence on FOP.

Once consumers have purchased and consumed the product, they re-evaluate the overall characteristics of the product and update their perceptions based on experienced attribute (i.e., their taste experience). In this study, the extrinsic characteristics of the product (yoghurt) are represented by NCs and HCs. As previously mentioned, prior research demonstrates that food products with NCs and HCs are seen as healthy alternatives and that, overall, consumers are willing to pay a price premium for them. Therefore, based on self-reported pre-consumption evaluation, we expect that consumers will choose yoghurts with NCs and HCs on the FOP rather than unlabelled yoghurts (**H1**). However, a number of studies also suggest that information overload may generate consumer disutility (Barreiro-Hurle et al., 2010). Thus, we expect participants to mostly select yoghurts with NCs, as they present short and concise information, compared to HCs (**H2**).

A contributory factor to H2 is that consumer choice decisions are usually made within a few seconds (Milosavljevic & Cerf, 2008). Partially due to this fact, consumers may not be able to consider all the information reported in NCs and HCs during the decision process (Van Herpen & Van Trijp, 2011). The information contents on NCs and HCs might also play a determinate role. For instance, HCs typically include longer statements than NCs, requiring more cognitive effort. Therefore, we expect consumers' visual attention to be higher for HCs as compared to NCs (**H3**). Alternatively, instead of devoting more time and attention to HCs, consumers may ignore them, such that ANA may be greater for HCs due to their length (**H4**).

In this study, attention is assessed using ET technology, which is considered a promising tool in the field of consumer behaviour and marketing.

ET also allowed us to account for visual ANA behaviour[21] and to test both H3 and H4 via FC[22]. These competing predictable behaviors, as well as the acceptance step in the decision process (figure 4.1), lead to the question on whether attention on NCs and HCs translates into choice behaviour. In this regard, empirical studies assessing whether consumers pay attention to food products with NCs have suggested that attention is strongly linked to the final purchase decision (Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Samant & HanSeok, 2016; Uggeldahl, Jacobsen, Lundhede, & Olsen, 2016; Van der Laan, Hooge, Ridder, Viergever, & Smeets, 2015; Van Loo et al., 2015; Vu, Tu, & Duerrschmid, 2016). More specifically, results from these studies generally indicate that the higher the product fixation the higher the likelihood of the product being chosen. Based on these findings, we expect to find a relationship between the attributes with the highest visual attention and the attributes that generated the highest utilities from the DCE, and that this relationship might increase the likelihood of a product being purchased **(H5)**.

While incorporating ET allows us to estimate the impact of NCs and HCs on purchase behaviour, whether extrinsic and intrinsic attributes lead to repeated purchases remains unknown without a post-consumption evaluation. In this study, we used between-subject sensory analysis to approximate how taste (intrinsic attribute) influences choice behaviour.

[21] Visual ANA is defined as visually ignoring information about attribute levels (Balcombe, Fraser, & McSorley, 2015). Two other approaches have been proposed so far in the DCE literature to identify ANA. These are: stated and inferred. In stated ANA, subjects are asked ex-post whether they intentionally ignored certain attributes when making their choices (Caputo, Van Loo, Scarpa, Nayga, & Verbeke, 2018). In the inferred approach, ANA behavior is elicited through the estimation of analytical models (Caputo, Nayga, & Scarpa, 2013; Scarpa, Thiene, & Hensher, 2010).

[22] The FC is the fixations' frequency recorded inside an AOI.

Prior studies have found that taste plays a key role in purchasing behaviour for healthy foods, including yoghurt[23]. Prior studies have found that taste plays a key role in purchasing behaviour for healthy foods, including yoghurt[24]. Other research has indicated that consumers value healthy food less after consumption, noting that it does not taste as good as expected (Suzuki & Park, 2018). Based on this, we expect that consumer utility for NCs and HCs will decrease after taste (**H6**). In addition, we also expect a secondary effect of taste on visual attention; namely visual ANA will be lower when taste is experienced, since taste may induce consumers to acquire more information (**H7**). Overall, our theoretical background highlights the need for a comprehensive experimental setting when analysing consumer preferences for HCs and NCs.

[23]Vickers (1993) combined sensory and conjoint analysis to study the effects of sensory characteristics, brand, price, and HCs on the intention to buy strawberry yoghurts. The study confirmed that sensory quality is very important in purchasing yoghurts with HCs and that taste and HCs have the largest influence on buying intention among all attributes. Johansen, Næs, Øyaas, and Hersleth (2010) studied the acceptance of yoghurts with different levels of sweetness and richness, while corresponding information about sugar and fat content was given simultaneously to the tasting. The results showed that sweetness and information about sugar content have significant effects on liking and purchase probability.

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4.3. Experimental procedures

4.3.1. Choice experiment: Product and attribute selection

Plain yoghurt was selected as the product of interest for this study[25], while selection of the NCs and HCs[26], followed three steps. The first step consisted of a detailed examination of the EC Regulations No. 1924/2006 (Smith, 2015) and (EC) No. 432/2012 (i.e., to familiarize ourselves with the criteria for carrying NCs and HCs on the FOP) (see the EU's official definitions of NCs and HCs in Appendix E). The second step involved exploring the presence of NCs and HCs on food products in the Spanish market. In this regard, we created a database of information about food products that were available in different hypermarkets and supermarkets in autumn 2015. The food product sample included in the database was selected according to the individual products' importance in the shopping basket of Spanish households[27] (Ministry of Agriculture and Fisheries, Food, and Environment (MAPAMA), 2014). From the preliminary results of this food database, we chose yoghurt for further analysis for three reasons: i) it was the product that carried the most NCs and HCs, ii) it is considered a healthy food product (Moore, Horti, & Fielding, 2018), and iii) it is consumed in the majority of Spanish households (Ministry of Agriculture and Fisheries, Food, and Environment (MAPAMA), 2014). In total, there were 251 plain yoghurts that had one type of NC and 67 yoghurts with one type of HC on the FOP that corresponded to the official EU definitions (Regulations (EC) No. 1924/2006 and (EC) No. 432/2012). Table 4.1 reports the NCs and HCs selected for this study.

[25] In the Spanish market, plain yoghurt is known by consumers as natural. Therefore, during the experiments all the yoghurts products were named 'natural product' to indicate plain yoghurt without added flavor.

[26] By presenting the HC together with the NC, it is assured that differences in consumer preferences refer to the claimed health benefit and not merely to the nutrient mentioned in the health claim (Van Wezemael et al., 2014).

[27] According to the Consumer Observatory in Spain, 89% of the per capita consumption of packaged food consisted of liquid milk, processed meat, yoghurts, cheeses, industrial bread, and biscuits (Ministry of Agriculture and Fisheries, Food, and Environment (MAPAMA), 2014).

Table 4.1. Levels of nutritional and health claims and the variable names used

No.	NC levels	Variable name[a]	Presence[b] (%)	No.	HC levels	Variable name[c]	Presence (%)
1	Fat-free	Nc_fat	(42.78)	1	Reducing the consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels (A)*	Hca[d]_fat	-
2	Low sugar	Nc_sug	(11.99)	2	The consumption of food containing sweeteners instead of sugar induces lower blood glucose (A)	Hca_sug	-
3	High fibre	Nc_fib	(1.09)	3	Fibre contributes to an acceleration of intestinal transit	Hcp[e]_fib	3.80
				4	Fibre contributes to an increase in fecal bulk (A)	Hca_fib	-
4	Source of vitamin B_6	Nc_vit	(10.63)	5	Vitamin B_6 helps your defences and reduces fatigue	Hcp_vit	10.33
				6	Vitamin B_6 contributes to the normal functioning of the nervous system (A)	Hca_vit	-
5	Source of calcium	Nc_cal	(21.25)	7	Calcium is necessary for maintaining bones under normal conditions	Hcp_cal	2.17
				8	Calcium contributes to normal muscle function (A)	Hca_cal	-
6	No-label	Baseline			(12.26)		

Notes: *(A) indicates that a HC has not yet been introduced to the local market – absent. [a] indicates the variable names for the nutritional claims used in the model estimations. [b] indicates the presence of the NC and HC on yoghurts in the local market and is expressed as a percentage. [c] indicates the variable names for nutritional and health claims. [d] Hca represents the health claims that are not commercialized (absent). [e] Hcp represents the health claims that are present in the market.

Several studies have indicated that HCs, in general, are not fully understood by the 'average consumer'[28] (Asp & Bryngelsson, 2008; Nocella & Kennedy, 2012; Richardson, 2003). Hence, in addition to those present in the local market (e.g., HCs 3, 5, and 7, as reported in Table 4.1), we used five additional HCs in the experiment, which were extracted from Regulations (EC) No. 1924/2006 and (EC) No. 432/2012 (e.g., HCs 1, 2, 4, 6, and 8, as reported in Table 4.1) that are not commercialized, and are easy to understand according to a focus group of 20 'average consumers' of different ages and education levels carried out before the experiment. In accordance with the Spanish database, we chose a packaging size of 500 g (4 containers, each with 125 g), as it has the highest presence in the market. A full-fat plain with no NC and HC labels (no-label) yoghurt was selected as the baseline product and 5 levels of NCs and 8 levels of HCs were chosen for the other treatments.

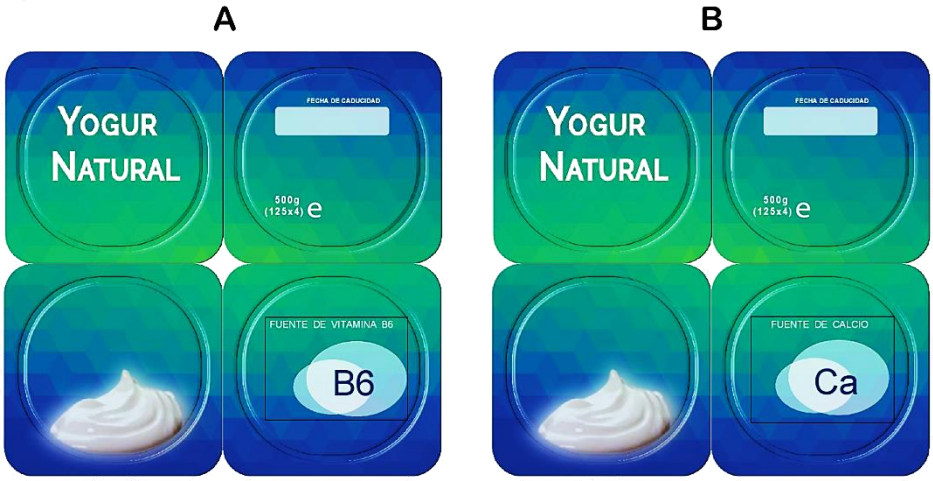
In our study, we replicated Carlsson et al. (2007), who conducted a DCE without the price attribute. Other examples of studies that excluded the price attribute in CEs combined with ET were undertaken by Bialkova and Van Trijp (2011) and Bialkova et al. (2014). These analyzed the attention paid to, and choice of, nutritional information. In line with Carlsson et al (2007), we told the participants that all the alternatives cost the same, since yoghurt is regularly consumed in Spanish households[29] and individuals are aware of the price variation[30] for different types of yoghurts. Figure 4.2 displays an example of a choice task used during the DCE.

[28] The enactment of Council Directive 84/450/EEC of 10 September 1984 concerning misleading and comparative advertising defines the average consumer as someone '…who is reasonably well-informed and reasonably observant and circumspect, taking into account social, cultural and linguistic factors, as interpreted by the Court of Justice, but makes provision to prevent the exploitation of consumers whose characteristics make them particularly vulnerable to misleading claims.'

[29] According to the results from the Consumer Observatory in Spain (Ministry of Agriculture and Fisheries, Food, and Environment (MAPAMA), 2014) and the questionnaire on yoghurt consumption frequency in households, 56% of households consume yoghurt once a week and 14% twice a week.

[30] The yoghurt market prices in the period of October 2016, for a 4×125 g pack, were: natural (€1.09), fat-free (€1.80), low in sugar (€1.92), source of fiber (€1.99), source of vitamin B6 (€1.99), and source of calcium (€1.69).

Figure 4.2. An example of a choice question



Note: Option A contains the NC saying yoghurt is a *source of vitamin B_6*, while the NC on option B refers to the yoghurt as a *source of calcium*. Areas of interest (AOIs) were not marked in black in the original evaluation choice task. 'Ninguno' is the 'no-buy' option.

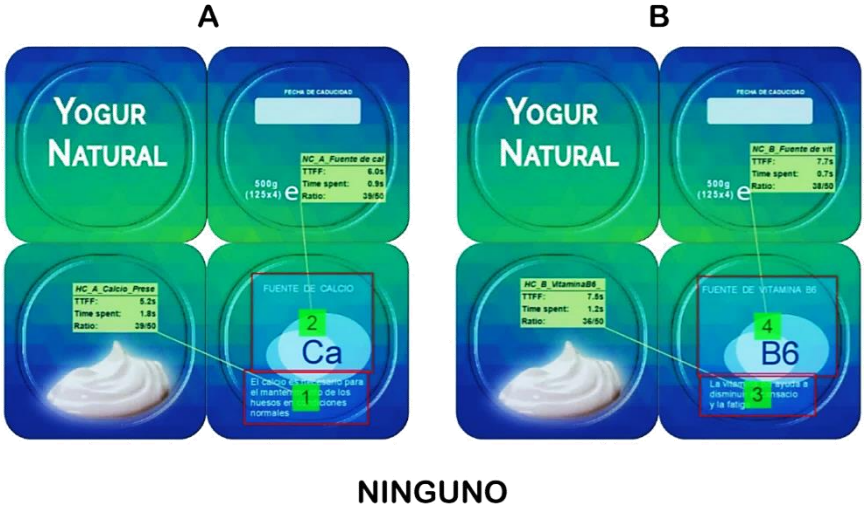
Using the NCs and HCs listed in Table 4.1, and following the experimental design employed by Bialkova and Van Trijp (2011) and Bialkova et al. (2014), we applied an availability design (see Lazari & Anderson, 1994; Rose & Hensher, 2006, for an overview). Given our experimental set up and crossing all alternatives, this would have resulted in 91 possible choice tasks or choice questions excluding the repeated ones (mirror effect choice questions). To reduce the number of choice questions, and therefore fatigue among participants, we used only 44 choice questions[31], which were randomly split into 4 blocks of 11 choice tasks for each participant. Participants were then randomly assigned to only one of the blocks, thus facing 11 choice questions, whose order was also randomized. Each choice question was composed of three alternatives, two yoghurts, each with a different HC and NC level and a no-buy option (see Figure 4.2).

[31] According to the main objective of the study, the 44 choice questions included all the product alternatives combining NCs and HCs.

4.3.2. Eye tracking and its measurement

The ET device usually tracks parameters using an infrared light reflection from the centre of the pupil and measures the distance and angle of that reflection in terms of gaze and fixation (Duchowski, 2007). Following Van Loo et al. (2015), we defined a set of AOIs[32] to capture the eye fixations (see Figure 4.3) corresponding to each of the selected NCs and HCs. Visual attention was measured for each attribute/AOI in terms of FC.

Figure 4.3. An example of an AOI and the information provided after the experiment



Note: Option A contains the NC saying yoghurt is a *source of vitamin B_6* and HC 'Calcium is necessary for maintaining bones under normal conditions'. The NC on option B refers to the yoghurt as a *source of calcium* and is accompanied by the HC 'Vitamin B_6 helps your defences and reduces fatigue'. AOIs were not marked in red in the original evaluation choice task. 'Ninguno' is the 'no-buy' option. The yellow boxes provide metrics for separate AOIs. For each AOI, they report the name of the AOI, the time-to-first-fixation (TTFF) in seconds, the time spent in seconds inside this AOI, and the ratio, which is the number of participants who visited this AOI.

The FC is the number of times a participant fixated her/his gaze on the AOI. A higher FC means that the area is more noticeable with respect to the rest of the AOIs present in that choice task (Poole, Ball, & Phillips, 2005).

[32] The AOI is the selected area within an image that will provide the eye-tracking data.

The combination images were presented one-by-one in full colour on a 24' computer screen with a 1920×1080 pixel resolution. Eye positions were sampled at 50 Hz, with a remote ET device (Tobii X2-30 eye tracker) integrated under the computer screen on which the stimuli were displayed. The distance between the ET device and the participants' eyes was approximately 58–60 cm. Before the display, a 9-point calibration procedure was run and the participants were familiarized with the process using an example of a 2-alternative choice question. Participants had 15 seconds to observe the 2 products in each question and then verbally stated their preferred yoghurt (A, B, or neither) to the research assistant.

4.3.3. Experimental design

The experiment consisted of two treatments: *Taste DCE* and *No-Taste DCE*. In both treatments, we used ET to track eye movement within AOIs, in our case NCs and HCs. The sessions involved one participant at a time, with a total of 218 participants.

Upon arrival, the participants received information about the main purpose of the experiment and signed a consent form for participation. One of the research assistants introduced the general overview of the working session, while the other research assistants distributed the material (consent form, DCE protocols, and questionnaire) to the participants. The *Taste DCE* treatment consisted of three phases: i) the taste test for the different yoghurts; (ii) the ET and DCE; and iii) a short questionnaire. Table 4.2 summarizes the treatments used in the experiment.

Table 4.2. Experimental treatments

Treatments/Phases	*Taste DCE* treatment (N=115)	*No-Taste DCE* treatment (N=103)
Phase I - Sensory analysis (NCs and HCs)	✓	
Phase II - ET and DCE	✓	✓
Phase III - Questionnaire	✓	✓

In the *Taste DCE* phase I, each respondent tasted 6 different types of yoghurts (unlabelled, fat-free, low sugar, high fibre, source of vitamin B6, and source of calcium), each with the corresponding table of nutrition

content information. More specifically, for each type, five grams of yoghurt were served in single-use plastic cups with a teaspoon[33]. The tasting cups were randomized and coded using one digit corresponding to the six different yoghurts to be tasted. None of the yoghurts used in the experiments contained added flavours or fruit, except the yoghurt with fibre, which contained several types of cereal (e.g., oats, barley, wheat, and wheat bran).

To be able to compare the healthiness of yoghurts before tasting, the participants were provided with enlarged nutrition table information placed close to each yoghurt with the corresponding NCs and HCs. After tasting each yoghurt, the consumers evaluated the taste on a nine-point scale ranging from 'I like it very much' (9) to 'I dislike it very much' (1) and on a five-point scale from 'definitely yes' (5) to 'definitely no' (1) indicating whether they would purchase it. Before evaluating the next yoghurt, the participants were instructed to drink some water and cleanse their palate (see the sensory evaluation questionnaire in Appendix F (Figure F1) and an example of the information page provided to participants while evaluating them in Appendix F (Figure F2) – these appendixes were not included in this published article).

In the *Taste* DCE phase II, the ET and DCE, the yoghurts displayed to the participants differed in two attributes (NCs and HCs) (see Figure 4.1). A nine-point calibration procedure was used to calibrate participants' vision with the ET device before the example warm-up task and after starting the data collection. The participants were asked to answer 11 choice questions (each participant was faced with only one of the four DCE blocks). In each question, they were given 15 seconds to evaluate the three alternatives (two yoghurts and the no-buy) before indicating their most preferred yoghurt/alternative.

[33] The tasting procedures were approved by alimentary experts at the Laboratories of Analysis and Technological Assistance (LATA) from the Center of Investigation and Food Technology of Aragon (CITA).

Finally, in phase III, the respondents filled out a short questionnaire[34]. At the end of the experiment, the participants received a gift equivalent to €7. Similarly, the *No-Taste DCE* also comprised three phases: i) evaluating yoghurts based only on the information provided (i.e., an enlarged nutrition table and the corresponding NCs and HCs); ii) the ET and DCE; and iii) the exit questionnaire. Hence, no-sensory evaluation (i.e., taste) was performed by the participants in this treatment and, as in the *Taste* DCE, in phase II the participants were asked to answer 11 choice questions (only one of the four DCE blocks).

4.3.4. Data analysis

While the sensory and ET data were analyzed using descriptive statistics, the DCE data were analyzed using random utility models. According to the RUT, the utility that individual *n* derives from alternative *j* can be expressed as follows:

$$\mathrm{U}_{njt} = \mathrm{V}_{njt} + \ \varepsilon_{njt} \qquad (1)$$

where $\mathrm{V}_{\mathrm{njt}}$ is the systematic portion of the utility function that depends on X_{njt}, a vector of product attributes (e.g., NCs and HCs); β_{n} are the coefficients to be estimated; and ε_{nj} is an independently and identically distributed (IID) error term.

