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Consumer understanding of health claims: methods for assessment and potential antecedents

PhD dissertation

Violeta Stancu

Aarhus BSS
Aarhus University
Department of Management
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English summary

The growth of the global health and wellness food market registered in the past few years is expected to be sustained in the near future (Euromonitor International, 2012; Nielsen, 2015). One of the main reasons for this ascending trend has been consumers' increasing awareness and interest in health. Consumers have started to rely more and more on their food choices in order to achieve a healthy lifestyle (Nielsen, 2015). In light of these changes in the health and wellness market, the communication of the health benefits of foods has become critical.

One of the means to communicate the healthfulness of food products is by use of health claims; those messages that link a food or one of its constituents to health. There are harmonized rules at the European Union level, set by Regulation (EC) No 1924/2006, for the use of health claims on foods. The health claims authorised so far under this regulation are recorded in the EU register of nutrition and health claims. Consumer understanding is set as a general condition for use of health claims. Yet, the regulation does not provide any guidelines regarding the definition or assessment of understanding.

Against this background, the present thesis draws on consumer research and consumer behaviour theories to study consumer understanding of health claims, its antecedents and the effectiveness of attempts to improve the understandability of authorised claims. Three research questions were defined to this end:

- ✓ *RQ1: How can we assess consumer understanding of health claims?*
- ✓ *RQ2: Which factors play a role in consumer understanding of health claims?*
- ✓ *RQ3: How can we improve the comprehensibility of health claims?*

Three empirical studies have been conducted to answer these research questions. The *first study* aimed to explore the motivation and ability-related antecedents of consumer understanding of health claims and to evaluate the robustness of selected methods to measure consumer understanding. Consumer understanding was assessed in a cross-sectional survey with an experimental design using two methods adapted from prior literature. Furthermore, the survey,

conducted in Italy and Denmark, contained measures of potential antecedents of understanding derived from dual processing theories and prior literature on consumer responses to health claims. The results showed that some consumers can be seen as understanding the claims adequately; however, consumer understanding of health claims varies by claim. The motivation and ability-related factors considered in this study as potential antecedents of understanding had only relatively small effects. This study has implications for public policy and industry as it gives insights into the groups of consumers who are more likely to misunderstand health claims.

The *second study* aimed to elicit the inferences made by consumers from different variations of a health claim in order to gain an understanding of potential ways to improve consumers' understanding of health claims. Two sub-studies were carried out among consumers in Denmark. In the first sub-study, open-ended questions in a cross-sectional survey were used to elicit inferences. In the second sub-study, face-to-face laddering interviews were conducted (Reynolds & Gutman, 1988) to elicit hierarchical inferences. Re-wording an authorised health claim or providing additional information did not result in improved consumer understanding. Hence, the study provides insights into the potential drawbacks of attempts to make health claims more understandable.

The *third and final study* aimed to examine the effect of time constraints, in addition to claim and carrier-related factors, on consumer understanding of health claims. Moreover, the association between misunderstanding and intention to buy was explored. Consumer understanding was assessed in a cross-sectional survey conducted in Denmark. The online survey used a time constraint manipulation and measured understanding for products with various versions of health claims as well as a control option with no claim. Consumers' understanding of health claims was lower under time constraint, while factors related to the claim or the carrier made little difference. A second measure of understanding confirmed these results. Interpretations representing misunderstanding of health claims were linked with intention to buy, while objective understanding was not. The results of this study contribute to advance our knowledge of antecedents of consumer understanding and its subsequent effect on purchase intention.

The three studies reported in this thesis contribute to broaden our knowledge of factors that play a role in consumer understanding of health claims, robustness of measures to assess understanding and ways to improve consumer understanding. The studies reported in the thesis were carried out in connection with the CLYMBOL project, a European research project partly funded by the European Community's Seventh Framework Programme under Grant Agreement No. 311963.

The thesis is structured in five chapters. Chapter 1 gives an introduction to this research by providing a review of the literature on consumer responses to health claims, the theoretical background and an overview of the research papers included in this thesis. Chapter 2 describes the overall methodological approach of the thesis. Chapters 3 to 5 present the empirical studies conducted to answer the research questions. Finally, Chapter 6 contains the general conclusions and implications of the research.

Dansk resumé

Den stigende vækst på det globale marked for sunde fødevarer forventes at fortsætte (Euromonitor International, 2012; Nielsen, 2015). En af de vigtigste årsager til denne stigende tendens har været forbrugernes øgede bevidsthed om og interesse for sundhed. Forbrugerne er begyndt at lægge stadig mere vægt på deres valg af fødevarer for at føre en sund livsstil (Nielsen, 2015). I lyset af disse ændringer på markedet for sunde fødevarer har budskaberne om de sundhedsmæssige fordele ved disse fødevarer indtaget en vigtig plads.

En af måderne hvorpå man kan kommunikere, hvor sundt et produkt er, er ved brug af sundhedsanprisninger; disse beskrivelser der knytter en fødevare eller en af dens bestanddele til begrebet sundhed. På EU-plan findes der harmoniserede regler qua forordning (EF) nr. 1924/2006 for anvendelsen af sundhedsanprisninger på fødevarer. De sundhedsanprisninger, der hidtil er tilladte i henhold til denne forordning, er registreret i EU's register over ernærings- og sundhedsanprisninger af fødevarer. Forbrugernes forståelse af disse anprisninger anses som en generel betingelse for anvendelsen af sundhedsanprisninger. Alligevel har forordningen ikke nogen retningslinjer for definitionen af begrebet eller graden af forståelse.

På dette grundlag og baseret på forbrugerforskning og forbrugeradfærdsteorier vil forbrugernes forståelse af sundhedsanprisninger samt dens forudsætninger blive undersøgt i denne afhandling. Derudover vil effektiviteten af forsøg på at forbedre forbrugernes forståelse af tilladte anprisninger også blive behandlet. Dette munder ud i følgende tre forskningsspørgsmål:

- ✓ **Spørgsmål 1:** *Hvordan kan vi vurdere forbrugernes forståelse af sundhedsanprisninger?*
- ✓ **Spørgsmål 2:** *Hvilke faktorer spiller en rolle i forbrugernes forståelse af sundhedsanprisninger?*
- ✓ **Spørgsmål 3:** *Hvordan kan vi forbedre forståeligheden af sundhedsanprisninger?*

For at besvare disse forskningsspørgsmål er der blevet udført tre empiriske undersøgelser. Den **første undersøgelse** havde til formål at udforske forbrugernes motivation og evne-relaterede forudsætninger for at forstå sundhedsanprisninger samt at vurdere robustheden af udvalgte metoder til at måle forbrugernes forståelse. Forbrugernes forståelse blev vurderet via et eksperimentelt design, som bestod af to metoder hentet fra eksisterende litteratur på området.

Derudover indeholdt tværsnitsundersøgelsen, som blev gennemført i Italien og Danmark, målemetoder vedrørende potentielle forudsætninger for forståelse. Disse metoder stammer fra duale proces-teorier og eksisterende litteratur om forbrugernes reaktioner på sundhedsanprisninger. Resultaterne viste, at nogle forbrugere tilsyneladende kan forstå sundhedsanprisningerne rigtigt, men at forbrugernes forståelse af anprisningerne varierer, afhængig af hvilken anprisning der er tale om. Faktorerne, som vedrørte forbrugernes motivation og forståelsesevner som forudsætning for at forstå anprisningerne, havde kun en relativt lille effekt. Resultaterne af denne undersøgelse kan få konsekvenser for politiske beslutninger og virksomheder, da der herved er fremkommet vigtig viden om de grupper af forbrugere, der er mere tilbøjelige til at misforstå sundhedsanprisninger.

Den *anden undersøgelse* havde til formål at klarlægge de slutninger, som forbrugerne drog af forskellige variationer af en sundhedsanprisning. Dette skulle skabe en forståelse for, hvordan det kunne blive muligt at forbedre forbrugernes forståelse af sundhedsanprisninger. To yderligere studier blev udført blandt forbrugere i Danmark. I det første studie blev der i en tværsnitsundersøgelse stillet åbne spørgsmål for at klarlægge forbrugernes slutninger. I det andet studie blev der udført personlige ladder-interviews (Reynolds & Gutman, 1988) for at fremkalde hierarkiske slutninger. Det viste sig her, at en omformulering af en godkendt sundhedsanprisning eller det at give yderligere oplysninger ikke resulterede i en forbedret forståelse hos forbrugerne. Undersøgelsen giver således indsigt i de potentielle ulemper, der kan være ved forsøg på at gøre sundhedsanprisninger mere forståelige.

Den *tredje og sidste undersøgelse* havde til formål at undersøge effekten af tidspres, ud over faktorer ang. selve anprisningen og selve produktet, på forbrugernes forståelse af sundhedsanprisninger. Desuden blev sammenhængen mellem misforståelse og købsintention undersøgt. Forbrugerforståelsen blev vurderet via en tværsnitsundersøgelse, som blev gennemført i Danmark. I online-spørgeskemaet var der indlagt en tidsbegrænsende manipulation, og formålet med skemaet var at vurdere forbrugernes forståelse af produkter med forskellige versioner af sundhedsanprisninger sammenholdt med en kontrol-option, hvor der ikke var nogen sundhedsanprisning. Forbrugernes forståelse af sundhedsanprisninger var lavere under tidspres, mens der var en mindre forskel, når det handlede om faktorer relateret til anprisningen eller det tilhørende produkt. En derpå følgende måling af forbrugernes forståelse bekræftede disse

resultater. Mellem misforståede sundhedsanprisninger var der en sammenhæng med hensigten om at købe et bestemt produkt, mens der ikke blev konstateret nogen sammenhæng over til forbrugers objektive forståelse. Resultaterne af denne undersøgelse bidrager til at fremme vores viden om forudsætningerne for forbrugernes forståelse af sundhedsanprisninger og den efterfølgende effekt på købsintentionen.

De tre undersøgelser i denne afhandling bidrager til at øge vores viden om faktorer, der spiller en rolle i forbrugernes forståelse af sundhedsanprisninger, brugbarheden af målemetoder til at vurdere forståelse, og måder hvorpå man kan forbedre forbrugernes forståelse. Undersøgelserne blev udført i forbindelse med CLYMBOL-projektet, som er et europæisk forskningsprojekt, der delvist er finansieret af Det Europæiske Fællesskabs syvende rammeprogram under tilskudsaf tale nr. 311963.

Afhandlingen er inddelt i fem kapitler. Kapitel 1 giver en introduktion til forskningen på området. Her gennemgås litteraturen om forbrugernes reaktioner på sundhedsanprisninger samt den teoretiske baggrund, og her præsenteres en oversigt over de forskningsartikler, der indgår i denne afhandling. Kapitel 2 beskriver den overordnede metodiske tilgang til afhandlingens forskningsspørgsmål. I kapitel 3-5 præsenteres de empiriske undersøgelser, der blev udført for at besvare forskningsspørgsmålene. Endelig indeholder kapitel 6 de generelle konklusioner på og konsekvenser af denne forskning.

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Chapter 1. Introduction

1.1. Background

The health and wellness market has been growing in the past years (Euromonitor International, 2012; Nielsen, 2015). The health and wellness foods had a market share of about 20%, while the healthy drinks accounted for slightly over 40% of the beverage market in 2011 (Euromonitor International, 2012). In the last years the growth of healthy food categories has outpaced the growth of the indulgences (e.g. carbonated soft drinks, chips or cookies) (Nielsen, 2015). The health market is expected to continue rising globally in the coming years (Technavio, 2015) and to reach sales of 1 trillion US \$ in 2017 (Euromonitor International, 2012).

Consumers are increasingly interested in following a healthy lifestyle. This is in part due to their increased health awareness (Euromonitor International, 2012; Nielsen, 2015). It has long been known that the healthfulness of food is an important motive in consumers' food choices (Stephoe, Pollard, & Wardle, 1995). Nowadays, consumers are relying more and more on changes in their lifestyle to take responsibility for their health. To this end, people are interested in foods that are natural (e.g. natural ingredients, no genetically modified organisms, no artificial flavours), functional foods (foods that contribute to reduced risk of disease or promotion of good health like foods high in fibre or high in protein) or sustainable products (e.g. fair-trade, organic, local), to support their goals of following a healthy lifestyle (Nielsen, 2015).

Due to increased consumer interest in healthy food products, future growth is expected in segments like naturally healthy foods, "better for you" products, organic foods or functional foods (Euromonitor International, 2012). To ensure the success of their products, manufacturers of healthy food products can use a variety of means to communicate the health attributes of their products to consumers. The provision of information through claims, front-of-pack labelling systems or symbols is a widely used explicit approach to communicate food healthfulness (Bech-Larsen & Scholderer, 2007; Chrysochou, 2010; Storcksdieck genannt Bonsmann et al., 2010). Several types of claims (e.g. nutrition or health claims, sustainability claims, clean label claims), front-of-pack labelling systems (e.g. traffic light system) and symbols designating "better for you" products (e.g. choices logo, keyhole logo) or sustainable products (e.g. organic logo) can be

used on food packaging or in advertisements. In addition, package design elements like health imagery or colours, represent more implicit ways to communicate the healthfulness of food products (Chrysochou & Grunert, 2014; Karnal, Machiels, Orth, & Mai, 2016).

The use of health claims is one of the options that manufacturers of foods with health benefits have for provision of health-related information. Health claims represent those messages linking a food or one of its constituents to a health benefit (Regulation (EC) No 1924/2006). At the European Union level, the Regulation (EC) No 1924/2006 covers the harmonized rules for use of health claims on foods (for further details see Appendix 1.1). One of the general conditions for use of health claims is that the average consumer “can be expected to understand the beneficial effects as expressed in the claim” (Art. 5.2.). However, no guidelines as to how understanding can be defined or assessed are stated in the regulation.

For the consumers, health claims can answer their increased interest in information about health benefits of foods and can help them make informed choices (Leathwood, Richardson, Sträter, Todd, & van Trijp, 2007; Nocella & Kennedy, 2012). The use of health claims can support consumers in achieving their goals to follow a healthy lifestyle by promoting healthier choices (Barreiro-Hurlé, Gracia, & de-Magistris, 2010) and healthy eating (Williams, 2005).

From a public health perspective, the changes in individuals’ choices and eating behaviour, enabled by use of health claims, can lead to significant improvements in public health (Ippolito & Mathios, 1991, 1994). Even though products bearing nutrition and/or health claims are healthier to some extent compared to those without claims (Kaur et al., 2016), some do not see a big potential for health claims to enable consumers to follow healthy diets (de la Hunty, Ashwell, Arens, Gibson, & Sadler, 2014).

For the food industry, the use of health claims can lead to increased sales (Aschemann-Witzel & Hamm, 2010; Nielsen, 2015). At the same time, health claims provide important opportunities for product innovation (Ippolito & Mathios, 1991; Nielsen, 2015; Richardson & Eggersdorfer, 2015). The communication of truthful health benefit information by means of health claims can further contribute to the corporate social responsibility strategy of the manufacturer (Lähteenmäki, 2013; van Trijp, 2009).

There are some stakeholders that do not view health claims very positively, though. The European consumers' organization for example is rather sceptical towards the use of such claims (BEUC, 2011). Some of the concerns raised by BEUC revolve around the fact that health claims are not always relevant to the consumers, or that their wording uses too technical language meaning that they cannot be well understood by consumers (BEUC, 2011). Overall, however, there are benefits to using health claims for several stakeholders like consumers, the food industry or public policy.

Prevalence of health claims on the European market

Food products carrying nutrition and health claims are quite frequent on the European market. Nutrition claims are generally more common than health claims (e.g. Hieke et al., 2016; Kaur et al., 2016; Lalor, Kennedy, Flynn, & Wall, 2010). A comprehensive study conducted in the EU-27 countries and Turkey in 2008-2009 found that 4% of the surveyed products carried health claims on back-of-pack, while 2% carried health claims on front-of-pack (Storcksdieck genannt Bonsmann et al., 2010). Higher prevalence of health claims on food products, 18%, was identified on the Irish market by a survey of the market carried out in 2007 (Lalor et al., 2010).

The prevalence of health claims has increased compared to 2008-2009 (Storcksdieck genannt Bonsmann et al., 2010) as shown by studies conducted in selected European countries. In the UK, 15% of food products were carrying at least one health claim in 2011-2012 (Kaur et al., 2016), while in Slovenia the prevalence of health claims was at 13% in 2011 (Pravst & Kušar, 2015). The most recent survey of the European market, conducted in 2013 in five European countries, reported 11% of products carrying health claims. The prevalence was similar across the countries under study with the highest number of foods carrying health claims (including symbolic depictions) in the Netherlands (14%) and lowest in Spain (7%) (Hieke et al., 2016).

Outside Europe health claims are similarly frequent. In Australia 14% of products carry health claims (Williams et al., 2006) while in the US, 9% of foods carry health claims and 6% structure/function claims (Colby, Johnson, Scheett, & Hoverson, 2010). However, direct comparisons of the prevalence of health claims in the EU and outside the EU are challenging due to differences in the nutrition and health claims Regulations across jurisdictions (de Boer & Bast, 2015).

The most common health claims encountered on the European market were the general health claims. These were followed by the nutrient and other function claims (Hieke et al., 2016; Kaur et al., 2016; Lalor et al., 2010). On the other hand, the reduction of disease risk health claims and children's development health claims were very rare in Europe (Hieke et al., 2016; Kaur et al., 2016; Lalor et al., 2010; Pravst & Kušar, 2015), and outside of Europe (Colby et al., 2010; Schermel, Emrich, Arcand, Wong, & L'Abbé, 2013).

Health claims were most commonly found on foods for specific dietary use (e.g. milk formulas) (Hieke et al., 2016) or on yoghurts or yoghurt drinks (Lalor et al., 2010; Pravst & Kušar, 2015). Further food categories with rather high prevalence of health claims were breakfast cereals (Lalor et al., 2010; Pravst & Kušar, 2015), milk and dairy products (Kaur et al., 2016; Lalor et al., 2010), edible oils and oil emulsions (Hieke et al., 2016; Pravst & Kušar, 2015) and beverages (Hieke et al., 2016; Kaur et al., 2016).

Health claims are rather frequent in the marketplace, although there are some differences between the EU countries. It could be expected that more health claims will appear on the market in coming years as the Regulation may provide opportunities for product innovation. When health claims are noticed by consumers, they can impact people's attitudes, understanding or behaviour. The following section will describe the impact of health claims on consumer responses and the factors that affect these responses.

1.2. Consumers and health claims

1.2.1. Consumer responses to health claims

There has been a lot of interest in the study of consumer responses to nutrition and health claims on food products. Most studies have focused on the effects of health claims on attitudes towards the claims (e.g. Grunert et al., 2009; van Trijp & van der Lans, 2007; Wong et al., 2013; Wong et al., 2014) or the products with claims (e.g. Abrams, Evans, & Duff, 2015; Hoefkens & Verbeke, 2013; Lähtenmäki et al., 2010; Orquin & Scholderer, 2015; Wong et al., 2014) and choice or intention to buy products carrying health claims (e.g. Annunziata & Vecchio, 2013; Contini et al., 2015; Dean et al., 2012; Lähtenmäki et al., 2010; Orquin & Scholderer, 2015; Siegrist, Shi, Giusto, & Hartmann, 2015; Wong et al., 2014). Fewer studies have investigated the effect of

health claims on consumption or willingness to use/try products with health claims (e.g. Ares, Giménez, & Gámbaro, 2009; Belei, Geyskens, Goukens, Ramanathan, & Lemmink, 2012; Chandon & Wansink, 2007; Crockett, Jebb, Hankins, & Marteau, 2014; Vassallo et al., 2009) or consumer understanding of health claims (e.g. Bilman, Kleef, Mela, Hulshof, & van Trijp, 2012; Grunert, Scholderer, & Rogeaux, 2011; Wong et al., 2013).

Consumers' responses to health claims and to foods carrying health claims are influenced by several factors which can be broadly categorized into claim-related factors, product-related factors and individual-related factors (Lähtenmäki, 2013). In the following, the evidence regarding consumers' responses to health claims and the factors found to impact these will be detailed. An overview of the concepts covered in this literature review is presented in Figure 1. As consumer understanding is the main focus of this thesis, it will be treated in a separate sub-section compared to the other consumer responses presented in Figure 1. Previous studies have used different health claims or products carrying health claims as stimuli as well as different measurements with methodologies ranging from interviews to experimental studies. These differences between studies make the comparison of results challenging and could explain some of the contradictory evidence found. The evidence reported here is structured by consumer responses; within each sub-section, the factors influencing these responses will be discussed.

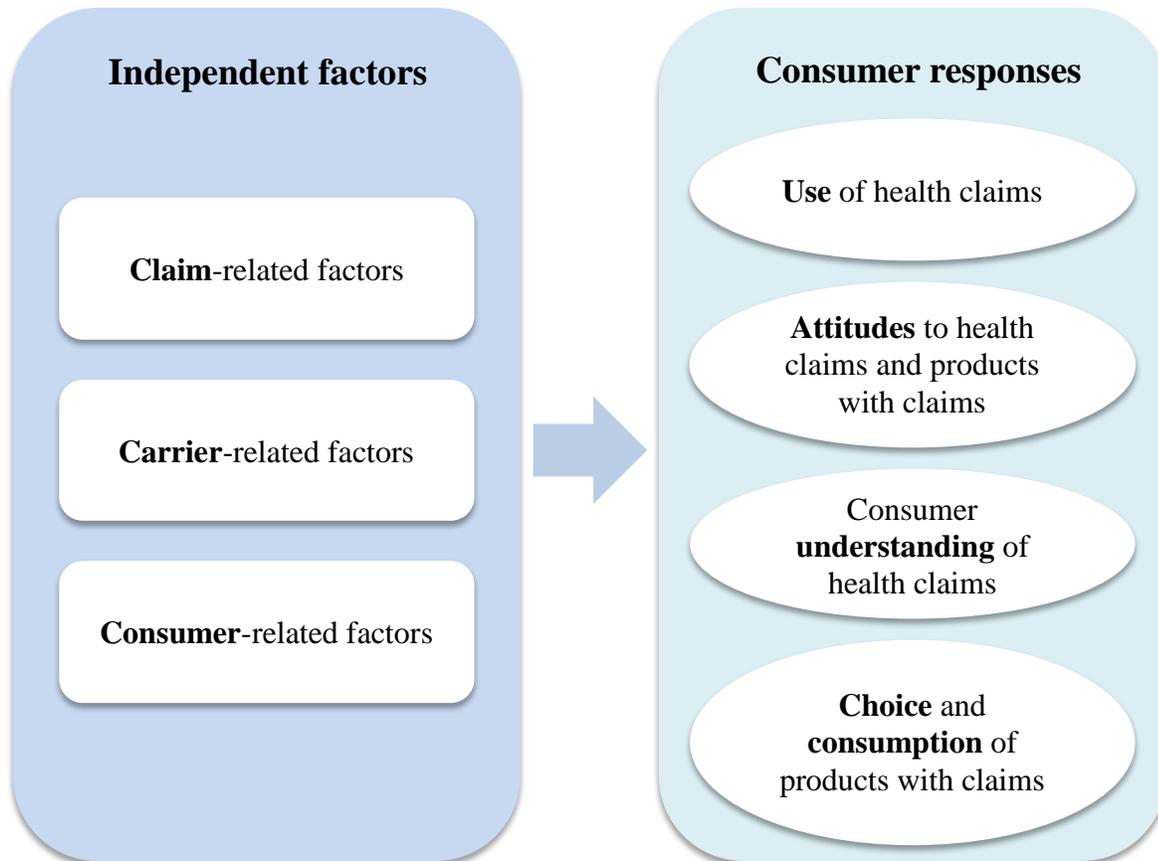


Figure 1. Overview of concepts covered in the literature review

Use of health claims

The reported levels of consumers' use of nutrition and/or health claims on food products are not very high. About 24% of consumers stated that they check nutrition and health claims on food labels often or always, while 38% say they never check this information (Rejman & Kasperska, 2011). Higher prevalence of consumers who seek claims was reported in Ireland, where 67% of respondents said they read labels, and 42% said they seek claims on food products (Lynam, McKeivitt, & Gibney, 2011). The use of health claims by consumers is beneficial as it has the potential to lead to healthier choices (Barreiro-Hurlé et al., 2010). These studies have relied on consumers' self-reported use of health claims which can be a biased estimate of actual use. Indeed, observational studies regarding use of nutrition labels or health logos show lower percentages of use as opposed to studies using self-reports (Grunert, Fernández-Celemín, Wills, Bonsmann, & Nureeva, 2010; Vyth et al., 2010).