Given our experimental setting, $\mathrm{V}_{\mathrm{njt}}$ in equation (1) can be rewritten as:

$$\mathrm{V}_{njt} = \mathrm{OptOut} + \sum_{k=1}^{K} \beta_{nk}\, x_{njtk} \qquad (2)$$

where $OptOut$ is the alternative-specific constant representing the opt-out option: β_{nk} is a vector of utility weights; and x_{njtk} is a K-vector of observed attributes (NCs and HCs as reported in Table 4.1) of alternative *j* as reported in Table 4.1. The NC and HC variables enter the model as dummy variables

[34] The questionnaire contained both closed- and open-ended questions regarding the consumption and purchase frequency of yoghurts, the importance attached to NCs and HCs, their knowledge about NCs and HCs, their motivation to process and general interest in HCs, and their demographic characteristics.

taking the value of 1 if the product displays them on the FOP and 0 otherwise. Unlabelled plain yoghurt represents the baseline. Depending on the assumptions about consumer preferences, different random utility models can be estimated. In this application, we estimated a GMXL model (see Fiebig, Keane, Louviere, & Wasi, 2009), which allows researchers to account for both random taste variation and scale heterogeneity (Fiebig et al., 2009). In the GMXL model, β_n is expressed as follows:

$$\beta_n = \sigma_n \beta + \gamma \eta_n + (1-\gamma)\sigma_n \eta_n \quad (3)$$

where: $\sigma_n = \exp[\overline{\boldsymbol{\sigma}} + \tau w_n]$ is the individual-specific standard deviation of the idiosyncratic error term capturing scale heterogeneity; and γ is a parameter between zero indicating how the variance of residual taste heterogeneity varies with scale; and η_n is the vector of person *n*-specific deviations from the mean. For computational details see Fiebig et al., 2009 and Hensher, Rose, & Greene, 2015.

Since this study uses two sources of data (taste vs no-taste treatments), following Hensher et al. (2015), we also allowed for scale differences between data sources in the GMXL scale factor. We did so by allowing τ in σ_n to be a function of a dummy variable that identifies the presence of scale heterogeneity between the two datasets: taste vs no-taste treatment. The dummy variable, named '*Taste Treatment*' is equal to 1 if respondents tasted the yoghurts before the DCE questions and zero otherwise. For computational details see Hensher, Rose, & Greene, 2015. Finally, following previous studies exploring treatment effects using a pooled data approach (Caputo, Scarpa, & Nayga, 2016), equation (2) was extended to also include interaction terms between NCs and HCs and a dummy variable identifying the treatment effect. The dummy variable, named *treat,* is equal to 1 if respondents tasted the yoghurts before the DCE questions (taste treatment) and zero otherwise (4).

$$V_{njt} = \text{OptOut} + \sum_{k=1}^{K} \beta_{nk} x_{njtk} + \sum_{g=1}^{G} \delta_k (x_{njtk} * treatment) \quad (4)$$

where the δ_k coefficients capture the interaction effect between the NCs and HCs and the taste treatment, while the remaining variables are specified as

in (2). The significance of the estimated δ_k and their signs reveal whether consumer preferences for NCs and HCs differ across the taste vs no-taste treatments. Overall, three GMXL were specified. The first model, named Model I, was specified to embed the traditional assumption of fully compensatory behaviour, whereby respondents are assumed to pay attention to all the attributes while making food choices. Previous studies have shown that models assuming partially compensatory behaviour may best describe preference structures. Therefore, we specified two additional models: Model II-FC1 and Model III-FC2, both accounting for visual ANA[35] behaviour elicited through the use of the ET technology during the experiments. More specifically, in Model II-FC1 we restricted the coefficients in the utility function to 0 for those attributes with a fixation count cut-off set as lower than one, while in Model III-FC2 we restricted the coefficients to 0 for those attributes with a FC cut-off set as lower than two.

4.4. Results

4.4.1. Sample characteristics

The experiment was conducted in 2016 in Zaragoza (Spain), which is widely used by food marketers and consulting companies, since the socio-demographics of this town are representative of the Spanish Census of Population (see Appendix B – Table B1). A total of 218 participants[36] aged 18 years or older, and without eye problems, completed the experiment. Table 4.3 shows the socio-demographic characteristics of the sample of

[35] The visual ANA measured in two previous studies (Balcombe et al., 2015; Holmquist, McCluskey, & Ross, 2011) made the assumption that at least two FCs are required to consider an attribute to be visually sensed. However, according to a more recent research, even one FC has to be taken into consideration, because that means that the person may have detected the information (Van Loo, Nayga, Campbell, Seo, & Verbeke, 2017). Hence, we estimated the visual ANA model when the FC was at least one following Van Loo et al. (2017) and at least two following the suggestions of Balcombe et al. (2015) and Holmquist et al. (2011).

[36] It should be noted that 13 participants were not able to complete the entire experiment due to problems with their vision.

respondents and the percentage values of participants for each treatment (taste vs no-taste).[37] Participants were recruited via email by a recruiting agency and selected through random stratification with proportional allocation for age, gender, and education to avoid under/overrepresentation of consumer profiles. More females (53%) than males participated in the experiment. With respect to age and education, our sample is similar to the population in Spain, with approximately a quarter of the respondents aged between 35 and 44 years and over 40% being older than 55 years.

Table 4.3. Descriptive analysis of the sample and socio-demographic characteristics

	Sample (N=218)	Spanish population	Taste treatment (N=115)	No-taste treatment (N=103)
Gender				
Male	47.25%	50.00%	49.57%	44.66%
Female	52.75%	50.00%	50.43%	55.34%
Age of respondents[c]	48.8 (15.26)[c]	42.90	41.07 (13.45)	57.56 (12.17)
From 18 to 34 years	19.72%	22.24%	34.78%	2.91%
From 35 to 44 years	20.64%	19.55%	28.70%	11.65%
From 45 to 54 years	18.35%	18.28%	17.39%	19.42%
More than 55 years	41.28%	39.93%	19.13%	66.02%
Education level[b]				
Primary studies	26.61%	24.88%	6.96%	48.54%
Secondary studies	41.74%	47.64%	41.74%	41.75%
University studies	31.65%	27.48%	51.30%	9.71%

Note: [a] Provisional data obtained on January 1, 2017 (INE, 2017). [b] OCDE (2014). [c] Number in parentheses are standard deviations.

4.4.2. Sensory analysis and visual attention: some statistics

Table 4.4 reports the product liking mean comparison scores across the taste vs no-taste treatments. Looking at the results it can be noted that except for the 'high fibre' *(Nc_fib)* and 'source of vitamin B_6' *(Nc_vit)* types of

[37] This study is part of a larger study exploring consumer behavior regarding nutritional and health claims in Spain, in which multiple experiments were conducted.

yoghurts, there are significant differences in liking for the rest of the yoghurts. More specifically, participants preferred the taste of the plain yoghurt (*Nc_nat*) the most, followed by the low sugar yoghurt (*Nc_sug*), whereas, the yoghurt with the NC 'Source of Calcium*'* *(Nc_cal)* received the lowest valuation in the taste treatment. Surprisingly, in the no-taste treatment, the hedonic valuation for all varieties is slightly higher than in the taste treatment, except for the plain yoghurt. This suggests that consumers have higher expectations with regards to the taste if they do not get to try the product. Contrary to the 'taste' treatment the 'Source of Calcium' yoghurt had the second highest valuation after the 'fat-free' *(Nc_fat)* yoghurt, while the plain yoghurt ranked the lowest. This result partially confirms H6 suggesting that consumers attach a lower product liking to yoghurts with NCs and HCs when taste is experienced rather than the taste in not experienced.

Table 4.4. Product liking mean comparison scores between the taste vs no-taste treatment.

	Taste (N=115) Mean (SD)[a]	No-taste (N=103) Mean (SD)	Δ[b]	T-test
Nc_nat	6.88 (1.43)	5.19 (2.31)	1.68	6.56***
Nc_fat	6.29 (1.78)	7.20 (1.43)	-0.92	-4.17***
Nc_sug	6.78 (1.89)	6.32 (1.94)	0.46	1.78***
Nc_fib	6.20 (1.92)	6.38 (1.99)	-0.18	-0.67
Nc_vit	6.16 (1.87)	6.25 (1.88)	-0.10	-0.38
Nc_cal	5.16 (2.10)	6.82 (1.61)	-1.66	-6.50***

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. [a] SD stands for standard deviation. [b] Δ represents the difference between the two group means.

Table 4.5 reports the visual attention mean comparison scores between the taste vs no-taste treatments. The visual attention means were calculated using a fixation count of one (FC1) and two cut-offs (FC2), while differences across treatments were computed using a t-test. Appendix G provides the means of visual attention (FC1) in the form of a heat-map. (Figure G1 and G2) – These appendixes were not included in this published article.

Table 4.5. Visual attention mean comparison scores between the taste vs no-taste treatment

	FC 1						FC 2					
	Taste N=115		No taste N=103				Taste N=115		No taste N=103			
	Obs.	Mean (SD)[a]	Obs.	Mean (SD)	Δ[b]	t-test	Obs.	Mean (SD)	Obs.	Mean (SD)	Δ	t-test
Nutritional claims												
Nc[c]_Nat	715	1.41(0.62)	548	1.31 (0.51)	0.11***	3.23	248	2.19 (0.44)	154	2.09 (0.29)	0.10***	2.46
Nc_fat	774	5.01 (3.52)	833	5.12 (3.78)	-0.11	-0.60	668	5.64 (3.37)	696	5.93 (3.62)	-0.28**	-1.49
Nc_sug	948	5.52 (3.93)	822	5.41 (3.95)	0.10	0.56	815	6.25 (3.76)	697	6.20 (3.78)	0.05	0.26
Nc_fib	1423	3.26 (2.59)	1253	3.41 (2.73)	-0.15*	-1.46	1009	4.19 (2.55)	896	4.38 (2.68)	-0.18*	-1.53
Nc_vit	1980	5.96 (4.39)	1719	5.93 (4.40)	0.03	0.23	1733	6.67 (4.24)	1509	6.62 (4.26)	0.05	0.37
Nc_cal	1904	5.49 (4.09)	1687	5.47 (4.30)	0.01	0.10	1621	6.27 (3.94)	1389	6.43 (4.15)	-0.16	-1.10
Health claims												
Hca[d]_fat	698	9.40 (6.01)	765	7.85 (6.09)	1.55***	4.90	650	10.02 (5.77)	658	8.96 (5.85)	1.06***	3.30
Hca_sug	845	8.71 (6.31)	758	8.23 (6.16)	0.48**	1.54	756	9.62 (6.09)	677	9.09 (5.96)	0.52**	1.65
Hcp[e]_fib	822	6.45 (4.73)	683	5.61 (4.48)	0.84***	3.52	720	7.23 (4.55)	553	6.70 (4.31)	0.53***	2.11
Hca[f]_fib	809	5.75 (4.60)	708	5.58 (4.40)	0.17	0.75	687	6.60 (4.49)	601	6.40 (4.29)	0.20	0.82
Hcp_vit	825	6.88 (4.99)	694	5.93 (4.56)	0.94***	3.84	729	7.65 (4.80)	590	6.79 (4.41)	0.86***	3.33
Hca_vit	814	7.43 (5.35)	714	6.48 (5.08)	0.95***	3.53	724	8.23 (5.14)	614	7.37 (4.94)	0.85***	3.08
Hcp_cal	856	8.47 (6.10)	742	7.59 (6.00)	0.88***	2.90	785	9.15 (5.92)	637	8.68 (5.80)	0.47**	1.51
Hca_cal	823	7.13 (5.23)	695	6.23 (4.82)	0.90***	3.48	722	7.99 (5.02)	592	7.14 (4.65)	0.85***	3.17

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. [a] SD stands for standard deviation. [b] Δ represents the difference between the two group means. [c] Nc means nutritional claim. [d] Hc means health claim. [e] Hcp means health claims that are present in the local market. [f] Hca means health claims that are absent from the local market.

Results reported in Table 4.5 show that, on average, NCs received slightly more attention in the situation where tasting occur than in situation where tasting did not occur in both FC1 and FC2. However, only two NCs in FC1 (e.g., *Nc_fat* and *Nc_fib*) and three NCs in FC2 (e.g., *Nc_nat*, *Nc_fat*, and *Nc_fib*) differ significantly between the visual attention group means. This implies that the actual taste of the product did influence the visual attention paid by the participants when nutritional and health claims are labelled together vs when NCs are labelled alone. These results partially confirm our research hypothesis H3 showing a higher visual attention for HCs as compared to NCs in both treatments (taste vs no taste). Table 4.6 reports the percentages of visual ANA measured in terms of FC (FC1 and FC2 cut-off) for both NCs and HCs across treatments (taste vs no taste).

Table 4.6. Visual ANA for FC1 and FC2 cut-offs between treatments (% of choice tasks).

Attributes	FC1				FC2			
	Taste N=115		**No taste** N=103		**Taste** N=115		**No taste** N=103	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Nutritional claims								
Nc_fat	185	17.87	184	19.85	313	30.24	308	33.23
Nc_sug	187	18.07	190	20.50	309	29.86	306	33.01
Nc_fib	764	39.08	699	39.92	1107	56.62	989	56.48
Nc_vit	281	14.37	287	16.39	495	25.32	465	26.56
Nc_cal	352	18.01	315	17.99	589	30.13	577	32.95
Health claims								
Hca_fat	198	19.13	162	17.48	254	24.54	269	29.02
Hca_sug	190	18.36	169	18.23	279	26.96	250	26.97
Hcp_fib	213	20.58	244	26.32	315	30.43	374	40.35
Hca_fib	924	89.28	847	91.37	939	90.72	853	92.02
Hcp_vit	213	20.58	233	25.13	309	29.86	337	36.35
Hca_vit	224	21.64	213	22.98	314	30.34	313	33.76
Hcp_cal	182	17.58	185	19.96	253	24.44	290	31.28
Hca_cal	214	20.68	232	25.03	315	30.43	335	36.14

Regarding respondents' visual ANA, results show that there is almost double the proportion of visual ANA when the FC is set to two. Looking more closely at whether taste vs no-taste treatments affect visual ANA, results suggest that experiencing the actual taste of yoghurt results in a lower visual ANA compared to scenarios in which no taste is experienced. When comparing the visual ANA between NCs and HCs, it can be noted that NCs have a slightly higher visual ANA than HCs. Generally, the attributes that received the highest ANA in both treatments are the *Nc_fib* and *Hca_fib* labels. On the other hand, the yoghurts that bear the *fat-free* and *low-sugar* NCs and HCs received the lowest ANA in both treatments. These descriptive results reject our research hypothesis H4 showing a higher visual ANA for NCs as compared to HCs in both treatments (taste vs no taste). In addition, they confirm H7 is indicating a lower visual ANA when the real product taste is experienced. This might be because a positive product experience (tasting) may induce respondents to pay more attention when selecting food products.

4.4.3. Estimates from the visual ANA–GMXL models

Table 4.7 reports the results from the GMXL model. Three models were specified. The first model (Model I) represents the fully compensatory model (full attribute attendance) and is our baseline model. The second (Model II) and third (Model III) models imply partially compensatory behaviour and incorporate the data from the visual ANA with a FC cut-off of one and two respectively. Both the ANA models were estimated with the parameters for the visually ignored attributes constrained to zero, while all the models use pooled data (taste vs no-taste treatments) and incorporate interaction terms between the treatments to determine whether taste affects preferences.

Looking at the results from Model I, it can be seen that the coefficient of the opt-out alternative is negative and statistically significant in all the models, indicating that the participants maximized their utility by choosing one of the proposed NC and HC alternatives with respect to the opt-out alternative.

Table 4.7. Summary of the GMXL model results (N=218)

	Model I		**Model II – FC1**		**Model III – FC2**	
Parameter	*Coeff.* (*t-ratio*)	SD (*t-ratio*)[e]	*Coeff.* (*t-ratio*)	SD (*t-ratio*)	*Coeff.* (*t-ratio*)	SD (*t-ratio*)
Random parameters in the utility functions						
Opt-out	-0.14*** (-4.87)	-	-0.65*** (-14.64)	-	-0.81*** (-20.62)	-
Nc[a]_fat	1.06*** (3.19)	0.05 (0.68)	2.31*** (5.63)	2.87*** (30.97)	2.44*** (7.83)	0.94*** (24.40)
Nc_sug	-0.19 (-0.55)	0.10 (1.29)	-0.68** (-2.03)	3.79*** (28.81)	0.27 (1.13)	0.53*** (11.31)
Nc_fib	1.65*** (10.94)	2.93*** (29.83)	1.02*** (4.35)	2.53*** (30.16)	1.14*** (4.77)	1.65*** (68.53)
Nc_vit	0.18 (0.68)	1.08*** (17.23)	1.02*** (4.46)	2.02*** (16.23)	0.78*** (4.35)	0.73*** (17.41)
Nc_cal	0.38 (1.55)	1.02*** (16.39)	1.60*** (6.97)	1.30*** (17.77)	0.89*** (4.81)	0.12*** (2.83)
Hca[b]_fat	6.69*** (17.72)	4.84*** (23.61)	7.69*** (10.08)	3.79*** (28.81)	4.91*** (15.34)	0.32*** (9.03)
Hca_sug	4.19*** (10.95)	3.84*** (23.06)	1.86*** (4.44)	4.95*** (29.01)	2.81*** (9.21)	2.07*** (40.26)
Hcp[c]_fib	2.70*** (17.16)	0.75*** (10.68)	2.23*** (7.73)	1.79*** (14.00)	2.71*** (9.44)	0.94*** (19.17)
Hca[d]_fib	-0.38** (-2.06)	0.08 (0.94)	-0.46 (-0.96)	0.18 (0.78)	-2.93 (-1.41)	0.31** (2.51)
Hcp_vit	5.16*** (15.12)	0.68*** (7.89)	4.69*** (14.04)	0.20* (1.69)	3.82*** (13.51)	0.10 (0.92)
Hca_vit	4.35*** (20.93)	0.80*** (9.77)	4.28*** (10.75)	1.24*** (6.19)	3.39*** (12.53)	0.05 (0.22)
Hcp_cal	5.01*** (16.10)	0.42*** (5.46)	5.27*** (14.18)	1.06*** (7.10)	4.25*** (14.40)	0.13 (0.34)
Hca_cal	4.32*** (20.45)	0.62*** (10.53)	4.07*** (12.46)	1.44*** (8.43)	3.38*** (12.29)	0.27 (1.55)
N	9589		9589		9589	
Variance parameter in scale (τ)	0.89*** (31.59)		1.06*** (27.98)		1.41*** (32.53)	
Heterogeneity in scale factor (taste)	-0.68*** (-12.15)		-0.90*** (-13.16)		-0.27*** (-38.09)	
Log-lik.	-6433.75		-6925.06		-8385.18	

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. [a] Nc means nutritional claim. [b] Hc means health claim. [c] Hcp means health claims present in the local market. [d] Hca means health claims absent from the local market.

Table 4.7 continuation: Summary of the GMXL model results (N=218)

	Model I		**Model II – FC1**		**Model III – FC2**	
Parameter	*Coeff.* (*t-ratio*)	SD (*t-ratio*)[e]	*Coeff.* (*t-ratio*)	SD (*t-ratio*)	*Coeff.* (*t-ratio*)	SD (*t-ratio*)
Interaction terms between attributes and treatments (taste)						
Nc_fat	-0.34 (-1.07)		-0.66* (-1.71)		-0.78** (-2.30)	
Nc_sug	-0.27 (-0.88)		0.41 (1.29)		0.10 (0.49)	
Nc_fib	-0.95*** (-6.64)		-1.03*** (-4.44)		-0.45*** (-2.66)	
Nc_vit	-0.32 (-1.30)		-1.12*** (-4.99)		-0.23* (-1.70)	
Nc_cal	-0.53** (-2.19)		-1.43*** (-6.77)		-0.20 (-1.46)	
Hca_fat	-2.96*** (-7.82)		-3.70*** (-5.69)		-1.28*** (-6.11)	
Hca_sug	-1.95** (-5.95)		-0.95** (-2.27)		-0.98*** (-4.49)	
Hcp_fib	-0.74*** (-4.60)		-0.91*** (-3.35)		-0.67*** (-3.51)	
Hca_fib	0.70*** (3.78)		-0.34 (-0.65)		0.71 (0.93)	
Hcp_vit	-2.30*** (-7.26)		-2.24*** (-7.30)		-0.80*** (-4.25)	
Hca_vit	-2.13*** (-9.99)		-2.14*** (-5.77)		-0.70*** (-4.01)	
Hcp_cal	-2.49*** (-8.18)		-2.90*** (-8.56)		-1.26*** (-6.63)	
Hca_cal	-2.37*** (-10.61)		-2.30*** (-7.32)		-0.92*** (-5.27)	

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. [e] SD stands for standard deviation and *t-ratio*.

Also, the coefficients for all HCs are positive and statistically significant (i.e., *Hca_fat*, *Hca_sug*, *Hcp_fib*, *Hca_fib*, *Hcp_vit*, *Hca_vit*, *Hcp_cal*, and *Hca_cal*), suggesting that the utility of the participants increased when these HCs were included on yoghurts' FOP. More specifically, consumers gain the highest utility from the fat-free HC (*Hca_fat*) followed by the source of vitamin B6 (*Hcp_vit*) and source of calcium (*Hcp_cal*) HCs. Turning to the coefficients of the NCs, it can be seen that only two (*Nc_fib* and *Nc_fat*) out of five NCs (*Nc_sug*, *Nc_vit*, and *Nc_cal*) are positive and statistically significant, suggesting that overall consumers prefer HCs as compared to NCs. This result rejects H2 stating that participants will mostly choose yoghurts with NCs compared to yoghurts with HCs. Moreover, most of the standard deviations (SDs) are statistically significant, implying unobserved heterogeneity in taste preferences across participants. Finally, looking at the interaction terms which detect treatment effects (taste vs no-taste), it is observed that the participants attached lower utility to the NCs and HCs in the taste treatment than in the no-taste treatment.

In fact, apart from *Hca_fib*, which was valued positively after experiencing the taste of the product, the remaining NCs and HCs received negative and lower utility in comparison with the no-taste treatment. These results confirm our research hypothesis H6 which indicates that consumers' utility for yoghurts bearing NCs and HCs decreases after taste. Turning to the results from the ANA models (Model Ⅱ and Model Ⅲ), it can be seen that most of the parameters are positive and statistically significant, indicating that participants' utility increases when NCs and HCs are presented on the FOP compared with unlabelled yoghurts, thus, confirming H1 that consumers choose yoghurts with NCs and HCs on FOP rather than the unlabelled product. Most standard deviations are also statistically significant, suggesting unobserved preference heterogeneity (Scarpa, Campbell, & Hutchinson, 2007).

More specifically, the results from Model Ⅱ with FC1 show that the coefficients of the NCs and HCs are all positive and statistically significant, with the exception of *Hca_fib* which is not statistically significant. The top preferred NCs and HCs are *Hca_fat* followed by *Hcp_cal* and *Hcp_vit*.

Compared with Model I, in Model II, the NCs are statistically significant, albeit obtaining lower utility than the HCs when the NCs are accompanied by their HC. The findings from the interaction terms confirm that, when the participants tasted the yoghurt, they attached lower utility to the NCs and HCs. Model III with FC2 presents similar results to Model II. In particular, the participants attached the highest utility to *Hca_fat* followed by *Hcp_cal* and *Hcp_vit*. Also, the results from the interaction terms in which taste is included shows that the utility of the participants declined, suggesting that taste did not generate higher utility than no-taste. This further confirms H6. Finally, we have a statistically significant parameter estimate for the coefficient on the overall unobserved scale heterogeneity, τ, in both Model I (0.89, t-ratio of 31.59), Model II (1.06, t-ratio of 27.98), and Model III (1.41 t-ratio of 32.53). We also observed lower variance in unobserved heterogeneity in the taste data (i.e., higher scale) compared to the no-taste data (heterogeneity in GMXL scale factor (S) is equal to -0.68, t-ratio of -12.15 for model I, -0.90, t-ratio of -13.16 in models II and -0.27 t-ratio of -38.09 in model III respectively). The implication of these results suggests that we have less variability in the no-taste treatment.

Overall, results from Table 4.7 confirm i) H3 indicating a higher visual attention for HCs vs NCs, ii) H7 suggesting that visual ANA to be lower when taste is experienced rather when taste is not experienced, and iii) H5 indicating that higher visual attention increases the likelihood of a product being purchased. Although longer in in length, results reject H4 indicating a lower visual ANA for HCs vs NCs.

4.5. Discussion

In this paper, we examined the impact of NCs and HCs on yoghurt selection. More specifically, based on findings from previous studies, we explored a number of research hypotheses related to consumer food preferences for NCs and HCs on FOP.

Our results showed that the utility of participants increased when the NCs and HCs are present on the yoghurts' FOP, as compared to the baseline unlabelled yoghurt. This indicates that NCs and HCs increase both the utility

and the valuation of a product. This is in line with previous studies and H1, meaning that consumers will prefer products with NCs and HCs. However, our results reject hypothesis H2 that participants will mostly select yoghurts with NCs, as they present brief and concise information, compared to HCs. This result contradicts previous studies that found negative interaction effects when NCs and HCs are labelled together (Barreiro-Hurle et al., 2010; Szathvary & Trestini, 2014). More specifically, other studies state that consumers have stronger preferences for simple (Bitzios, Fraser, & Haddock-Fraser, 2011) and more familiar claims (Lähteenmäki et al., 2010). Yet, Ballco & de-Magistris (2018) suggested that the higher impact of HCs results from their relative novelty compared to NCs, which were introduced to the market a long time ago and, hence, might be in the maturity stage of the product lifecycle.

In addition, our results indicated that when NCs and the corresponding HCs appear jointly, consumers generate higher utilities not only in terms of stated preferences (Model 1), but they also receive the highest visual attention in terms of FC (Model II and III) (Table 4.7). This result is consistent with hypothesis H3 (consumers' visual attention is expected to be higher for HCs as compared to NCs) and contradicts H4 (instead of devoting more time and attention to HCs, consumers may ignore them, such that the ANA may be greater for HCs due to their length). Although, longer in length, HCs received slightly lower visual ANA than NCs. More specifically, the participants' utility was maximized when the fat-free HC (*Hca_fat*) that controls cholesterol is present on the yoghurt FOP. Previous research has suggested that the fat content of yoghurts has a major effect on consumers' healthiness perception of yoghurt labels (Ares et al., 2013). Moreover, our result is in line with prior research, which found that products claiming to lower or control cholesterol levels are well accepted by dairy product consumers (Ares & Gámbaro, 2007; Landström, Hursti, Becker, & Magnusson, 2007) even for participants without high cholesterol (Marette, Roosen, Blanchemanche, & Feinblatt-Mélèze, 2010). Moreover, we accept H5 (a relationship between the attributes with the highest visual attention and the attributes that generated the highest utilities from the DCE, and

that this relationship might increase the likelihood of a product being purchased). More specifically, we found empirical evidence of a relationship between the most highly valued NCs and HCs, as measured by the full model (Model I) and the partially compensatory models (Models II and III) (*Hca_fat, Hcp_cal* and *Hcp_vit*) in terms of FC (one and two cut-offs) (Table 4.7). Even though we find that the presence of NCs and HCs on yoghurts' FOP increases visual attention, we cannot prove this with certainty, but can only assume that attention might be linked to an increased likelihood of affecting the final decision to purchase yoghurts with NCs and HCs. As defined by Orquin & Holmqvist (2018), it is difficult to support an eye-mind assumption, because researchers cannot know whether the presence of fixation implies that the object has been processed or not, and vice versa. This result is in line with the existing work on food products, suggesting that ET data can reveal how respondents value the attributes used in a DCE (Balcombe et al., 2017; Bialkova & Van Trijp, 2011; Bialkova et al., 2014; Ballco, de-Magistris, & Caputo, 2019; Graham & Jeffery, 2011; Samant & HanSeok, 2016; Van Loo et al., 2015, 2017).

Finally, while we showed that NCs and HCs significantly influence the utility of the yoghurt, we also found a decrease in their effect if consumers tasted the product, thereby confirming H6 (consumer utility for NCs and HCs decreases after taste). Our results are consistent with previous research (Augustin, 2001; Cox et al., 2004; Gilbert, 2000; Tuorila & Cardello, 2002; Urala & Lähteenmäki, 2004; Verbeke, 2006) and demonstrate that consumers are not fully prepared to compromise on taste over health. Hence, consumers will only change their purchase behaviour to incorporate more healthy items if the taste is comparable or superior. Taste also affected the visual ANA. In line with H7 (visual ANA will be lower when taste is experienced), tasting the yoghurt resulted in a lower visual ANA compared to scenarios in which no taste is experienced. This is an expected result because after identifying the real taste of the product, consumers wanted to better identify the attributes that caused either positive or negative taste experience. As shown in Figure 4.1, attention is a result of intrinsic and extrinsic attributes.

By experienced attribute (taste) the attention is therefore increased. This is an important result to be considered by researchers in the food industry because it implies that including sensory analysis in experimental designs might reduce ANA behaviour. Concerning the visual ANA fixation cut-offs, we demonstrate an almost double proportion of visual ANA when the FC is set to two (Table 4.6). This result, however, does not imply the exclusion of the FC of one from the estimation analysis. In line with the study by Van Loo et al. (2017) even one FC has to be taken into consideration, because it means that the person might have detected the attributes presented to them.

4.6. Conclusions

This study provides insights into assessing consumer preferences for NCs and HCs on a healthy food product (yoghurt) by exploring whether and how taste influences consumer preferences and attention paid to NC and HC labels.

Our results generally indicate that consumer utility increases with the presence of NCs and HCs on the FOP. In particular, we showed that the joint presence of NCs and HCs had a higher impact on utility and resulted in lower ANA compared to the presence of only NCs, which might be a result of the relative novelty of HCs on the FOP. The stated preferences and the visual attention in terms of FC suggest a relationship between the most highly valued NCs and HCs. This relationship affirms that the final product selection is based not only on the type of labelling on the package, but also on the visual attention that consumers pay to it. Regarding the visual ANA, we find evidence that participants ignore certain attributes in the DCE and do not notice many attributes during visual attention, especially when the fixation cut-off is two. This result supports the previous findings, suggesting that ET could provide a way in which researchers can effectively design DCEs to reduce the extent of visual ANA and perhaps maximize consumers' attention across all the attributes. Most notably, we also found that taste trumped the effect of NCs and HCs, meaning that consumers are not willing

to compromise on taste in favour of healthier nutrition. However, more evidence needs to be provided, perhaps in yoghurts with fruits and flavours instead of plain ones, or in another type of healthy food product. Furthermore, visual attention was higher and ANA was lower in the taste treatment compared to the no-taste treatment, since the experience of intrinsic attributes increased the overall attention paid to the product. Future research could confirm these findings by expanding the experiment to other type of food products.

Given the limited scope of our study, future studies should also test the robustness of our findings using a sample in other locations (e.g., a different region or country) and different food products. It is particularly important to explore the latter, as there may be interaction effects between a product and its nutritional value and the impact of the claim on the final decision or visual attention. The FOP of a food product generally includes multiple NCs and HCs in the FOP (e.g., free fat and low sugar) as well as other quality cues (e.g., price, brand names, quality standards, etc.) that compete for consumers' attention. Therefore, future studies could evaluate the impact of stated preference and visual attention when multiple food labels are present on food packages. Despite these limitations, this research contributes to advancing consumer preference literature and policy research, as it provides detailed insights into the effect and interaction of NCs and HCs, as well as experienced attribute (taste). First, our findings suggest that the efforts made by policy makers in introducing and supporting NC and HC regulation have a positive effect on consumers who are more likely to positively value and pay more attention to the products when the NCs and the corresponding HCs appear jointly on the FOP. Hence, the use of NCs and HCs represent a successful marketing differentiation. However, this is a necessary condition, but it is not sufficient. Actually, the results also demonstrate that the experienced attribute (taste) still represents a barrier for these products because consumers are not fully prepared to compromise on taste over health. In this context, it is really important for the food industry to invest in I+D and technology innovation in order to produce not only healthier food products with NCs and HCs, but also tastier products than the competitive ones.

4.7. References

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Chapter 5

Consumer characteristics of food with nutritional and health claims

This chapter is based on:

Ballco, P., & De Magistris, T. (2019). Spanish Consumer Purchase Behaviour and Stated Preferences for Yogurts with Nutritional and Health Claims. *Nutrients*, *11*(11), 27–42. https://doi.org/10.3390/nu11112742

Abstract

Nutritional and health claims are useful tools for promoting healthier food choices and prevent NCDs. Exhaustive literature that has investigated consumer evaluation of the presence of NCs and HCs during the decision-making process suggest that consumers' sensitivity towards NCs and HCs are still fragmented and should be further investigated. Our objective is to study the relationship between choice behaviour, attitudes and socio-demographic characteristics in order to evaluate the effectiveness of consumer characteristics in predicting Spanish consumers' choice of products with NCs and HCs. A DCE for yoghurt was conducted on a sample of 218 Spanish consumers, stratified by age, gender, education level, and income. Applying a latent class (LC) approach has enabled us to identify a niche of individuals, sensitive of NCs and HCs and to characterize them with respect to the rest of population. Results suggest that consumers positively valued most claims, however, the valuation was heterogeneous, and three consumer segments were identified: 'health-claims oriented', 'nutritional- and health-claim oriented' and 'indifferent'. The results supply insights for the development of more targeted promotion campaigns, as well as for further actions in food marketing.

RQ14 Is there an association between attitudes (interest in healthy eating, importance and use of NCs and HCs) and choice behaviour?

RQ15 What consumer characteristics predict Spanish consumers' choice of healthy products with NCs and HCs?

5.1. Introduction

The epidemic of overweight and obese individuals presents a major challenge to chronic-disease prevention and to health over the course of life worldwide. Fuelled by increasingly sedentary lifestyles and a nutritional transition towards processed foods and high-calorie diets, many countries have witnessed the prevalence of obesity amongst its citizens double, even triple (Hruby & Hu, 2015). One key mechanism that policy makers have presented to encourage healthier eating is the provision of information on food packages via nutritional labels (Jo & Lusk, 2018), such as NCs and HCs (Regulation (EC) No 1924/2006). Both types of claims are an attempt by the EU Regulation (EC) Nº 1924/2006, with the aim to help consumers make well-informed choices (Van Kleef & Dagevos, 2015; Leathwood, Richardson, Sträter, Todd, & Van Trijp, 2007) at a glance (Hartmann, Hieke, Taper, & Siegrist, 2018). However, NCs and HCs are credence attributes. This type of attributes is neither directly observable by consumers before purchase, nor can it be experienced after purchase (Ballco, Caputo, & de-Magistris, 2020; Ballco & Gracia, 2020). Therefore, to guarantee trustworthy information to consumers the EFSA requires that NCs and HCs in food products be based only on scientific evidence (Smith, 2015). Since the introduction of the EU regulations, the agro-food industry has increasingly made efforts in the innovation processes to obtain healthier products by reducing saturated fats, sugars, and salt, while the retail sector has increased considerably the presence of processed products with NCs and HCs in the EU markets. In 2015 about 85% of all packaged food products in Europe were sold with NCs (Hieke et al., 2016; Prieto-Castillo, Royo-Bordonada, & Moya-Geromini, 2015) with Spain ranking as second, after the UK (Hieke et al., 2016). Regarding the type of claims used in the Spanish market, Cuevas (2012) reported that the NCs with the highest presence pertain to food products that are: rich in fibre (47.5%), without added sugar (41%), free of saturated fat (41%), low in calories (39%), rich in whole grains (34%), rich in vitamins and minerals (26%), low in salt or salt-free (25%), and rich in omega-3 fatty acids (22%) (Cuevas, 2012). Similarly, Royo-Bordonada et al. (2016) who examined the availability of food with NCs and HCs in Spanish television advertisements over a seven-day period identified 169 food products, of

which 28.5% belong to the dairy group and 60.9% to the non-core or miscellaneous category. A total of 53.3% of products contain NCs, and 26.6% contain HCs. Low-fat dairy products are the category with the highest percentage of NCs and HCs (Royo-Bordonada et al., 2016). Finally, a more recent study by Lopez-Galán & De-Magistris (2017) on the presence of NCs in the Spanish market found that, out of 4568 product types, about 900 contain NCs. The most frequent nutrients found are related to the fat (42%), sugar (32%), dietary fibre (20%), and salt (6%) contents. The results from these studies demonstrate that Spanish consumers have access to food alternatives with NCs and HCs, however it has been reported that only a very small percentage of consumers purchase them (Lopez-Galán & De-Magistris, 2017).

Beside the availability and exposure to the market of foods with NCs and HCs, other factors that affect the purchase of food with these claims are several attitudinal and cognitive characteristics, which are related to nutritional and health knowledge, understanding, GHI, and socio-demographic characteristics (see Fernqvist & Ekelund (2014) and Grunert & Wills (2007) for an overview). Understanding the NCs and HCs provided on the FOP implies that consumers recognise and know what each nutrient term and measurement unit means. It also assumes that they understand the relationships between the different nutrients and the role of each nutrient in the body (Cowburn & Stockley, 2005). In this regard, Prieto-Castillo et al. (2015) report that over half of the participants in Madrid (52.4%) stated to have a full understanding of nutrition labels. The highest percentage was found in consumers over 65 years old (63.6%), retired (62.5%), living alone (62.1%), and with a high level of education (61.8%). Higher education was also found to be positively correlated with information search and self-perceived understanding of NCs in another Spanish study (Prieto-Castillo et al., 2015). Regarding knowledge towards foods with nutrition labels, previous research noted that consumers' knowledge of the nutritional properties of food products play a role in the importance associated with the labelled claims, as it may increase the perceived benefits of the product (Ares, Giménez, & Gámbaro, 2009; Williams, 2005).

Two Spanish studies (Barreiro-Hurlé, Gracia, & de-Magistris, 2010a; Gracia, Loureiro, & Nayga, 2007) indicated that a higher level of nutritional knowledge is linked to healthy individuals, with high income, and households with children who are more motivated to search for nutrition information. Hence, Spanish consumers with greater knowledge of nutrition information are more likely to use nutritional labels (Gracia et al., 2007). Finally, the need for information about food, diet and health is driven by most importantly, consumers' use and interest in healthy eating (Hung, Grunert, Hoefkens, Hieke, & Verbeke, 2017). One may have sufficient knowledge of the nutritional properties of the food product and understand the labels, but not the GHI and use of NCs and HCs in the decision-making. Hence, consumers' use and GHI eating is the attitudinal characteristic studied in this research as these type of consumers tend to be more engaged in health-promoting behaviours (Kaur, Scarborough, & Rayner, 2017).

In overall, products with NCs and HCs have been considered to be part of a healthy diet (Kaur et al., 2017), and the appeal of HCs is positively linked to the interest in healthy eating (Dean et al., 2012). However, research regarding preferences and GHI eating of food with NCs and HCs in Spain is limited and the results are mixed. Specifically, (Barreiro-Hurlé et al., 2010a) report that although individuals use nutrition-facts panels and NCs, most consumers use only one of these claims (33%) and of these, the majority pay no attention and show a low interest in using NCs (68%). This is also consistent with the results of Prieto-Castillo et al. (2015) and Barreiro-Hurle et al. (2010b), who found that only a small percentage of individuals in Spain were interested to use NCs. Lastly, López-Galán & de-Magistris (2019) who explored the effects of emotional eating in the purchase behaviour, found that emotional eating had a negative impact on the purchase behaviour of food with NCs. On the contrary, recent research on consumer preferences for NCs and HCs in Spain suggest that preferences are very heterogeneous. In particular, de-Magistris et al. (2016) assessed the influence of body image on consumer preferences for potato chips carrying NCs among obese and normal-weight participants. Their findings indicated that obese people with body-image dissatisfaction were willing to pay more for healthier chips

compared to normal-weight participants with the same problem. Finally, Jurado & Gracia (2017) examined Spanish consumer evaluation of NCs (i.e. high in fibre and reduced saturated fat) on breakfast biscuits. They report that consumers positively valued both NCs, and premium prices may be attached to targeting either of two subpopulation segments (low-saturated-fat seekers and high-fibre seekers). In our view, these studies are important. Nevertheless, we believe that the full advantage of using multiple types of NCs and HCs was not taken. In overall, the results from this literature suggest that our understanding of Spanish consumers' sensitivity towards NCs and HCs is still fragmented and should be further investigated.

Given the aforementioned, the purpose of this research is to examine the relationship between choice behaviour, attitudes, and socio-demographic characteristics, and evaluate the effectiveness of consumer characteristics in predicting Spanish consumers' choice of products with NCs and HCs. To achieve these objectives, we used a DCE on plain yoghurts. To find out whether there is a segment of Spanish consumers responsive to NCs and HCs and how it differs from the rest of population, we applied the latent class (LC) approach which permits an analysis of determinants of consumer choices, taking into account the heterogeneity that may exist between different segments.

This study focuses on NCs and HCs because they are a simpler way of presenting information compared to nutritional tables. They do not list the amount of a nutrient, but instead summarise the information for a specific nutrient and communicate it to consumers in simple, easy-to-process language (e.g., fat-free). We chose yoghurt as a product of reference, as it has been recommended as part of a healthy diet in many countries (Eržen, Kač, & Pravst, 2014), and it contains the most NCs and HCs among all the food products in Spain.[38] We chose Spain as the location of research due to the high number of NCs and HCs available in the Spanish market (Hieke et al., 2016; Jurado & Gracia, 2017).

[38] From a market analysis on various food products present in different hypermarkets and supermarkets in Spain, it is the product that carries the most NCs and HCs.

While the existing literature provides a wealth of insights into attitudinal and cognitive characteristics such as nutritional and health knowledge, and understanding of food products with NCs and HCs, to the best of our knowledge, this is the first study that analyses consumer heterogeneity in preferences for multiple NCs and HCs on the FOP by identifying Spanish consumer segments. The characterisation of consumers based on categories would allow food companies and public authorities to tailor strategies to promote healthy food choices.

5.2. Materials and methods

5.2.1. Discrete choice experiment: Product and attribute selection

It is worth mentioning that an NC indicates only the nutrient on the FOP of the yoghurt, while an HC presents both the nutrient (i.e. NC) and a description of its health benefits. The selection of NCs and HCs used in this study was conducted following the official definitions from the EU regulations (EC) No 1924/2006. To determine their presence in the market, we created a database that collects information regarding food products with both types of claims available in the Spanish market between July and September 2015. The products included in the database were selected based on their importance in the shopping basket of Spanish households[39] (Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), 2014). From the results of this database, we chose yoghurt for further analysis, because it carries the most NCs and HCs, is considered a healthy food product and is frequently consumed by Spanish households (Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), 2014). Table 5.1 presents the NCs and HCs that were presented to consumers.

[39] According to the Ministry of Agriculture and Fisheries, Food and Environment – MAPAMA, (2014) Consumer Observatory in Spain, 89% of the per-capita consumption of packaged food consists of liquid milk, processed meats, yoghurts, cheeses, and industrial bread and biscuits (Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), 2014).