Women and older consumers seem to be more likely to seek claims on food products (Lynam et al., 2011), although others find no effect of gender or age on the likelihood that people read health claims on foods (Petrovici, Fearne, Nayga Jr, & Drolias, 2012). Individual differences in motives for food choice, nutrition knowledge, diet quality and attitudes to health claims were all linked to consumers' tendency to read health claims (Petrovici et al., 2012). Consumers who attach higher importance to brand and family preferences in their food choices are more likely to use health claims, while those who place higher importance on quality/freshness are less likely to do so. Higher nutrition knowledge and perceived accuracy of health claims have a positive impact on the use of health claims. On the other hand, the perceived need to improve one's diet, the household size and the perceived scepticism towards the usefulness of health claims were associated with lower likelihood to read health claims (Petrovici et al., 2012).

As it could be expected, not all consumers are seeking the type of health-related information provided by health claims. However, if people do attend to labels and have an interest in health claims, it is then relevant to investigate how these messages impact their responses.

Attitudes towards health claims and products carrying health claims

Health claims are generally seen as advantageous (Urala, Arvola, & Lähteenmäki, 2003). Likewise, recent studies show that consumers have more positive attitudes towards health claims, in terms of credibility and attractiveness, compared to a control condition using a taste claim (Wong et al., 2013; Wong et al., 2014). In terms of products carrying health claims, one of the most studied consumer perceptions is consumers' perceived product healthiness (Lähteenmäki, 2013; Wills, Storcksdieck genannt Bonsmann, Kolka, & Grunert, 2012). There is quite strong evidence that consumers perceive products carrying health claims as healthier (e.g. Abrams et al., 2015; Bech-Larsen & Grunert, 2003; van Trijp & van der Lans, 2007; Wong et al., 2013; Wong et al., 2014). Yet, some studies report only minor or no impact of claims on product healthiness (Lähteenmäki et al., 2010; Orquin & Scholderer, 2015). In addition to product healthfulness perception, other attitudinal reactions towards products bearing health claims like product attractiveness or credibility have been investigated by some studies (Hoefkens & Verbeke, 2013; Lähteenmäki et al., 2010; Verbeke, Scholderer, & Lähteenmäki, 2009).

Several factors related to the health claim (e.g. claim type, benefit claimed), the carrier product (e.g. perceived healthfulness of the carrier) or the consumer (e.g. socio-demographics, relevance of the health claim for the consumer) were found to impact consumers' attitudes towards health claims and towards products with claims (Lähteenmäki, 2013).

The type of claim is consistently found to have an impact on consumer attitudes towards the claims; however, there are differences in terms of the direction of this effect. Some studies find that disease risk reduction claims are most attractive and credible (Wong et al., 2014). Others show that the function claims are preferred by consumers or are seen as more convincing (Lynam et al., 2011; Verbeke et al., 2009). Further, some studies find that nutrition claims are most credible (van Trijp & van der Lans, 2007) and that increasing the strength of the claim above the nutrient content claim does not lead to increases in the perceived advantageousness of the claim (Urala et al., 2003). There are also studies showing no difference in credibility between different types of health claims (Wong et al., 2013) and only small impacts on claim appeal (van Trijp & van der Lans, 2007). Finally, the effect of claim type on consumer attitudes towards the claim was found to differ by benefit claimed (van Trijp & van der Lans, 2007).

Similar effects of the claim type are found on consumer attitudes towards products with claims. Products carrying reduction of disease risk claims are perceived by consumers as healthier than products with nutrition and/or function claims (Bech-Larsen & Grunert, 2003; Saba et al., 2010; Wong et al., 2013; Wong et al., 2014). Yet, the claim type does not always have a significant impact on product healthiness perceptions (Ares et al., 2009; van Trijp & van der Lans, 2007). Furthermore, while reduction of disease risk claims generally have a positive impact on perceptions of healthiness of the product, this does not necessarily hold for consumers' perceptions regarding the attractiveness or credibility of products with claims. Instead, products carrying reduction of disease risk claims were found to be less attractive or credible to consumers as opposed to function claims and/or nutrition claims (Hoefkens & Verbeke, 2013; Verbeke et al., 2009). Nonetheless, the effects of the claim type on attitudes towards products with claims vary by benefit claimed (Lähteenmäki et al., 2010; van Trijp & van der Lans, 2007), product base (Verbeke et al., 2009) or ingredient claimed (familiar vs. unfamiliar) (Lähteenmäki et al., 2010).

Some benefits tend to have more credibility than others; for example, benefits related to “infection” (van Trijp & van der Lans, 2007) or “reduction of feelings of hunger” (Lalor, Kennedy, & Wall, 2011) were found as most credible to consumers. Perceived healthiness of products bearing health claims varies by benefit claimed as well, such that products claiming “infection-related” benefits are perceived most healthy, while those claiming “stress-related” or “concentration” benefits are seen as least healthy (van Trijp & van der Lans, 2007). The impact of the benefit type is found to interact with the ingredient claimed (familiar vs. unfamiliar) and country, though (Lähteenmäki et al., 2010; van Trijp & van der Lans, 2007).

Health claims referring to familiar ingredients/components (e.g. omega-3) are preferred over unfamiliar ones (e.g. bioactive peptides) (Grunert et al., 2009). The familiarity of the ingredient had one of the most important impacts on consumers’ perceived convincingness of health claims. Similarly, other studies find that more frequent users of the product find the health claims more convincing or advantageous as opposed to less frequent users (Urala et al., 2003; Verbeke et al., 2009). When consumers see claims relating to familiar ingredients, the nutrient content claims are seen as advantageous as claims with information regarding the function and benefit (Urala et al., 2003). Therefore, especially for familiar ingredients where consumers already know the related health benefits, consumers do not differentiate between nutrition claims and health claims.

Products carrying claims referring to familiar ingredients are perceived more positively in terms of healthiness and attractiveness as opposed to those carrying claims regarding unfamiliar ingredients (Lähteenmäki et al., 2010). Similarly, consumers perceived yoghurts carrying a familiar probiotic claim more favourably as opposed to yoghurts carrying an unfamiliar claim related to fat metabolism (Miklavec, Pravst, Grunert, Klopčič, & Pohar, 2015). Besides, the familiarity of the ingredient claimed is important as it interacts with the claim type and benefit type claimed as mentioned previously (Lähteenmäki et al., 2010). For instance, when the claim is referring to a familiar ingredient (e.g. omega-3), products carrying claims about “heart related” benefits are seen similarly in terms of healthiness as claims mentioning only the ingredient but benefits for “memory” or “weight” are perceived as less healthy compared to the same product with no claim. On the contrary, when the claim refers to an unfamiliar ingredient (e.g. bioactive peptides) the “heart related” benefits lead to lowest decrease in healthiness while the ingredient

only claim leads to highest decrease in perceived healthiness as compared to the product with no claim, with “memory” and “weight” benefit being in-between (Lähteenmäki et al., 2010).

Other factors related to the claim, namely its framing or length, were linked to attitudes towards the claim or towards products with health claims (Ares et al., 2009; Aschemann-Witzel & Grunert, 2015; Grunert et al., 2009; Wansink, Sonka, & Hasler, 2004). However, such effects are generally smaller (Grunert et al., 2009; van Kleef, van Trijp, & Luning, 2005). Health claims accepted in the EU are either positively framed, namely those function claims which promise a beneficial effect on health, or negatively framed, respectively those reduction of disease risk claims which promise reduction of the risk of a health condition. The small effects of framing on consumer attitudes towards the claim, like claim convincingness or attractiveness, vary by benefit claimed (Grunert et al., 2009; van Kleef et al., 2005). For example, consumers view the negatively framed claims as more attractive or credible than the positively framed ones in the case of benefits related to cardiovascular diseases (van Kleef et al., 2005).

On the other hand, framing of the health claim does not seem to have an impact on perceived healthiness of the product (Ares et al., 2009). However, whether health claims are presented in a scientific frame (i.e. health-related informational context emphasizing scientific evidence) or in a “soft” frame (i.e. health-related informational context referring to naturalness or tradition) has an impact on consumers’ attitudes toward the product (Aschemann-Witzel & Grunert, 2015). The “soft” framing of the health claim had a positive influence on consumers’ attitudes toward the product carrying it in Denmark. Conversely, the “scientific” framing had a positive impact on health-related inferences in the US, but had no impact on attitudes towards the product (Aschemann-Witzel & Grunert, 2015).

The wording of a health claim can generally refer to three elements: an ingredient, the physiologic function and the health benefit. Most of the currently authorised health claims at the European Union level contain two of these elements, namely an ingredient and a function. *The present thesis focuses mainly on the health claims authorised in the EU.* Consumers can be split in two groups when it comes to their attitude towards the structure of wording of a health claim, with one group feeling more positive about the short claims which only emphasize the benefit, while others having more positive attitudes towards the long claims containing all three elements

in their wording (Grunert et al., 2009). Other studies, however, find that consumers prefer short claims (Williams, 2005) and that products carrying such claims are seen more positively (Wansink et al., 2004). Furthermore, the use of qualifiers in the wording of the claim (e.g. “may”) to decrease the certainty of the claimed effect has only a small negative impact on consumers’ perceived convincingness or credibility of the claim (Grunert et al., 2009).

The carrier product is one of the most important factors affecting consumer responses to health claims (Lähteenmäki, 2013). Consumers have more positive attitudes towards health claims, namely they find them more credible or attractive, when these are found on products with a healthy image (e.g. bread or yoghurt) (Dean et al., 2007; Lalor, Kennedy, et al., 2011; Lähteenmäki et al., 2010; Saba et al., 2010; van Kleef et al., 2005) as opposed to indulgence carriers (e.g. chocolate). However, this is not always the case. Consumers may actually have a more positive attitude towards enrichments or claims on products that have a less healthy image as then the added benefit may be seen as valuable (Bech-Larsen & Grunert, 2003) as opposed to carriers that are already perceived as healthy. Carriers for which there is a history for use of labels or claims may also be preferred as opposed to those where claiming health benefits is novel. For example, adding a health claim on pork chops led to strong decreases in perceived healthiness whereas this was not the case for products that are usual carriers of claims like bread or yoghurt (Lähteenmäki et al., 2010). However, consumers’ preferences of carrier products may differ by country (Saba et al., 2010).

While products carrying health claims may be perceived as healthier compared to those that do not carry such claims, the impact is not necessarily positive for other product attributes or for the products’ attractiveness overall (Lähteenmäki et al., 2010). Health claims are found to decrease perceptions of tastiness, attractiveness and naturalness (Lähteenmäki et al., 2010; Orquin & Scholderer, 2015). Decreases in naturalness are highest and may explain to some extent why consumers see the product overall as less attractive (Lähteenmäki et al., 2010). These detrimental impacts vary by country though. While in Iceland there is no detrimental impact, in Denmark there is the strongest negative impact of health claims on perceptions of tastiness, naturalness and attractiveness (Lähteenmäki et al., 2010).

Socio-demographics have an important influence on consumers' attitudes towards health claims and towards products with health claims (van Trijp & van der Lans, 2007). Women are quite consistently shown to perceive health claims as more advantageous or believable (Lynam et al., 2011; Urala et al., 2003), however, the perceived importance of health claims did not differ by gender (Cavaliere, Ricci, & Banterle, 2015). Similarly, some show that women perceive products with claims as healthier compared to men (Ares et al., 2009), others show that men find products carrying claims more credible (Verbeke et al., 2009) and some find no effect of gender on product healthiness perception (Dean et al., 2012) or on attitudes towards functional foods in general (Urala & Lähteenmäki, 2007). Education, age and income level were associated in some cases with consumers' attitudes towards health claims (Cavaliere et al., 2015; Lynam et al., 2011; Urala et al., 2003). Older consumers tend to view foods carrying health claims as healthier and more beneficial (Dean et al., 2012), though younger consumers may find such foods more credible (Verbeke et al., 2009). While effects of socio-demographics are generally small, the country-wise differences can be substantial (Bech-Larsen & Grunert, 2003; Lähteenmäki et al., 2010; Saba et al., 2010; van Trijp & van der Lans, 2007).

The personal relevance of health claims for consumers, assessed as whether individuals or those close to them suffer from health conditions linked to the claimed benefit, plays an important role in attitudes towards health claims. Personal relevance translates into more positive perceptions of health claims with regards to attractiveness, advantageousness or credibility (Urala et al., 2003; van Kleef et al., 2005). However, other studies find no effect of hypertension status on attractiveness or credibility of sodium-related claims (Wong et al., 2013). Consumers view products carrying health claims as more beneficial, regardless of country of residence (Lyly, Roininen, Honkapää, Poutanen, & Lähteenmäki, 2007). More importantly though, consumers for whom the health claim was personally relevant perceived the product carrying the claim as more beneficial for themselves and more healthy as opposed to consumers who found the claim not personally relevant for themselves or those close to them (Dean et al., 2007; Lalor, Madden, McKenzie, & Wall, 2011; Wong et al., 2013). Furthermore, some studies combined the personal relevance of health claims assessment (i.e. whether individuals suffer from a health condition) with a subjective measure of perceived relevance of health claims (i.e. whether people consider that they have a risk of developing a health condition related to the claimed benefit), and found that this measure was one of the most important psychological factors affecting consumers'

perceptions of personal benefit and healthiness of products carrying health claims (Dean et al., 2012). The existing studies suggest that perceived relevance may play a major role in consumer responses towards health claims; yet, more evidence regarding the role of perceived relevance of health claims assessed independently is still needed.

While both personal and perceived relevance of the claim are seen as important individual related factors, other motivation and ability related factors were found to significantly impact consumers' attitudes towards health claims and products with claims. Consumers' nutrition knowledge (Lalor, Kennedy, et al., 2011), belief in diet-disease link (van Trijp & van der Lans, 2007), trust in the information source (Urala et al., 2003) or their self-reported health status (Cavaliere et al., 2015) play a role in consumers' perception of the claim appeal, credibility or importance. Additionally, positive attitudes towards functional foods in general translate into higher perceived benefit, credibility or attractiveness of products carrying specific health claims (Dean et al., 2012; Verbeke et al., 2009). Similarly, consumers' health interest, their health-related motive orientation, belief in the diet-disease link, familiarity with functional foods and subjective knowledge have a positive impact on consumers' perceived healthiness, benefit, credibility and attractiveness of products carrying health claims (Dean et al., 2012; Hoefkens & Verbeke, 2013; van Trijp & van der Lans, 2007; Verbeke et al., 2009). On the other hand, higher perceived control over one's health and scepticism towards functional foods (i.e. perception that functional foods are a marketing scam) have a negative impact on perceived product credibility or attractiveness (Verbeke et al., 2009).

Finally, other context elements on pack can have an impact on perceived healthiness of products carrying health claims (Chrysochou & Grunert, 2014; Saba et al., 2010). There is not a lot of consensus in the literature regarding the relative importance of these elements compared to health claims. Some studies find that health imagery has stronger impacts on perceived healthiness of the product than health claims (Chrysochou & Grunert, 2014), or that front of pack labels are seen by consumers as more useful than health claims (Talati et al., 2016). Other studies, however, find that pictorial representations or colour of pack have small or no impacts on perceived healthiness (Orquin & Scholderer, 2015; Saba et al., 2010). This implies that health claims play a role in consumers' product attitudes, but they compete with other elements to impact consumer responses.

Overall, consumers seem to evaluate positively products with health claims in terms of healthiness, perceived benefit, credibility or attractiveness. Yet, the use of health claims may lead to negative impacts on perceived tastiness or naturalness of the product. Several factors play a role in consumers' attitudes towards health claims and products carrying health claims. The most important factors seem to be those related to the benefit, the carrier as well as country and relevance of the claim to the consumer.

Choice or willingness to buy products with health claims

Several prior studies have investigated the impact of health claims on consumers' purchase intentions or behaviour. Most of these studies have used self-reported measures of behavioural intentions (e.g. Dean et al., 2012; Hoefkens & Verbeke, 2013; Orquin & Scholderer, 2015; Siegrist et al., 2015; van Trijp & van der Lans, 2007; Wong et al., 2014). Only few studies have used choice experiments to estimate utilities of health claims as product attributes (e.g. Contini et al., 2015) or have estimated willingness to pay based on experimental auctions or choice experiments (e.g. Hellyer, Fraser, & Haddock-Fraser, 2012; Van Wezemael, Caputo, Nayga Jr, Chryssochoidis, & Verbeke, 2014) or have employed purchase simulations to assess choice (Aschemann-Witzel & Hamm, 2010).

The provision of nutrition and health claims on food products has a positive impact on consumers' purchase behaviour (Aschemann-Witzel & Hamm, 2010; Hellyer et al., 2012; Lalor, Madden, et al., 2011; Wong et al., 2013; Wong et al., 2014). Consumers' purchase intentions are shown to be higher for products carrying health claims as opposed to those carrying taste claims (Wong et al., 2013; Wong et al., 2014) or those carrying no claim (Roe, Levy, & Derby, 1999). Moreover, increases in sales for products carrying health claims can be expected (Aschemann-Witzel & Hamm, 2010) as well as higher willingness to pay for presence of health information on products (Hellyer et al., 2012). However, some studies do not find a significant impact of function claims on intention to buy (Chrysochou & Grunert, 2014; Saba et al., 2010) while others even find decreases in intention to buy products carrying health claims as opposed to those without health claims (Orquin & Scholderer, 2015; Siegrist et al., 2015).

Consumers' willingness to buy products with health claims varies depending on claim-, product- and consumer-related factors (e.g. Annunziata & Vecchio, 2013; Aschemann-Witzel & Hamm,

2010; Dean et al., 2012; Saba et al., 2010; van Trijp & van der Lans, 2007). Besides, other attributes of the products (e.g. taste, brand, health imagery) may have an even stronger impact on intention to buy compared to health claims (e.g. Ares, Giménez, & Deliza, 2010).

Consumers express higher intentions to buy products carrying reduction of disease risk claims as opposed to other types of claims (i.e. nutrition claim, function claim) or no claim (Lin, 2008; Wong et al., 2014). Similarly, prevention claims were more valued by consumers as opposed to generic claims or psychological claims (Annunziata & Vecchio, 2013). Consumers are also less likely to buy products with psychological claims (e.g. reduction of tiredness) as opposed to those carrying physiological health claims (e.g. reduction of the risk of osteoporosis) (Siegrist, Stampfli, & Kastenholz, 2008). However, while reduction of disease risk claims lead to higher likelihood to buy than function claims, some show that the willingness to buy does not differ compared to nutrition claims (Wong et al., 2013). Yet, there is also evidence that reduction of disease risk claims lead to lower intention to buy as compared to other types of health claims (Hoefkens & Verbeke, 2013; Verbeke et al., 2009).

These diverging findings for the effect of type of claim could be explained to some extent by the fact that the effects of type of claim depend to a significant extent by the benefit claimed (van Trijp & van der Lans, 2007). Type of claim on its own seems to be a rather weak predictor of purchase intention or claim appeal (Lin, 2008; van Trijp & van der Lans, 2007); however, it may be more important than some individual-related factors like health motive orientation (Hoefkens & Verbeke, 2013).

The type of benefit claimed is found to have strong main effects on willingness to buy or claim appeal (includes intention to buy) (van Kleef et al., 2005; van Trijp & van der Lans, 2007). Benefits related to osteoporosis (van Kleef et al., 2005) or infections (van Trijp & van der Lans, 2007) as opposed to benefits like heart health or stress are associated with higher intention to buy. The effect of benefit claimed is found to differ by country, though (van Trijp & van der Lans, 2007).

Consumers are more likely to buy products carrying a negatively framed health claim (e.g. lowering the risk of cardiovascular disease) compared to a positively framed claim (e.g. strengthening of the heart) (van Kleef et al., 2005). Similarly, a negatively framed health claim

regarding fat resulted in higher utilities and willingness to pay as opposed to positively framed claims on iron or protein in choice experiments (Van Wezemaal et al., 2014).

The carrier product has an impact on willingness to buy. Similar to findings regarding attitudes to the claim, people seem to be more willing to buy products with health claims when the carrier has a healthy image (e.g. yoghurt) (Siegrist et al., 2008). However, others find that consumers are even more willing to pay for claims on products that are seen as less healthy (Barreiro-Hurle, Gracia, & De-Magistris, 2010). The carrier product is found by some to be the most important factor impacting consumers' choices (Annunziata & Vecchio, 2013), while others found no impact of product concepts on intention to buy (Verbeke et al., 2009).

While effects on intention to buy may differ by carrier, it seems that the perceived fit between the carrier and the component claimed could have stronger impacts on intention to buy (Krutulyte et al., 2011). Further, familiarity with the product boosted people's intentions to buy products with claims (Dean et al., 2012; Verbeke et al., 2009). Similarly, the familiarity of the ingredient-carrier combination to the market (as assessed by experts) had an impact on intention to buy; however, the effect is mediated by perceived fit between the carrier and the claimed ingredient (Krutulyte et al., 2011).

Several socio-demographic characteristics and other individual differences were linked to intention to buy foods carrying health claims. There is some consistency regarding the main impact of two consumer-related factors, namely country and personal relevance of the claim. First, several cross-cultural studies have found that the effects of health claims on purchase vary substantially by country (Contini et al., 2015; Saba et al., 2010; Siegrist et al., 2015; van Trijp & van der Lans, 2007; Van Wezemaal et al., 2014), meaning that culture plays a vast role in willingness to buy foods with health claims. Second, consumers tend to be more likely to buy products with claims referring to a health condition relevant for them as opposed to claims that are not relevant to them personally (Contini et al., 2015; Dean et al., 2012; Wong et al., 2013; van Kleef et al., 2005).

While perceived healthiness of products may not always translate to purchase (Provencher & Jacob, 2016), having positive attitudes towards foods with health claims and perceiving higher benefit from such products have been associated with higher intention to buy or with choice of

products with health claims (Contini et al., 2015; Dean et al., 2012; Dean et al., 2007; Krutulyte et al., 2011; Verbeke et al., 2009). Similar effects are found for consumer health interest or motivation (Aschemann-Witzel & Hamm, 2010; Contini et al., 2015; Dean et al., 2012; Krutulyte et al., 2011; Siegrist et al., 2015). Consumers' trust in the food industry has a positive effect on intention to buy (Siegrist et al., 2015; Siegrist et al., 2008). Likewise, lower scepticism towards health claims or general trust in health claims has a positive impact on choice of products with health claims (Contini et al., 2015). However, the impact of scepticism differs by carrier (Aschemann-Witzel & Hamm, 2010). On the other hand, food neophobia has a detrimental impact on willingness to buy foods with health benefits but only in some cultures (Siegrist et al., 2015).

Consumers' choice of products with health claims varies depending on several socio-demographics factors in addition to country. However, the role of these is rather small as opposed to factors related to the claim or the carrier (van Trijp & van der Lans, 2007). Gender, age, presence of children and education have been linked to varying extents to intention to buy or choice behaviour of consumers (Contini et al., 2015; Lynam et al., 2011). Such effects, if confirmed, are rather small and they may to some extent be mediated through attitudinal factors (Contini et al., 2015).

Health is important in consumers' choices; however, there are other factors which can play an even stronger role in their purchase behaviour like taste or brand (Ares et al., 2010; Lalor, Madden, et al., 2011; Steptoe et al., 1995). Health claims have the potential to decrease expected tastiness of products (Lähteenmäki et al., 2010; Orquin & Scholderer, 2015). Some consumers may compromise on taste for health, however consumers are generally not willing to do so, thus, they may not choose products carrying health claims (Carrillo, Varela, & Fiszman, 2012). Similarly, consumers appreciate foods that are natural (Rozin et al., 2004), but health claims seem to decrease the perceived naturalness of food (Lähteenmäki et al., 2010) which could impede consumers from choosing these foods. Other factors that could be seen as barriers for consumers' choice of products with health claims are a tendency to purchase by habit or not having read the claim on the product (Aschemann-Witzel & Hamm, 2010).

Finally, even for those consumers interested in the health properties of foods, health claims may compete with other attributes which consumers associate with health, like health imagery (e.g. Choices logo or keyhole) or organic label (Magnusson, Arvola, Hursti, Åberg, & Sjärdén, 2003; Orquin & Scholderer, 2015). Such elements may have stronger impacts on intentions to buy than claims (Chrysochou & Grunert, 2014; Orquin & Scholderer, 2015), even though some find only limited impacts, if any (Orquin & Scholderer, 2015; Saba et al., 2010).

Overall, health claims do have the potential to impact consumer choices, with some consumers being especially sensitive to health claims; however, other elements can act as barriers to choice (e.g. taste). Yet, the effects of health claims differ mainly by type of benefit, type of claim, country and personal relevance of the claims.

Consumption or willingness to use products with health claims

The evidence on the effects of health claims on consumption or willingness to try or use products with health claims is less extensive compared to purchase behaviour and comes mostly from studies on nutrition claims.

Consumers are on average willing to use products with functional ingredients (Vassallo et al., 2009) and are even more willing to try products when they carry health claims as opposed to when they do not (Ares et al., 2009). More positive attitudes towards the products carrying claims in terms of perceived healthiness and tastiness as well as consumers' health motivation or their perceived need for the claimed benefit have been linked to higher willingness to use products with functional ingredients (Lyly et al., 2007; Vassallo et al., 2009). Moreover, women and older consumers are most willing to try such products (Ares et al., 2009). There are some country differences in willingness to use products with claims and effects of age and gender though (Lyly et al., 2007).

However, some studies show that the use of claims can also have drawbacks. Provision of a nutrition claim/label (e.g. "low fat") on snacks has been found to lead to overconsumption (Wansink & Chandon, 2006). This finding is especially relevant as the overweight consumers tend to overeat regardless of whether the snack is relatively healthy or unhealthy, whereas normal weight people show increased consumption mostly for snacks that have a relatively

healthy image (Wansink & Chandon, 2006). Other field studies do not find a main effect of the low fat label; however, it does seem that some people may be more prone to overconsume than others: among consumers of high socio-economic status, those who were weight concerned consumed more than those who were weight unconcerned (Crockett et al., 2014).

There is some evidence that such detrimental effects on consumption only happen for certain types of claims: health claims emphasizing functional attributes (e.g. antioxidants) were not found to lead to overconsumption as opposed to claims emphasizing hedonic attributes (e.g. low fat) (Belei et al., 2012). For snacks with health claims focusing on hedonic attributes there are some strategies to avoid the overconsumption effect. First, provision on pack of objective serving size information counteracts to some extent the effect of low fat labels, but only for normal weight consumers (Wansink & Chandon, 2006). Secondly, giving explicit cues that promote the low fat product as a healthy alternative has the potential to prevent overconsumption among all consumers. This is the case because the health-related cues will activate consumers' health goals leading to a conflict between these goals and consumers' indulgence goals which finally translates to lower consumption (Belei et al., 2012).

Overall, the use of health claims on food products may increase consumers' willingness to try these products, however at least some claims may have the potential to lead to detrimental impacts on some consumers' consumption behaviour.

1.2.2. Consumer understanding of health claims

There is an extensive amount of literature on consumer perceptions and responses to health claims; however, the research on consumer understanding of health claims is still scarce. The few existing studies on consumer understanding have focused on different types of understanding and used various methods for assessing understanding. The different types of understanding addressed in prior literature will be described in the next sub-section, followed by insights into the determinants of understanding and its subsequent effects on consumer behavioural responses.

Types of understanding

Subjective understanding

Subjective understanding refers to consumers' perceived ease or difficulty of understanding a particular health claim (van Trijp & van der Lans, 2007) or the perceived clarity/understandability of a particular claim (Lynam et al., 2011; Ternus, McMahon, Lapsley, & Johnson, 2006; Wong et al., 2014). Consumers' reported levels of subjective understanding are found to be high (Lynam et al., 2011; Ternus et al., 2006) or moderate at best (van Trijp & van der Lans, 2007; Wong et al., 2014) in various prior studies.

People who perceive a particular health claim to be easy to understand might not necessarily objectively understand the meaning of the health claim though, i.e. understanding in line with the scientific evidence behind that claim. There is an indication that the link between what people think they understand and whether they actually objectively understand may not be very strong. For example, in a study where consumers reported high levels of subjective understanding for a cholesterol lowering health claim, only few consumers could accurately mention that the claim referred to "heart health" benefits in open-ended questions (Lynam et al., 2011). However, the extent to which there is a relationship between subjective understanding and understanding of the health claim in line with the evidence behind it remains largely unexplored.

Specific types of misunderstanding

Some studies have investigated specific types of misinterpretations that consumers could make from health claims. A seminal paper by Roe et al. (1999) identified two main types of misinterpretations that consumers make from health claims. First, a *halo effect* occurs when consumers perceive a product carrying a particular health claim to be superior in terms of other health-related attributes which are not stated in the health claim. Secondly, when consumers go even further and attribute some inappropriate health benefits to the product carrying a specific health claim then a *magic bullet effect* occurs (Roe et al., 1999).

Some prior studies support the occurrence of halo effects (Andrews, Netemeyer, & Burton, 1998; Harris, Thompson, Schwartz, & Brownell, 2011), however, other studies do not find evidence of a halo effect (Lähtenmäki et al., 2010; Orquin & Scholderer, 2015) nor full support for a magic

bullet effect (Lähteenmäki et al., 2010). On the contrary, these studies find a negative halo effect on other product attributes, whereby consumers' perceived naturalness of the product (Lähteenmäki et al., 2010) or its perceived tastiness (Lähteenmäki et al., 2010; Orquin & Scholderer, 2015) decrease when the product carries a health claim.

Overall, these studies provide useful insights into the extent to which consumers make specific misinterpretations due to health claims. It is less clear from such studies, though, to what extent consumers understand the health claim in line with its objective content.

Adequate understanding (objective understanding)

Qualitative studies show that consumers are somewhat confused by health claims and lack understanding of the meaning of health claims (Svederberg, 2002). However, very few studies have investigated how consumer understanding compares to the scientific evidence behind the health claim (e.g. Bilman et al., 2012; Grunert et al., 2011). This approach to consumer understanding is most in line with the provision of the EU regulation on nutrition and health claims stating that health claims should be expected to be understood by consumers (Art. 5.2, Regulation (EC) No 1924/2006). Therefore, *the present PhD thesis will focus on this type of understanding.*

The definition of adequate understanding, developed by Leathwood et al. (2007) in the context of the EU regulation, *is adopted in this PhD thesis.* Adequate understanding of a health claim entails that the consumer “makes inferences that are justified by the objective content of the claim without significant embellishment or exaggeration” (Leathwood et al., 2007, p. 477). The definition suggests that consumers can make several inferences based on a health claim of which some could be justified by the objective content of the health claim while others could not be justified. Assessing understanding would then imply that the meanings attached by consumers to a health claim will be held up against the scientific evidence behind the claim to find out the proportion of consumers who show adequate understanding (Grunert et al., 2011; Leathwood et al., 2007).

The definition of adequate understanding is closely linked to the categorization of inferences that consumers make from products with health claims into three groups - safe, risky or vague - put

forth by Grunert et al. (2011). The study by Grunert et al. (2011) used an open-ended approach developed by Danone (Rogeaux, 2010) to assess consumers' understanding of a health claim on yoghurt. Inferences that were in line with the scientific evidence behind the health claim were seen as safe, those that were not in line with the objective evidence were seen as risky and those that expressed a vague or irrelevant notion were considered vague. Based on their overall answers consumers can then be divided into groups according to their understanding. For instance, consumers who make only safe interpretations or interpretations that are partly safe and partly vague will be categorised as "safe" consumers (Grunert et al., 2011). It was found that 67% of consumers could be seen as "safe" in their interpretation: their understanding was in line with the scientific evidence behind the claim, implying that these consumers showed adequate understanding.

Two other studies have used a similar open-ended approach to the one reported by Grunert et al. (2011), however, they did not report how consumers' answers compared to the scientific evidence behind the studied claims (Wong et al., 2013; Wong et al., 2014). Based on the reported themes identified in consumers' answers, it seemed that consumers did not always understand the claims in accordance with the scientific evidence. Moreover, respondents perceived the products carrying a health claim as more beneficial to people with several health conditions, some of which were unrelated to the claims, compared to a product carrying a taste claim (Wong et al., 2013). Other studies support the finding that consumers attribute some benefits to health claims which go beyond the literal effect claimed (Harris et al., 2011; Lynam et al., 2011). On the other hand, in a study on satiety-related claims, consumers' over-interpretations of the health claims were limited, suggesting that most consumers may understand these claims adequately (Bilman et al., 2012). Nevertheless, these studies did not aim to identify the percentage of respondents whose understanding would be in line with the scientific evidence behind the health claims.

Previous studies of consumer understanding have used various measures of understanding, based on open-ended approaches or closed-ended ones. However, there is still no generally accepted standardized method to assess consumer understanding of health claims. Several methodologies for assessing consumers' understanding of health claims were evaluated by Leathwood et al. (2007). The recommended approach for the study of understanding was one that combines

qualitative and quantitative methods. First, the variety of interpretations that consumers attach to health claims can be identified with qualitative methods. Subsequently, the accuracy of these interpretations, as compared to the evidence behind the claims, can be tested quantitatively to identify the prevalence of consumers who adequately understand the claims (Leathwood et al., 2007). *These recommendations will be followed in the present PhD thesis.* This approach to measure understanding was adopted because it combines the advantages of qualitative and quantitative methods. First, the use of qualitative methods, like for example open-ended questions, does not preclude any answer and allows gaining rich insights into the types of inferences that consumers could make from products carrying health claims. In the second step, the identified types of inferences can be used in closed-ended questions to assess them quantitatively; in this way their prevalence in the population could be assessed and subsequently the proportion of consumers who adequately understand the tested health claims can be identified. Moreover, this approach was suggested in the context of consumer understanding as required in the EU regulation which is the type of understanding under focus in the present PhD thesis.

Overall, consumers do not always understand the health claims in line with the scientific evidence behind them. However, there is only little published literature on consumer understanding of health claims, particularly regarding the approved health claims for use in the EU, meaning that it is difficult to draw conclusions regarding prevalence of adequate understanding. The study of consumer understanding of the approved health claims in the EU is therefore critical (J. van buul & Brouns, 2015; Leathwood et al., 2007; Lähteenmäki, 2013; Wills et al., 2012).

Antecedents of consumer understanding

There are several studies assessing antecedents of subjective understanding; however, their focus has been mainly on claim related factors. The claim type and benefit claimed play an important role in consumers' perception of clarity of the claim or ease of understanding (van Trijp & van der Lans, 2007; Wong et al., 2013; Wong et al., 2014). Consumers found claims regarding cardiovascular disease more difficult to understand while claims on concentration or weight were perceived as easier to understand (van Trijp & van der Lans, 2007). The claim type impacts

subjective understanding, however its effect differs by benefit claimed (van Trijp & van der Lans, 2007; Wong et al., 2014).

Some factors related to the individual consumer, as for example consumers' subjective knowledge or their belief in the diet-disease relationship, are found to play a role as well, but these generally have a small impact (van Trijp & van der Lans, 2007). Moreover, some socio-demographics such as gender (Lynam et al., 2011) or age (van Trijp & van der Lans, 2007) have an impact on subjective understanding. More importantly, though, there are country-wise differences in ratings of subjective understanding of health claims (van Trijp & van der Lans, 2007).

On the other hand, studies assessing antecedents of consumers' objective understanding are scarce. The limited existing evidence shows that consumer understanding varies depending on health claim related factors or individual characteristics (Bilman et al., 2012; Grunert et al., 2011). The wording of health claims is an important health claim-related factor as it makes an impact on the extent to which people over-interpret the meaning of a health claim (Bilman et al., 2012). Furthermore, individual-related factors like consumers' attitudes towards functional foods, restraint eating and nutrition knowledge are significant determinants of understanding (Andrews, Burton, & Netemeyer, 2000; Andrews et al., 1998; Bilman et al., 2012; Grunert et al., 2011).

Consumers with positive attitudes towards functional foods were more likely to make interpretations which were not in line with the scientific evidence behind the claim (i.e. consumers categorized as "risky" in their understanding). Alternatively, those consumers with neutral or very negative attitudes were more likely to make only vague interpretations (i.e. consumers categorized as "other" in their understanding) (Grunert et al., 2011). A negative effect on consumer understanding was also found for restrained eating: consumers who were restrained eaters were more prone to over-interpret satiety-related health claims (Bilman et al., 2012). On the other hand, consumers with higher levels of objective nutrition knowledge were found to overgeneralize to a lower extent than consumers with low nutrition knowledge in terms of nutrient content not mentioned in nutrition claims (Andrews et al., 1998) or overall healthiness of

the product (Andrews et al., 2000). Measures of subjective knowledge of foods with health claims made no impact on understanding though (Grunert et al., 2011).

The personal relevance of the claim, assessed as whether consumers have a health condition related to a certain health claim (e.g. hypertension status for a sodium reduction health claim) seems to have some effect in consumer understanding. Hypertensive respondents reported a product carrying any sodium claim as more beneficial for several groups of people (e.g. all people, healthy people, people with heart problems) as opposed to normotensive respondents (Wong et al., 2013). The relationship between relevance and understanding is seen as important by prior literature (Lähteenmäki, 2013); however, the evidence to date is still inconclusive as to its effect on objective understanding.

In terms of socio-demographic characteristics, some find no effect (Grunert et al., 2011) while others find small effects for some claims but no consistent effect across the studied claims (Bilman et al., 2012). Nonetheless, there were important country-wise differences in the likelihood that consumers over-interpret health claims, with UK consumers showing lower tendency to over-interpret compared to French, German and Italian consumers (Bilman et al., 2012).

The determinants of consumer understanding of health claims have received little attention so far. However, insights into such factors can provide highly relevant information, especially for public policy, regarding which types of claims are more likely not to be adequately understood or which consumers are more likely not to understand the claims adequately (Bilman et al., 2012; Grunert et al., 2011). Therefore, future research investigating the antecedents of understanding including a wider range of factors, is needed.

Subsequent effects of consumer understanding

The subsequent effects of consumer understanding or misunderstanding are largely unexplored. Health claims are thought to help consumers make healthy or informed choices. However, if health claims are misunderstood and those misunderstandings lead to purchase then health claims would be seen as misleading consumers. A somewhat recent study shows that out of those perceived meanings that parents attached to claims on children cereals, those meanings which

were further from the literal meaning of the claim were the ones linked to higher intention to buy the product (Harris et al., 2011). More research is, however, necessary to conclude on the subsequent effects that consumer understanding of health claims may have on consumer behaviour.

The issue of adequate consumer understanding

The health claims authorised so far for use in the EU are listed in the EU register of nutrition and health claims made on foods (<http://ec.europa.eu/nuhclaims/>). At a first glance through the register, it becomes clear that a lot of the health claims authorised in the EU use technical or scientific terms (e.g. connective tissue, oxidative stress). The currently authorised wording may be a good attempt to keep the claims as close as possible to the scientific evidence in order to avoid misleading claims. However, there are strong concerns that the wording used is too technical or scientific which makes it cumbersome for the average consumer to understand the claims (e.g. BEUC, 2011; Mariotti, Kalonji, Huneau, & Margaritis, 2010; Nocella & Kennedy, 2012; Williams, 2005).

The EU Regulation (EU) No 432/2012 and the EU register (under its terms and conditions) mention that some flexibility of wording for health claims is allowed to the extent that its purpose is to facilitate consumer understanding. In 2012, experts from 17 Member States have agreed upon a set of general guiding principles regarding the flexibility of wording for health claims¹. These guidelines could be followed by food business operators when they want to re-word health claims so as to improve consumer understanding. However, the described possibilities for re-wording of the health claims detailed in these guidelines allow only minor changes which may not have significant impacts on consumer understanding. In addition to these principles, it is acknowledged that there could be national guidelines developed by national authorities in some of the Member States¹.

A promising approach to improve the understandability of authorised health claims has been developed by the Danish Food and Drink Federation. Through a systematic step-wise procedure an authorised health claim was developed into a “health claim complex”. The “health claim

¹https://www.foedevarestyrelsen.dk/SiteCollectionDocuments/25_PDF_word_filer%20til%20download/07kontor/Ern%C3%A6rings-%20og%20sundhedsanprisninger/health%20claims%20-%20flexibility%20of%20wording%20principles%2014%20Dec%202012.pdf

complexes” consist of the following elements: 1) a re-worded version of the authorised health claim, 2) an unspecific claim typically regarding a general health benefit related to the authorised claimed benefit and 3) additional information to provide context for the authorised claim, for instance information about the function and/or component claimed (Peetz-Schou, 2014). These elements can potentially improve consumer understanding.

The “health claim complexes” approach has been applied by a public-private partnership called The Meal Partnership in Denmark. In the partnership representatives from business and trade organizations and the authorities have developed “health claim complexes” to support the national food based dietary guidelines. The representatives from the Danish authorities involved in the partnership had the responsibility to conduct legal assessments of the “health claim complexes”, which were developed to ensure compliance with the Regulation (EC) No 1924/2006. For example, for the re-worded versions of the authorised health claims the flexibility of wording guidelines have been followed and the unspecific claims are allowed by Regulation (EC) No 1924/2006 (Art. 10) as long as there is a specific claim as well on pack. However, ultimately the decision on this lies with the European Court of Justice. The “health claim complexes” developed starting from several authorised health claims can be found in a report published by the Danish Food and Drink Federation, only available in Danish (Peetz-Schou, 2014).

Therefore, there are some attempts from public policy and industry aimed at improving the understandability of the authorised health claims. Even though these initiatives are in place, little is known about the effectiveness of such approaches in facilitating consumer understanding of health claims.

1.3. Research questions

The issuing of the EU regulation on the use of nutrition and health claims made on foods (Regulation (EC) No 1924/2006) has motivated extensive research on consumer perceptions and responses to health claims. On the contrary, research on consumer understanding of health claims is still scarce. Consumer understanding of health claims is one of the criteria set by regulation together with the scientific substantiation of health claims. While other criteria for use, for instance that there should be sound scientific evidence for the claimed effect, are

enforced through the authorisation procedure set by regulation, there is no such enforcement for the consumer understanding criterion. The decisions on consumer understanding will ultimately be taken by the European Court of Justice when issues arise.

The scarcity of research on consumer understanding may be due to a lack of guidelines in the Regulation as well as the literature on how to assess it. Out of the few studies on consumer understanding of health claims some of the most influential ones are not very recent and are not using the EU authorised health claims as stimuli. Thus, there is an acute lack of literature on consumer understanding of approved claims in the EU. Another gap found through the literature review is that there is a lack of understanding of which consumers are more prone to misunderstand health claims. Finally, while there are attempts to improve the understandability of authorised health claims, their effectiveness is largely unknown.

Against this background, the present PhD thesis focuses on objective understanding of health claims and especially of the health claims approved in the EU. The thesis seeks to address the identified lack of research in the areas of antecedents of consumer understanding of health claims, levels of consumer understanding for the authorised health claims in the EU, methods for assessment of consumer understanding and effectiveness of attempts to improve the understandability of authorised claims. To this end the following research questions will be addressed:

- ✓ **RQ1:** *How can we assess consumer understanding of health claims?*
- ✓ **RQ2:** *Which factors play a role in consumer understanding of health claims?*
- ✓ **RQ3:** *How can we improve the comprehensibility of health claims?*

These research questions have practical relevance for public policy as well as for the food industry as they can shed light into levels of consumer understanding and factors affecting it. In addition, this research has theoretical implications as it can provide significant contributions regarding the factors affecting consumer information processing, especially in terms of message and consumer related factors. The empirical studies conducted to address the research questions of this PhD thesis are described in Section 1.5 of this Chapter.

1.4. Theoretical background

From a theoretical standpoint, consumer understanding of health claims can be seen as information processing. Information processing theories have provided the theoretical background for several studies on the effects of nutrition information on consumers' responses (Andrews, Burton, & Kees, 2011; Grunert & Wills, 2007; Moorman, 1990; van Trijp, 2009). Information processing theories involve a number of stages that consumers go through when processing information. Consumers can only be expected to process certain information (e.g. health claims), if they are *exposed* to it. Subsequently, once the information is attended to, it can enter people's perceptual system. *Perception* can further lead to *understanding*, namely the meaning attached to the perceived information (Grunert & Wills, 2007; van Trijp, 2009).

Dual processing theories posit that there are different levels of processing that consumers may engage in when they are exposed to information like health claims (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). Studies on consumer understanding of health claims have drawn upon such theories (Grunert et al., 2011). The Elaboration Likelihood Model (ELM) and the Heuristic-Systematic Model (HSM) differentiate between two processing modes: deep processing (i.e. central route or systematic processing) and shallow processing (i.e. peripheral route or heuristic processing) (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). In *deep processing* consumers use more effort and time to elaborate on the available information and are presumed to use this available information to a large extent. On the other hand, in *shallow processing* little time and effort is used to interpret the available information. Shallow processing relies heavily on easily noticeable cues, learned associations and simple heuristics or rules of thumb to assess the available information as fast as possible (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). These two modes of information processing represent the extremes of the amount of elaboration that people engage in (i.e. elaboration continuum) (Petty & Cacioppo, 1986) and the HSM proposes that these can occur simultaneously or they can interact (Chen & Chaiken, 1999).