Table 5.1. Levels of nutritional and health claims and variable names used

Nº	Attributes and levels	Variable names[a]	Presence[b] (%)
	Nutritional claims		
1	Fat-free	Nc_fat	(42.78)
2	Low sugars	Nc_sug	(11.99)
3	High fibre	Nc_fib	(1.09)
4	Source of vitamin B_6	Nc_vit	(10.63)
5	Source of calcium	Nc_cal	(21.25)
6	Unlabelled (Baseline)	Nc_nat	(12.26)
	Health claims		
1	Reducing consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels (A)*	Hca[c]_fat	-
2	Consumption of food containing sweeteners instead of sugar induces lower blood glucose (A)	Hca_sug	-
3	Fibre contributes to an acceleration of intestinal transit	Hcp[d]_fib	3.80
4	Fibre contributes to an increase in faecal bulk (A)	Hca_fib	-
5	With vitamin B_6 that helps your defences and reduces fatigue	Hcp_vit	10.33
6	Vitamin B_6 contributes to the normal functioning of the nervous system (A)	Hca_vit	-
7	Calcium is necessary for maintaining bones under normal conditions	Hcp_cal	2.17
8	Calcium contributes to normal muscle function (A)	Hca_cal	-

Notes: * indicates that an HC has not yet been introduced to the local market - absent (A). [a] Represents a variable name for the NCs used in the model estimations. [b] Indicates the percentage prevalence of NCs and HCs found on yoghurt packages. [c] Hca represents an HC that is not present in the market (absent), whereas [d] Hcp represents one that is.

In total, 251 yoghurts that carry one NC and 67 with one HC on the FOP correspond to the official EU definitions (Regulation (EC) No 1924/2006 and (EC) No 432/2012). All the products used are plain yoghurts with no added flavours or fruits, except for one added-fibre variety, which contains several types of cereals (oats, barley, wheat, and wheat bran). An unlabelled yoghurt was also selected as the baseline for comparison.

Previous research suggests that, overall, HCs are not fully understood by the 'average consumer'[40] (Nocella & Kennedy, 2012; Richardson, 2003). Hence, in addition to the ones present in the local market (numbers 3, 5, 7, as reported in Table 5.1), we extracted five additional HCs from Regulation (EC) No 1924/2006 (numbers 1, 2, 4, 6, 8 in Table 5.1) that are easier to understand, according to a focus group of 20 'average consumers' of different ages and education levels surveyed before the experiment. Based on the market database, we selected a 500-g package (four containers, each with a weight of 125 g), because it is the most common size on the market. Concerning the price, two Spanish studies found that consumers who pay more attention to price when shopping are less likely to use NCs and HCs (Barreiro-Hurlé et al., 2010a; Gracia et al., 2007). Therefore, our study followed the methodology of Carlsson et al. (2007) who conducted a DCE without the price attribute. Other investigations that exclude price were performed by Bialkova & Van Trijp (2011) and Bialkova et al. (2014).

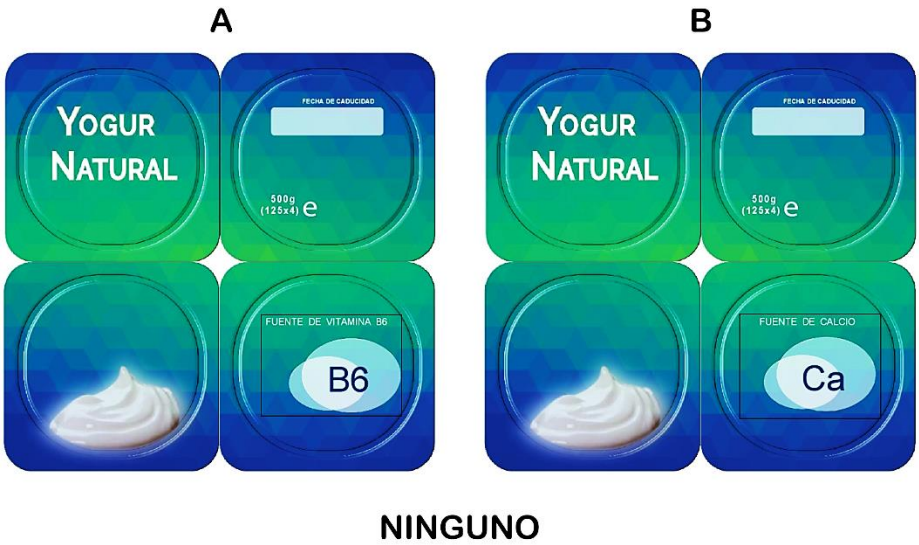
As with Carlsson et al. (2007), we told the participants that all the options cost the same amount, since yoghurt is regularly consumed in Spanish households[41], and the individuals are aware of the price

[40] EU Regulation 1924/2006 Recital 15 defines the average consumer as someone 'who is a reasonably well informed and reasonably informed observant and circumspect, taking into account social, cultural and linguistic factors'.

[41] According to the results from the Consumer Observatory in Spain (Ministry of Agriculture and Fisheries, Food, and Environment) (Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA), 2014) and the questionnaire on consumption frequency, 56% of households consume yoghurt once a week, and 14% do so twice a week.

variations[42] for different types of yoghurts. Using the NCs and HCs listed in Table 5.1 and following the experimental design employed by Bialkova and Van Trijp (2011) and Bialkova et al. (2014), we applied an availability design (Rose & Hensher, 2006). The experimental set-up resulted in 91 possible choice tasks or questions, excluding repeated ones (mirror-effect choice questions). To reduce this number and prevent fatigue effects, we only used 44 choice questions[43], which were randomly split into four blocks of 11 choice tasks for each participant. The respondents were then randomly assigned to only one of the blocks, thus, each person only answered 11 choice questions, which were also presented in random order. Each question is composed of three alternatives: two yoghurts, each with a different HC and NC level, and a no-buy option (see Figure 5.1).

Figure 5.1. An example choice task.



Option A represents the Spanish version of yoghurt with a *source of vitamin B6*, and option B refers to one with a source of calcium. '*Ninguno*' is the 'no-buy' option.

[42] The yoghurt market prices in October 2016, for a 4×125 g pack, were: natural (€1.09), fat-free (€1.80), low in sugar (€1.92), source of fibre (€1.99), source of vitamin B6 (€1.99), and source of calcium (€1.69).

[43] According to the main objective of the study, the 44 choice questions included all the product alternatives combining NCs and HCs.

The DCE was presented on a computer screen. After observing the two product combinations, the participants selected their preferred one on an evaluation form (see Appendix A, Figure A1 for an example of the evaluation page) presented after each choice task.

5.2.2. Participants and recruitment

The experiment was conducted in 2016 in Zaragoza, Spain, which is popular among food marketers and consulting companies, since the socio-demographics of the town are representative of the Spanish Census of Population (see Appendix B – Table B1).[44] For the selection of participants, an external company recruited individuals who consumed yoghurt, were responsible for the food purchase in the household, and were older than 18 years at the time of the study.

5.2.3. Implementation procedure and measures

Upon arrival, participants received information on the main purpose of the experiment and signed a document to indicate their informed consent. An ID number was assigned to each respondent to guarantee anonymity. Subsequently, a general overview of the whole working session and the approximate duration was provided. Consumer choices were measured by asking the respondents to make 11 selections between two products with different NCs and HCs and a no-buy option. They were reminded throughout the session to imagine that they were in supermarket purchasing yoghurt for their regular consumption.

After choosing their preferred yoghurt with NCs and HCs, the participants completed a brief questionnaire. The first part of the questionnaire measures purchase and consumption frequency. Besides, the respondents were asked to rate the importance to which they attach different attributes when purchasing yoghurts on a 5-point scale.

[44] This study is part of a larger investigation of consumer behaviour regarding NCs and HCs in Spain, where multiple experiments have been conducted.

The second part assesses knowledge associated with various nutrients and substances and the recommendations of health experts (see Grunert et al. (2010) for an overview). The third part of the questionnaire measures the use of nutritional information (i.e. whether the participants pay attention to NCs and HCs on the products they buy) on a 4-item and a 5-point Likert scale (e.g. 'I use the nutritional information on the label when making most of my food selections'). The response options range from 'completely disagree' (1) to 'completely agree' (5), with a Cronbach's α of 0.69. Interest in healthy eating was evaluated on an 8-item and a 5-point Likert scale (e.g. 'It is very important to me that my diet is low in fat'), with options ranging from 'completely disagree' (1) to 'completely agree' (5) and a Cronbach's α of 0.76 (see Roininen et al. (1999) for an overview). Lastly, the participants were asked to report their socio-demographic consumer characteristics (e.g. gender, family size and composition, age, educational level, and income bracket) (see the general questionnaire in Appendix H – this appendix was not included in this published article). Cross-tabulations with $\chi 2$ statistics were used to test for any association between the categorical variables. For the comparison of mean scores, we used the Kruskal–Wallis rank test instead of the Anova-Bonferroni, because the results from the Shapiro-Wilk test demonstrated that our data are not normally distributed.

5.2.4. Model specification and estimation

Our theoretical model is based on the Lancastrian consumer theory of utility maximization. Lancaster (1966) proposes that the total utility associated with the provision of a good can be decomposed into separate utilities for theoretic component attributes. However, this utility is known to the individual and not to the researcher. The researcher observes some attributes of the alternatives, but some components of individual utility are unobservable and hence treated as stochastic (following RUT). Therefore, the utility is taken as a random variable, where utility from the n^{th} individual facing a choice among j alternatives within choice set J on the t^{th} choice occasion can be represented as:

$$U_{\mathrm{njt}} = \beta X_{\mathrm{njt}} + \varepsilon_{\mathrm{njt}} \quad (1)$$

In the above formula, β is the estimated vector of parameters, and ε_{njt} is an independent identically distributed (i.i.d.) error term over time, individuals, and alternatives. Traditionally, consumers have been assumed to be homogeneous in terms of taste, and conditional logit models have been used (McFadden, 1973). However, numerous choice-experiment empirical studies have found consumer preferences for food products to be heterogeneous, and the specified model needs to allow for variations in the taste parameters of the observed variables in the population. Two alternative models have gained popularity in choice-modelling literature when addressing the issue of heterogeneity: RPL and LC logit. Both are versions of the mixed logit model (Hynes, Hanley, & Scarpa, 2008).

The RPL model has been widely used in applications of discrete choice modelling across disciplines, especially in agro-food research (Ballco, de-Magistris, & Caputo, 2019; de-Magistris et al., 2016; Jurado & Gracia, 2017; Kallas, Vitale, & Gil, 2019; Van Loo et al., 2015). Heterogeneity is incorporated into this approach via consideration for each individual's unique set of preferences and estimates of the utility function. When estimating the choice model, an additional vector of parameters is included to incorporate individual preference deviations with respect to the mean values.[45] However, if preferences are assumed not to be 'unique' for each individual but rather distinct for a set number of individual classes or segments (as referred from this point), the LC model is more appropriate for modelling choices. In this approach, consumers are assumed to belong to different segments, each characterised by different segment-specific utility parameters. In other words, within each segment, consumer preferences are homogeneous, but they vary between segments, reflecting a 'lumpy' spread preference and allowing a more in-depth understanding of heterogeneity (Hynes et al., 2008). This approach has also been used to analyse consumer preferences for agricultural products, enabling the identification of distinct patterns of valuation and behaviour (El Ansari & Berg-Beckhoff, 2017; Jurado & Gracia, 2017; Peschel, Grebitus, Alemu, & Hughner, 2019; Schnettler et al., 2018; Segovia & Palma, 2016; Zhu et al., 2016), among

[45] *β* in [1] is not constant, but varies across individuals as a variable *βn*.

others. In the LC model, the utility of the individual *n* choosing alternative *j* in the t^{th} choice alternative is calculated as follows:

$$U_{\mathrm{njt\ |S}} = \beta_S X_{\mathrm{njt}} + \varepsilon_{\mathrm{njt\ |S}} \quad (2)$$

where β_S is a parameter vector of class *S* associated with the vector of explanatory variables, and X_{njt} and $\varepsilon_{njt\ |S}$ are error terms that follow a Type-I (or Gumbel) distribution. The deterministic proportion of utility can be separated into two components, one related to the choice attributes and another latent one associated with the socioeconomic and psychometric characteristics of the individual (Boxall & Adamowicz, 2002). Thus, the probability that an individual will select alternative *i*, conditional on belonging to segment *S*, can be expressed as follows:

$$P_{ni} = \sum_{S=1}^{S} P_{nS} \prod_{t=1}^{T} P_{\mathrm{njt\ |S}} \quad (3)$$

where P_{nS} is the assignment of individual *n* to segment *S* (i.e. probability of segment *S*), and $P_{njt\ |S}$ is the probability that individual *n*, conditional on belonging to segment *S (S = 1,...,S)*, chooses alternative *j* from a particular set *J* comprised of *j* alternatives, on choice occasion *t* (Hensher & Greene, 2003). The parameters for the attributes and individual characteristics are simultaneously estimated by maximising the likelihood function in the state of incomplete prior information on segment membership or choice probabilities (Pouta, Heikkilä, Forsman-Hugg, Isoniemi, & Mäkelä, 2010). Subsequently, the number of segments is endogenously determined along with the utility coefficients. The LC model was estimated using NLogit 6.0. Econometric Software, Inc. (http://limdep.com/products/nlogit/). In the LC model, two groups of variables require further specification: those that enter the utility function and those that explain the segment-allocation function. The utility function comprises the attributes analysed, and one alternative-specific constant is given in the following way:

$$U_{\mathrm{njt}} = \beta_0\, nobuy + \beta_1\, ncfat_{njt} + \beta_2\, hcafat_{njt} + \beta_3\, ncsug_{njt} + \beta_4 hcasug_{njt} + \beta_5 ncfib_{njt} + \beta_6 hcpfib_{njt} + \beta_7 hcafib_{njt} + \beta_8 ncvit_{njt} + \beta_9 hcpvit_{njt} + \beta_{10} hcavit_{njt} + \beta_{11} nccal_{njt} + \beta_{12} hcpcal_{njt} + \beta_{13} hcacal_{njt} + \varepsilon_{\mathrm{njt}} \quad (4)$$

In the above equation, n is the number of respondents, j represents the available choices in the choice sets (two experimentally designed yoghurt profiles and the no-buy option), and t is the number of choice situations. $OptOut$ is the alternative-specific constant representing the no-buy option. The other 13 attributes (as reported in Table 5.1) enter the model as dummy variables, where the 'unlabelled' yoghurt represents the baseline.

5.3. Results

5.3.1. Socio-demographic characteristics

Considering the main components of the model discussed in the previous section, we first present the individual differences across the three segments. Table 5.2 shows their socio-demographic characteristics. Participants were selected through random stratification with proportional distribution of age, gender, and education to avoid under-/over-representation of consumer profiles. The final sample consists of 218 individuals.

Most of the respondents are female (52.8%). The average age of our sample is 49 years. Approximately 20.6% of the respondents are between 35 and 44, and 41% are over 55. Around 41.7% of the sample has completed secondary studies. Almost 53.7% have a monthly household income that ranges from €1501 to €3500. About 53.2% of the participants are of normal weight, and the majority reported no health problems. In terms of consumer segments, we found statistically significant differences between various categories for age (18–34 years and over 55 years), education level (primary studies and university), and monthly household income (< €900 – €1500). Regarding the level of education, the results suggest that individuals with secondary education were under-represented, while those with higher education were over-represented. Many studies tend to have a high proportion of university-educated participants, because more educated people are more inclined to participate (Jurado & Gracia, 2017; Verhoef, 2005).

Table 5.2. Descriptive analysis of socio-demographic characteristics in percentages; *n* = 218

	Sample	Population	HC-oriented	NC- and HC-oriented	Indifferent
Sample size	218	-	34.70	50.40	14.90
Gender[1]					
Male	47.25	49.02	46.05	51.35	37.50
Female	52.75	50. 98	53.95	48.65	62.50
Age of responders [1]	48.8 (15.26) [c]	42.90	-	-	-
From 18 to 34 years***	19.72	22.24	6.67[a]	23.42[a]	37.50 [b]
From 35 to 44 years	20.64	19.55	24.00	19.82	15.63
From 45 to 54 years	18.35	18.28	17.33	17.12	25.00
More than 55 years ***	41.28	39.93	52.00	39.64	21.88
Education level [2]					
Primary studies ***	26.61	24.88	36.00	24.32	12.50
Secondary studies	41.74	47.64	34.67	47.75	37.50
University studies **	31.65	27.48	29.33	27.93	50.00
Monthly household income					
<900 € to 1500 € **	37.61	N/A[e]	46.67	35.14	25.00
1501 € to 3500 €	53.67	N/A	46.67	54.95	65.63
3501 € to >4500 €	8.72	N/A	6.67	9.91	9.38

Note: ** and *** indicate statistical significance at the 5% and 1% levels, respectively. [1]Provisional data obtained (INE) on 1 January, 2017 (INE, 2017). [2] (OCDE, 2014). Superscript letters [a-b] indicates that the percentages vary using the χ^2-square test. [c] indicates the average (and standard deviation), whereas [d] indicates percentages. [e] means 'not available'.

Continuation Table 5.2. Descriptive analysis of socio-demographic characteristics in percentages; *n* = 218

	Sample	Population	HC-oriented	NC- and HC-oriented	Indifferent
Body mass index [d]					
Normal weight	53.21	N/A	43.42	57.52	62.07
Overweight	19.27	N/A	25.00	17.70	10.34
Obese	27.52	N/A	31.58	24.78	27.59
Self-reported health problems [d]					
Cardiovascular diseases (heart)	6.88	N/A	5.26	9.73	0.00
High blood pressure	15.14	N/A	13.16	14.16	24.14
High blood cholesterol	23.39	N/A	23.68	23.89	20.69
Diabetes	5.96	N/A	3.95	7.08	6.90
Osteoporosis	12.84	N/A	13.16	12.39	13.79
None of the above	35.79	N/A	36.84	32.75	34.48

Note: ** and *** indicate statistical significance at the 5% and 1% levels, respectively. [1]Provisional data obtained (INE) on 1 January, 2017 (INE, 2017). [2] (OCDE, 2014). Superscript letters [a-b] indicates that the percentages vary using the χ^2-square test. [c] indicates the average (and standard deviation), whereas [d] indicates percentages. [e] means 'not available'.

5.3.2. Purchase habits and attribute importance

The varying purchase habits and attribute importance corresponding to different consumer segments are presented in Table 5.3.

Table 5.3. Purchase habits and attribute importance

	Sample	HC-oriented	NC- and HC-oriented	Indifferent
Which type of nutrient is mentioned in the yoghurt you buy? (%)				
Source of calcium	31.65	32.89	33.63	20.69
Fat free*	52.29	60.53[a]	49.56	41.38[b]
Low sugar	44.04	46.05	44.25	37.93
High fibre	31.19	27.63	34.51	27.59
Source of vitamin B_6	15.60	15.79	16.81	10.34
The importance attached to attributes when buying yoghurts (average)				
Price***	3.53	3.62[a]	3.59[b]	3.07[c]
Health	4.15	4.22	4.16	3.90
Taste	4.19	4.25	4.18	4.07
Familiarity	3.27	3.37	3.19	3.28
Natural ingredients	3.97	4.08	3.95	3.79
Nutritional claim content*	3.91	4.12[a]	3.87	3.52[b]
Health claim content***	3.71	3.97[a]	3.64[b]	3.31[c]

Notes: * and *** indicate statistical significance at the 10% and 1% levels, respectively. Superscript letters [a-c] indicate that group means differ for continuous variables using the Kruskal-Wallis rank test, and that the percentages vary for discrete variables using the χ^2-square test.

Regarding purchase habits, more than half of the consumers (52.3%) state that they purchase fat-free yoghurts, followed by those that are low in sugar (44%), and ones that contain a source of calcium (31.7%). The relative attribute importance for yoghurt is highest for taste, followed by health (i.e. the product is healthy), natural ingredients, and NC and HC content. Concerning to the statistically significant differences between segments, we found differences between the fat-free labels on the purchased yoghurt, and three attributes that are important to our segments when purchasing yoghurts (price, NCs, and HCs; see Table 5.3).

5.3.3. Nutritional information use and interest in healthy eating

Finally, the results from the descriptive analysis of nutritional information use and interest in healthy eating are presented in Table 5.4.

Table 5.4. Use of nutritional information and interest in healthy eating

	Sample	HC-oriented	NC- and HC-oriented	Indifferent
Use of nutritional information (average)				
I usually pay attention to nutritional information when I see it in an advertisement or elsewhere.	3.53	3.57	3.58	3.24
I use the nutritional information on the label when making most of my food selections. **	3.67	3.82[a]	3.69	3.24[b]
I do not spend much time in the supermarket reading nutrition information.	2.54	2.46	2.58	2.62
I read about nutritional in magazines and books.	2.91	3.03	2.90	2.62
Interest in healthy eating (average)				
The healthiness of food has little impact on my food choices.	2.22	2.17	2.21	2.38
I am very particular about the healthiness of the foods I eat.	3.74	3.80	3.73	3.62
I eat what I like without worrying about whether it is healthy or not.	2.14	2.16	2.10	2.24
It is very important to me that my diet is low in fat. ***	3.43	3.66[a]	3.39	3.00[b]
I always follow a healthy and balanced diet.	3.42	3.43	3.42	3.38
It is important to me that my diet contains a lot of vitamins and minerals.	3.50	3.55	3.52	3.28
The healthiness of snacks makes no difference to my food choices.	1.96	1.93	1.95	2.07
I do not avoid foods even when they may raise my cholesterol. ***	2.22	1.99[a]	2.30[b]	2.55[c]

Notes: ** and *** indicate statistical significance at 5% and 1% levels, respectively. Superscript letters [a-c] indicate that group means differ for continuous variables using the Kruskal-Wallis rank test, and that the percentages vary for discrete variables using the χ^2-square test.