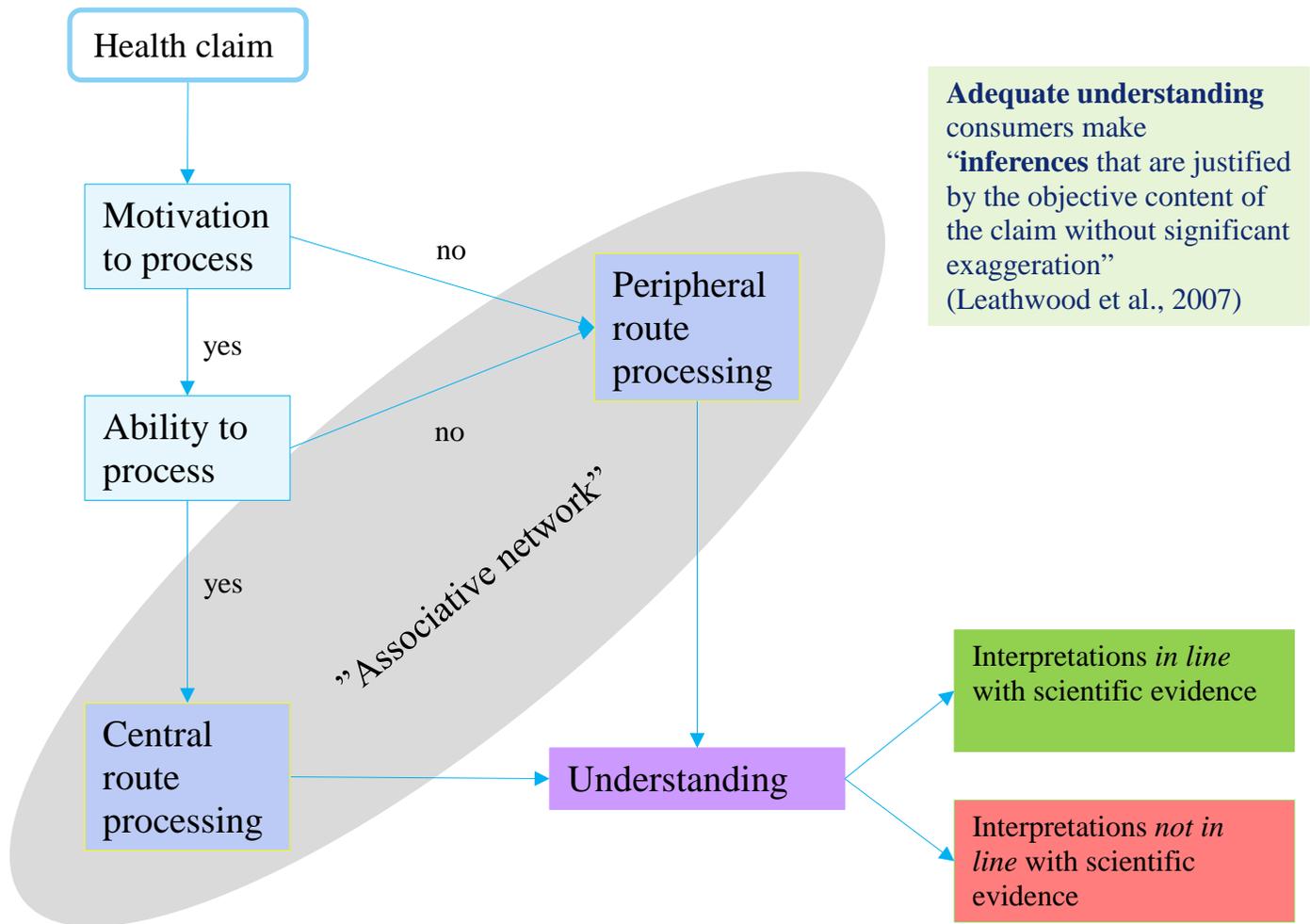
The type of processing that consumers engage in depends on their motivation and ability to process the information (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). At high levels of motivation and ability to process the provided information (e.g. health claims), consumers are expected to engage in deep processing, while if these are low, they would engage in shallow

processing. However, other factors related to the message can impact the amount of processing that people engage in (Petty & Wegener, 1998). In the area of health claims, motivation factors can be consumers' attitudes towards foods with health claims (Urala & Lähteenmäki, 2007) or their health interest (Roininen, Lähteenmäki, & Tuorila, 1999). Moreover, the personal relevance of a specific claim (Dean et al., 2012) or consumers' perceived appeal of a particular claim (van Trijp & van der Lans, 2007) can also affect the type of processing that consumers would engage in. Among the ability-related factors, consumers' objective or subjective knowledge of nutrition and relationships between food and health (Andrews et al., 1998; Grunert et al., 2011) or the amount of time available could be expected to play a role in consumer understanding of health claims.

Consumers are active information processors, meaning that they use their prior knowledge stored in their memory to elaborate on new information when confronted with it (Graeff & Olson, 1994). Consumers' memory is assumed to be organised as a network of associations consisting of concepts or nodes that are linked according to the relationships between them (Anderson, 1983). Concepts that are strongly associated will have stronger links between them (Anderson, 1983). During elaboration, some of the concepts stored in consumers' memory can be accessed through a process called "spreading activation". When a specific concept from consumers' associative network is activated, due, for example, to exposure to certain terms in a health claim, it causes spontaneous activation of other concepts that are linked to it. If the activation exceeds a threshold level, then the information stored in the activated concept becomes conscious (Anderson, 1983). The strength of the associations between concepts affects the amount of activation spread between them. "Spreading activation" can occur regardless of the type of processing that people engage in. Because of "spreading activation", consumers may make inferences which go beyond what is manifestly stated in the health claim (Graeff & Olson, 1994; Leathwood et al., 2007). For example, in many consumers' minds cholesterol and fat could be closely related. If a consumer would be confronted with a health claim regarding the benefits of low cholesterol, then the concept of fat may be activated in his/her mind. This could lead the consumer to interpret the claim as meaning that the product is low in fat (Andrews et al., 1998), even though this information is not in line with the information manifestly presented in the claim.

Consumers' associative networks consist, in part, of knowledge relevant for their buying decisions. This part of the associative network can be modelled by means-end chains theory (Olson & Reynolds, 2001). The basic model differentiates between three different types of knowledge that vary in level of abstraction from most concrete to the most abstract: attributes of the product, the consequences of using the product and the values or goals that using the product can help achieve. These three types of knowledge are linked to form so-called chains. The resulting chains are hierarchical because they link concrete product attributes to increasingly abstract levels of meaning like consequences and values which motivate consumers' choices (Gutman, 1982). This theory suggests that attributes of the product have value to the consumers to the extent that they help achieve desired consequences or goals (Olson & Reynolds, 2001). When it comes to processing of health claims, consumers may already have in their memory associations between health claims as product attributes and relevant consequences or goals that using products with health claims can help them achieve. The inferences that consumers may make when this part of their associative network is accessed during elaboration will be hierarchical inferences that link the concrete information in the health claim with more abstract consequences or goals that are important for consumers. By this logic, if consumers are confronted with a health claim about blood pressure, they may interpret it in terms of achieving good heart health which could contribute to their wellbeing.

The theoretical framework described so far is depicted in Figure 2.



based on Petty & Cacioppo 1996, Chen & Chaiken 1999 and Leathwood et al. 2007

Figure 2. Theoretical framework of consumer understanding of health claims

To sum up, when consumers are exposed to a health claim, if they attend to it, depending on their motivation and ability to process, they will engage in deep or shallow processing of the information. Regardless of the type of processing, the existing knowledge stored in their memory will be used during elaboration. Because of spreading activation in their associative network during elaboration, some of the meanings that people will attach to health claims will be inferences or hierarchical inferences which may go beyond what is stated in the claim. The totality of inferences and interpretations that a consumer attaches to a certain health claim can be seen as his/her understanding of the claim. However, some of the interpretations may not be in line with what the health claim was intended to communicate (according to the scientific

evidence behind the claim). A consumer can only be seen to adequately understand a health claim when he/she “makes inferences that are justified by the objective content of the claim without significant embellishment or exaggeration” (Leathwood et al., 2007, p. 477).

1.5. Overview of research papers

Three research papers based on empirical studies are reported in this PhD thesis. The reported papers contribute to a better understanding of how to assess consumer understanding of health claims, the factors that play a role in understanding and the ways to improve consumer understanding of health claims.

The *first research paper* (Chapter 3) addressed two of the three research questions in this PhD thesis, namely 1) *How can we assess consumer understanding of health claims* and 2) *Which factors play a role in consumer understanding of health claims*. The aim was to explore the motivation and ability-related determinants of consumer understanding of health claims and to assess the robustness of selected methods to assess consumer understanding. In a cross-sectional survey conducted in two countries, Italy and Denmark, two methods were adopted from prior literature to assess consumer understanding, the Consumer Understanding Test (CUT) (Rogeaux, 2010) and rating of pre-defined statements reflecting potential meanings of health claims (Grunert et al., 2011). Potential antecedents of understanding derived from dual processing theories and prior literature on consumer responses to health claims were assessed and their effect on consumer understanding was explored. We find that understanding of health claims varies by claim but a proportion of consumers can be seen as understanding the claims adequately. The motivation and ability-related factors were only weakly related to consumer understanding. The findings have implication for identifying groups of consumers more prone to misunderstand health claims.

The *second research paper* (Chapter 4) addressed two of the research questions in this thesis, 1) *How can we assess consumer understanding of health claims* and 3) *How can we improve the comprehensibility of health claims*. The aim of this study was to elicit the inferences that consumers make from different versions of a health claim in order to gain an understanding of how consumers’ understanding of health claims can be improved. Two sub-studies were conducted among consumers in Denmark. One sub-study used the Consumer Understanding Test

(CUT) method to elicit inferences, while the second one used face-to-face laddering interviews (Reynolds & Gutman, 1988) for elicitation of hierarchical inferences. Re-wording an authorised health claim or adding information did not lead to improvements in consumer understanding. These findings show that attempts to improve consumer understanding by providing more information or using more common terms may have the drawback of facilitating exaggerated interpretations. The study provides insights into the advantages and disadvantages of the selected methods for assessment of consumer understanding of health claims.

The *third research paper* (Chapter 5) sought to contribute to some extent to the three research questions in this thesis, 1) *How can we assess consumer understanding of health claims*, 2) *Which factors play a role in consumer understanding of health claims* and 3) *How can we improve the comprehensibility of health claims*. The purpose was to examine the effect of time constraints, in addition to claim and carrier-related factors, on consumer understanding of health claims. Moreover, the association between misunderstanding and intention to buy was explored. Consumer understanding was assessed in a cross-sectional survey conducted in Denmark. The online survey used a time constraint manipulation and measured understanding for products with various versions of health claims as well as a control option with no claim. Consumers' understanding of health claims was lower under time constraint, while factors related to the claim or the carrier made little difference. A second measure of understanding confirmed these results. Interpretations representing misunderstanding of health claims were linked with intention to buy, while objective understanding was not. The findings provide insights into the effect of an ability-related factor, time availability, on consumer understanding of health claims and the subsequent effect of understanding on intention to buy. Furthermore, the study broadens our understanding of ways to measure consumer understanding of health claims.

Throughout the empirical studies, the recommendations put forth by Leathwood et al. (2007) regarding the assessment of consumer understanding of health claims were followed. That is, assessments of understanding encompass elicitation of inferences and subsequent quantification of the prevalence of these inferences in the population. In research paper 1, the inferences used in the closed-ended questions were elicited in a small pilot test. The first study provided further insights into the application of the CUT method and the rating of pre-formulated statements on potential meanings of health claims method, which were useful in planning and conducting the

studies in research papers 2 and 3. Further, research paper 2 provided the basis for the statements reflecting potential meanings of health claims that were used in the quantitative methods in research paper 3.

These empirical studies have contributed to advance our knowledge of antecedents of understanding, ways to measure understanding and how to improve understanding by changes in wording or amount of information provided in the claims. The overarching conclusions and implications based on the three studies are detailed in Chapter 6 of this PhD thesis.

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Appendix 1.1

European Regulation on health claims made on foods

In the European Union the harmonized rules for the use of health claims made on food products are laid down in Regulation (EC) No 1924/2006. The Regulation was adopted to harmonize the rules of the Member States for use of nutrition and health claims in order to achieve two main objectives. The first one was to facilitate the free movement of foods within the EU. The second was to ensure consumer protection against untruthful and misleading claims on the market in order to facilitate informed choices (Gilsenan, 2011; Verhagen, Vos, Francl, Heinonen, & van Loveren, 2010).

The Regulation (EC) No 1924/2006 sets general conditions for use of all claims (Art. 3) and for nutrition and health claims in particular (Art. 5). Health claims can be used to the extent that they meet the following general conditions:

1. Health claims are scientifically substantiated, namely there is enough “generally accepted scientific evidence” supporting the link between the component and the claimed effect (Art 5.1). Moreover, the nutrient or ingredient claimed should be contained / reduced in appropriate or significant amount and is in a form that the body can use. The significant amount of the nutrient/ingredient claims should be provided by consuming a reasonable amount of the food (Art 5.1)
2. The average consumer “can be expected to understand the beneficial effects as expressed in the claim” (Art. 5.2)

The first criterion, regarding the scientific substantiation of health claims, is enforced in the EU. The European Food Safety Authority (EFSA) has been given the responsibility to evaluate the scientific substantiation behind health claims. EFSA evaluates health claims and issues an opinion on the scientific evidence supporting the claims. After the EFSA opinion is issued, the European Commission in cooperation with representatives of the Member States has the responsibility to authorise the health claim for use or to reject it (Gilsenan, 2011). In 2012 the EU Commission issued Regulation (EU) No 432/2012 which established a list of authorised health claims “other than those referring to the reduction of disease risk and to children’s

development and health”. The reduction of disease risk claims and children’s development and health claims undergo a case by case authorisation process.

At the EU level a register has been developed containing all nutrition and health claims. Thus, all the authorised health claims to date can be found in the EU Register on nutrition and health claims along with the conditions that food products should meet to carry the claims and EFSA’s opinions on the scientific substantiation of the claims (<http://ec.europa.eu/nuhclaims/>). Only those health claims that are authorised can be used by manufacturers when their food products meet the criteria for carrying the respective claim.

When it comes to the second criterion, regarding consumer understanding of health claims, there is no assessment procedure set by Regulation. Moreover, the Regulation does not provide any guidelines as to how consumer understanding should be defined or how it could be assessed. EFSA suggests a certain wording for each health claim; however, the assessment panel decided that assessing whether the wording would be understood by the average consumer was not under their competence (Verhagen et al., 2010). As there is no enforcement at the EU level for this criterion, it is left to the National Food Safety Authorities to make judgements on it (Verhagen et al., 2010).

Even though there is no requirement yet to provide evidence that the average consumer understands a health claim in order to use it, the Regulation does stipulate that there should be an expectation that the average consumer will understand the beneficial effect as intended (Leathwood et al., 2007). The average consumer is defined by Regulation as a consumer “who is reasonably well-informed and reasonably observant and circumspect, taking into account social, cultural and linguistic factors” (Regulation (EC) No 1924/2006, Recital 16). When health claims are aimed towards a specific group of consumers then the average consumer would have to be an average member of that particular group. The Regulation acknowledges though that the “average” consumer is not to be understood from a statistical standpoint. Decisions about the understanding of the average or typical consumer will come down to the National courts and authorities for specific cases when these arise (Regulation (EC) No 1924/2006, Recital 16).

Academics have challenged and debated the definition of the “average consumer” and suggest that the average consumer concept could be replaced by the intended or target consumer

(Leathwood et al., 2007; Nocella & Kennedy, 2012). Intended consumers would be those “consumers in search of specific benefits contained in health claims capable of satisfying their needs” (Nocella & Kennedy, 2012, p. 578). Similarly, in studies undertaken by food businesses (e.g. Danone) to assess consumer understanding of health claims, the average consumer is seen as the marketing target, meaning that users and non-users who would not be reluctant to buy the product under study were included in the studied sample (Rogeaux, 2010). *These views will be considered in the choice of inclusion criteria for sampling in the empirical studies covered in this PhD Thesis.*

Types of health claims defined in Regulation (EC) No 1924/2006

The EU regulation on the use of nutrition and health claims distinguishes between two main types of claims, nutrition and health claims. Nutrition claims are those claims that refer to the particular beneficial nutritional properties of a food (Regulation (EC) No 1924/2006, Art. 2.4). Health claims refer to “any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health” (Regulation (EC) No 1924/2006, Art. 2.5). The regulation describes several types of health claims (Regulation (EC) No 1924/2006 Art. 10.3 & Art. 1.3, Art. 13, Art. 14). The categories of health claims according to the EU regulation are described in Table 1.

Table 1. Types of health claims according to Regulation (EC) No 1924/2006 which sets the rules for use of health claims in the EU

Regulation Article	Health claim type	Definition	Example
Art. 10.3 Art. 1.3	General health claims	“Reference to general, non-specific benefits of the nutrient or food for overall good health or health-related well-being”. This category can refer as well to trademarks or brand names which could be seen as a nutrition or health claim.	Bone health support (Pravst & Kušar, 2015)
Art. 13	Function claims (i.e. Health claims other than those referring to the reduction of disease risk)	Health claims that describe or refer to: “a) the role of a nutrient or other substance in growth, development and the functions of the body; b) psychological and behavioural functions; or c) without prejudice to Directive 96/8/EC, slimming or weight-control or a reduction in the sense of hunger or an increase in the sense of satiety or to the reduction of the available energy from the diet”	Calcium is needed for the maintenance of normal bones (http://ec.europa.eu/nuhclaims/)
Art. 14.1 (a)	Reduction of disease risk claims	“Any health claim that states, suggests or implies that the consumption of a food category, a food or one of its constituents significantly reduces a risk factor in the development of a human disease”	Barley beta-glucans has been shown to lower/reduce blood cholesterol. High cholesterol is a risk factor in the development of coronary heart disease (http://ec.europa.eu/nuhclaims/)
Art. 14.1 (b)	Children development and health claim	Any health claim that makes a specific mention regarding children’s development and health (definition adapted from Hieke et al. (2016) due to lack of definition in the regulation)	Calcium is needed for normal growth and development of bone in children (http://ec.europa.eu/nuhclaims/)

The majority of health claims currently authorised in the EU is represented by function claims (Art. 13), according to the EU register of nutrition and health claims. Only few children's development claims and reduction of disease risk claims have been authorised so far (<http://ec.europa.eu/nuhclaims/>).

Chapter 2. Method and research design

This chapter presents the methodological approach taken in this thesis and provides details regarding the research design of the empirical studies.

2.1. Research approach

Consumer understanding of health claims has received little attention in prior research. According to its definition in this thesis (see Chapter 1), understanding is largely a matter of inferences that consumers make based on health claims. This implies that the study of consumer understanding should encompass two main steps. The **first** step covers the elicitation of meanings and inferences that consumers make regarding foods with health claims. The **second** step will then have the purpose of quantifying the elicited meanings and inferences to identify their prevalence in the population.

This approach, depicted in Figure 1, is in line with recommendations by Leathwood, Richardson, Sträter, Todd, and van Trijp (2007) regarding the assessment of consumer understanding. Therefore, this was the approach to assess understanding taken in this thesis. The two steps approach taken to measure understanding in this thesis ensures that when consumers are asked to rate certain statements in closed-ended questions, the statements that they are exposed to can realistically be expected to be made by consumers.

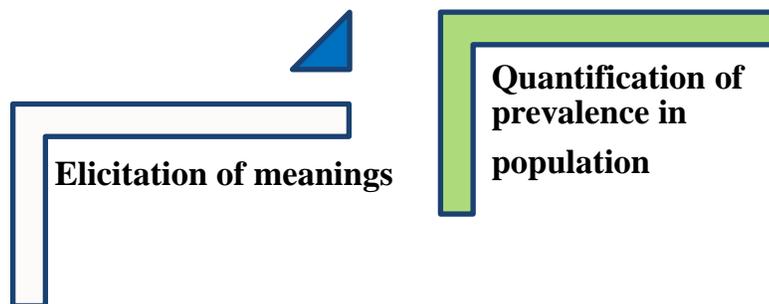


Figure 1. Two step approach to assess consumer understanding of health claims

In this thesis, both qualitative and quantitative research methods were applied. Qualitative methods were used in relation to step one in the assessment of understanding while the quantitative methods contributed to step two of the assessment. Given the use of qualitative as well as quantitative methods, this thesis falls under the mixed methods approach (Johnson, Onwuegbuzie, & Turner, 2007).

The mixed method approach involves the mix of qualitative and quantitative elements in one study or in one project in order to achieve a broad but also deep understanding of the topic as well as for corroboration purposes. Given the prevailing focus on quantitative methods in this thesis, the type of approach taken can be further detailed as quantitative dominant mixed methods research (Johnson et al., 2007). There are several rationales for the use of mixed methods (Johnson et al., 2007). Some of the most relevant for this thesis are that they allow for triangulation (i.e. looking for convergence of results between different methods investigating the same phenomenon); complementarity (i.e. results from one method can allow for further elaboration of results from another method); development (i.e. the results of one method contribute to inform another method) or expansion (i.e. looking to expand the breadth of investigation) (Greene, Caracelli, & Graham, 1989). These broad aims or rationales were pursued in this thesis by using several qualitative and quantitative assessments of consumer understanding of health claims.

2.2. Research design of empirical studies

The three papers reported in this thesis are based on four empirical studies. One empirical study used both qualitative and quantitative methods and was reported in paper 1, two empirical studies used a dominantly qualitative approach and were reported in paper 2, while the remaining study used a dominantly quantitative approach and was reported in paper 3.

An overview of the empirical studies and methods used is provided in Figure 2.

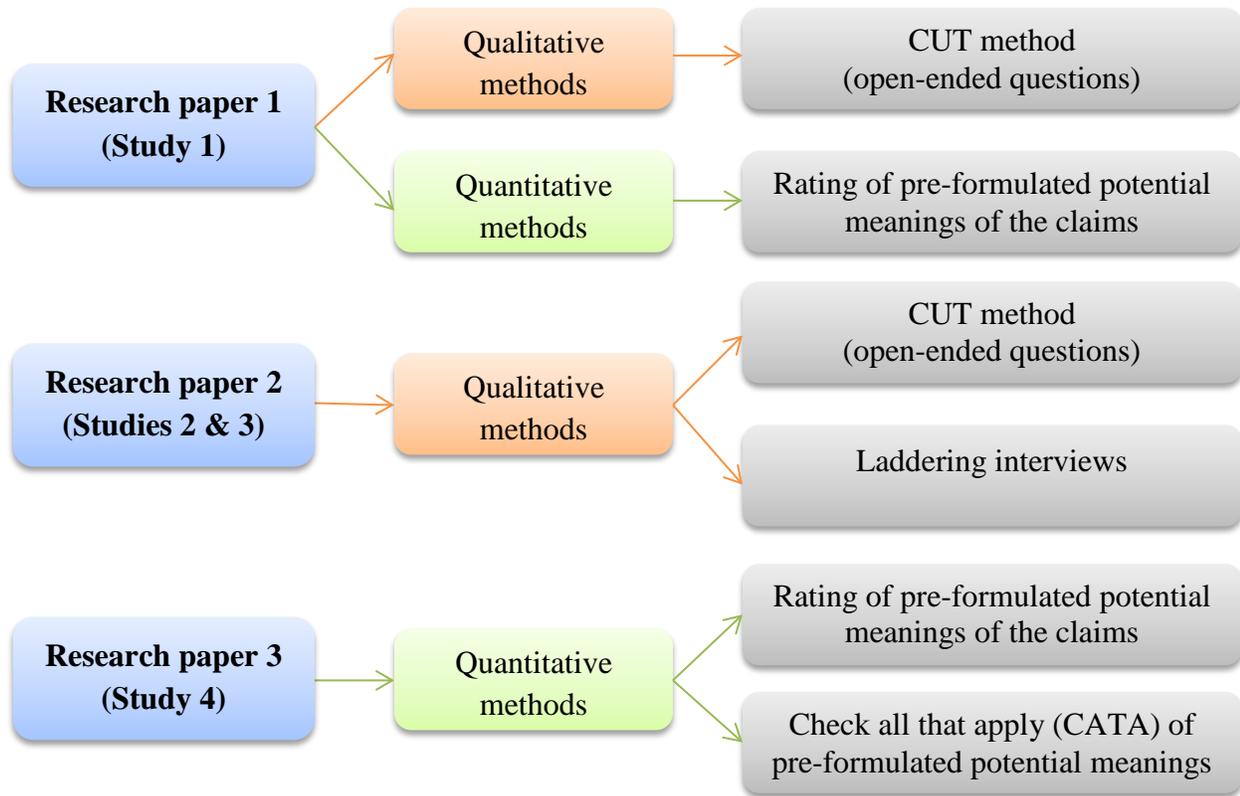


Figure 2. Research design of empirical papers

2.2.1. Study 1

The first empirical study used a mixed methods approach as it combined a qualitative method and a quantitative method where the latter was dominant. This study is reported in paper 1 (Chapter 3) and contributes to answering research questions 1, referring to ways to assess consumer understanding of health claims, and 2, related to factors that play a role in consumer understanding. A cross-sectional online survey with a between-subjects experimental design was conducted to assess consumer understanding of three health claims on olive oil. Furthermore, the survey measured potential antecedents of consumer understanding. The study was conducted in Denmark and Italy. Part of the data collected in this study is not covered in this thesis and was reported elsewhere (Contini et al., 2015).

Data were collected in collaboration with nationwide market agencies in Denmark and Italy in December 2013. The online survey was targeted at respondents between 18 to 74 years old who purchase and use olive oil. The samples, about 1000 respondents per country, represented a good

diversity in socio-demographic characteristics. Two methods adopted from prior literature were used to assess consumer understanding. One method used open-ended questions, and the second consisted of rating pre-formulated statements reflecting potential interpretations of the health claims (Grunert, Scholderer, & Rogeaux, 2011). Potential antecedents of consumer understanding derived from prior literature and dual-processing theories were assessed using measures adopted from prior literature (e.g. Lähteenmäki et al., 2010; van Trijp & van der Lans, 2007).

The data gathered by means of the open-ended questions were content analysed and subsequently, consumers were categorised into one of three understanding groups based on their overall answers. For the rating method, an index was computed as the difference between the means of the safe interpretations (those statements that are in line with the scientific evidence behind the health claim) and the risky ones (those statements that are not in line with the scientific evidence behind the health claim). The decisions whether certain interpretations were in line with the scientific evidence behind the health claims were taken in collaboration with research assistants with a background in nutrition. Finally, regression analyses were conducted to assess the role of the potential antecedents of consumer understanding of health claims considered in the study.

2.2.2. Studies 2 & 3

The second and third empirical studies used qualitative methods adopted from prior literature on consumer responses to foods with health claims for data collection. The studies were reported in paper 2 (Chapter 4) and contributed to answering research questions 1, related to ways to assess consumer understanding of health claims, and 3, related to ways to improve the comprehensibility of health claims. The studies were conducted between July and October 2014 in Denmark.

Data were collected in collaboration with a professional market agency in Denmark. The study targeted respondents above 18 years old who were Danish speakers, who have some responsibility for food shopping in their household, who are interested in health at least to some extent when shopping and who buy and use the carrier products considered (yoghurt and bread). Similarity in individual characteristics such as age, gender and education between the samples of

Studies 2 and 3 was ensured by the market agency. The similarity in samples allows comparison of the results from the two qualitative studies. Overall, 300 respondents participated in Study 2 and 109 in Study 3. Some of the respondents in Study 2 (N=114) have seen stimuli which are not covered in this thesis, thus they were excluded from the analyses.

Study 2 used the CUT method (Rogeaux, 2010) based on open-ended questions in a cross-sectional online survey with an experimental design. Consumers answered open-ended questions regarding five versions of a beta-glucans health claim on either fruit yoghurt or wholegrain bread. The third study used face-to-face laddering interviews (Reynolds & Gutman, 1988). Details regarding the procedure used in the laddering interviews are provided in paper 2 (Chapter 4). The interviews were carried out by two interviewers trained in the laddering method and generally lasted between 30 and 60 minutes. All participants in Studies 2 and 3 completed some background measures as well, which were not reported in this thesis as they are outside its purpose.

The data gathered in Study 2 were analysed in two steps. First, a content analysis was carried out and frequencies of the identified codes were reported. Subsequently, each respondent was categorized into one of four understanding groups based on his/her overall answer to the open-ended questions, and the prevalence of respondents in each group was reported. In Study 3, the data were first content analysed according to level of abstraction of the laddering elements (i.e. attributes, consequences and values). Next, hierarchical value maps (HVMs) were created in MECAnalyst+ for each of the five versions of the beta-glucans health claim.

Studies 2 and 3 used qualitative methods aimed at elicitation of interpretations and inferences that consumers make from five versions of a beta-glucans health claim. The study offered important input for Study 4 where pre-formulated statements developed based on findings of Studies 2 and 3 were quantified.

2.2.3. Study 4

The last empirical study employed quantitative methods and was reported in paper 3 (Chapter 5). The study contributed to all three research questions in this thesis. A cross-sectional online survey with a between-subjects experimental design was conducted to assess consumer

understanding of two health claims (a) vitamin D claim on fruit yoghurt and b) beta-glucans claim on fruit yoghurt or wholegrain bread). There were five versions of each health claim, the same as in Studies 2 and 3. Moreover, a control group was exposed to the carrier products with no health claim. Part of the data collected in this study is not covered in this thesis and will be reported elsewhere.

Data were collected in collaboration with a professional market agency in Denmark in September-November 2016. The respondents had to fulfil the same inclusion criteria as in Studies 2 and 3. A total of 2236 respondents completed this study. The sample provided a good spread in socio-demographic characteristics.

Two methods adapted from prior literature were used to assess consumer understanding of health claims (e.g. Bilman, Kleef, Mela, Hulshof, & van Trijp, 2012; Grunert et al., 2011). Both methods used 16 pre-formulated statements reflecting potential interpretations of the health claims which were developed based on results of Studies 2 and 3. One method (Rating method) asked participants to rate the statements on a Likert type scale while the second method (CATA method) asked participants to select all statements that applied and additionally gave them a “none of the above” option. In the target group (products with health claims) the instructions referred to how well the statements reflect the meaning of the claim, while in the control group (products with no health claims), the instruction was related to how well the statements reflect a benefit of the product.

Moreover, the study used a *time constraint manipulation*. Respondents in the target group or control group were randomly assigned to either a no time constraint condition or to a time constraint condition. In the time constraint condition, respondents were given a limited time to complete the understanding task. The limit was set to the 40th percentile of the time used by respondents to complete the tasks in a pilot test of the measures (computed separately for products with claims vs. products without claims). Consumers’ perceived relevance of the claims and their intention to buy the products with claims were assessed using measures based on prior literature (e.g. Lähteenmäki et al., 2010; van Trijp & van der Lans, 2007; Zaichkowsky, 1994).

The pre-formulated statements used in the measures of understanding reflected several types of interpretations. To determine levels of objective understanding, it was decided a-priori for each

statement whether it reflects a justifiable or unjustifiable interpretation. The decisions of whether certain interpretations were in line with the scientific evidence behind the health claims were taken in collaboration with researchers with a background in nutrition. Analyses of variance and regression analyses were conducted to assess the impact of time constraint on understanding and the relationship between understanding and the intention to buy.

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Chapter 3. Consumer understanding of health claims: Motivation and ability related antecedents¹

Abstract

The European Union regulation on the use of nutrition and health claims on foods (*Regulation* (EC) No 1924/2006) specifies that health claims should be understood by consumers, due to concerns that health claims may mislead consumers. The extent to which consumers adequately understand health claims can be influenced by several factors. The present study aimed to examine the antecedents of consumer understanding of health claims. In an online survey conducted in two countries, Denmark (n=1024) and Italy (n=1000), two methods, the Consumer Understanding Test (CUT) and the rating of pre-formulated statements reflecting potential meanings of health claims, were used to assess consumers' understanding of health claims. The data were analysed using regression analysis. Our findings suggest that understanding of the health claims was rather high; however, there were distinctions between different claim wordings and many consumers made vague interpretations of the health claims. Consumers' motivation and ability to process the health claims were weakly related to understanding, with socio-demographics and claim type playing a role as well. Several implications of these findings for policy makers are discussed.

Keywords: health claims; understanding; motivation to process; ability to process

¹ **This chapter is under review as:** Stancu, Violeta; Contini, Caterina; Grunert, Klaus G.; Lähteenmäki, Liisa; Juhl, Hans Jørn; Casini, Leonardo; Romano, Caterina; Scozzafava, Gabriele. Consumer understanding of health claims: Motivation and ability related antecedents.

3.1. Introduction

The healthiness of foods is an important criterion considered by consumers in their food choices (Grunert, 2005; Steptoe, Pollard, & Wardle, 1995) as they are increasingly concerned with their health (Lähteenmäki, 2013). As response to these concerns, manufacturers of products with health-related benefits can communicate these benefits to consumers by using health claims, which are any claims that "state, suggest or imply that a relationship exists between a food category, a food or one of its constituents and health" (Regulation (EC) No 1924/2006).

Health claims are expected to facilitate informed choices (Leathwood, Richardson, Strater, Todd, & van Trijp, 2007; Nocella & Kennedy, 2012) and promote healthy eating (Williams, 2005), thus contributing to public health (Ippolito & Mathios, 1991). In the European Union, the use of health claims is governed by Regulation (EC) No 1924/2006, which requires that health claims can be used only if, in addition to sound scientific evidence, the average consumer can be expected to understand them. This requirement is due to concerns that consumers may be misled by health claims (recital 16 in Regulation (EC) No 1924/2006).

There is a large body of literature on consumers' responses to health claims (for recent reviews: Lähteenmäki, 2013; Pothoulaki & Chryssochoidis, 2009), however, studies on consumer understanding of health claims are scarce (for recent reviews: Nocella & Kennedy, 2012; Wills, Storcksdieck Genannt Bonsmann, Kolka, & Grunert, 2012). Yet, understanding is essential as it can impact choices (van Trijp & van der Lans, 2007; Wills et al., 2012) and lack of it can affect market efficiency by invalidating the efforts of the food industry in communicating the health claims in a responsible manner (Nocella & Kennedy, 2012).

Prior literature has used several measures of understanding, from qualitative methods (e.g. interviews, Svederberg, 2002), to mixed methods (e.g. the CUT method, Grunert, Scholderer, & Rogeaux, 2011) to quantitative methods (e.g. rating of potential meanings of health claims, Bilman, van Kleef, Mela, Hulshof, & van Trijp, 2012). However, there is still no commonly accepted standard for a method to measure understanding and prior studies call for more research in this area (e.g. Wills et al., 2012).

Not only is there a lack of insight into levels of consumer understanding of health claims and standardized measures to assess it, but there is also little knowledge of which factors are related to understanding. Motivation and ability-related factors are potentially important determinants of understanding (Grunert et al., 2011); however, the range of such factors explored by prior literature is quite limited. The aim of the present study was twofold, namely to identify which of the motivation and ability-related factors considered are related to consumer understanding of health claims and to evaluate the robustness of selected methods to assess understanding of health claims.

The structure of the rest of the paper is as follows. The next section presents findings of prior literature and the theoretical background of this study. Further, the methodology of the study is described and the results of the data analyses follow. Finally, we conclude with some discussions and implications for future research and for public policy.

3.2. Prior literature and theoretical background

Consumer understanding of health claims is required by the EU regulation (Regulation (EC) No 1924/2006), yet no definition of understanding or reference to how it should be assessed is suggested. Consumer understanding of health claims can be viewed as an outcome of information processing. Dual processing theories, like the Elaboration Likelihood Model (ELM) and the Heuristic-Systematic Model (HSM), postulate that there are different modes of information processing, similar to the distinction between the two systems of cognition (Kahneman & Frederick, 2002). The ELM distinguishes between central route processing, involving more time and effort to assign meaning to a message, and peripheral route processing, being fast and easy and relying more on available cues and learned associations (Petty & Cacioppo, 1986). In the HSM these two types of processes are named as systematic and heuristic processing (Chen & Chaiken, 1999). Peripheral or heuristic processing of health claims can lead to irrelevant or general inferences, whereas central or systematic processing may lead to more inferences, due to increased cognitive effort and prior knowledge that makes more concepts accessible at the point of processing (Grunert et al., 2011; Lähteenmäki, 2013).

When processing health claims, consumers may assign meanings to them which are not manifestly present in the claim. These can be seen as inferences which go beyond the manifest

information in the health claim (Kardes, Posavac, & Cronley, 2004). Assuming that consumers' memory is organized as an associative network of nodes and links, spreading activation theory posits that when a concept is activated it can lead to activation of other linked concepts (Anderson, 1983). This theory suggests how inferences can occur when consumers are faced with a health claim. For example, consumers were found to interpret "no cholesterol" claims as "low fat" (Andrews, Netemeyer, & Burton, 1998), which could be due to the close association between fat and cholesterol in consumers' associative network. This shows that consumers' understanding is influenced by their existing knowledge (Leathwood et al., 2007).

According to prior research, the assessment of consumers' objective understanding of health claims implies comparison of consumer understanding to the scientific evidence behind the health claim (Bilman et al., 2012; Grunert et al., 2011; Harris, Thompson, Schwartz, & Brownell, 2011). In this study we use the definition of objective understanding developed by Leathwood et al. (2007, p. 477), which is based on information processing theories and accounts for the role of inferences in understanding, namely adequate understanding implies that the average consumer *"makes inferences that are justified by the objective content of the claim without significant embellishment or exaggeration"*.

Few prior studies have assessed consumer understanding of health claims. Some of these find limited understanding of health claims (Harris et al., 2011; van Trijp & van der Lans, 2007) and an extent of confusion (Svederberg, 2002), while others show that over-interpretation of benefits is limited (Bilman et al., 2012), and most consumers make rather safe inferences (i.e. those that are in line with the scientific evidence behind the health claim) (Grunert et al., 2011).

In terms of determinants of understanding there is even less prior evidence. In the view of dual processing theories, the level of processing that consumers engage in when faced with messages is mainly determined by their motivation and ability to process the information (Petty & Cacioppo, 1986). High motivation has been linked to higher information elaboration, while ability is needed in order to comprehend the information (Moorman, 1990). Based on dual processing theories, consumers with high motivation and high ability are more likely to process the health claims in depth, elaborate more on the task relevant information and make more product specific inferences. On the other hand, when either motivation or ability is low,

consumers are more likely to engage in shallow processing, meaning that they are more likely to make general or vague inferences (Sujan, 1985; Wansink, 2003).

Motivation and ability-related factors can be either enduring (i.e. characteristics of the person), or stimulus-induced (i.e. related to a particular stimulus that consumers are exposed to) (Moorman, 1990). In the present study, these both types of motivation and ability-related factors were addressed. In order to identify relevant health claim specific factors, insights of prior studies on consumer perceptions of foods with health claims were considered (Lähteenmäki et al., 2010; van Trijp & van der Lans, 2007; Verbeke, Scholderer, & Lähteenmäki, 2009).

Motivation factors used in prior research on consumer understanding of health claims (e.g. Grunert et al., 2011) were attitudes towards functional foods (Urala & Lähteenmäki, 2007) and general health interest (Roininen, Lähteenmäki, & Tuorila, 1999). Another important factor with a role in information processing is perceived relevance of the information (Petty & Wegener, 1998). The relevance of the health claim can affect consumer responses in terms of perceived personal benefit, perceived healthfulness of product or intention to buy (Dean et al., 2012; Wong et al., 2013). While relevance of the claim is associated with such consumer responses, its link to understanding of health claim has not been explored to our knowledge. Relevance of the health claims can be seen as a motivation factor that is specific to the health claim (i.e. stimulus specific factor). Other health claim-specific factors, which could play a motivational role in consumer understanding, are consumer perceptions related to the claim's appeal (e.g. importance of the claim for themselves, how interesting or how credible is the health claim for the consumer).

From the perspective of dual processing theory it is challenging to establish the expected direction of the relationship between motivation factors and understanding, as higher motivation is expected to lead to higher elaboration and more specific inferences; however, these will not necessarily be safe interpretations of the health claim. Prior studies on consumer understanding of health claims or health symbols found that consumers with the most positive attitudes were those making risky interpretations of health claims, those that are not in line with the scientific evidence behind the health claim (Grunert et al., 2011), while high general health interest was associated with more correct interpretations of health symbols (Grunert, Fernández-Celemín, Wills, Bonsmann, & Nureeva, 2010). Based on these prior insights from the literature we expect

that positive attitudes towards foods with health claims will have a negative impact on understanding, as consumers with favourable attitudes are more likely to expect exaggerated benefits from foods with health claims compared to those with less favourable attitudes and thereby being more circumspect in relation to health claims. A similar effect could be expected for the motivation factors which are health claim specific.

For ability to process, prior studies on consumer understanding of health claims have considered consumers' objective or subjective nutrition knowledge (Andrews et al., 1998; Grunert et al., 2011), which can be seen as enduring ability-related factors (Moorman, 1990). Additionally, stimulus-induced ability to process can impact consumer understanding of a particular claim (Moorman, 1990). The subjective understanding of health claims and familiarity with the health claims can be seen as stimulus-induced ability-related factors. Even though these have been studied in prior literature on consumer perceptions of health claims (van Trijp & van der Lans, 2007), their association with understanding of the health claims has remained, to our knowledge, largely unexplored.

From the perspective of dual processing theories, higher ability to process the health claims can lead to more specific inferences as result of deeper processing of information (Petty & Cacioppo, 1986). While specific inferences can be safe or risky interpretations of the health claim, we expect consumers having more knowledge about health claims to be better able to make safe interpretations, thus, overall we expect a positive impact of the ability-related factors on consumer understanding. However, some prior studies find no evidence of a link between knowledge and interpretations of health claims (Andrews et al., 1998; Grunert et al., 2011), while others did find a positive association between knowledge and number of correct interpretations of nutrition information (Grunert et al., 2010).

Finally, several studies have found that impacts of health claims depend on consumer-related characteristics (i.e. socio-demographics) and vary by claim, in addition to motivation and ability-related factors (Lähteenmäki, 2013; Saba et al., 2010; Wong et al., 2013). Therefore, the impacts of the different claims used in the present study; that is a function claim, a risk reduction claim and a reformulated version of the function claim (i.e. claim type), and socio-demographics on consumer understanding of the health claims were taken into account.

The overall conceptual model for this study is presented in Figure 1.

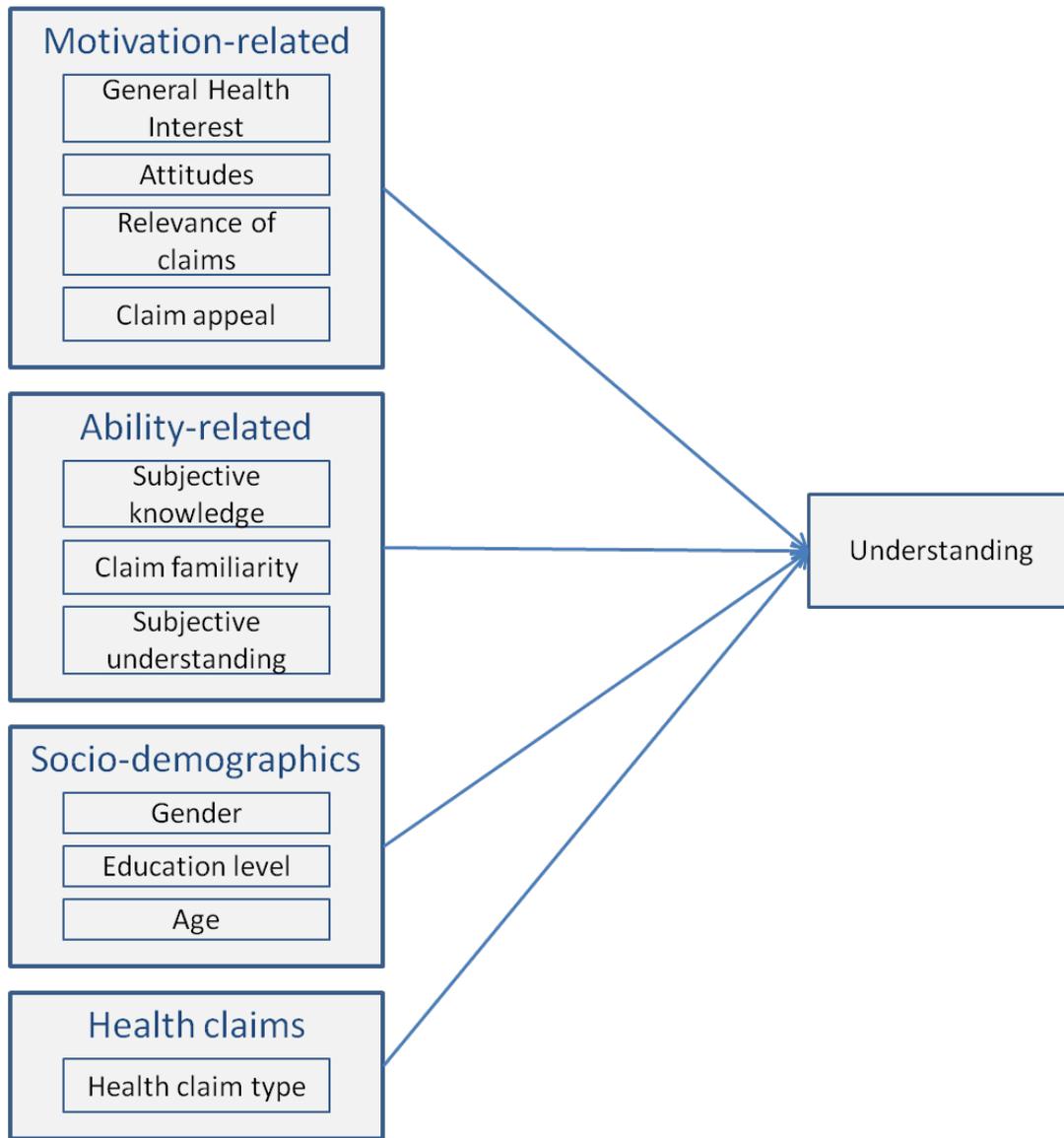


Figure 1. Conceptual model of antecedents of consumer understanding of health claims

3.3. Method

3.3.1. Design

One of the key context factors in relation to health claims is the carrier product, as consumers' responses to health claims are found to differ widely depending on the carrier-claim

combinations (Krutulyte et al., 2011; Lähteenmäki, 2013). The carrier product, extra virgin olive oil, was selected due to the fact that it is naturally healthy and can, thus, carry health claims that are not based on enrichment, which is usually a deterrent for consumers (Lähteenmäki et al., 2010).