Our findings suggest that the segments differ in terms of nutritional information use when making most food selections. Likewise, in terms of interest in healthy eating, the consumer groups differ in assigned importance to low-fat products in their diet, and whether they avoid foods that may raise cholesterol (Table 5.4).

5.3.4. Utility estimates of latent classes

The LC model was estimated using NLogit 6.0 Econometric Software, Inc. (http://www.limdep.com/products/nlogit/). To estimate the optimal number of segments, we constructed models with one to five classes for each product category. The model fit information criteria, such as the Akaike information criterion (AIC) and Bayesian information criterion (BIC), as well as the log-likelihood values, are normally used to discuss the relative fit with the selected number of optimal segments (Table 5.5).

Table 5.5. Comparison of information criteria

S	(p)	(LL)	BIC	BIC /N	AIC	AIC /N	3AIC	3AIC /N	ρ^{-2}
2	39	-7287.96	14,933	1.557	14,653	1.528	14,692	1.532	0.30
3	59	-6814.08	14,169	1.478	13,746	1.434	13,805	1.440	0.35
4	79	-6540.32	13,804	1.440	13,238	1.381	13,317	1.389	0.37
5	99	-6301.53	13,510	1.409	12,801	1.335	12,900	1.345	0.39

Note: S indicates the segments. (p) indicates the parameters. (LL) indicates the Log-likelihood which evaluated at zero is -8342.84.

The lower the information criteria, the better the model fit. It is known that using BIC (AIC) tends to under-fit (over-fit) models, while evidence from previous studies (Caputo, Nayga, & Scarpa, 2013; Dias, 2006) shows that AIC3 (with three weights instead of two for parameter penalisation) outperforms the other two, correcting for over-fitting effects. Nevertheless, the BIC assumes that one of the models is the true one, which is unlikely to be the case here, as the calculated information criteria continuously decreased. Previous research with similar issues (Jurado & Gracia, 2017; Peschel et al., 2019) has reported that, besides the AIC and BIC, other factors that help to define the number of segments are accounting for changes in ρ-2 and lowering standard errors. Considering that the ρ-2 is normalised to the model with three segments, and the estimated parameters in the one

with four- and five-segments started to deteriorate due to higher standard errors, we chose the LC with three segments. In other words, the estimated parameter in model four- and five-segment models started to deteriorate, resulting in larger standard errors. According to previous research, this signals the termination of model estimation with a higher number of segments (Jurado & Gracia, 2017).[46] Table 5.6 illustrates the results of the LC model for three segments (HC-oriented, NC- and HC-claim oriented and indifferent) and the Multinomial Logit Model (MNL) for comparison.

Table 5.6. Results: LC model (*n* = 218).

	MNL	**LC**		
		HC- oriented	**NC- and HC-oriented**	**Indifferent**
Variables		*β* Coefficient (*t-ratio*)		
No-buy	-0.50*** (-6.53)	-0.95*** (-3.66)	-1.95*** (-11.61)	-0.13 (-1.00)
Nc[a]_fat	0.23** (2.45)	-17.24 (0.00)	0.21* (1.77)	-0.09 (-0.36)
Nc_sug	-0.16* (-1.69)	0.35 (1.09)	-0.30** (-2.56)	-0.52** (-2.05)
Nc_fib	0.24*** (3.78)	-0.06 (-0.41)	0.43*** (4.97)	-0.04 (-0.28)
Nc_vit	-0.20*** (-3.06)	0.02 (0.12)	-0.11 (-1.27)	-0.69*** (-3.86)
Nc_cal	-0.05 (-0.77)	0.05 (0.28)	0.06 (0.70)	-1.33*** (-5.18)
Hca[b]_fat	1.73*** (18.08)	22.60 (0.00)	1.03*** (8.66)	0.92*** (3.85)
Hca_sug	1.10*** (12.01)	3.73*** (11.57)	0.26** (2.21)	0.51** (2.03)
Hcp[c]_fib	0.92*** (14.33)	1.46*** (8.93)	0.96*** (10.48)	0.75*** (4.59)
Hca[d]_fib	0.08 (1.09)	-0.35* (-1.89)	0.12 (1.13)	0.50*** (3.12)
Hcp_vit	1.61*** (19.75)	3.40*** (15.04)	1.46*** (13.00)	0.28 (1.32)
Hca_vit	1.33*** (18.21)	3.16*** (16.33)	1.16*** (11.50)	-0.32 (-1.58)
Hcp_cal	1.44*** (18.63)	3.86*** (15.44)	1.23*** (11.73)	-0.77*** (-2.73)
Hca_cal	1.05*** (14.95)	3.40*** (16.23)	0.76*** (7.88)	-1.98*** (-5.66)
Segment Size	-	**34.70*** (10.43)**	**50.40*** (14.45)**	**14.90*** (6.12)**
N	9589		9589	
Log-lik.	-8342.84		-6814.08	
K	19		59	
AIC	1.744		1.434	

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. [a]Nc = nutritional claim; [b]Hc = health claim; [c]Hcp = health claims present in the local market; [d]Hca = health claims absent from the local market.

[46] Data are available upon request.

As expected, the no-buy alternative is negative and statistically significant in the MNL model, and two out of the three segments of the LC model indicate that consumers obtain higher utility from choosing any NC and/or HC product than the no-buy option. Most NCs and HCs in the MNL model are positive and statistically significant, suggesting that the utility for participants increases when these claims are present on yoghurt FOPs compared to the baseline (i.e. the unlabelled yoghurt). However, these results are not the best representation of consumer behaviour, as the log-likelihood and the AIC indicates that the LC is superior in terms of statistical properties. The estimated parameters for the three segments suggest heterogeneity in preferences across segments.

Segment 1 (HC-oriented) represents 34.7% of respondents, segment 2 (NC- and HC-oriented) 50.4% of the respondents, and segment 3 (indifferent) 14.9%. The first group attaches higher utilities to health claims and is indifferent about NCs. More precisely, this segment mostly valued the calcium HC, which is present in the market (e.g. '*calcium is necessary for maintaining bones under normal conditions*') followed by the one for sugar (*'consumption of food containing sweeteners instead of sugar induces a lower blood glucose')* and the calcium HC that is absent from the market (*'calcium contributes to normal muscle function')*. All NCs in this segment are non-statistically significant, indicating no effect on the utility of the participants. The second group of shoppers is characterised by high utility in terms of both NCs and HCs. Finally, indifferent consumers attach negative utilities to most NCs and HCs.

5.3.5. Consumer segments for yoghurts with NCs and HCs

The estimated parameters for the three segments confirm that there is heterogeneity across segments because the estimated values differ substantially between them, not only in magnitude but also in sign. The HC-oriented (S1) segment (34.7% of participants) is likely to be: female, over 55 years old, primary-educated, and in the low monthly household income bracket (i.e. < €900 – €1500; see Table 5.2).

In contrast with the other two segments (NC- and HC-oriented; indifferent), the HC-oriented group stated that free-fat information is mentioned on the FOP of the yoghurt that they habitually buy. These consumers attach the highest importance to NCs, followed by HC content, compared to the other two segments (see Table 5.3), and they use the nutritional information on the FOP when making most food selections. They also believe it to be important that their diet is low in fat (see Table 5.4). In terms of the utility attached to NCs and HCs, the respondents in this segment attach the highest utility to HCs out of all the groups, and they are indifferent towards NCs. They attach the greatest utility to HCs related to the fat content (*Hcp_fat* [3.86]), followed by sugar (*Hca_sug* [3.73]), and calcium content (*Hca_cal* [3.409]; see Table 5.6).

The NC- and HC-oriented segment make up 50.4% of the participants; they are more likely to be male, older than 55, with university degrees and low household income (Table 5.2). The consumers in this segment chose the content of an HC on the package and the price as the most important attributes when purchasing yoghurts (Table 5.3). They exhibit lower interest in healthy eating compared to the HC-oriented segment, and they do not avoid foods that may raise their cholesterol (Table 5.4). However, they attach positive utility when NCs are present along with HCs on the yoghurt packages. More specifically, these consumers attach the highest importance to nutrition information related to vitamin B_6 content (*Hcp_vit* [1.46] and *Hca_vit* [1.16]), followed by calcium (*Hcp_cal* [1.23]; Table 5.6).

Lastly, the indifferent segment contains the smallest percentage of participants (14.9%). This segment consists of young female consumers between 18 and 34 years old, who have completed university studies (see Table 5.2). This group attaches high importance to fat-free yoghurts, believe HCs to be the most important attribute in purchasing yoghurts, and use nutritional information less frequently than the other two segments (Tables 5.3 and 5.4). They deem it important that their diet is low in fat, but they also reported not avoiding the purchase of foods that may raise their cholesterol (Table 5.4).

The respondents in this segment attach a much lower utility compared to NC- and HC-oriented group to claims related to the fat content of the product (*Hca_fat* [0.92]), followed by fibre (*Hcp_fib* [0.75]) and sugar (*Hca_sug* [0.51]). However, utility declines when other NCs and HCs are present on the yoghurt package (Table 5.6). The no-buy alternative in this segment is also non-statistically significant, indicating that consumers in this group are indifferent about the presence of NCs and HCs on yoghurt packages.

5.4. Discussion

Overall, the results indicate that consumers positively value both NCs and HCs on yoghurt FOPs. This is consistent with the general literature review findings that consumers are willing to pay premium prices for these type of claims (Ballco & de-Magistris, 2018; Barreiro-Hurlé et al., 2010a; Barreiro-Hurle et al., 2010b; Cavaliere, Ricci, & Banterle, 2015; de-Magistris & Gracia, 2016; de-Magistris & Lopéz-Galán, 2016; de-Magistris et al., 2016; Grunert, 2006; Jurado & Gracia, 2017; Lopez-Galán & De-Magistris, 2017; Van Wezemael, Caputo, Nayga, Chryssochoidis, & Verbeke, 2014). In addition, this result aligns with previous research, which suggests that individuals prefer dairy products with HCs and NCs rather than similar ones without these claims (Ares et al., 2009; Bech-Larsen & Grunert, 2003; Bimbo et al., 2017). In this study, however, we identified three segments with heterogeneous preferences across consumers: HC-oriented (34.7% of participants), NC- and HC-oriented (50.0%), and indifferent (14.9%).

In terms of gender, our results reveal the presence of a gender dimension in the preference for yoghurts with NCs and HCs, highlighting that women (HC-oriented) display higher levels of acceptance for fat-free yoghurts and yoghurts with added calcium than men do (NC- and HC-oriented). This is consistent with Johansen et al.'s (2011) study, which found more positive attitudes towards low-fat yoghurts among Danish, Norwegian, and U.S. (Californian) female consumers compared to male shoppers (Johansen, Næs, & Hersleth, 2011).

In the same line, our results agree with Wardle et al. (2004), who report that women are more health-conscious than men and that the former mainly prefer fat-free or reduced-fat dairy products because they support weight control. Concerning the calcium content, our results illustrate that older women perceive higher utility for calcium-related HCs ('calcium is necessary for maintaining bones under normal conditions' and 'calcium contributes to normal muscle function') present on yoghurt packages (HC-oriented). This result is consistent with the previous research (Ares et al., 2009; Ares & Gámbaro, 2007) findings that female consumers are more willing to try yoghurts with added calcium. One reason that women prefer functional dairy products that are rich in calcium and promote bone health is due to their higher risk of developing osteoporosis (Ares & Gámbaro, 2007; Bimbo et al., 2017; Hailu, Boecker, Henson, & Cranfield, 2009).

With respect to age differences among segments, we found that HC-oriented as well as NC- and HC-oriented consumers who are older than 55 years attach higher utilities to both types of claims compared to younger members of the indifferent group (18 to 34 years old). This result agrees with previous studies, which have reported that being older is positively associated with a higher interest in dairy products that promote disease risk-reduction properties such as lowering cholesterol (Bimbo et al., 2017; Urala & Lahteenmaki, 2007; Urala & Lähteenmäki, 2004). In addition, older consumers have been exposed for a longer period of time to food products with functional properties; hence, they are more knowledgeable and familiar with functional dairy products and their effects on health (Messina et al., 2008; Urala & Lahteenmaki, 2007; Urala & Lähteenmäki, 2004).

Besides age, another interesting finding is one of homogeneity: the majority of people of normal body weight across all segments evaluate taste as the most important attribute. Having a normal body weight and no health problems (Table 5.3) also explains the behaviour of consuming tasty food that may raise cholesterol. Hence, regarding preferences in taste, the results suggest that participants across all segments are highly sensitive to the taste of food, and they do not compromise on this aspect for the sake of health.

This observation is even stronger among the participants who are indifferent towards and disinterested in purchasing yoghurts with NCs and HCs. This result is consistent with ones reported by Verbeke (2006), who found that consumers who purchase functional foods in Belgium are also not ready to compromise taste for health.

The results regarding NC and HC preferences suggest that, in overall, consumers from all segments prefer yoghurts with these claims compared to those without. However, when it comes to comparing higher utilities between NCs versus HCs, the study demonstrates that the latter carry higher utility. In other words, presenting both types of claims together on yoghurt packages generates higher preferences. This finding differs from that of Barreiro et al. (2010b), who obtained negative utility from the combination of NCs and HCs on the package of a less healthy product (pork frankfurter sausage). However, our results are consistent with other studies that have explored consumer preferences for functional food products. Among the many claims available on the market, shoppers generally prefer HCs to NCs (Annunziata & Vecchio, 2013; Bimbo et al., 2017; van Kleef, Van Trijp, & Luning, 2005; Williams, Ridges, Batterham, Ripper, & Hung, 2008). These results have practical implications for food companies and public authorities. Presenting both types of claims on the package can be used as a differentiation strategy by food companies. For the operators of the agri-food sector, the diffusion of foods with NCs and HCs can represent an opportunity to grab by means of implementing marketing strategies aimed at the different consumer segments. Policymakers will have to introduce HCs that are highly valued by consumers (e.g. *Hca_sug* and *Hca_cal*) but are not yet available on the market for yoghurts. Although the level of education is increasing and people today are more informed than ever before, there is still a segment of consumers (i.e. young people without any health problems) who are indifferent towards consuming products with NCs and HCs, and who do not avoid foods that may raise cholesterol.

Hence, in terms of public health nutrition aspects[47], it may be constructive to use behavioural insights rather than device new policies. In this context it is worthwhile to introduce healthier-eating programmes and reinforce the consumption of healthy diets (e.g., the Mediterranean diet) to young Spanish people and combine it with food products with NCs and HCs. Five decades ago, the Spanish diet was a typical example of the Mediterranean diet, however, lately, Spanish consumers have moved away from that pattern (Abellán Alemán et al., 2016). Previous research, among other, the PREvention con DIeta MEDiterranea (PREDIMED) suggested that a better adherence to the Mediterranean diet pattern together with a regular physical activity exerts a greater impact in lowering obesity and all-cause mortality (Arpón et al., 2018; Busquets-Cortés et al., 2018; Cárdenas Fuentes et al., 2018; Papadaki et al., 2018; Santiago et al., 2016). With respect to the dairy products and precisely yoghurts, which form part of Mediterranean diet, it is well demonstrated that whole-fat and low-fat yoghurt consumption is associated with a reduced risk of general obesity (Martinez-Gonzalez et al., 2014; Santiago et al., 2016) and also abdominal obesity (Crichton & Alkerwi, 2014; Sayón-Orea et al., 2015). Therefore, public expenditure could encourage the promotion of typical Mediterranean products with NCs and HCs in high schools and colleges. The extensive use of TV for educational purposes to reach children with an attractive food program; linking healthy food habits with sports celebrities and leisure offers, as well as to search for more accurate the appropriate combination of healthy food based on the ingredients of the Mediterranean diet is also another form of educating consumers. Finally, the popularity, acceptability, and generally perceived healthy image of yoghurt all make it an ideal snack or meal accompaniment in many cultures. The consumption of yoghurt as a healthy food can be promoted especially among adolescents whose consumption of milk is low, hence, yoghurt can be considered as a milk substitute.

[47] We thank an anonymous reviewer for pointing out this possibility.

Yoghurt should not replace fruit as a typical dessert of the Mediterranean diet but public health interventions should promote its consumption on health and educational campaigns as it plays a role in the prevention of weight gain and overweight/obesity (Martinez-Gonzalez et al., 2014).

Finally, this study has some limitations and further research opportunities. First, due to limited funding, it was conducted in Spain. Hence, it should be replicated in other countries to provide more evidence. Second, future research using choice experiments should be developed, not only in laboratory conditions but also in a supermarket with real products to test consumer preferences and decision making in different contexts. In our study, we used schematic choice cards as opposed to actual product packaging, which would have been more realistic (see for example Jongen et al. (2015)). In addition, hypothetical choice experiments do not use actual purchase and monetary risk, which is still a disadvantage compared to real choice experiments. Therefore, care should be taken in fully translating our results to real-life choice situations. Conducting real choice experiment with real products and real economic incentives will increase realism and avoid the hypothetical bias, which is a limitation in our research. Third, the FOP of a food product generally includes not only the NCs and HCs, but also other extrinsic information (e.g. price, brand name, ingredients list, symbols, etc.). Therefore, further studies should include packages carrying other information cues in addition to NCs and HCs to evaluate the impact of these attributes in a choice environment. Finally, in terms of climate impacts[48] (e.g., green-house gas emissions, blue water footprint, land use etc.) associated with shifts to diets and dietary recommendations, it is important to point out that yoghurt is a dairy product, which presents a high carbon food print per caloric intake. The previous research of Heller & Keoleian (2015) suggested that following a diet reduced in calories (estimations based on consumption rather than intake) results in a 1% decrease in diet-related green-house gas emissions.

[48] We thank an anonymous reviewer for pointing out this possibility.

In addition, Meier & Christen (2013) found that following an iso-Caloric shift to the German Nutrition Society Official food-based dietary recommendation could reduce energy use by 7%, blue water use by 26%, emissions by 11%, and land use by 15%. Lastly, Vanham et al. (2013) determined that shifting to the same German dietary guidelines within the EU and Croatia while also accounting for a reduction in caloric intake reduces the diet-related blue water footprints by 18%. Taking into account these studies, it would be very interesting to investigate in the future whether the Spanish consumer who attaches more importance to NCs and HCs on dairy products contribute or not to climate impacts such as reducing energy use, emissions, and blue water footprint.

5.5. Conclusions

In this paper, we studied the relationship between choice behaviour, attitudes and socio-demographic characteristics and evaluated the effectiveness of consumer characteristics in predicting Spanish consumers' choice of products with NCs and HCs.

Consumers generally understand the connection between food and health, and many have an interest in the use of NCs and HCs. However, the degree of interest to use NCs and HCs differs amongst consumers and coexists with other aspects of food products (e.g. price and taste). Overall, our results suggest that there is heterogeneity in consumer preferences for multiple NCs and HCs in the Spanish marketplace. We found three segments of consumers (1 – HC-oriented, 2 – NC- and HC-oriented, and 3 – indifferent) with regards to yoghurts carrying NCs and HCs. In addition, our findings suggest that HCs, which report the nutrient (NC) as well as the benefit of that nutrient to our health (HC), are more valued than NCs presented on the yoghurt FOP alone. Our study has contributed to drawing a clearer view of the relationships between socio-demographic and attitudinal characteristics and choice behaviours, which can be of great help in developing new products and implementing specific marketing strategies.

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Chapter 6

General discussion and conclusion

Previous chapters have discussed the study findings and implications in detail. This final chapter is divided into four sections and provides a general discussion with respect to the research questions (Section 6.1) and general conclusions (Section 6.2), acknowledges the limitations of this doctoral research and proposes opportunities for further research (Section 6.3), and, finally, provides implications for the public and the food industry (Section 6.4).

6.1. Discussion

6.1.1. Research objectives and research questions revisited

The overall objective of this dissertation was to gain a better understanding of consumers' preferences in buying food with NCs and HCs. The product of reference was yoghurt, as it is considered to be a healthy food, it is an essential part of the Spanish diet, and it is an important component in the purchase basket of Spanish households. Visual attention towards multiple NCs and HCs during food selection was investigated. Moreover, the premium prices (in terms of implicit prices) for NCs and HCs on the real market, consumers' general interest in healthy eating, the importance of these claims, and the use of them in the purchase decision were measured.

6.1.1.1. RO1: Price effects of NCs and HCs on yoghurts in Spain

RQ1 Which attributes influence yoghurt prices in the market?

RQ2 What type of claims affect yoghurt market prices?

RQ3 Which claim (NCs vs. HCs) receives the highest premium price?

The first objective aimed to investigate the exposure of, among other intrinsic and extrinsic characteristics, NCs and HCs, as well as examine their effect on yoghurt prices. Overall, the market competition of yoghurt attributes was based in quality attributes related to quantity, brand, type of retailer, type of yoghurt (e.g. natural, with fruit flavours, bifidus, Greek, etc.), and NCs and HCs.

More specifically, yoghurt prices were positively affected by private brands purchased at neighbourhood stores, in comparison to leader brands purchased at hypermarkets. This was an expected result, since the neighbourhood stores, such as Mercadona, in Spain have the highest market share (23.6%) compared to the remaining supermarkets and hypermarkets (8.5%) (Berengueras, 2017). Moreover, the presence of the private brands in neighbourhood stores ascended to 56.6% in 2017, compared to super-hypermarkets (34.1%) (San Esteban, 2017). Natural Greek and drinking yoghurts received the highest premium price compared to the other types of yoghurt (i.e. bifidus, natural, and yoghurts with fruits and flavours). This result supports the findings of Bonanno (2013) in the Italian yoghurt market, which revealed that consumers seem to prefer drinking yoghurts over regular ones (*RQ1*). Notably, NCs related to fat-free, no added sugar, and fibre contents had negligible effect on yoghurt prices. This result contradicts the overall preferences of consumers for low-calorie and fat-free food products that are simple and more familiar than the other claims (e.g. HCs) (Bitzios, Fraser, & Haddock-Fraser, 2011; Lähteenmäki et al., 2010). However, the results are in line with two previous studies conducted on yoghurts in the Italian market, which found a negative marginal price for the zero-fat (Bimbo, Bonanno, & Viscecchia, 2016) and low-fat claims. With respect to the NC related to fibre content, results are in line with those of Ares & Gámbaro (2007), who discovered that fibre added to yoghurts was perceived as interfering with the naturalness and healthfulness of the product, which may reduce acceptance by consumers and affect price. In contrast, NCs related to the source of vitamin B6 and source of protein had a positive influence on yoghurt prices.

Conversely, HCs outperformed NCs, leading to higher premium prices in the Spanish market. In particular, claims related to reducing the risk of developing cholesterol, and related to problems with lactase digestion are well accepted by dairy product consumers (Ares & Gámbaro, 2007; Landström, Hursti, Becker, & Magnusson, 2007), even among those without high cholesterol problems (Marette, Roosen, Blanchemanche, & Feinblatt-Mélèze, 2010). The HC related to lactose digestion was the second most valued claim after the cholesterol claims.

This was an expected result due to the fact that, in 2015, the Spanish Society of Digestive Pathology, in collaboration with the Spanish Society of General and Family Physicians, found that between 30% and 50% of the Spanish population suffers from lactose intolerance (Argüelles-Arias et al., 2015). Finally, in contradiction to the price effect of the NC related to calcium content, the HC was found to have a positive impact and received an important premium. This result suggests that, when NCs are presented with their corresponding HC on the food package, they receive higher premiums than when labelled alone. Premium prices were also given to yoghurts bearing the vitamin B6 joint NCs and HCs. This result contrasts with two previous studies, which found negative interaction effects when NCs and HCs were labelled together (Barreiro-Hurle, Gracia, & De-Magistris, 2010; Szathvary & Trestini, 2014). Lastly, the fibre HC did not receive any premium price. This result is similar to that of Ares & Gámbaro (2007), who found that consumers exhibit positive attitudes towards dairy products enriched with calcium, rather than fibre, since the functional component (fibre) is 'artificially' inherited to this product category (*RQ2* and *RQ3*).

6.1.1.2. RO2: Consumers' visual attention and choice decision for multiple NCs

RQ4 Do NCs on yoghurts' FOP attract the visual attention of consumers, and which claims attract the most?

RQ5 What are the consumer preferences for NCs on yoghurts?

RQ6 Is there any relationship between the most visually attended and the chosen NCs?

RQ7 How do people with a different buying behaviour differ in terms of preferences towards NCs?

The aim of this second research objective was to investigate consumers' preferences for alternative NCs (fat-free, low sugar, high fibre, source of vitamin B6, and source of calcium) and explore the impact of consumers' visual attention on their final choice.

Eye-tracking measures suggested that NCs on yoghurt packages increased consumers' visual attention in comparison to yoghurt without such claims. Some claims received greater visual attention compared to others. More precisely, consumers attached visual attention in terms of FT and FC to the source of calcium NC, followed by the fat-free and high fibre claims. The source of vitamin B_6 and low sugar claims received fewer fixations than the other NCs (*RQ4*). Consumer-stated preferences (without considering the visual attention measures) indicated that the fat-free, high fibre, and source of calcium claims were the most preferred (*RQ5*). Interaction terms between the stated preferences and visual attention indicated positive correlations for the respected NCs. A higher FT or FC for NCs is related to a higher utility for these claims, which illustrates that people who visually attend more to those claims are more likely to choose yoghurts carrying them and value them more. Thus, spending more time and fixating more on NCs relates to a higher preference for these attributes when making food choices, as well as increases the likelihood of choosing yoghurts that carry NCs (*RQ6*). Eye-tracking measures reveal meaningful information about the value that consumers attach to the product attributes when making food choices and contribute to explaining choice behaviour for healthy food such as yoghurts.

Consumer heterogeneity was also taken into account through consumer segmentation, which entailed the classification of the participants into two segments by consumer characteristics. More specifically, segment 1 were more likely to be male, between 18 and 34 years old, have completed secondary studies, and have a low income. They attached the greatest level of importance to the fat-free claim compared to the rest. Segment 2 was characterized by females aged between 18 and 34 years, with a higher income than segment 1, who had completed secondary education. For this segment, the most important claim considered when purchasing yoghurts was the source of calcium claim (RQ7).

6.1.1.3. RO3: Visual attention, sensory analysis and choice decisions for yoghurts with NCs and HCs

RQ8 Will consumers choose a healthy food (yoghurt) with NC and HC rather than an unlabelled one?

RQ9 Will HCs be considered an information overload on the food package and, thus, be less chosen compared to NCs which are short and concise?

RQ10 Will there be a relationship between the NCs and HCs with the highest visual attention and the claims that generated the highest utilities, and will this relationship affect the likelihood of the product being chosen?

RQ11 How will the taste of a healthy food with NCs and HCs affect visual attention and final choices?

RQ12 Does accounting for attribute non-attendance in food choice experiments using eye-tracking measures influence the model estimates?

RQ13 Does the taste of a food influences the attribute non-attendance in choice experiments?

This objective aimed to explore consumer preferences for multiple NCs and HCs on a healthy food (yoghurt). It explored whether and how taste influenced consumer preferences for NC and HC labels, as well as determined whether visual attention led to an increased likelihood of the product being purchased. Overall, the results revealed that the utility of participants increased when the NCs and HCs were present on the yoghurts' FOP, as compared to yoghurts without these claims (*RQ8*). This suggests that NCs and HCs increase both the utility and the evaluation of a product. Compared to NCs, participants' utility increased when both claims were labelled on the FOP of yoghurts (*RQ9*). This result contradicts previous studies that found negative interaction effects when NCs and HCs were labelled together (Barreiro-Hurle et al., 2010; Szathvary & Trestini, 2014).

In addition, the results illustrated that, when NCs and the corresponding HC appeared jointly, consumers not only generated higher utilities in terms of stated preferences, but they also gave the greatest visual attention in terms of FC (*RQ9* and *RQ10*). Moreover, we found empirical evidence of a relationship between the most highly valued NCs and HCs, as measured by stated preferences and the visual attention in terms of FC (one and two cut-offs) (*RQ10*). Yet, this is an assumption that attention might be linked to an increased likelihood of affecting the final decision to purchase yoghurts with NCs and HCs, because, as defined by Orquin & Holmqvist (2018), it is difficult to support an ET mind assumption, as researchers cannot know whether the presence of fixation implies that the object has been processed, and vice versa. However, this result is in line with the existing work on food products, suggesting that ET data can reveal how respondents value the attributes used in a DCE (Balcombe, Fraser, Williams, & McSorley, 2017; Bialkova et al., 2014; Bialkova & Van Trijp, 2011; Graham & Jeffery, 2011; Samant & HanSeok, 2016; Van Loo et al., 2015; Van Loo, Nayga, Campbell, Seo, & Verbeke, 2017). Regarding the sensory aspects of a healthy food with NCs and HCs, findings demonstrated a decrease in liking when consumers tasted the product. Notably, in the no-taste treatment, the hedonic valuation for all varieties was slightly higher than in the taste treatment, suggesting that consumers created higher expectations with regard to taste if they did not get to try the product. Consumers' utility decreased when they tasted the products, though the visual attention increased (*RQ11*). Nutritional and health claims received slightly more visual attention in the situation in which tasting occurred than in the situation in which tasting did not occur (*RQ11*). Regarding the visual ANA, we found evidence that participants ignored certain attributes in the DCE and did not notice many attributes during visual attention, especially when the fixation cut-off was two. This result supports the previous findings, suggesting that ET could provide a way in which researchers can effectively design DCEs to reduce the extent of visual ANA and perhaps maximize consumers' attention across all attributes (*RQ12*). Taste also affected visual ANA. In other words, tasting the yoghurt resulted in a lower visual ANA compared to scenarios in which no taste was experienced (*RQ13*).

This is an important result to be considered by researchers in the food industry, because it implies that including sensory analysis in experimental designs might reduce ANA behaviour.

6.1.1.4. RO4: Spanish consumer characteristics of healthy foods with NCs and HCs

RQ14 Is there an association between attitudes (interest in healthy eating, importance and use of NCs and HCs) and choice behaviour?

RQ15 What consumer characteristics predict Spanish consumers' choice of healthy products with NCs and HCs?

The aim of this objective was to study the relationship between choice behaviour, attitudes, and socio-demographic characteristics to predict Spanish consumers' choices of healthy food with NCs and HCs. The purchase habit results suggest that more than half of consumers (52.3%) purchase fat-free yoghurts, followed by those that are low in sugar (44%) and those that provide a source of calcium (31.7%). The relative attribute importance was highest for taste, followed by health (i.e. the product is healthy), natural ingredients, and NC and HC content. Overall, consumers stated to use the nutritional information on the label when making most of their food selections, and they claimed to generally pay attention to nutritional information when they see it in an advertisement or elsewhere. In terms of interest in healthy eating, the respondents stated to be very particular about the healthfulness of the food they consumed, and it was crucial that their diet contained many vitamins and minerals and was low in fat. These results are also reflected in the utility model, in which the highest utility was generated when a yoghurt contained the NC and HC related to fat content (*RQ14*). Consumer preferences, however, were heterogeneous, and three segments were identified: HC-oriented (34.7% of participants), NC- and HC-oriented (50.0%), and indifferent (14.9%) (*RQ15*).

The HC-oriented segment was likely to be female, over 55 years old, primary educated, and in the low monthly household income bracket. In contrast with the other two segments (i.e. NC- and HC-oriented, indifferent), the HC-oriented group stated that fat-free information was mentioned on the FOP of the yoghurt that they habitually bought. These consumers attached the greatest importance to NCs, followed by HC content, as compared to the other two segments, and they used the nutritional information on the FOP when making most food selections. They also believed it to be important that their diet was low in fat. In terms of the utility attached to NCs and HCs, the respondents in this segment attached the greatest utility to HCs out of all of the groups, and they were indifferent towards NCs. They attached the greatest utility to HCs related to the fat content, followed by sugar, then calcium content.

The NC- and HC-oriented segment was more likely to be male, older than 55, with a university degree, and with low household income. The consumers in this segment chose the content of an HC on the package and the price as the most important attributes when purchasing yoghurt. They exhibited lower interest in healthy eating compared to the HC-oriented segment, and they did not avoid foods that may raise their cholesterol. However, they attached positive utility when NCs were present along with HCs on the yoghurt packages. More specifically, these consumers attached the greatest importance to nutrition information related to vitamin B6 content, followed by calcium.

Finally, the indifferent segment consisted of young female consumers, between 18 and 34 years old, who had completed university studies. This group attached great importance to fat-free yoghurt, believed HCs to be the most important attribute in purchasing yoghurt, and used nutritional information less frequently than the other two segments. They deemed it important that their diet was low in fat, but they also reported not avoiding the purchase of foods that may raise their cholesterol. The respondents in this segment attached a much lower utility compared to the NC- and HC-oriented group to claims related to the fat content of the product, followed by fibre and sugar.

However, utility declined when other NCs and HCs were present on the yoghurt package. The no-buy alternative in this segment was also non-statistically significant, indicating that consumers in this group were indifferent about the presence of NCs and HCs on yoghurt packages (*RQ15*). In terms of gender, the results revealed the presence of a gender dimension in the preference for yoghurts with NCs and HCs, highlighting that women (HC-oriented) display higher levels of acceptance for fat-free yoghurts and yoghurts with added calcium than do men (NC- and HC-oriented). This is consistent with prior literature, which observed more positive attitudes towards low-fat yoghurts among female consumers compared to male shoppers (Johansen, Næs, & Hersleth, 2011). In addition, the results are consistent with Wardle et al. (2004), who report that women are more health-conscious than men and that the former mainly prefer fat-free or reduced-fat dairy products because they support weight control. Concerning the calcium content, our results illustrate that older women perceived higher utility for calcium-related HCs ('calcium is necessary for maintaining bones under normal conditions' and 'calcium contributes to normal muscle function') present on yoghurt packages (HC-oriented). This result is consistent with previous research, which has suggested that female consumers are more willing to try yoghurts with added calcium (Ares, Giménez, & Gámbaro, 2009; Ares & Gámbaro, 2007). One reason that women prefer functional dairy products that are rich in calcium and promote bone health is due to their higher risk of developing osteoporosis (Ares & Gámbaro, 2007; Bimbo et al., 2017; Hailu, Boecker, Henson, & Cranfield, 2009).

Age differences among segments suggest that HC-oriented, as well as NC- and HC-oriented, consumers who are older than 55 years attached higher utilities to both types of claims compared to younger members of the indifferent group (18 to 34 years old). This result is in line with previous research, which has reported that being older is positively associated with a higher interest in dairy products that promote disease risk-reduction properties such as lowering cholesterol (Bimbo et al., 2017; Urala & Lähteenmäki, 2007; Urala & Lähteenmäki, 2004).

Having a normal body weight and no health problems also explained the behaviour of consuming tasty food that may raise cholesterol. Hence, regarding taste preferences, the results suggest that participants across all segments were highly sensitive to the taste of food, and they did not compromise on this aspect for the sake of health. This observation was even stronger among the participants who were indifferent towards and disinterested in purchasing yoghurts with NCs and HCs. Finally, the results regarding NC and HC preferences suggest that, overall, consumers from all segments preferred yoghurts with these claims compared to those without. However, when it comes to comparing utilities between NCs and HCs, this study demonstrated that the latter carried greater utility. In other words, presenting both types of claims together on yoghurt packages generated higher preferences (*RQ15*).

6.2. General conclusion

Dietary guidelines worldwide advise that consumers decrease their consumption of saturated fat, sugar, and salt, and increase their consumption of fresh fruits and vegetables. Various policymakers have introduced a number of food labelling systems with the goal of helping consumers make more informed and healthier food choices. One of the actions taken by the EU is the launch of NCs and HCs (Regulation [EC] No 1924/2006), reported on the FOP of pre-packaged food products. While these tools empower consumers to take health into account, they are also aimed at increasing the motivation to consume healthy food and to make healthy food choices. Yet, although consumers express positive evaluations towards food with NCs and HCs, some food products, although healthier compared to other foods without functional properties, do not meet the sensory expectations (i.e. taste) of consumers (Civille & Oftedal, 2012). An issue related to the sensory aspects of food products is that consumers must rely on either previous taste experiences or the information presented on the FOP to form taste perceptions, which may later result in positive or negative experiences.

During a purchase decision, however, consumers typically make choice decisions within a few seconds; thus, they may not attend to all of the information available on the FOP (Milosavljevic & Cerf, 2008).

Generally, some of the information is selected to be further processed, while the rest is lost, and consumers are typically not even aware of its presence on the label (Oliveira et al., 2016; Wedel & Pieters, 2008). For this reason, studying consumers' attention to food labels is becoming a key aspect in label design. This dissertation focuses on NCs and HCs as information provision tools which allow for more informed food choices and encourage healthy food choices. As the first of its kind, this dissertation combines DCEs and ET with sensory analysis. More specifically, the following objectives are researched in this dissertation. The price effects of NCs and HCs on yoghurts in the Spanish market are assessed. Consumers' visual attention and choice decisions for multiple NCs are studied. Visual attention and choices for NCs and HCs on a health food are examined, and the influence of taste on the final purchase decision is investigated. Finally, the relationships between choice behaviour, attitudes, and socio-demographic characteristics in predicting Spanish consumer characteristics of health foods with NCs and HCs are examined.

Findings related to the price effects of NCs and HCs on yoghurts in the Spanish market (Objective 1 – Chapter 2) indicate that yoghurt is a highly differentiated food product. The market competition was based on quality attributes related to quantity, brand, type of retailer, type of yoghurt, and NCs and HCs. The applied hedonic function provided a measure of the market values of these attributes and investigated some important features of the Spanish yoghurt industry to offer insights on certain competitive strategies. The findings imply that NCs and HCs matter in determining yoghurts' premium price. This result is also reflected in the examination of consumers' visual attention and choice decision for multiple NCs (Objective 2 – Chapter 3).

All NCs received greater visual attention than the unlabelled yoghurt. The claims that received the greatest visual attention were the fat-free and source of calcium claims, which were also the most chosen.

This means that a greater visual attention toward NCs may lead to higher evaluation, similarly as the post-purchase dissonance. This may be caused by the exposure effect, which states that attention has a casual effect on preference formation and may lead to greater visual attention to an attribute, resulting in a higher value and preference for that attribute. In sum, the use of ET reveals meaningful information about the attention to NCs and relates to the value or importance attached to them, as well as contributes to explaining choice behaviour.

In addition to examining NCs alone on the FOP of healthy food, this dissertation also provides insights into assessing consumer preferences for NCs and their corresponding HCs by exploring whether and how taste influences consumer preferences, the visual attention paid to NC and HC labels, and the final choices. This doctoral dissertation studies the use of ET as a tool to evaluate visual attention and the visual ANA, which are incorporated in the choice modelling (Objective 3 – Chapter 4). Consumers' utility increased with the presence of NCs and HCs on the FOP. In particular, a joint presence of NCs and HCs had a greater impact on utility and resulted in lower visual ANA compared to the presence of only NCs. The stated preferences and the visual attention in terms of FC suggest a relationship between the most highly valued NCs and HCs. This relationship affirms that the final product selection is based not only on the type of labelling on the package, but also on the visual attention that consumers pay to it. Regarding visual ANA, we found evidence that participants ignore certain attributes in the DCE and overlook many attributes during visual attention.

Regarding taste, the findings indicate that taste trumped the effect of NCs and HCs, meaning that consumers were not willing to compromise on taste in favour of better nutrition. However, visual attention was higher and visual ANA lower when consumers tasted the products as compared to the no-taste treatment, since the experience of intrinsic attributes increased the overall attention paid to the product.

Finally, this study investigated the relationship between choice behaviour, attitudes, and socio-demographic characteristics, as well as evaluated the effectiveness of consumer characteristics in predicting Spanish consumers' choice of products with NCs and HCs (Objective 4 – Chapter 5). Overall, Spanish consumers understand the connection between food and health, and many have an interest in the use of NCs and HCs. Yet, the degree of interest in using NCs and HCs differs amongst consumers and coexists with other aspects of food products (e.g. price and taste). Findings revealed three segments of consumers with heterogeneous preferences (1-HC-oriented, 2-NC- and HC-oriented, and 3-indifferent) with regard to yoghurts carrying NCs and HCs. Furthermore, the findings revealed that HCs were more highly valued than NCs when presented alone on the yoghurt FOP.

6.3. Limitations and future research

There are limitations associated with this doctoral research which need to be acknowledged and which also open up opportunities for further research.

First, the data collection applied in this doctoral research imposed some limitations. One limitation is related to the people of one country alone (Spain) having participated in this doctoral dissertation. There is a substantial need to examine to which extent NCs and HCs influence consumer behaviour among participants of other countries and different cultures (e.g. northern or southern Europe or the United States). One should also consider that the language differences and dietary patterns are likely to have an impact on theory involvement in healthy eating. Therefore, extrapolation to other populations remains to be further validated, and future studies should test the robustness of these findings using samples in other locations with different dietary patterns.

Second, aside from the ET measures, the rest of the studies in this research relied on self-reported measures, which is highly common in this field, though they likely suffered from social desirability bias that may deviate from actual behaviour (Fisher, 1993). The studies did not control for social desirability, common methods error bias, and cognitive consistency.

To overcome these limitations, more experimental and observational research is needed. Future research should study actual behaviours or revealed preferences. In addition, DCEs are of hypothetical nature, as they rely on stated preference data. It is well reported that hypothetical choices might suffer from hypothetical bias, as subjects facing a hypothetical buying decision tend to behave differently than subjects in a real buying situation (Carlsson & Martinsson, 2001; Hensher, 2010). To overcome the issue of hypothetical bias, non-hypothetical or incentive-compatible mechanisms can be applied. In the future, more research on NCs and HCs using non-hypothetical and incentive-aligned methods to validate these findings would be desirable, such as experimental auctions, non-hypothetical, or real choice experiments.

Third, the consumer quality perception process theoretical framework was described based on the consumer quality perception process adopted from Fernqvist & Ekelund (2014) and Steenkamp (1990). Several phases of this framework were studied separately. Future research should focus on the different relations in the framework. This dissertation only measured the knowledge, understanding, and interest in using NCs and HCs. While these are important, the interest in using the label also depends on whether the consumers believe these claims are credible, trust them, and feel that the information provided by them assists consumers in making healthy food choices. Thus, future studies could also evaluate the trust, credibility, belief, and knowledge related to the different NCs and HCs used in this study. While knowledge, understanding, and the interest in using NCs and HCs were analysed separately, there are numerous factors that can influence the consumer decision-making process regarding NCs and HCs. Future research could include the MOA framework or person-, product- and environmental-related factors. As suggested by Kotler et al. (2013), there are four sets of consumer characteristics that influence the consumer quality perception process. These include personal (demographics, personality, lifestyle), psychological (knowledge, perceptions, motives, attitudes, involvement), cultural (social class, reference group), and social factors (family, reference groups).