Three health claims were used as stimuli. One was a risk reduction claim which is not authorised in the EU but is authorised in the US, the second one was a health claim authorised in the EU and the third one was a reformulation of the second one to make it more consumer friendly.

1. **Health claim 1:** text ‘2 tablespoons (ca. 20 g.) of olive oil per day may reduce the risk of coronary heart disease’ (claim not authorised in the EU but approved in US)
2. **Health claim 2:** text ‘Olive oil polyphenols contribute to the protection of blood lipids from oxidative stress. The beneficial effect is obtained with a daily intake of 20 g of olive oil’ (claim authorised in the EU)
3. **Health claim 3:** text ‘20 g of this olive oil per day help to protect blood lipids from harmful reactions’ (consumer friendly version of health claim 2 developed for the purpose of the present study)

Understanding of health claims was measured by means of a cross-sectional survey implemented online, in a between-subjects design. Each participant was randomly assigned to assess one of the three health claims. Understanding was measured at the beginning of the survey. The motivation and ability-related measures were administered after assessing understanding of the health claim. Some socio-demographic and background measures were administered before the understanding measure (e.g. frequency of olive oil consumption) and others at the end of the survey (e.g. perceived health status). Part of the background factors are not covered in the present paper and were presented elsewhere (Contini et al., 2015).

3.3.2. Participants

Data were collected by means of web-based surveys in Denmark and Italy in December 2013. In both countries participants were recruited from national panels by professional market research agencies.

The selection of the two countries was based on differences in the role of the carrier product under study in the diets of consumers. In Italy, a Mediterranean country, olive oil is an integral part of the diet, whereas in a Northern country, Denmark, olive oil is not a traditional element of the diet. The target group were respondents between 18-74 years old who were buyers and users of olive oil. The Danish sample consisted of 1024 respondents and the Italian one of 1000 participants. These samples provided good variety in terms of socio-demographics (Table 3).

3.3.3. Measures

Understanding measures

Objective understanding of the health claims was assessed using two methods that have been applied in prior literature, namely the Consumer Understanding Test method (CUT) (Rogaux, 2010) and the rating of pre-formulated statements related to potential inferences from the health claims (Bilman et al., 2012; Grunert et al., 2011).

Understanding measure 1: Consumer Understanding Test method (CUT)

The CUT method has been used in prior literature on consumer understanding of health claims (Grunert et al., 2011). The method uses two open-ended questions to measure consumer understanding of health claims and suggests a coding scheme for the analysis of the answers.

In the present study, the CUT method was used as follows. Participants saw on their screen an instruction to “*imagine seeing an extra virgin olive oil with the following claim on it*” and then the text of one of the three health claims was displayed below the instruction. On the same screen, the following two open-ended questions, adapted after Grunert et al. (2011), from the CUT method were displayed one after the other and respondents had space to insert their answers for each question:

- *If you had to tell a friend what (the product) does, what would you say?*
- *And if you had to tell your friend how it works?*

The wording of the questions was slightly adapted as respondents were not shown an entire product unlike in the prior study; however, the core of the questions was not modified.

The CUT method suggests that based on their answers consumers could be grouped into those making safe, risky or other inferences. Consumers in the *safe group* are those making safe inferences that are in line with the scientific evidence behind the claim (i.e. the objective meaning of the claim), those in the *risky group* make risky inferences that are not in line with the scientific evidence behind the claim and those who cannot be classified as safe or risky are categorized to the *other group*.

Understanding measure 2: Understanding index

This second understanding measure involved rating of pre-formulated statements reflecting potential meanings of the health claims. It was always used after the CUT measure, in order to avoid that the pre-formulated statements used in this measure would bias the answers to the open-ended questions in the CUT measure. Consumers saw the same health claim in both measures.

In this method, respondents saw the same instruction as in the CUT method to “*imagine seeing an extra virgin olive oil with the following claim on it*”. Below this instruction they were shown again the same health claim they had seen in the CUT method. On the same screen, 15 statements were displayed in a random order and respondents were asked to rate the degree to which they agreed or disagreed that the statements reflected the meaning of the claim on a 7-point agreement scale ranging between “strongly disagree” and “strongly agree”.

To inform the development of these statements, open interviews were conducted prior to the survey. The statements were then developed in collaboration with researchers with a nutrition background in order to have statements that reflect objectively safe (i.e. in line with the scientific evidence for the claim) or risky (i.e. not in line with the scientific evidence for the claim) inferences (see Table 1). As the health claims were referring to the same final health benefit (heart health) the same 15 statements were used for all three health claims. The 15 statements used and their categorization is presented in Table 1. The answers to these pre-formulated statements were used to compute an index of understanding based on the objective categorization of the statements done by researchers with a background in nutrition. The index was computed as follows:

$$\text{Understanding index} = \text{Average score on safe items} - \text{Average score on risky items}$$

The index reflects the difference between consumers' agreement/disagreement with the safe statements on average and their agreement/disagreement with the risky items on average, giving an indication of people's ability to differentiate between the safe and risky statements. Thus, higher values of the index represent higher understanding. For the analysis one understanding index measure was created containing the pooled scores for the three health claims.

Table 1. Pre-formulated statements that consumers rated in terms of whether they reflect the meaning of the health claims under study and their objective categorization

Pre-formulated closed-ended statements	Categorization of statements (safe = in line with scientific evidence behind the claim; risky = not in line with scientific evidence behind the claim)
<i>This extra virgin olive oil...</i>	
Protects blood vessels from getting filled with fat	Safe interpretation
Protects the blood lipids from getting stuck to the blood vessels	Safe interpretation
Helps to protect blood lipids against damage from oxidation	Safe interpretation
Prevents blood clots	Safe interpretation
Prevents from developing cardiovascular diseases or metabolic syndrome	Safe interpretation
Helps to maintain a normal blood pressure	Risky interpretation
Is healthy	Safe interpretation
Is a good type of oil	Safe interpretation
Is good for the whole body	Risky interpretation
Is healthy for the joints	Risky interpretation
Is good for the skin	Risky interpretation
Moisturizes the body from within	Risky interpretation
Reduces the risk of coronary heart disease	Safe interpretation
Reduces the risk of cardiovascular diseases	Safe interpretation
Reduces the risk of heart diseases	Safe interpretation

Motivation and ability-related factors

Consumers' attitudes towards foods with health claims and their interest in health were measured as general motivation-related factors, while claim appeal and relevance of the health claims under study were measured as claim-specific motivation-related factors. Attitudes towards foods

with health claims were measured with 20 selected items adapted from the scale developed by Urala and Lähteenmäki (2007). The wording “functional foods” was replaced by “foods with health claims” or “health claims” in the present study due to this study’s focus on health claims. Interest in healthy eating was measured with General Health Interest, an 8-items scale developed by Roininen et al. (1999). Claim appeal was assessed with the following five items in relation to each claim: “*How convincing is this claim for you?*” adapted from Verbeke et al. (2009) and rated on a 7-point rating scale ranging between “*not at all convincing*” and “*extremely convincing*”; “*How credible for you is this claim?*” rated on a 7-point rating scale ranging between “*not at all credible*” and “*extremely credible*”, “*How interesting for you is this claim?*” rated on a 7-point rating scale ranging between “*not at all interesting*” and “*extremely interesting*”, and “*How important for you is this claim?*” rated on a 7-point rating scale ranging between “*not at all important*” and “*extremely important*”, all adapted from van Trijp and van der Lans (2007) and finally, “*How attractive is this claim for you?*” adapted from Lähteenmäki et al. (2010) and rated on a 7-point scale ranging between “*not at all attractive*” and “*extremely attractive*”.

To assess relevance of the health claims, respondents were asked whether they or someone in their family had any of a number of health conditions (e.g. high cholesterol levels; high blood pressure; cardiovascular diseases, etc.). The measure is adapted from prior literature (Dean et al., 2012). As the health claims considered in this study relate to the final benefit of heart health, consumers who said that either they or someone in their family/household had high blood cholesterol levels or heart problems were categorized into the *high personal relevance group*, otherwise they were assigned to the *low personal relevance group*.

Consumers’ subjective knowledge of foods with health claims was assessed as general ability-related factor, while consumers’ familiarity with the health claims and their subjective understanding of the health claims were assessed as claim specific ability-related factors. Consumers’ subjective knowledge was measured with a scale adapted from Flynn and Goldsmith (1999), where the “fashion/ fashion clothing” wording was replaced for this study by “foods with health claims”. Claim familiarity was measured for each health claim under study with one item, “*How familiar for you is this claim?*”, rated on a 7-point rating scale ranging between “*not at all familiar*” and “*extremely familiar*”. Subjective understanding of each health claim under study

was assessed with one item adapted from van Trijp and van der Lans (2007), “*How difficult or easy is it for you to understand this claim?*”, rated on a 7-point rating scale ranging between “*very difficult to understand*” and “*very easy to understand*”.

Socio-demographics

A number of socio-demographic characteristics have been measured in this study (Table 3). Respondent’s gender, age and education level have been used in the present analyses. For education and age, dummy variables were used in the analyses. For age, three dummies were created to reflect the following age groups: between 18 and 34 years old; 35 to 55 years old and above 55 years old. For education, a dichotomous variable was used where those respondents with Bachelor degree or higher were assigned to the high education group and the others to the low education group.

3.3.4. Data analyses

Data analyses were conducted using NVivo 10 and SPSS 21 for the coding of the open-ended measures while SPSS 21 was used for the rest of the analyses.

Coding of answers to the CUT method to assess understanding

Answers to the CUT questions were coded according to a scheme containing safe, vague and risky inferences (Table 2) in collaboration with researchers with a background in nutrition. Some respondents made several types of interpretations (e.g. safe and risky and vague). Based on the types of interpretations that consumers had made they were categorized into three groups, ***safe***, ***risky*** or ***other***. Respondents who had made any risky interpretations in their answers were categorised as ***risky***. Similarly, those who had made only vague inferences were categorised as ***risky***, if some of these interpretations were benefit-related. Those who had made at least one safe interpretation but no risky interpretations were categorized as ***safe***, and finally those who had made only irrelevant or vague interpretations or gave no answer were categorized as ***other***. Thus, eventually each participant was assigned to one of the three categories (i.e. safe, risky or other). The categorization of respondents in one of the three groups was pooled together in one measure across the three health claims.

Table 2. CUT method coding scheme

Codes	Description
Safe inferences	<p><i>Safe inferences</i></p> <p>The statements are in line with the scientific evidence behind the health claims with no substantial embellishment or exaggeration (e.g. the product would reduce the risk of heart disease, the product would help protect against blood cloths, the product would lower cholesterol levels)</p> <p><i>Restatements of the health claim</i></p> <p>The statements consist of play-backs of parts of the health claim or entire health claim</p>
Vague benefit-related inferences	<p>The statements are related to the benefit claimed, however they are not specific enough to be safe (e.g. good for the blood, good for the heart)</p>
Vague general inferences	<p><i>Vague general inferences</i></p> <p>The statements express a vague general notion (e.g., a healthy product, good for the body) or general statements about olive oil (e.g. it is a good type of oil, better than animal fat, has unsaturated fats)</p> <p><i>Other inferences</i></p> <p>Any other answers not covered above (e.g. don't know)</p>
Risky inferences	<p><i>Risky inferences</i></p> <p>The statements are not in line with the scientific evidence behind the health claim. Also includes those statements which are clear over-exaggerations of effects (e.g. it would help with all kinds of diseases, it would reduce stress in the entire body, it prevents one from getting sick)</p> <p><i>Unrelated inferences</i></p> <p>The statements refer to a vague health benefit which is unrelated to the one stated in the claim (e.g. good for the skin, healthy for the joints)</p>

Computation of motivation and ability related factors

The ***GHI scale*** had a high reliability in both countries, Cronbach's alpha=.76 in Italy / .82 in Denmark, thus a composite variable was computed by averaging the scores of the GHI items. The negatively worded items were reversed prior to the computation so that higher values represent higher levels of general health interest.

Attitudes towards food with health claims have been assessed with 20 selected items adapted from the measure developed by Urala and Lähteenmäki (2007). As only a selected number of items were used from the original scale, an exploratory factor analysis with maximum likelihood extraction method and varimax rotation, as used by Urala and Lähteenmäki (2007), was run on the 20 attitude items in order to identify the underlying structure of the scale. The analysis (Appendix 3.1) revealed a two-factor structure in Italy and a three-factor structure in Denmark. However, when a two-factor structure was imposed on the Danish data, the structure of the items was the same as in Italy. Therefore, the two-factor structure was used in both countries. The reliability of the two factors, one named Reward (Cronbach's $\alpha=.92$ in Italy / $.92$ in Denmark) and the second named Necessity (Cronbach's $\alpha=.91$ in Italy / $.85$ in Denmark), was highly satisfactory in both countries. Thus, a composite variable was computed for each of the two factors by averaging the scores of the items loading on each factor. The negatively worded items were reversed prior to the computation so that higher values represent higher levels of the composite variable.

The *claim appeal* was measured with 5 items adapted from prior studies on consumer responses to health claims in relation to each of the three health claims under study. The claim appeal items scores reflect the appeal of the same health claim that the participant had seen in the understanding task. An exploratory factor analysis with principal components extraction and varimax rotation, as used by van Trijp and van der Lans (2007) from where most items were adapted, was run in order to identify the dimensional structure of the aggregated items. A one factor solution was found in both countries under study (Appendix 3.1). The claim appeal scale had good reliability (Cronbach's $\alpha=.96$ in Italy / $.95$ in Denmark). Thus, a composite variable was computed by averaging the scores of the items loading on the claim appeal factor.

Among the ability-related factors, the *subjective knowledge* scale had satisfactory reliability (Cronbach's $\alpha=.65$ in Italy / $.84$ in Denmark), only slightly under the threshold of $.70$ in Italy. A composite variable was computed by averaging the scores of the subjective knowledge items. The negatively worded items were reversed prior to the computation so that higher values represent higher levels of subjective knowledge.

As claim specific ability to process the information, **consumers' familiarity** with the three health claims under study and their **subjective understanding** of the health claims were assessed. The claim specific ability items scores used in the analysis reflect the ability to process the same health claim that the participant had seen in the understanding task. The two items measuring claim specific ability, namely familiarity with the claim and subjective understanding of the health claim, were used separately in the analysis, due to multicollinearity concerns. The two items measuring claim specific ability did load on one factor in an exploratory factor analysis using principal components extraction method (Appendix 3.1) and the reliability of the measures was satisfactory in Italy (Cronbach's alpha =.84 in Italy / .61 in Denmark) and only slightly under the threshold of .70 in Denmark. However, the composite measure for claim specific ability was highly correlated with the claim appeal composite variable ($r=.91$ in Italy and $r=.87$ in Denmark). On the other hand, when the two items measuring claim specific ability, namely subjective understanding of health claims and claim familiarity, were used separately, the highest correlation between the independent variables used in our analyses was of $r=.72$, thus, multicollinearity was not a concern anymore.

Test of the conceptual model

The effects of antecedents of understanding, when measured with the CUT method, were investigated by means of multinomial regressions. When understanding was measured with the understanding index method, multiple regressions were used to identify the role of the antecedents considered in the present study².

A summary of the descriptive statistics for all the variables used in the analyses is presented in Table 3.

² Few multivariate outliers were identified in both countries under study (0.5% of respondents in DK; 1,1% of respondents in Italy). When removing the multivariate outliers from these analyses there were only minor changes in the results, thus, all cases were retained in the reported results.

Table 3. Descriptive statistics of independent and dependent variables (N_DK=1024; N_IT=1000)

Variable name	Denmark		Italy	
	Mean	Standard deviation	Mean	Standard deviation
Understanding index	.90	1.17	.45	.97
GHI	4.55	1.06	4.76	.98
Reward	3.42	1.18	4.87	1.13
Necessity	3.83	1.09	4.42	1.34
Claim appeal	3.30	1.65	5.16	1.33
Subjective knowledge	3.40	1.32	4.13	1.10
Subjective understanding	3.59	1.94	5.17	1.70
Claim familiarity	2.48	1.71	4.82	1.71
	N	%	N	%
CUT				
Safe	322	31%	303	30%
Risky	247	24%	356	36%
Other	455	45%	341	34%
Relevance of claims				
Low	642	63%	513	51%
High	382	37%	487	49%
Claim type^a				
Claim 1	350	34%	342	34%
Claim 2	336	33%	330	33%
Claim 3	338	33%	328	33%
Age^a				
Under 34	278	27%	366	37%
Between 35&55	470	46%	530	53%
Over 55	275	27%	104	10%
Education				
Low	682	67%	697	70%
High	342	33%	303	30%
Gender				
Male	436	43%	513	51%
Female	588	57%	487	49%

^a These variables were used as dummies in the analyses; age dummies were used with Over 55 as reference group and Claim type dummies were used with Claim 2 (the EU authorised health claim) as reference.

3.4. Results

3.4.1. Consumer understanding of health claims

Understanding measure 1: CUT method to assess understanding

Based on the content analysis of the open-ended questions on understanding, the prevalence of consumers who can be categorised as *risky* based on their interpretations (i.e. they make interpretations which are not in line with the scientific evidence of the claimed benefit) was lower overall compared to those categorized in the *safe* or *other* group in Denmark (Table 4). Overall, Danish consumers were most often categorized as *other*, meaning that they gave vague or irrelevant answers. Only about one in three could be classified as *safe* in their interpretations. Consumer understanding was found to differ significantly between the three health claims. As shown in Table 4, in Denmark health claim 1 was understood better than the other two health claims. Namely, the prevalence of consumers categorized as *safe* (i.e. make interpretations in line with the scientific evidence behind the health claim) was the highest while the proportion of consumers categorized as *risky* was the lowest for health claim 1. On the other hand health claim 2, which is the currently authorised health claim in EU, was the least well understood as most of the consumers were categorized as *other* or *risky*.

Compared to Denmark the distribution across the three understanding categories is more even in Italy (Table 5). For health claim 1, 38% of Italian consumers were categorized as *risky*, followed by those in the *safe* group. For health claim 2 the prevalence of consumers categorized as *safe* was the lowest and the prevalence of those consumers categorized as *other* was the highest compared to the other two health claims. While, for health claim 3 the prevalence of consumers into each of the three understanding groups was similar.

Table 4. CUT understanding measure and health claims cross tabulation Denmark

		Health claim			Total	
		1 may reduce the risk of coronary heart disease	2 protection of blood lipids from oxidative stress	3 helps to protect blood lipids from harmful reactions		
CUT	1 safe	Count	162	61	99	322
		% within Claim	46.3%	18.2%	29.3%	31.4%
	2 risky	Count	60	108	79	247
		% within Claim	17.1%	32.1%	23.4%	24.1%
	3 other	Count	128	167	160	455
		% within Claim	36.6%	49.7%	47.3%	44.4%
Total		Count	350	336	338	1024
		% within Claim	100.0%	100.0%	100.0%	100.0%

Pearson Chi-square = 67.604; Asymp. Sig =.000.

Table 5. CUT understanding measure and health claims cross tabulation Italy

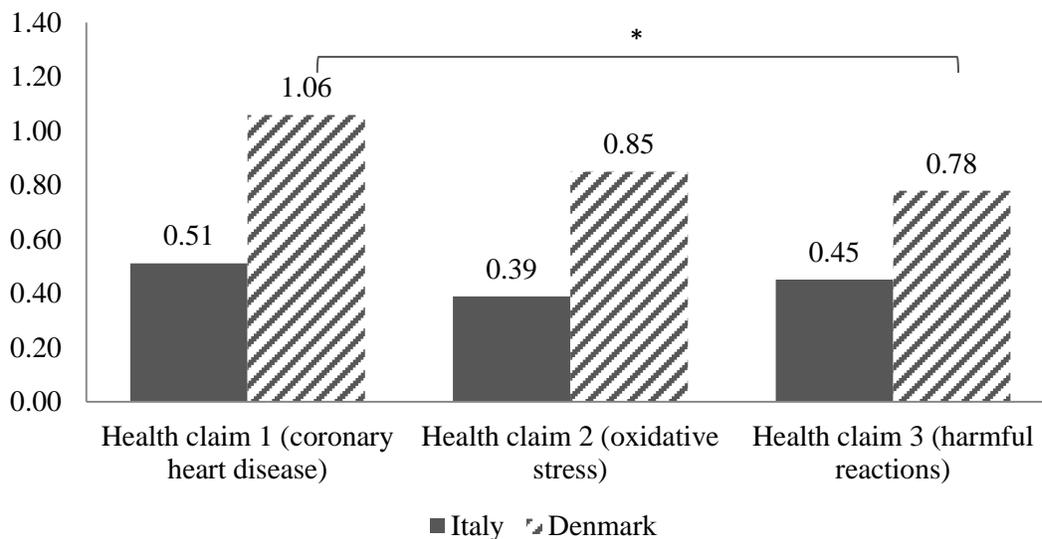
		Health claim			Total	
		1 may reduce the risk of coronary heart disease	2 protection of blood lipids from oxidative stress	3 helps to protect blood lipids from harmful reactions		
CUT	1 safe	Count	117	80	106	303
		% within Claim	34.2%	24.2%	32.3%	30.3%
	2 risky	Count	131	112	113	356
		% within Claim	38.3%	33.9%	34.5%	35.6%
	3 other	Count	94	138	109	341
		% within Claim	27.5%	41.8%	33.2%	34.1%
Total		Count	342	330	328	1000
		% within Claim	100.0%	100.0%	100.0%	100.0%

Pearson Chi-square = 17.468; Asymp. Sig =.002.

Understanding measure 2: Understanding index

The index describing consumers' objective understanding based on the closed-ended questions was, on average, in both countries higher than zero meaning that consumers gave higher ratings to the safe statements than to the risky ones (Table 3).

Among the different health claims, in Denmark, consumer understanding was highest for health claim 1. Pairwise comparisons with Bonferroni adjustment showed that health claim 1 was significantly better understood compared to health claim 3 (Figure 2). On the other hand, even though in Italy the mean of understanding was slightly higher for health claim 1, there were no significant differences in consumer understanding between the three health claims under study (Figure 2).