In addition to consumer characteristics, environmental factors (e.g. situational influences such as time and occasion) and product-related factors (e.g. product type, price, place, promotion, product attributes) may influence the process. Therefore, future studies could include a series of different factors that influence the quality perception process.

Fourth, while this dissertation considers consumer preferences for NCs and HCs on a healthy product (plain yoghurts), future research should, in addition to using yoghurts with various fruits and flavours, include other healthy products such as juices from fruits and vegetables, seafood, and/or meat products. In addition, the FOP of a food product might include multiple NCs (e.g. fat-free and low sugar), as well as other quality cues (e.g. price, brand names, quality standards, etc.) that compete for the attention of consumers. Thus, future studies could evaluate the impact of stated preferences and visual attention when multiple food labels are present on food packages.

Fifth, the ET technology that measures consumers' visual attention has some limitations. First, ET shows where participants fixate their attention, but not why. Therefore, the motivations and cognitions underlying these eye movements remain unknown to the researcher (Graham, Orquin, & Visschers, 2012; Pieters, Rosbergen, & Hartog, 1996; Pieters, Rosbergen, & Wedel, 1999). Graham et al. (2012) suggests that conducting an interview after an ET task may provide greater insight into what respondents were thinking during the task. While ET studies might be less prone to social desirability compared to studies that ask respondents directly about the information to which they attend, knowing that their eye movements will be monitored may also influence consumers' behaviour (Graham et al., 2012). Finally, ET is a relatively expensive and time-consuming method. Hence, considerations with respect to value-for-money, as well as budget and time constraints, are also important.

Sixth, packaging plays an important role in attracting consumers' attention and in communicating information about credence attributes at the point of

purchase (Bialkova, Grunert, & Van Trijp, 2013; Varela, Antúnez, Cadena, Giménez, & Ares, 2014). Bottom-up factors with respect to the design of NCs and HCs (e.g. format, colour, representation, and size) on the package and location on the package could be studied. Information density is a bottom-up factor that could influence attention (Bialkova et al., 2013), and food packages usually include information other than NCs and HCs. Thus, future studies should include packages with more information cues and evaluate the visual attention to NCs and HCs in a choice environment with more information (e.g. NCs, HCs, and organic labels). Currently, many of the studies that apply ET with respect to food choice are hypothetical. People might behave differently and, thus, visually attend to information differently, depending on whether their food choices have real economic incentive. This is a potential area for future research.

Finally, Chapter 4 focuses on the use of ET to address visual ANA in DCEs. Although ET technology has been considered a promising tool to address ANA, further research is recommended to optimize the use of this technology in the context of choice behaviour, attention, and ANA (Orquin & Mueller Loose, 2013). While we included only one type of ANA, future studies should include all three types of ANA (visual, stated, and inferred) and evaluate which is the most appropriate to account for ANA.

6.4. Public and industry implications

Despite its limitations, this doctoral thesis has several public and industry implications. The results of this doctoral thesis indicate that the existing regulations on NCs and HCs present a marketing opportunity for the yoghurt sector that is currently not being fully considered. Manufacturers could consider the growing consumer concerns regarding healthier food products and build strategies based on their preferences. Especially in the yoghurt market, health-enhancing product differentiation through functional food ingredients is one of the most profitable methods of product differentiation.

Although certain NCs had no effect on yoghurt prices, a profitable strategy may be to accompany them with the corresponding HC that precisely defines the benefits of that nutrient to one's health.

The fact that some NCs had no effect on yoghurt prices means that consumers are not willing to pay premium prices for yoghurts that bear these claims; however, this does not necessarily mean that consumers will not choose to purchase them. Nutritional and health claims related to fat content received premium prices in the market, were mostly attended to, and generated the highest utility. An increasing number of NCs and HCs is allowed by EU legislation, yet HCs related to fat content are not present in the Spanish yoghurt market. Since this research has demonstrated that HCs can be a promising avenue, producers, processors, and manufacturers could differentiate their products and not only include the claims that are most preferred by consumers, but also introduce those that are not yet available on the market (fat and sugar HCs). In addition, to help consumers better understand the meaning of the HCs, producers, processors, and manufacturers should include HCs that are easy to understand. New product development could focus on yoghurt products that fulfil the criteria for the use of NCs and HCs. Depending on the type of nutrient, the EU legislation offers a large variety of claims to be used; thus, consumer studies or focus groups on the understanding of HCs should be used before launching them in the market. Besides the information on the package, it must also be noted that health and taste are two choice criteria, with taste being one of the most important factors in the food purchase decision. As long as consumers perceive a negative correlation between taste and health, interest in healthy eating will be limited. However, for the yoghurt industry, a decrease in the level of fat and sugar is a challenge – these are important indicators of taste, and consumers are unlikely to compromise on taste over health.

In this context, it is important for the food industry to invest in investigation and development (I+D) and technology innovation to find a balance between healthy and tasty food. One alternative is to reformulate high-energy-density foods by lowering or replacing their energy density (e.g. fat) with water, fibre fillers, or fruits and vegetables.

Although people believe that healthy food is less tasty, sensory tests indicate otherwise. Rolls et al. (2004) suggests that people who eat lower-energy-density foods eat the same volume as the conventional food, rate themselves as equally satisfied as those who eat high-energy-density foods, and do not perceive the foods as tasting worse (Rolls et al., 2004; Raghunathan et al., 2006; Rolls 2005; Wansink and Huckabee 2005). Research suggests that about 20% of the fat in a high-energy-density food can be replaced with healthier food, such as fruits and vegetables, without consumers noticing a difference in taste (Rolls et al., 2004). This finding indicates that consumers are not knowledgeable enough about the composition of foods to realize that their favourite unhealthy food can be successfully reformulated to be just as tasty without being as unhealthy. To avoid mistrust and deception, marketing strategies should involve sampling, credible sources, and opinion leaders. Sampling would be an important factor in the acceptance of this newly reformulated, healthier food to convince consumers that the food is as tasty as the conventional, full-calorie version. These samples could be given in store, sent home through the mail, or, more appropriately, handed out at sports and fitness centre events. These products could also be endorsed by health and fitness experts.

Re-educating consumers on what constitutes 'healthy' is also important. While it is correct to perceive a food product with less/zero fat, especially with less saturated fat, as healthier than its conventional alternative, fat is not the only nutrient that can harm one's health. Consumers can better distinguish the healthfulness of their food based on the fat content because the food industry has primarily differentiated the healthfulness of foods by focusing mainly on the fat content (e.g. colour codes based on fat content, symbols or percentages of fat on the FOP, etc.). Thus, from a policy perspective and since it has been demonstrated that 65% of the population are visual learners (Bradford, 2011), one possibility could be to homogenize and use mandatory colour-coded packaging that accompanies certain nutrients in addition to fat (e.g. Spanish full-fat yoghurt packages are usually dark blue or red, while low-fat are light blue or green). For example, in addition to NCs and HCs on the FOP, packages might be homogenized based on the total number of calories.

A food low in calories might have a light blue package, versus a different colour for its conventional equivalent. Given the heterogeneity of preferences, findings also suggest that, besides accompanying NCs with HCs so that consumers know what, precisely, is being communicated, such labels may need to be supplemented by nutrition education. Nationwide nutrition education is likely to be costly, and results of such a campaign are uncertain; however, it is considered to be an effective means of educating consumers.

In addition, healthier-eating programmes should be enforced to young Spanish people by public bodies, and the consumption of healthy diets (e.g. the Mediterranean diet) might also be combined with food products that contain NCs and HCs. Five decades ago, the Spanish diet was a typical example of the Mediterranean diet; however, Spanish consumers have recently moved away from that pattern. The Prevención con Dieta Mediterránea (PREDIMED) research suggests that a better adherence to the Mediterranean diet pattern, together with a regular physical activity, exerts a greater impact on lowering obesity and all-cause mortality (Cárdenas et al., 2018). Yoghurt is an essential component of the Mediterranean diet, it is healthy, and the consumption of low-fat yoghurt is associated with a reduced risk of general and abdominal obesity (Santiago et al., 2016; Sayón-Orea et al., 2015). Therefore, public expenditure could encourage the promotion of yoghurt as part of the typical Mediterranean diet in high schools and colleges. Finally, the extensive use of the TV for educational purposes to reach children with an attractive food program, link healthy food habits with sport celebrities and leisure offers, and more accurately identify the appropriate combinations of healthy food based on the ingredients of the Mediterranean diet, is yet another form of educating consumers.

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Appendixes

Appendix A

Figure A1 – An evaluation form of the most-preferred yoghurt

Note: The question is translated from Spanish as follows: 'Which of these two yoghurts would you choose?' 'Alternativa A' refers to option A, 'Alternativa B' refers to option B, and 'Ninguno' is the 'no-buy' option.

Appendix B

Table B1 – Population in Spain and Zaragoza (%)

Total		Sex[a]		Age					
		Female	Male	0–14	15–34	35–54	55–64	65–84	85 and above
Spain	46,624,382	51	49	15.06	22.59	32.20	11.76	15.60	2.79
Zaragoza	1,317,847	50	50	14.06	21.13	31.53	12.24	17.24	3.80

Source: Spanish Census of Population, 2017, www.ine.es. [a] In percentages.

Appendix C

Appendix C1 – Classification questionnaire for the eligibility of participants to be included in the study.

Classification Questionnaire

In the Centre for Research and Agrifood Technology (CITA) an investigation is being carried out with the aim of studying consumer preferences regarding different nutritional and health information in yoghurts. Your opinions will be very useful, so we ask for your collaboration. We would like to let you know that most questions are of opinion, so there is no right or wrong answers. We want to assure that the information you provide will be treated anonymously and strictly confidential.

You just have to fill this simple questionnaire to participate in the study that will last approximately 45 minutes.

The study session consists of the following tasks:

- **Task 1:** Rate different yoghurts based on the information provided on each of them
- **Task 2:** Answer a brief questionnaire
- **Task 3:** Use the technology that will allow us to track your eyes during this session

As a **reward** you will receive 1 bottle of extra virgin olive oil.

In order to participate in this study, you must be over 18 years of age.

Next, we ask you to answer a few short questions (it will not take you more than 10 minutes). If you have any questions, please ask one of the monitors in the room.

Thank you for your cooperation!

1. - Do you have any type of lactose allergy / intolerance?

☐ Yes
☐ No

2. - Do you consume yoghurt in your household?

☐ Yes
☐ No

3. - How old are you (years)?

_____

4. - Please select your gender

☐ Male
☐ Female

Information about the eye: Now we are going to ask you some different questions about your eyes, because we will use a simple technology to track the eye during the study.

5. - Do you wear contact lenses or glasses to read the computer screen?

☐ Yes
☐ No **Go to question 8**

6. - Are your glasses for:

☐	Just reading
☐	Seeing only distant objects
☐	Both (use bifocals, trifocals, layered lenses or regression lenses).

7. - Can you read the computer screen without difficulty with your contact lenses and / or glasses?

☐ Yes
☐ No

8. - Do you have cataracts?

☐ Yes
☐ No

9. - Do you have any eye implant?

- [ ] Yes
- [ ] No

10. - Do you have glaucoma?

- [ ] Yes
- [ ] No

11. - Do you suffer from any type of colour blindness?

- [ ] Yes
- [ ] No

12. - Do you use any screen reader, amplifier or other assistive technology to use your computer?

- [ ] Yes
- [ ] No

13. - Are any of your pupils dilated permanently?

- [ ] Yes
- [ ] No

Please enter your email address

Thank you for your cooperation!

Appendix D

Appendix D1 – model fit comparison

The model fit information criteria, such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), as well as the log-likelihood values, can be used to discuss the relative fit of the various models (Table D1). The lower the information criteria, the better the model fit. It is known that using the BIC (AIC) tends to under-fit (over-fit) models, while evidence presented in previous studies (Caputo, Nayga, & Scarpa, 2013; Dias, 2006) shows that AIC3 (with three instead of two weights for parameter penalization) outperforms the other two, correcting for the over-fitting.

Table D1 – Comparison of the information criteria

Model	Choices	Log-Lik.	Parameters	BIC/N	AIC/N	AIC3/N
MNL	1499	-1227.45	6	1.650	1.646	1.650
RPL1	1499	-934.08	21	1.261	1.274	1.288
RPL2	1499	-895.10	66	1.334	1.282	1.326
RPL3	1499	-868.14	66	1.298	1.246	1.290

Nevertheless, the BIC assumes that one of the models is the true one, which is unlikely to be the case here, while the AIC aims at finding the model that approximates the unknown data-generating process (by minimizing the expected estimated Kullback–Leibler divergence). All three, BIC, AIC, and AIC3, favour RPL1 and RPL3 over the competing models. The combined evidence from ruling out RPL2 and preferring RPL1 and RPL3 suggests that these two are indeed the best models. In addition, the log-likelihood is closer to zero and the information criteria are lower in RPL1 and RPL3 than in RPL2, implying that the incorporation of visual attention in terms of fixation count information as covariates improves the model fit.

Appendix E

Appendix E1 – European Union official definitions for nutritional and health claims

A nutrition claim is '*…any statement that suggests or implies that a food has specific beneficial nutritional properties…*' (Smith, 2015). This definition distinguishes two types of nutritional claims. The first group denotes the content of nutrients or substances, for example 'Source of vitamin B_6' while the second group compares the content in terms of reducing or increasing a nutrient or the substance of a product with respect to its conventional version (i.e. 'High calcium content'). Health claims, on the other hand, always have to be labelled with the corresponding nutritional claim and are defined as '*… any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health…*' There are four types of HCs: (i) Article 14 health claims related to the risk reduction for a disease; (ii) claims regarding children's development and health; (iii) Article 13(5) claims that are based on newly developed scientific evidence and may include a request for the protection of proprietary data, and; (iv) Article 13 health claims also known as ´general health claims´ that describe the effect of a substance on a body function.

Appendix F

Appendix F1 – Sensory evaluation questionnaire

We have six different types of yoghurts. We ask that you read the information that corresponds to each yoghurt you are going to taste and then answer two simple questions for each of them.

TASTING INSTRUCTIONS

- Take yoghurt number 1
- Take some yoghurt trying to keep it in the front of the mouth.
- When you have tasted enough, please answer question 1 and 2 in column number 1 (yoghurt 1).
- Drink some water before going on to taste the next yoghurt.
- Take the next yoghurt, 2, and repeat the above process until the last yoghurt, 6.

1. Based on the tasting and the information you just read: How much do you like this yoghurt? (mark with X)

	Yoghurt 1	Yoghurt 2	Yoghurt 3	Yoghurt 4	Yoghurt 5	Yoghurt 6
9. Like extremely						
8. Like very much						
7. Like moderately						
6. Like slightly						
5. Neither like nor dislike						
4. Dislike slightly						
3. Dislike moderately						
2. Dislike very much						
1. Dislike extremely						

2. Do you think you would buy this yoghurt in a future purchase? (Mark with X)

	Yoghurt 1	Yoghurt 2	Yoghurt 3	Yoghurt 4	Yoghurt 5	Yoghurt 6
Yes						
Probably yes						
Not sure						
Probably no						
No						

Figure F2 - an example of the information page provided to participants while evaluating yoghurts.

Informacion Nutricional

Natural Yoghurt

Fat free

Reducing the consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels

Ration Description	Reference size per 100 g
Energy value in kJ	177 kJ
Energy value in kcal	42 kcal
Fat	0.4 g
from which saturated	0.2 g
Carbohydrates	5.0 g
from which sugars	5.0 g
Proteins	4.0 g
Salt	0.2 g
Calcium	120 (15%**)
Chlorides	100 mg (12%**)

*IR – Reference intake for an average adult (8400kJ / 2000kcal)
**VRN – Nutrient Reference Value

Appendix G

Figure G1 – Visual attention (FC1) in terms of Heat maps for the taste treatment.

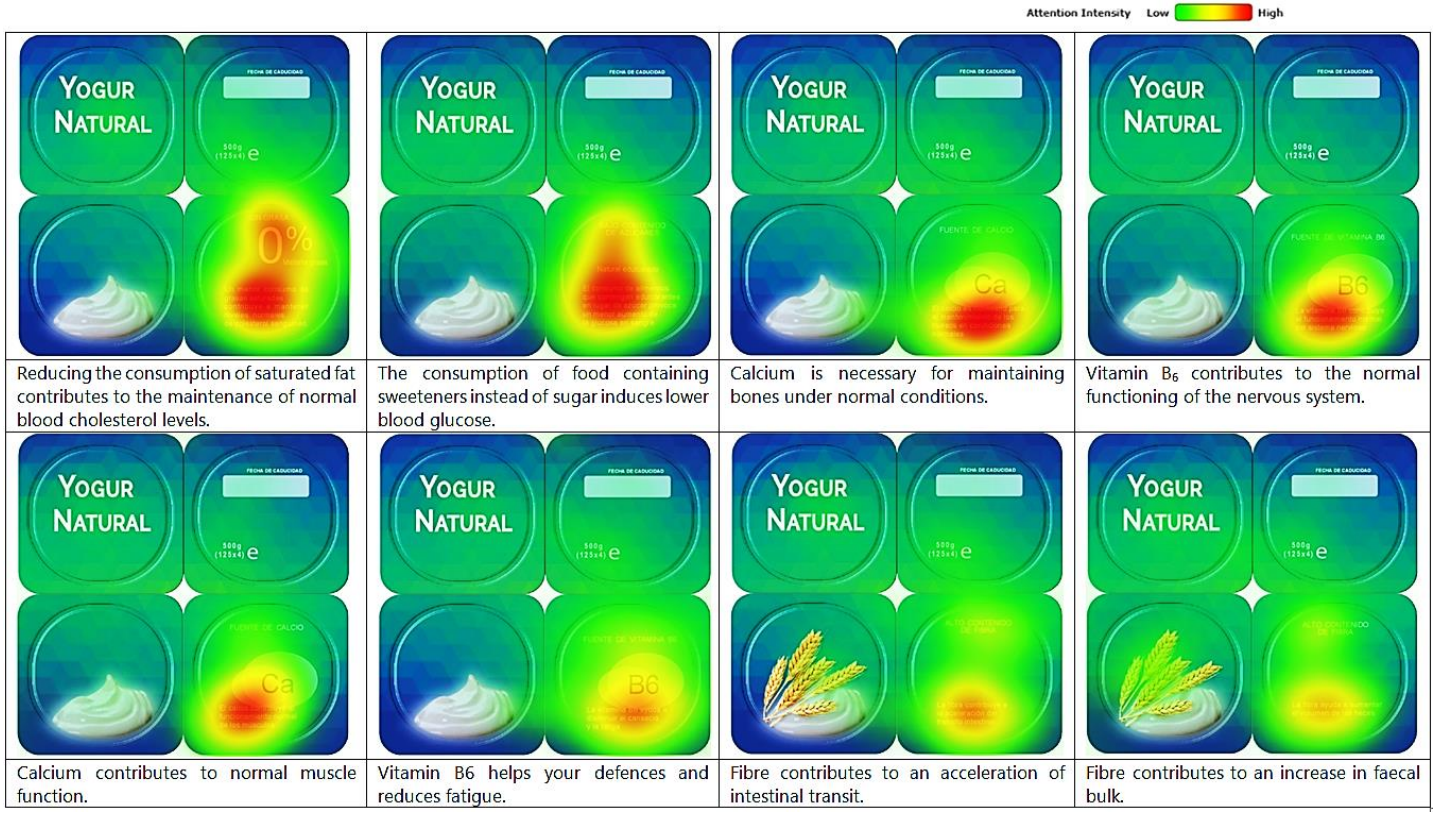
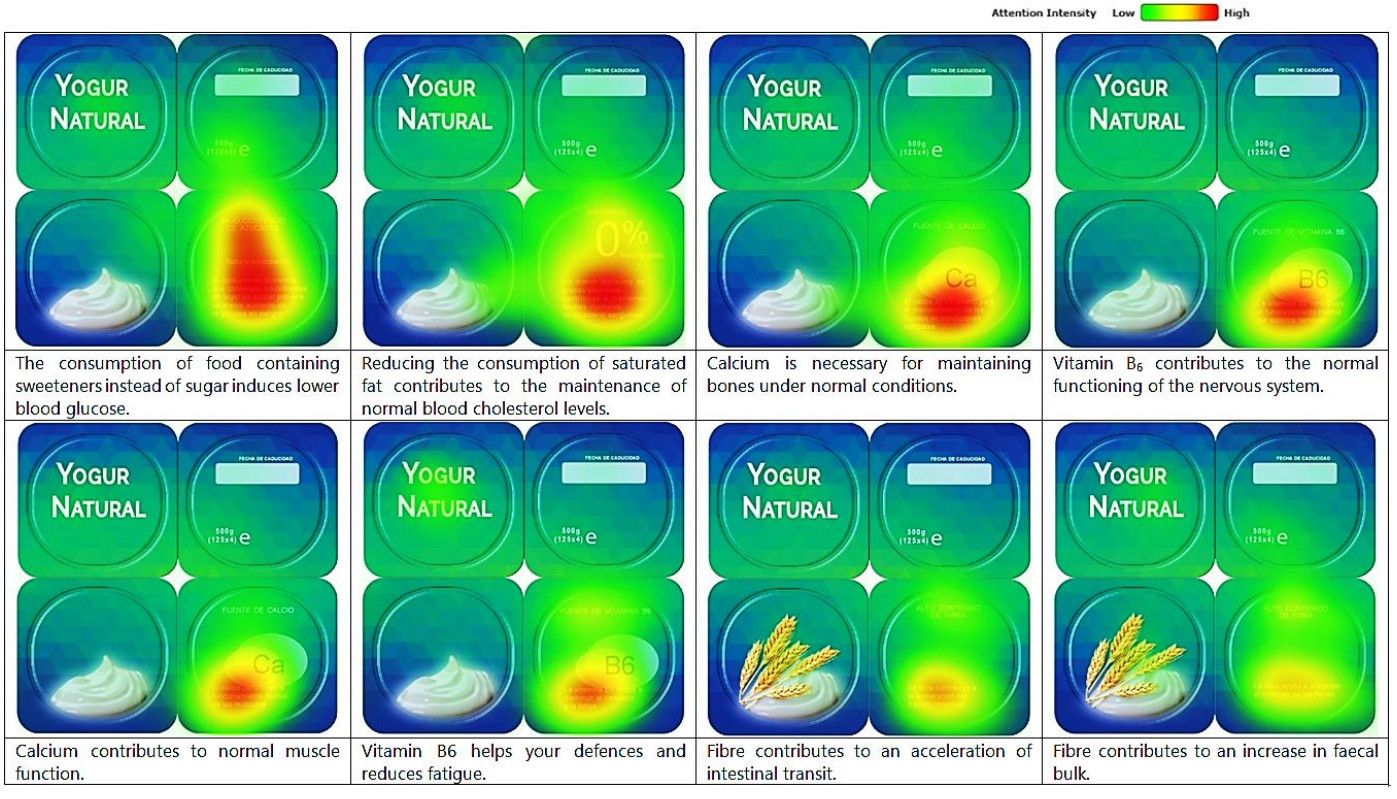


Figure G2 - Visual attention (FC1) in terms of heat maps for the no-taste treatment.