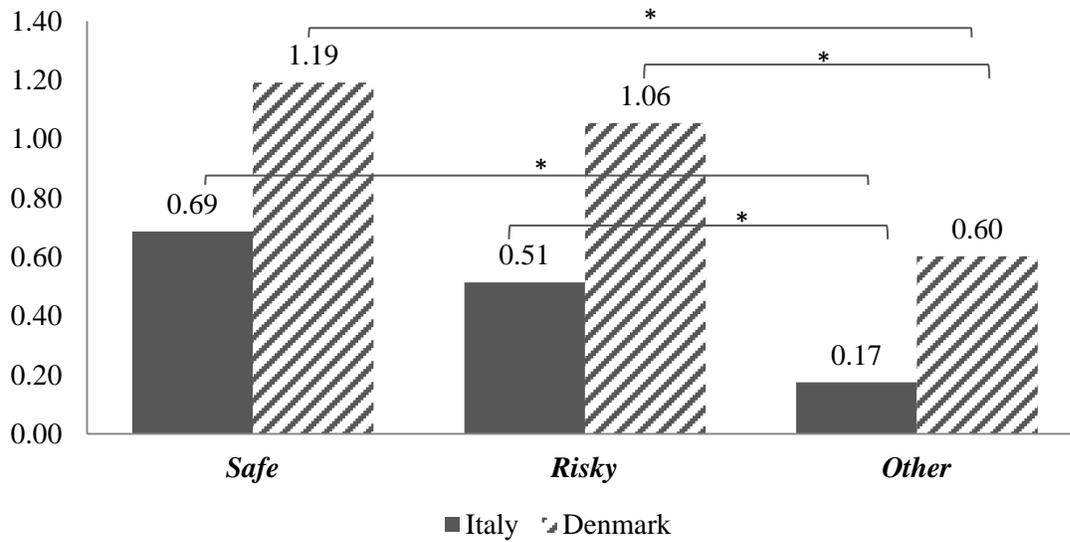


Note: only significant differences of one-way ANOVA analysis are marked

Figure 2. Understanding index by health claim in Denmark and Italy

Relationships between the two understanding measures

There is an association between the understanding measured with the CUT method and the understanding index measure (Figure 3). Consumers categorized as *safe* or *risky* scored higher on the understanding index compared to those consumers categorized as *other*. However, in both countries no significant difference was found between the *safe* and the *risky* groups in terms of their understanding index mean scores.



Note: Only significant differences of one-way ANOVA analysis are marked

Figure 3. Relationship between consumer understanding measured by the CUT method and the one measured with the understanding index

3.4.2. Antecedents of consumer understanding of health claims

3.4.2.1. Understanding measure 1: CUT method to assess objective understanding

The main factors that were associated with consumers' likelihood to be categorized as *safe* rather than *risky* were the socio-demographic variables and claim type (Table 6). Lower educated consumers and those who saw health claim 2 were more likely to be in the *risky* group rather than the *safe* one in Denmark, while in Italy males and those who reported higher familiarity with the health claim were more likely to be in the *risky* group rather than *safe* one. Most of the motivational and ability-related factors were associated with the likelihood of being categorized as *safe* rather than *other*. Those consumers who reported lower claim appeal or lower subjective knowledge of foods with health claims were more likely to be in the *other* group rather than the *safe* one in both countries. In addition, those consumers in Italy who see low necessity in having foods with health claims or those who reported lower subjective understanding of the health claims were associated with categorization in the *other* rather than the *safe* group. In both countries males and those who saw health claim 2 were also more likely to be in the *other* group rather than the *safe* group. Finally, in Denmark consumers older than 55 years and those with low education were more likely to be in the *other* group rather than the *safe* one.

Table 6. Estimates of the effects of motivation and ability factors on understanding assessed with the CUT method

		Italy				Denmark			
		B	Std. Error	Sig.	Exp(B)	B	Std. Error	Sig.	Exp(B)
2.00 <i>Risky</i>	Intercept	-.052	.631	.935		2.241	.621	.000	
	Gender	-.370	.164	.024	.691	-.309	.188	.100	.734
	Education_levels	-.049	.173	.778	.952	-.545	.194	.005	.580
	Under34	.286	.289	.322	1.332	-.229	.261	.380	.795
	Under55	.284	.275	.301	1.328	-.135	.236	.567	.874
	Claim_1	-.245	.209	.240	.783	-1.514	.230	.000	.220
	Claim_3	-.287	.205	.162	.750	-.752	.228	.001	.472
	GHI	-.099	.101	.324	.906	-.014	.092	.883	.986
	Reward	.022	.090	.808	1.022	-.015	.103	.884	.985
	Necessity	-.048	.070	.492	.953	-.056	.104	.589	.945
	Relevance_claims	-.063	.160	.696	.939	.092	.188	.625	1.096
	Claim_appeal	.058	.104	.578	1.060	-.080	.084	.338	.923
	Subjective_knowledge	.082	.084	.331	1.085	-.047	.074	.530	.955
	Subjective_understanding	-.116	.074	.117	.891	-.113	.058	.051	.893
Claim_familiarity	.191	.080	.017	1.211	.000	.065	.996	1.000	
3.00 <i>Other</i>	Intercept	5.196	.696	.000		4.210	.563	.000	
	Gender	-.550	.173	.002	.577	-.566	.167	.001	.568
	Education_levels	-.326	.187	.081	.722	-.587	.173	.001	.556
	Under34	-.090	.299	.763	.914	-1.170	.236	.000	.310
	Under55	.152	.282	.589	1.165	-.504	.202	.012	.604
	Claim_1	-.604	.220	.006	.546	-1.146	.208	.000	.318
	Claim_3	-.532	.211	.012	.587	-.451	.212	.034	.637
	GHI	-.038	.106	.723	.963	-.031	.082	.708	.970
	Reward	-.034	.098	.732	.967	.084	.093	.369	1.088
	Necessity	-.357	.077	.000	.700	-.170	.093	.068	.843
	Relevance_claims	.046	.169	.784	1.047	.108	.168	.519	1.114
	Claim_appeal	-.228	.107	.033	.796	-.336	.077	.000	.715
	Subjective_knowledge	-.276	.093	.003	.759	-.172	.067	.011	.842
	Subjective_understanding	-.202	.074	.007	.817	-.077	.051	.131	.926
Claim_familiarity	.163	.086	.057	1.177	.116	.060	.051	1.123	

Dependent variable: CUT categorization

The reference category is: 1.00 *Safe*.

Denmark: Chi-square=205.51, df=28, p=.000; Pseudo R-square Nagelkerke=.206/McFadden=.094.

Italy: Chi-square=170.21, df=28, p=.000; Pseudo R-square Nagelkerke=.176 / McFadden=.078.

3.4.2.2. Understanding measure 2: Understanding index

The multiple regression analysis revealed that education level, claim type and claim familiarity were associated significantly with the understanding index, in both countries (Table 7). Higher

education was correlated with a higher understanding index and health claim 1 was better understood as compared to health claim 2 in Denmark and as compared to both other health claims in Italy. Higher claim familiarity was associated in both countries with lower understanding of the claim. In addition, in Denmark, age had a significant impact, with those respondents under 34 years old understanding the health claims better than respondents over 55 years old. Similarly, higher claim appeal was associated with higher understanding in Denmark. In Italy, necessity of foods with health claims had a significant and positive impact on understanding. Those Italian consumers perceiving the foods with health claims as necessary had higher scores on the understanding index.

Overall, the antecedents of understanding considered in this study could explain 5% of the variance in the understanding index in Denmark and 12% in Italy (Table 7).

Table 7. Parameter estimates of antecedents of understanding

	Italy					Denmark				
	B	Std. Error	Beta	t	Sig.	B	Std. Error	Beta	t	Sig.
(Constant)	-.593	.221		-2.677	.008	.672	.229		2.941	.003
Gender	-.061	.060	-.031	-1.016	.310	-.091	.075	-.038	-1.216	.224
Education_levels	.227	.064	.108	3.559	.000	.388	.078	.156	4.944	.000
Under34	.007	.105	.003	.064	.949	.327	.104	.124	3.143	.002
Under55	.011	.099	.006	.113	.910	.158	.088	.067	1.789	.074
Claim_1	.209	.075	.102	2.791	.005	.188	.090	.076	2.082	.038
Claim_3	.148	.073	.072	2.040	.042	-.075	.090	-.030	-.839	.401
GHI	.011	.037	.011	.293	.770	.009	.036	.008	.257	.797
Reward	.016	.033	.019	.492	.623	-.076	.042	-.076	-1.795	.073
Necessity	.209	.025	.290	8.207	.000	.034	.042	.032	.825	.410
Relevance_claims	.021	.058	.011	.354	.723	-.081	.075	-.034	-1.080	.280
Claim_appeal	.033	.037	.045	.885	.376	.096	.035	.135	2.769	.006
Subjective_knowledge	.011	.031	.012	.351	.725	-.009	.030	-.010	-.282	.778
Subjective_understanding	.018	.026	.031	.675	.500	.010	.023	.017	.445	.657
Claim_familiarity	-.103	.029	-.182	-3.498	.000	-.105	.027	-.152	-3.862	.000

Dependent variable: Understanding_index

B represents the regression coefficient, while Beta is the standardized regression coefficient

Adj. R²= .12 in Italy / .05 in Denmark

Dummy variables were used for age and health claim type

3.5. Discussion

Consumer understanding of health claims

The present study used two methods to assess objective understanding of health claims. One measure was based on open-ended questions, where answers were content analysed and reflected against the scientific evidence behind the health claim, and consumers were grouped into *safe*, *risky* or *other* depending on the types of interpretations that they made (Grunert et al., 2011). The second measure used pre-formulated closed-ended questions, developed in collaboration with researchers with a background in nutrition to reflect safe or risky interpretations when reflected against the scientific evidence behind the health claims, based on which indexes of understanding were computed.

The health claim presented to respondents in the understanding task had an impact on consumer understanding, which is in line with prior studies finding that consumer perceptions of health claims vary by claim (Lähteenmäki, 2013). Furthermore, while the results were consistent to some extent between the two countries under study, there were also some differences, which support prior studies showing country-wise differences in consumer's responses to health claims (e.g. Saba et al., 2010; van Trijp & van der Lans, 2007).

Overall, the percentage of consumers categorized as *risky* based on their interpretations of the claims varied between 17% and 38% across claims and the two countries, while the prevalence of those who can be seen as *safe* ranged between around 18% and around 46%. Compared to prior studies using this method (Grunert et al., 2011), there is a lower percentage of respondents categorized as *safe* and a higher percentage categorized as *other* in the present study. This may have been the result of consumers needing to rely more on their prior knowledge due to the absence of other information except the health claim in the present study as opposed to the study by Grunert et al. (2011) where respondents were able to see an advertisement regarding the product as well.

The results of this study show that consumers seem to make openly risky interpretations only to a moderate extent; however, the number of consumers who were categorized as *other* due to their interpretations being dominantly vague was considerable, especially in Denmark. Based on dual-

processing theories (Chen & Chaiken, 1999), this finding could imply that a rather large number of consumers are not motivated or able to process the health claims, which results in them only giving vague answers. This can be problematic as these consumers cannot be seen as understanding the claims but they could still be likely to buy the product based on their general positive judgement of the product, meaning that they may pay a premium for a product characteristic that they do not understand if we assume that products with health claims may be more expensive than regular products. In addition, in the *other* group there are also those people who are reluctant towards any claim and such consumers may avoid products with health claims even when they could be helpful for their health. As to the comparison between countries, the mean scores for the motivation and ability related factors considered in the present study were considerably lower in Denmark compared to Italy, which based on dual-processing theories (Chen & Chaiken, 1999) could explain why in Denmark more consumers were categorized as *other* compared to Italy.

Based on the open-ended questions we find that the risk reduction claim approved in the US and the reformulated version of the currently authorised health claim in the EU are the ones with higher levels of understanding compared to the currently authorised health claim in the EU, however this pattern of results is most visible in Denmark. The fact that the authorised health claim in the EU was understood to the lowest degree is not surprising per se, as the health claim contains many technical terms which could be unknown to the consumers. We expected that the reformulated version of the authorised health claim in the EU would be easier to understand due to use of less technical wording compared to the authorised wording. The reformulated wording was developed in collaboration with researchers with a background in nutrition in order to make it more consumer friendly, thus less technical, while still maintaining the right message. Our results support in part that the reformulation of the wording can help consumers understand the claim better than the technical claim currently approved in the EU regulations. The risk reduction claim authorised in the US was best understood (i.e. highest prevalence of safe inferences) probably because it contained more common words and it also made explicit what is the final health benefit that the product provides, namely heart health.

The understanding indexes, based on the rating of pre-formulated statements, analysis shows that consumers on average agreed more strongly with the safe items compared to the risky ones.

However, this measure was able to a lower extent compared to the CUT method to differentiate between the health claims as only in Denmark there were significant differences between the risk reduction claim approved in the US and the reformulated version of the approved claim in the EU in terms of the understanding index. Overall, the CUT method was better able to capture differences in consumer understanding between the health claims.

There was some relationship between the CUT measure and the understanding index measure, which shows convergent validity. However, the understanding index could not discriminate between the three groups of consumers according to the CUT measure, namely *safe*, *risky* or *other*.

Antecedents of consumer understanding of health claims

Consumers' understanding of health claims was related to some extent to motivation- and ability-related factors, however, the socio-demographics and claim type played an important role as well. Among the motivation factors, consumers' attitudes towards foods with health claims and the claim's appeal had a positive impact on understanding. In the case of the CUT method, more favourable attitudes lowered the likelihood of being categorized in the *other* group rather than the *safe* one in Italy; while in both countries higher claim appeal lowered the likelihood of being categorized as *other* rather than *safe*. However, the motivation factors were not associated to the likelihood of being categorized as *risky* rather than *safe*. Even though prior literature found negative impacts of positive attitudes towards foods with health claims on understanding of claim messages (Grunert et al., 2011), the positive links found in the present study are consistent with dual-processing theory (Chen & Chaiken, 1999) which posits that people higher in motivation and ability will process the information given with more effort, which in turn can result in more specific inferences (i.e. as those made by respondents categorized as *safe*) rather than vague ones (i.e. as those made by the respondents categorized as *other*). The lack of association between the motivation factors and the likelihood of being categorized as *risky* rather than *safe* does not contradict dual processing theories either, as both the risky and safe interpretations are specific, therefore, they can be assumed as the result of higher processing.

When understanding was assessed as an index of agreement to safe rather than risky items, the same two motivation-related factors as for the CUT measure played a role. There was a positive

impact of attitudes towards foods with health claims on understanding in Italy and a positive impact of claim appeal on understanding in Denmark. The fact that in Italy the general motivation factor plays a role while in Denmark the claim specific one had an impact may be explained by the Danish consumers being reluctant towards health claims in general (Lähteenmäki et al., 2010) more so than the Italians (Contini et al., 2015; Saba et al., 2010) which may imply that a claim specific assessment is more appropriate for these consumers.

The ability-related factors had an impact on consumers' understanding, however not all of the factors were significant across both methods to assess understanding. Overall, the subjective knowledge and subjective understanding of the health claims were positively linked to understanding, while claim familiarity had a negative impact. Consumers' subjective knowledge was positively associated with understanding as measured by CUT. In particular for the CUT measure higher knowledge decreased the likelihood of being assigned to the *other* group rather than the *safe* one. However, the subjective knowledge was not found significantly associated with the understanding index measure. The lack of a consistent effect of subjective knowledge on understanding is not surprising as prior studies have found mixed results for subjective knowledge as well (e.g. Andrews, Burton, & Netemeyer, 2000; Grunert et al., 2011). The subjective understanding plays a minor role, having only a positive impact on understanding as measured by CUT in Italy. This result implies that if consumers find a health claim easier to understand or they feel they have knowledge about foods with health claims, they are more likely to process the health claim in depth as expected based on dual processing theories (Chen & Chaiken, 1999); however, it does not mean that consumers will objectively understand the health claims as well.

The only factor which played a role in differentiating between the *safe* and *risky* groups of consumers and which had an impact on the understanding index was the claim familiarity, which is a claim specific factor. The main finding was that claim familiarity had a negative impact on understanding, which is opposite to our expectations. This effect was found with both methods to assess understanding in Italy but only with the understanding index method in Denmark. While contrary to the initial expectations, a negative impact of claim familiarity on understanding is not entirely surprising. Consumers who are more familiar with the health claim could have a more complex associative network related to the health claim, which means that the health claim may

activate other concepts related to the health claim in consumers' minds (Anderson, 1983) even though those are not safe interpretations of the health claim. Moreover, since the risky interpretations in the present study were still specific interpretations which, thus, reflect deeper processing, the negative effect is nonetheless in line with dual processing theories, as higher familiarity can mean higher processing (Petty & Cacioppo, 1986). On the other hand, higher familiarity may also lead to people engaging in less processing (Moorman, 1990), which involves more reliance on available cues and learned associations (Chen & Chaiken, 1999; Petty & Cacioppo, 1986) and could, thus, result in misunderstanding.

The general health interest and relevance of the claims had no significant impact on understanding, regardless of the method used to assess understanding. This is consistent with prior research finding no significant impact of general health interest as motivation factor for understanding of health claims (e.g. Grunert et al., 2011). Moreover, as general health interest refers to nutritionally healthy eating more generally, it is not surprising that it did not make an impact in relation to foods with health claims in particular.

Of the socio-demographics, education level had the most consistent impact on understanding, with higher educated consumers understanding the health claims better. This result may reflect the fact that higher educated consumers may have higher objective knowledge about effects of food on health. Finally, the claim type had an impact on understanding, with the currently authorised health claim at the EU level on protection against oxidative stress being overall less well understood compared to the other health claims.

As understanding is found to vary by claim, it appears necessary to undertake case by case assessments of health claims as it is challenging to generalize the results from one claim to another. Moreover, while some results are similar between the two countries under study, there are also some differences which emphasize the need for case by case assessment of health claims as well as the culture may have an impact, as also expected based on prior literature (Lähteenmäki, 2013).

Overall, we find some evidence for the nomological validity of understanding as measured with the two methods, since we do find significant relationships between motivation, ability related factors and understanding as expected based on dual processing theories (Chen & Chaiken,

1999). Across the two methods, the CUT method is more sensitive to differences in understanding between health claims and makes it easier to test the expected effects of motivation and ability related factors based on dual processing theories (Chen & Chaiken, 1999). However, the understanding index while less able to identify differences in understanding between health claims, is a less resource intensive method to use and was able to pick up effects of motivation and ability factors.

Limitations

An important limitation of our study is that consumers' subjective knowledge was used as measure of ability to process the information. Even though the measure has been used in prior research for similar purposes, caution should be taken in deriving conclusions that knowledge does not impact understanding based on subjective measures alone.

The methods used to assess understanding are not without their limitations either. The CUT method involves some subjectivity in the categorization of respondents' answers. In order to limit the subjectivity, consumers' answers were coded in collaboration with researchers with a background in nutrition who could assess with a higher degree of objectivity whether the answers from respondents were in line with the evidence behind the health claims or not. In the rating of pre-formulated statements related to potential inferences from the health claims method, some of the safe items were quite close to the wording of the health claims. However, moving further from the wording of the health claims makes it more challenging to keep in line with the objective evidence behind the claims.

Furthermore, our study used only the text of health claims as stimuli, meaning that any effects of other elements such as package design were not manipulated. However, due to the complexity of our study which included a choice experiment (reported in Contini et al., 2015), it would have been difficult to manipulate different elements of the package for the understanding as well.

Finally, in Denmark the relevance of claims question was a check all that apply type of question, where if none applied respondents would move further while in Italy the respondents had the yes/no option for each health condition. However, the data were analysed similarly, namely that consumers who had any of the health conditions relevant for the claims were assigned in the high

relevance group and otherwise they were assigned in the low relevance group, thus the difference in the question type is not expected to have any impact on the results.

Future research

The present study shows that motivation and ability related factors play a role in understanding, but that the health claim and socio-demographics are also important. However, all these factors managed to explain a rather low amount of variation in the understanding levels, thus, future research could investigate which other factors may be important antecedents of understanding. One such factor could be the objective knowledge of the interest area. An important area for future research in order to test the effect of objective knowledge would be the development of an objective measure of knowledge of relationship between nutrients and health. This stream of research is as interesting as it is challenging, indeed consumers' objective knowledge is rather difficult to assess in relation to health claims as one nutrient can have several functions in the body and the assessment should contain potential links between the nutrients and health and not only the nutrition facts alone.

The lack of effect of relevance of claims as antecedent of understanding could be due to the fact that the relevance measure used in this study may have not managed to capture the intended theoretical concept. As two of the health claims were rather difficult to understand and not very explicitly linked to heart health it can be that people failed to link the health claims to the relevant end health benefit and as such they did not realise that the health claim would be relevant for them. As the use of proxies for assessing relevance may have been the reason why we did not find an effect of relevance, future research in developing a more suitable measure of perceived relevance would be highly useful. Moreover, other individual characteristics that can potentially impact perceived relevance, for instance generalized self-confidence (Bearden, Hardesty, & Rose, 2001) or involvement (Zaichkowsky, 1994), could be valuable additions in future studies assessing antecedents of consumer understanding of health claims.

The carrier product is found in prior literature to be an important context factor with impacts on consumer responses (Lähteenmäki, 2013). In the present study the olive oil was used as carrier for all the three health claims, thus the impact of the product cannot be tested, hence, future research could investigate the effects of carrier products on understanding.

Furthermore, there is still a need to assess the validity and reliability of measures to assess understanding as our study shows that the expected effects are not always consistent across health claims or countries, thus more research is needed in developing a measure of understanding. An important avenue for future research would be to study the behavioural impact of consumer understanding of health claims.

Implications for public policy

Our study has several implications for public policy. First, we found that the simplified reformulation of the authorised health claim in the EU (health claim 3) was better understood than the original claim with technical terms. Furthermore, presenting the current EU claim resulted in a high portion of respondents ending in the risky or other group when open-ended questions were used, even though the understanding index does not show a similar trend. Thus, it can be implied that rewording of health claims can have positive impacts on consumers' understanding of health claims, suggesting that enforcing obligatory testing of consumer understanding of the wording of claims could be one of the paths that public policy can take to improve understanding of health claims.

Secondly, the two measures of understanding were able to differentiate between the health claims, especially so the CUT method. We found that understanding levels, assessed by comparison to the scientific evidence behind the health claims, were rather high. However, there was an even larger proportion of consumers who were categorized in the *other* group in the CUT method which suggests that many consumers are not motivated or able enough to elaborate on the health claims. The large *other* group making vague inferences is interesting from the regulator's point of view as this group seems to lack the interest in processing the information; the vague inferences can be irrelevant to the claim and thus not create any unjustified health-related outcome expectations. Yet some of these consumers may buy products with claims based on their overall perception of the product even though they lack correct understanding. However, we also find that understanding depends on the health claim, meaning that testing of the different claims is needed before generalizing conclusions on prevalence of understanding to all health claims.