The consumption of food containing sweeteners instead of sugar induces lower blood glucose.	Reducing the consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels.	Calcium is necessary for maintaining bones under normal conditions.	Vitamin B_6 contributes to the normal functioning of the nervous system.
Calcium contributes to normal muscle function.	Vitamin B6 helps your defences and reduces fatigue.	Fibre contributes to an acceleration of intestinal transit.	Fibre contributes to an increase in faecal bulk.

Appendix H

Appendix H1 – The questionnaire used in this doctoral dissertation.

Questionnaire

1. How often do you buy food for your household? Please select one answer per row (mark with X)

Always	Usually	Sometimes	Rarely	Never

2. How often do you buy yoghurts? Please select one answer per row (mark with X)

Once every two months	Once a month	Twice a month	Once a week	Twice or more a week

3. Indicate the degree of importance that each of the following aspects has for you when you buy yoghurts. You can mark several options (mark with X)

	Not at all	**Slightly**	**Moderately**	**Slightly**	**Very**
Convenience					
Price					
Health					
Taste					
Brand					
Natural ingredients					
Indicates the content of fibre, fat, sugar, vitamin, calcium quantities					
Indicates the health benefits (Helps in reducing cholesterol, favours intestinal transit, etc.).					

4. Where do you usually buy yoghurt? Several options can be marked (mark with X).

Market	
Supermarket	
Hypermarket	
Neighbourhood store	
Gourmet specialty store	
Internet	
Other (specify)	

5. How often do you eat yoghurts? Please select one answer per row (mark with X).

Once or less a month	2-3 time a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	Several times a day

6. Have you ever bought yoghurts with nutritional claims?

Yes ○ No ○ If you have chosen **NO**, go to question 9.

7. What kind of nutrient is mentioned in yoghurts that you usually buy? You can mark several options (mark with X).

Calcium ○ Fat ○ Sugar ○

Fibre ○ Vitamin ○

8. How often do you consumer yoghurts with nutritional claims in your household? Please select an answer (mark with X).

Daily	Several times a week	Sometimes a week	Sometime a month	Rarely

9**.** Indicate the degree of importance that the yoghurt you buy has any of the following nutritional claims. Please select one answer per row (mark with X).

	Not at all	**Slightly**	**Moderately**	**Slightly**	**Very**
Low energy value					
Fat free					
Low sugars					
Source of calcium					
High fibre					
Saturated fat free					
Low fat					
No added sugar					
Source of fibre					
Source of vitamin B_6					

10. Indicate the degree of importance that each of the following statements have for you. Please select one answer per row (mark with X).

	Not at all	**Slightly**	**Moderately**	**Slightly**	**Very**
Reducing the consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels.					
The consumption of food containing sweeteners instead of sugar lower blood glucose.					
Fibre contributes to an acceleration of intestinal transit.					
Vitamin B6 helps your defences and reduces fatigue.					
Calcium is necessary for maintaining bones under normal conditions.					

11. Do you think that health experts recommend eating more, the same amount, less, or avoiding the following substances to lead a healthier diet? Please select one answer per row (mark with X).

	Completely avoid	Consume less	Consume the same	Consume more	I am not sure
Calcium					
Salt					
Fibre					
Saturated fat					
Sugar					
Calories					
Fat					
Vitamins					

12. From the following statements regarding nutrients and the benefit they bring to health, could you indicate whether you consider them true or false? (Mark with X).

	True	False	Don't know
Calcium strengthens bones			
Vitamin A converts to sugar and provides energy to the body			
Fibre decreases tiredness and fatigue			
Vitamin D helps absorb calcium			
Saturated fat causes cardiovascular disease			
Vitamin B6 keeps teeth in normal conditions			

13. Please indicate your degree of agreement or disagreement with the following statements: Please select one answer per row (Mark with X).

1= Strongly disagree – 5 Strongly agree.

	1	2	3	4	5
I usually pay attention to the nutritional information that appears in advertisements or other places	○	○	○	○	○
I usually use the nutritional information on the label to choose foods	○	○	○	○	○
I do not spend a lot of time in the supermarket reading nutritional information	○	○	○	○	○
I read about nutrition in books and magazines	○	○	○	○	○

14. Please indicate your degree of agreement or disagreement with each of the following statements: Please select one answer per row. (Mark with X).

1= Strongly agree – 5 Strongly agree.

	1	2	3	4	5
It has little influence on my choice that the food I consumer is healthy	○	○	○	○	○
I am very determined that the food I consume is healthy	○	○	○	○	○
I eat what I line without worrying too much about the healthiness of the food	○	○	○	○	○
It is very important for me to follow a low fat diet	○	○	○	○	○
I always follow a healthy and balanced diet	○	○	○	○	○
For me it is important that my daily diet provides many vitamins and minerals	○	○	○	○	○
I do not care if snacks are healthy or not	○	○	○	○	○
I do not avoid any food even if it can raise my cholesterol	○	○	○	○	○

Personal characteristics:

15. - Do you have any of the following health problems? Please select one answer per row (mark with X).

	Yes	No
Overweight or obesity		
Cardiovascular disease (heart problems)		
Hypertension (high blood pressure)		
High blood cholesterol levels		
Diabetes		
Osteoporosis or other bone problems		
None of the above		

16. Could you indicate the year of your birth? 19___

17. Please indicate your gender

○ Male ○ Female

18. - What is your weight (kilos)?

_____

19. - How tall are you (centimetres)?

_____

20. Could you tell us the number of members of your household (besides you)?

1+_____

21. Of the people in your household, how many are in the following age ranges?

☐ Under 18 years old ☐ From 18 to 65 years old ☐ More than 65 years old

22. Could you tell us your level of education?

☐ Primary (EGB, Primary) ☐ Secondary (BUP, Bachelor, FP) ☐ Superior (superior FP, university)

23. Could you please indicate the zip code of your area? ☐

24. What is your nationality? _____

25. On this scale from 1 to 6, could you indicate in what interval the net monthly income of your household stands? (Including the income of all its members) (Mark with X).

1.	< 900 € / month		4.	2.501- 3.500 € / month	
2.	901 - 1.500 € / month		5.	3.501 – 4.500 € / month	
3.	1.501 – 2.500 € / month		6.	> 4.500 € / month	

Thank you for your cooperation!

Appendix I

Appendix I – Justificacion de la contribucion del doctorando en los trabajos realizados en coautoria.

1. Ballco, P., & de-Magistris, T. (2018). Valuation of nutritional and health claims for yoghurts in Spain: A hedonic price approach. *Spanish Journal of Agricultural Research*, *16*(2), 01–08.

   Tiziana de-Magistris y Petjon Ballco diseñaron la metodologia y la estructura de la base de datos. Petjon Ballco recolecto y analizó los datos. Tambien, escribió y revisó el manuscrito. Tiziana de-Magistris revisó el manuscrito completo.

2. Ballco, P., de-Magistris, T., & Caputo, V. (2019). Consumer preferences for nutritional claims: An exploration of attention and choice based on an eye-tracking choice experiment. *Food Research International*, *116*, 37–48.

   Tiziana de-Magistris y Petjon Ballco diseñaron el experimento y desarollaron la metodología. Vincenzina Caputo y Petjon Ballco analizaron los datos, interpretaron y discutieron los resultados. Los tres revisaron el manuscrito.

3. Ballco, P., Caputo, V., & de-Magistris, T. (2020). Consumer valuation of European nutritional and health claims: Do taste and attention matter? *Food Quality and Preference*, *79*, 103–793.

   Tiziana de-Magistris y Petjon Ballco diseñaron el experimento y desarollaron la metodología. Vincenzina Caputo y Petjon Ballco analizaron los datos, interpretaron y discutieron los resultados. Los tres revisaron el manuscrito.

4. Ballco, P., & De Magistris, T. (2019). Spanish Consumer Purchase Behaviour and Stated Preferences for Yogurts with Nutritional and Health Claims. *Nutrients*, *11*(11), 27–42.

   Tiziana de-Magistris y Petjon Ballco diseñaron la metodologia y la estructura de la base de datos. Petjon Ballco recolecto y analizó los datos. Tambien, escribió y revisó el manuscrito. Tiziana de-Magistris revisó el manuscrito completo.

Curriculum Vitae

Petjon Ballco graduated in 2007 from Perrotis College, Thessaloniki, Greece, earning an associate degree in Marketing for the Food Industry with a scholarship granted from the Amercian Farm School. In 2010 he obtained his bachelor in 'Marketing and Management of the Agro-Food Industry' with a scholarship from University of Wales Institute, Cardiff (UWIC), United Kingdom. In 2015, he received a cum maxima laude Master of Science degree in 'Agro-food Marketing' with a scholarship from the Institute of the Mediterranean Studies of Zaragoza (IAMZ), Spain. In 2016, Petjon started his PhD in Agricultural Sciences and Natural Resources with a grant from the General Directorate of the National Institute of Research and Food Technology (INIA) working at the Agricultural Research and Food Technology Centre of Aragon (CITA). Petjon's research is associated with food marketing and consumer behaviour. His expertise is related to consumers' food choices, food policy, food marketing, behavioural eye-tracking research, sensory analysis and product tasting, healthy food choices and decision making. Petjon is author and co-author of various scientific publications in peer-reviewed journals and presented his research at several national and international conferences.

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Education

Oct 2015-Current	Agricultural Sciences and Natural Resources, PhD candidate - University of Zaragoza, Spain
Jun 2013–Jun 2015	Master of Science, Agro-food Marketing - Institute of the Mediterranean Studies of Zaragoza (IAMZ) – Spain
Sep 2005–Jul 2010	Bachelor in International Agribusiness University of Wales Institute, Cardiff, United Kingdom.
Jun 2003–Sept 2005	Associate degree Marketing for the Food Industry - Perrotis College – American Farm School, Thessaloniki, Greece.

Training

Feb 2019	Course: Tools for Scientific Writing University of Zaragoza, Spain
Jan 2019	Course: Food loss and waste reduction and management Institute of the Mediterranean Studies of Zaragoza (IAMZ), Spain
Dec 2018	Course: Advanced Excel University of Zaragoza, Spain
Oct 2018	Course: Business Model CANVAS, value proposition CANVAS and empathy map. Agricultural Research and Food Technology Centre of Aragon (CITA) Zaragoza, Spain
May 2018	Course: Choice experiments and Psychometrics – Theory, Methods and Applications University of Milan, Italy.
May 2018	Course: Learn to make the best presentations University of Zaragoza, Campus Iberus, Spain
Jan– Feb 2018	Course: Environmental Economics Reading Group, Michigan State University, USA.
Oct-Dec 2017	Course: Statistical Methods for Agricultural, Food & Resource Economics Michigan State University, USA
Jun 2017	Post graduate course of Econometrics University of Firenze, Italy
May 2017	Course: How to reach international food markets: Experiences from the US and EU. Institute of the Mediterranean Studies of Zaragoza (IAMZ), Spain
Apr 2016	Emotional intelligence, positive psychology, team coaching an entrepreneurship University of Zaragoza, Spain
Jan 2016	Course: Discrete choice experiments Institute of the Mediterranean Studies of Zaragoza (IAMZ), Spain

Honours - Fellowships & Awards

2015-2020	Full scholarship by the General Directorate of the National Institute of Research and Food Technology (INIA) to obtain a PhD, Zaragoza, Spain.
2018	Conference scholarship from the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) to present research at the 2nd Mediterranean Forum for PhD Students and Young Researchers, Bari, Italy.
2017	Conference scholarship from the Spanish Association of Agricultural Economists to present research at the XV European Association of Agricultural Economists (EAAE), Parma, Italy.
2013-2015	Full scholarship from the Institute of the Mediterranean Studies of Zaragoza (IAMZ) to obtain a Master of Science degree, Zaragoza, Spain.
2007-2010	Full scholarship from the American Farm School to obtain a Bachelor degree, Thessaloniki, Greece.
2005-2007	Full scholarship from Perrotis College to obtain an associate degree, Thessaloniki, Greece.

Publications in journals

Amato, M., Ballco, P., López-Galán, B., De Magistris, T., & Verneau, F. (2017). Exploring consumers' perception and willingness to pay for "Non-Added Sulphite" wines through experimental auctions: A case study in Italy and Spain. *Wine Economics and Policy*, *6*(2), 146–154.

Ballco, P., Caputo, V., & de-Magistris, T. (2020). Consumer valuation of European nutritional and health claims: Do taste and attention matter? *Food Quality and Preference*, *79*, 103–793.

Ballco, P., & de-Magistris, T. (2018). Valuation of nutritional and health claims for yoghurts in Spain: A hedonic price approach. *Spanish Journal of Agricultural Research*, *16*(2), 01–08.

Ballco, P., & De Magistris, T. (2019). Spanish Consumer Purchase Behaviour and Stated Preferences for Yoghurts with Nutritional and Health Claims. *Nutrients*, *11*(11), 27–42.

Ballco, P., de-Magistris, T., & Caputo, V. (2019). Consumer preferences for nutritional claims: An exploration of attention and choice based on an eye-tracking choice experiment. *Food Research International*, *116*, 37–48.

Ballco, P., & Gracia, A. (2020a). An extended approach combining sensory and real choice experiments to examine new product attributes. *Food Quality and Preference*, *80*, 103830.

Ballco, P., & Gracia, A. (2020b). Do market prices correspond with consumer demands? Combining market valuation and consumer utility for extra virgin olive oil quality attributes in a traditional producing country. *Journal of Retailing and Consumer Services*, *53*, 101999.

Oral Presentations at Conferences

Ballco, P., Gracia, A., (2019). Combining market valuation and actual consumer utilities for extrinsic extra virgin olive oil quality cues. 174th European Association of Agricultural Economists seminar. 10-12th October, 2019, Matera, Italy.

De Magistris, T., López-Galán, B., & Ballco, P., (2019). New trends to explore consumer preferences through a virtual reality store: Does hunger matter? 174th European Association of Agricultural Economists seminar. 10-12th October, 2019, Matera, Italy.

De Magistris, T., Ballco, P., & López-Galán, B., (2019). What will I buy? The role of health-related claims in healthiness and tastiness food within a virtual store setting. XII Congress of Spanish Association of Agricultural Economics. 4-6 September 2019, Lugo, Spain.

Ballco, P., De Magistris, T., & Caputo, T., (2019). Do taste and attention affect consumer preferences for multiple nutritional and health claims on a health food product? An empirical investigation on Spanish consumers. XII Congress of Spanish Association of Agricultural Economics. 4-6 September 2019, Lugo, Spain.

Ballco, P., & De Magistris, T. (2018). Preferencias de los consumidores por yogures con declaraciones nutricionales y de propiedades saludables. Combinando el experiment de eleccion con el seguimiento ocular y la percepcion del sabor. Instituto Universitario de Investigación Mixto Agroalimentario de Aragón (IA2) Universidad de Zaragoza, November 26th, 2018, Zaragoza, Spain.

Ballco, P., & De Magistris, T., (2018). Does taste matter? The importance of taste in the valuation of European Union mandatory nutritional and health claim labelling program in Spain. 2nd Mediterranean Forum for PhD Students and Young Researchers. September 18-20, 2018, Bari, Italy.

Ballco, P., Caputo, V., & De Magistris, T. (2018). Combining discrete choice experiment, eye tracking and sensory tests to assess consumer preferences for nutritional and health claims. Agricultural & Applied Economics Association. 5-7 August, 2018, Washington, United States.

Ballco, P., & De Magistris. T., (2017). Market valuation of nutritional and health claims on yoghurts in Spain: A hedonic price function approach. XI Congress of Spanish Association of Agricultural Economics. 13-15 September 2017, Elche, Spain.

Amato, M., Ballco, P., López-Galán, B., De Magistris, T., & Verneau, F., (2017). Assessing consumers' perception and WTP for "Non-added sulphite" wines through experimental auctions: A case study in Italy and Spain. XV European Association of Agricultural Economists (EAAE) congress. August 29th – September 1st, 2017, Parma, Italy.

Ballco, P., & De Magistris, T., (2017). Attention and choice: Use of eye-tracking in choice behaviour research for nutritional claims. An empirical evidence of yoghurts in Spain. XV European Association of Agricultural Economists (EAAE) congress. August 29th – September 1st, 2017, Parma, Italy.

Ballco, P., & Gracia, A. (2016). The importance of taste in the valuation of food product attributes: the case of extra virgin olive oil. 157th European Association of Agricultural Economists (EAAE) seminar. June 30th – July 1st, 2016, Barcelona, Spain.

Ballco, P., Gracia, A., & Jurado, F. (2015). Consumer preferences for extra virgin olive oil with Protected Designation of Origin (PDO). X Congress of Spanish Association of Agricultural Economics. 09-11 September 2015, Cordoba, Spain.

Invited Speaker

Ballco, P., & De Magistris T., 2019. Herramientas de neurociencia aplicadas al sector agroalimentario. March 7, 2019, Universidad de Burgos, Burgos, Spain.

Ballco, P., 2018. Attention and Choice: Use of eye-tracking in choice behaviour research of nutritional claims. An empirical evidence of yoghurts in Spain. February 27, 2018, Michigan State University, East Lansing, USA.

Ballco, P., 2018. The importance of taste in the valuation of food product attributes: The case of extra virgin olive oil. January 30, 2018, Michigan State University, East Lansing, USA.

International experience

Visiting PhD scholar: Wageningen University & Research, Department of Marketing and Consumer Behaviour, 01 May 2019 – 31 July 2019.

Visiting PhD scholar: Michigan State University (USA), Department of Agricultural, Food, and Resource Economics, 21 September 2017 – 31 March 2018.

Participation in research projects

- Project title: Análisis de la adopción de tecnologías no destructivas y el uso del etiquetado nutricional preciso por parte del consumidor
  Financing entity: Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria INIA
  Participating entities: Centro de Investigacion y Tecnologia Agroalimentaria de Aragón
  Duration: from: October 2019 to November 2023

- Project title: Recuperar la miel para recuperar el territorio: Analisis melisopalinologicos, analisis de potencial de mercado y apiturismo (FITEMIEL II)
  Financing entity: Gobierno de Aragón
  Participating entities: CITA Aragón
  Duration, from: October 2019 to October 2022

- Project title: Recuperar la miel para recuperar el territorio (FITEMIEL I)
  Financing entity: Gobierno de Aragón
  Participating entities: CITA Aragón
  Duration, from January 2018 to November 2018.

- Project title: Comportamiento del consumidor en la compra de alimentos con alegaciones nutricionales y/o de salud.
  Financing entity: Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria INIA
  Participating entities: CITA Aragón
  Duration, from: October 2014 to October 2017

- Project title: OBESECLAIM-Fighting against obesity in Europe: The role of health related-claim labels in food
  Financing entity: European Union
  Participating entities: CITA Aragón
  Duration, from: April 2013 to April 2017

- Project title: Papel del etiquetado y los símbolos relacionados con la salud en el comportamiento del consumidor (CLYMBOL).
  Financing entity: European Union
  Participating entities: CITA Aragón
  Duration, from: September 2012 to September 2016

- Project title: Cadena de producción, potencial de mercado y externalidades territoriales en la Denominación de Origen Aceite del Bajo Aragón
  Financing entity: Gobierno de Aragón
  Participating entities: CITA Aragón
  Duration, from: October 2014 to October 2016

Professional memberships

Agricultural and Applied Economics Association (AAEA), European Association of Agricultural Economists (EAAE), Spanish Association of Agricultural Economists (AEEA)