Thirdly, motivation and ability-related factors were related to understanding to some extent. This finding allows identifying groups that would be more prone to misinterpret health claims, such as those who are more familiar with the health claim or those with low motivation to process the health claims. These groups of people should be especially targeted by efforts to improve understanding of health claims. It could be that people who are not motivated to process the health claims are also less likely to buy products with the health claims, however, those consumer who are more familiar with the health claims may also purchase such products more frequently thus making them especially vulnerable to negative effects of misunderstanding. Familiarity with health claims may increase with increased exposure to such health claims due to higher prevalence of foods with health claims on the market, thus, efforts should be made to help consumers differentiate between justifiable and unjustifiable expectations regarding the health claims. Socio-demographic characteristics played an important role as well and can be used to identify groups prone to misunderstanding, however, these characteristics are at large not changeable.

3.6. Conclusion

Consumers' understanding of health claims seems to be rather high, even though a large proportion of consumers made only vague interpretations. Health claims containing special technical terms were understood to a lower extent. Consumers' general and claim-specific motivation and ability to process the health claims were associated with understanding to some extent. Overall, we find some support for the nomological validity of the understanding measures. Further research is needed to develop measures for other potentially important antecedents of understanding and to test their impact.

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Appendix 3.1

Factor loadings of the attitudes towards health claims items, the claim appeal items and the claim specific ability items

Factor loadings of the attitudes towards foods with health claims items

	Italy		Denmark			Denmark - forced to extract 2 factors	
	Factor		Factor			Factor	
	Reward	Necessity	1	2	3	Reward	Necessity
Foods with health claims can repair the damage caused by an unhealthy diet	.679	.067	.627	-.196	-.078	.640	-.168
The safety of foods with health claims has been thoroughly studied	.790	.079	.649	-.101	-.315	.630	-.247
The new properties of foods with health claims carry unforeseen risks	.275	.615	-.101	.337	.496	-.116	.557
Foods with health claims make it easier to follow a healthy lifestyle	.757	-.111	.685	-.357	-.105	.712	-.308
If used in excess. foods with health claims can be harmful to health	.136	.464	-.046	.257	.521	-.056	.506
I believe that foods with health claims fulfill their promises	.770	.093	.686	-.223	-.249	.686	-.298
For a healthy person. it is worthless to use foods with health claims	.074	.720	-.204	.585	.221	-.255	.579
Foods with health claims are completely unnecessary	-.048	.818	-.321	.677	.175	-.381	.614
The idea that I can take care of my health by eating foods with health claims gives me pleasure	.701	-.147	.677	-.431	-.002	.712	-.304
Health claims give exaggerated information about health effects	-.047	.669	-.254	.399	.331	-.279	.507
Foods with health claims	.642	.216	.748	-.165	-.225	.744	-.231

are science-based top products

I can prevent disease by eating foods with health claims regularly	.800	.012	.701	-.284	-.116	.725	-.256
I only eat foods without any medicine-like effects	.258	.498	-.131	.435	.165	-.165	.439
Using foods with health claims is completely safe	.744	.156	.515	-.012	-.441	.484	-.253
Foods with health claims promote my well-being	.797	-.041	.735	-.299	-.010	.764	-.199
The growing number of foods with health claims on the market is a bad trend for the future	.013	.820	-.329	.614	.283	-.379	.639
Foods with health claims are a total sham	-.119	.830	-.292	.535	.384	-.324	.650
My performance improves when I eat foods with health claims	.644	.352	.697	-.170	.007	.718	-.085
Health claims are not appropriate in delicacies	.016	.749	-.163	.532	.184	-.208	.524
In some cases, foods with health claims may be harmful for healthy people	.010	.775	-.081	.307	.621	-.093	.598

Extraction Method: Maximum Likelihood.

Criteria for determining number of factors: Eigenvalues greater than 1

Rotation Method: Varimax with Kaiser Normalization.

Note: The dimensional structure used is presented in black text.

Factor loadings of items measuring claim appeal

	Italy	Denmark
	Claim appeal	Claim appeal
	Component 1	Component 1
Claim_convincing	.921	.922
Claim_trust	.910	.902
Claim_interesting	.937	.919
Claim_importance	.933	.916
Claim_attractive	.906	.925

Extraction Method: Principal Components.
 Criteria for determining number of factors: Eigenvalues greater than 1.

Factor loadings of items measuring claim specific ability

	Italy	Denmark
	Claim specific ability	Claim specific ability
	Component 1	Component 1
Subjective_understanding	.928	.849
Claim_familiarity	.928	.849

Extraction Method: Principal Components.
 Criteria for determining number of factors: Eigenvalues greater than 1.

Chapter 4. Consumer inferences from different versions of a beta-glucans health claim¹

Abstract

Health claims communicate the health benefits of food products. The use of health claims is regulated and the regulation requires that the average consumer is able to understand the health claims, as means to protect consumers from misleading claims. Due to the technical terms used in the authorised health claims and the potential of such claims to mislead consumers, attempts to improve consumer understanding of health claims are relevant. The aim of this study was to elicit the inferences that consumers make from different variations of a health claim in order to gain an understanding of how consumers' understanding of health claims can be improved. Two methods for elicitation of inferences, the Consumer Understanding Test (CUT) and laddering interviews, were applied in a study conducted among consumers (N=295) in Denmark. Re-wording an authorised health claim or adding information did not improve understanding and could even decrease consumers' understanding of the claim. Several implications of these findings are discussed.

Keywords: health claims; consumer understanding; inferences

¹ **This chapter is submitted as:** Stancu, Violeta; Grunert, Klaus G.; Lähteenmäki, Liisa. Consumer inferences from different versions of a beta-glucans health claim.

4.1. Introduction

Consumers seem to be generally interested in the healthiness of the food they eat (Nielsen, 2015). One way to communicate the potential health benefits of food products is by use of health claims. The use of health claims on food is governed in the European Union by Regulation (EC) No 1924/2006 by providing a list of authorised health claims and conditions for their use. Health claims represent any claim that “states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health” (Regulation (EC) No 1924/2006). One condition set in the Regulation for use of health claims is that the average consumer should be expected to understand them.

Consumer understanding is set as a prerequisite for the use of health claims in the legislation, however, the Regulation provides no details as to how understanding should be defined or assessed. Prior literature sees understanding as “adequate” when the average consumer “*makes inferences that are justified by the objective content of the claim without significant embellishment or exaggeration*” (Leathwood, Richardson, Strater, Todd, & van Trijp, 2007, p. 477). In order to assess consumer understanding of health claims, an important step is to identify the inferences that consumers make in relation to health claims. Furthermore, these inferences need to be compared to the scientific support for the particular health claim to identify if consumers understand the health claim adequately. Also, inferences can form sequences leading to benefits and goals far removed from the health claim, as suggested in means-end chain theory (Gutman, 1982). Understanding such inferences may shed light on why or why not consumers develop an adequate understanding of a health claim.

Prior research looking into specific types of inferences that consumers make in relation to foods with health claims (e.g. overall healthiness of the product, tastefulness, reduction of disease risk) found that consumers may be misled by health claims (e.g. Andrews, Netemeyer, & Burton, 1998; Roe, Levy, & Derby, 1999), even though other studies have found only limited evidence for people being misled (Bilman, van Kleef, Mela, Hulshof, & van Trijp, 2012; Grunert, Scholderer, & Rogeaux, 2011; Lähteenmäki et al., 2010; Orquin & Scholderer, 2015). Given the potential of health claims to mislead consumers, attempts to improve consumers’ understanding

of health claims are an important topic. Such attempts should be subject to scientific scrutiny investigating whether they indeed improve understanding. This is the topic of this paper.

Health claim complexes

A promising approach to improve the understanding of authorised health claims is represented by the so-called “health claim complexes” developed by The Danish Food and Drink Federation (Peetz-Schou, 2014). A “health claim complex” refers to several elements developed on the basis of the authorised wording of a health claim with the aim to increase consumer understanding: a) a re-worded “easier to understand” version of the authorised wording of the claim, b) a general (i.e. unspecific) claim typically about a general health benefit related to the authorised claim benefit and c) additional explanatory information for instance about the component and/or function claimed.

Avoiding use of technical terms in the re-wording of a claim or addition of explanatory information about the claimed component and benefit can enhance consumers’ understanding of health claims because such changes may encourage deeper processing (Chen & Chaiken, 1999). On the other hand, such efforts may lead consumers to make more inferences that are not justified by the objective content of the health claim because consumers are likely to have more prior knowledge related to the re-worded version or additional information (Anderson, 1983).

The purpose of the studies to be presented in this paper was to study the inferences that consumers make from different variations of a health claim in order to gain an understanding of how we can improve consumers’ understanding of health claims.

4.2. Theoretical background

Consumer understanding of health claims can be seen from the perspective of information processing theories. When consumers are exposed to a health claim, they may engage in different levels of processing of the provided information (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). Consumers who have high motivation and ability to process the health claim are expected to engage in deeper processing of information, while those who have low motivation or ability are likely to engage in shallow processing of the health claim. Consumers use their prior knowledge when they engage in information elaboration in order to attach meaning to the

information provided by the health claim. Some of the meanings that consumers attach to health claims can be inferences that go beyond the information presented to them (Anderson, 1983; Petty & Cacioppo, 1986).

Consumers make inferences from a health claim by relating it to their prior knowledge as stored in their memory. Consumers' memory can be seen as a network of associations formed of concepts or nodes and the relationships between them (Anderson, 1983). The strength of the links between concepts reflects the strength of the associations between those concepts (Anderson, 1983). When a certain node in the associative network is activated, for example due to exposure to certain terms in a health claim, it leads to activation of other concepts or nodes related to it in the associative network, a process known as "spreading activation". The extent of the activation spread to related nodes depends on the strength of the relationship between the nodes. When activation of nodes surpasses a certain level, the information stored in those nodes becomes conscious (Anderson, 1983). Thus, this process of spreading activation can explain how inferences occur when people elaborate on the information in the claim.

The part of consumers' associative networks that has relevance for their purchase decisions has been modelled in means-end chain theory (Olson & Reynolds, 2001). The basic idea in means-end chain theory is linking product-related knowledge to more abstract concepts that provide motivation to choices. Three types of knowledge categories at three different levels of abstraction are distinguished: product attributes, the consequences brought by using the product having these attributes and the goals or values that using the product having these attributes helps achieve. The relationships between these elements, the so-called chains, are hierarchical as they link the concrete attributes of the products to more abstract levels of meaning, namely the consequences and values (Gutman, 1982). Therefore, product attributes are relevant to the consumer to the extent that they bring about desired consequences and help the consumers achieve their values and goals (Olson & Reynolds, 2001). Since a health claim can be seen as a product attribute, people may have existing associations between this attribute and consequences and values relevant to them. Therefore, some of the inferences that people make when elaborating on health claims will be hierarchical inferences linking the health claims to abstract consequences or values relevant for consumers.

Providing consumers with more information in addition to the authorised version of a health claim, such as adding a general claim or additional explanatory information about the claimed component or benefit, may lead to deeper processing of the information and thus to attribute-specific inferences (Sujan, 1985). Re-wording the authorised version of a health claim in order to avoid technical terms can have similar effects. Such effects could be expected as the changes in wording of the health claim may induce higher motivation or ability to process the provided information resulting in deeper processing of the information (Petty & Cacioppo, 1986). Thus, adding information or re-wording an authorised health claim may lead to more consumers reaching adequate understanding.

However, the addition of information to the authorised wording of a health claim or the re-wording of the authorised health claim may also have a reverse effect, resulting in a lower degree of understanding. Consumers may have a complex associative network for a less technical concept, meaning that a re-worded health claim can lead to activation of more related concepts in consumers' minds as opposed to a term that is technical and where consumers have little prior knowledge about it. Similarly, providing additional information to consumers can increase the likelihood that concepts linked to that information will be activated in consumers' minds. Overall, while re-worded versions of an authorised health claim or added information can lead to more attribute-specific inferences, depending on people's prior associations, those inferences may not necessarily be in line with what the claim is supposed to mean, in which case these will imply lower levels of understanding.

Prior literature has investigated specific types of inferences that people may make based on health claims. Consumers are found to infer that products with health claims have some health benefits which they in fact do not have (Roe et al., 1999) or to exaggerate the benefits of products carrying health claims (e.g. Andrews et al., 1998; Roe et al., 1999). Consumers may also associate unrelated nutrients to the ones claimed or they may make only vague interpretations of the health claims (Andrews et al., 1998; Grunert et al., 2011). While many of these types of inferences can be seen as incorrect or so called "risky" interpretations of health claims (Grunert et al., 2011), some prior studies show that many consumers can make correct or so called "safe" interpretations (Grunert et al., 2011). Some prior research supports the latter as consumers do not seem to make exaggerated inferences about other product attributes from

health claims (Lähteenmäki et al., 2010) or are found to over-interpret health claims only to a limited extent (Bilman et al., 2012).

4.3. Selected methods to elicit inferences

As understanding is a matter of inferences, one important step in assessing consumer understanding of health claims is to identify the types of inferences that people make (Leathwood et al., 2007). Previous research on consumer understanding of health claims has used various methods to study understanding, most of which were quantitative ones (e.g. Andrews et al., 1998; Bilman et al., 2012). Some of the qualitative methods used in prior studies, either as only method or in combination with other methods, are interviews (e.g. Sanchez & Casilli, 2008; Svederberg & Wendin, 2011), focus groups (e.g. Chan, Patch, & Williams, 2005), thought listing (e.g. Hooker & Teratanavat, 2008; Wansink, Sonka, & Hasler, 2004) or open-ended questions (Grunert et al., 2011; Roe et al., 1999; Wong et al., 2013).

In addition, methods enabling elicitation of inferences in the context of the means-end chain theory can prove useful in unfolding the hierarchical inferences that people make in relation to foods with health claims. The laddering technique, a specific in-depth interviewing method, has been extensively used to elicit information from consumers in the context of this theory (Grunert & Grunert, 1995; Reynolds & Gutman, 1988).

Two methods to elicit inferences were selected for use in this study based on prior literature on consumer responses towards foods with health claims or on consumer behaviour theories such as the means-end chain theory (Gutman, 1982). The two selected methods were the Consumer Understanding Test (CUT) (Grunert et al., 2011) and laddering interviews (Reynolds & Gutman, 1988). These two methods were selected as they are suitable for different objectives that are relevant for the purpose of this study.

The CUT method is focused on elicitation of inferences in relation to foods with health claims with the aim to compare the elicited inferences to the scientific evidence behind the health claim under study (Rogeaux, 2010). The CUT measure and adaptations of the measure have previously been used in studies on consumer understanding of health claims (Grunert et al., 2011; Wong et

al., 2013). This method is suitable for eliciting inferences about foods with health claims and assessing which of these are justifiable given the objective evidence behind the claim.

The laddering interviewing technique was selected as it is aimed at eliciting information from consumers in the context of means-end chain theory (Grunert & Grunert, 1995; Reynolds & Gutman, 1988). The method is suitable for the elicitation of the attributes related to products with health claims, relevant consequences and values or goals that consumers want to achieve and the links between these elements. In laddering interviews, the elicitation of attributes is focused towards those attributes that are relevant in a choice situation. Thus, the means-end chains elicited in laddering interviews reflect the part of consumers' cognitive structure which is relevant in explaining their buying behaviour (Grunert & Grunert, 1995). While the inferences elicited through laddering may be more challenging to compare to the scientific evidence behind a certain health claim, they will reflect inferences that people make in relation to products with health claims in a choice context.

The two selected methods have been applied in two separate studies with different objectives. Study 1 used the CUT method applied in an online survey and Study 2 used the laddering technique applied in face-to-face interviews.

4.4. Study 1

The **objective** of Study 1 was to elicit inferences from consumers regarding foods with health claims and to compare these inferences to the scientific evidence behind the health claim in order to identify the potential of different versions of a health claim to enhance the number of consumers with adequate understanding.

The Consumer Understanding Test (CUT) method was applied in this study and the guidelines for data coding put forward by CUT were followed (Grunert et al., 2011).

4.4.1. Method

This study was conducted between September and October 2014 in Denmark. The data were collected online by means of a cross-sectional survey. All participants were provided with an

introduction to the study in the beginning of the online survey and then were asked to give their consent to participate in the study.

Each respondent was exposed to one version of a beta-glucans health claim at random on one of two carrier products when completing the CUT measures. The reported results are part of a bigger study where other stimuli were used as well (see Appendix 4.1), however, those results will not be reported here.

Stimuli

Health claim versions

A health claim on beta-glucans was selected for use in the present study as it was considered relevant for the Danish population (Peetz-Schou, 2014). Moreover, the health claim referred to a component, beta-glucans, which was expected to be rather unfamiliar to the respondents.

Five versions of wording of this health claim, including the authorised claim, were tested for the purpose of this study (Table 1). The elements contained in the tested versions were developed by The Danish Food and Drink Federation in cooperation with The Meal Partnership in Denmark (a public-private partnership between representatives from Danish authorities and business- and trade organizations) based on the “health claim complexes” approach (Peetz-Schou, 2014). The five versions of wording used in the present study resulted from combining these elements as shown in Table 1. The selected combinations of the “health claim complexes” elements meet the legal requirements for use of health claims as, for example, a general or unspecific health claim is only allowed by Regulation (EC) No 1924/2006 if an authorised health claim is made on the product. Moreover, the flexibility of wording guidelines agreed upon by several Member States in the EU were used in the development of the re-worded versions of the health claims.

Table 1. Health claim versions

	Health claim versions	Wording
1	Authorised wording	Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal.
2	General (unspecific) claim + Authorised wording	Good for your blood sugar. Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal.
3	Authorised wording + Additional information	Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal. It is normal that your blood sugar rises after a meal. How much it rises depends, amongst others, of what you eat. It is good for the body if the fluctuations are not too large. Beta-glucans are a special type of dietary fibre. They are soluble in water and are found in the bran of the grain varieties barley and oat, amongst others.
4	General (unspecific) claim + Authorised wording + Additional information	Good for your blood sugar. Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal. It is normal that your blood sugar rises after a meal. How much it rises depends, amongst others, of what you eat. It is good for the body if the fluctuations are not too large. Beta-glucans are a special type of dietary fibre. They are soluble in water and are found in the bran of the grain varieties barley and oat, amongst others.
5	Re-worded wording	A meal with beta-glucans from oats limits blood sugar fluctuations afterwards.

Carrier products

Two products which could carry the selected health claim were used in the present study. The first selected carrier was fruit yoghurt due to the popularity of yoghurt as carrier in prior studies on health claims or functional foods (e.g. Ares, Giménez, & Deliza, 2010; Lähteenmäki, 2010; Saba et al., 2010) and the fact that this product was not naturally rich in fibre. The second carrier was wholegrain bread as it is an everyday product that can naturally contain the required amount of beta-glucans to carry the health claim.

The stimuli presented to consumers were pictures containing the name of the carrier product, a drawing of the product category of the carrier and one of the five versions of the health claim. The stimuli were developed using graphic design software. The size of the stimulus material in the online survey was 413x213 pixels. An example of a stimulus picture is presented in Figure 1.

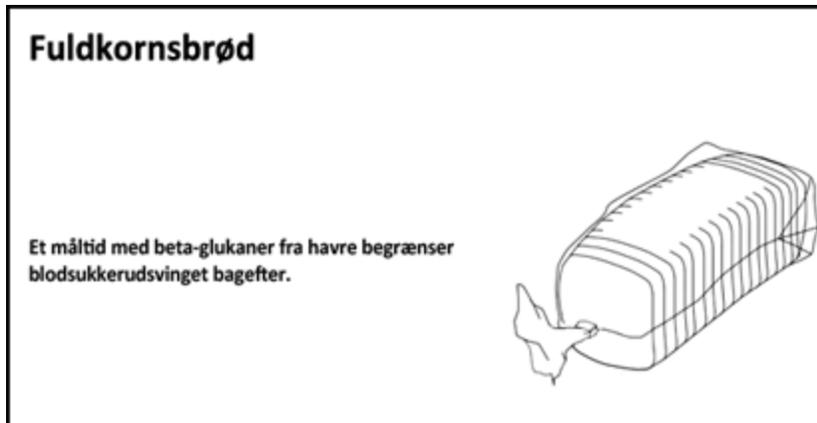


Figure 1. Wholegrain bread with the re-worded version of the beta-glucans health claim stimulus

Consumer Understanding Test (CUT)

This method, originally developed by Danone (Rogeaux, 2010), has been used in online surveys, where respondents are exposed to some stimulus material (e.g. picture of product, commercial) and are asked two open-ended questions. The method also gives guidelines for data coding and analysis (Grunert et al., 2011).

The application of the CUT method in the present study was adapted from Grunert et al. (2011). The method was used in an online survey, where consumers were presented with one stimulus picture at a time and with two open-ended questions related to the displayed stimulus:

- “If you had to tell a friend what [this fruit yoghurt / this wholegrain bread] does, what would you say?”
- “And if you had to tell your friend how it works?”

After finalizing the elicitation of inferences task, the respondents completed some background measures and socio-demographics. The background measures are not reported here as the focus of the present paper is on the elicitation of inferences.

Sample

The study targeted Danish speaking individuals above 18 years old, who were users and buyers of the carrier products and who were at least to some extent responsible for food shopping and

interested in health when shopping. The sampling was done by a market research agency in such a way as to ensure similarity in terms of age, gender and education of the respondents between this study and Study 2.

Overall, 300 respondents participated in the CUT survey of which 186 (50% M, 50% F; mean age 41y old) completed the CUT measure for one of the five versions of the beta-glucans health claim on one of two carrier products, fruit yoghurt or wholegrain bread. There were between 17 and 20 respondents seeing each stimulus. The remaining 114 respondents saw other stimuli (see Appendix 4.1) which are outside the scope of this paper.

Data analysis

The coding of the data gathered through the CUT method was conducted in NVivo 10, based on the procedure described by Grunert et al. (2011). First, the answers were content analysed using a hierarchical coding scheme. The lowest level of the developed scheme consisted of codes based on content of the answers, for example by health benefit mentioned or component mentioned. These low level codes were then aggregated to higher level codes depending on whether their content was in line with the scientific evidence behind the claim. The highest level codes in the hierarchical coding scheme are described in Table 2. The content of each answer to each of the CUT questions could be coded to several content categories from Table 2. The coding was performed by one coder, but the preliminary coding was reviewed by an assistant with a background in nutrition in order to ensure that the data were accurately coded according to the scientific evidence.

Table 2. Content categories developed for the CUT method answers (highest level codes and important sub-categories)

Content category and selected sub-categories	Description
Safe inferences	Statements that were in line with the scientific evidence behind the health claim
<i>Content inferences</i>	Statements that refer to the content of the claimed component in the product
Risky inferences	Statements that were not in line with the scientific evidence behind the health claim. The content coded at this category referred mainly to exaggerations of the claimed benefit
<i>Unrelated health benefits</i>	Statements that referred to health benefits which were unrelated to the one claimed
<i>Unrelated ingredient inferences</i>	Statements that refer to the content of a nutrient/component in the product other than the claimed component or just contain a mention of an ingredient which is unrelated to the claimed one
Vague benefit-related inferences	Statements that expressed a vague notion related to the claimed benefit
Vague inferences	Statements that expressed a vague notion (e.g. healthy product) or statements that were irrelevant in relation to the health claim (e.g. product is tasty). This code also includes the “do not know” types of answers
Restatements	Statements that were just a play back of the health claim, either of the entire claim or parts of it

As each respondent’s answer was coded to all applicable codes from Table 2, looking at the frequencies of these codes may not provide the clearest picture of adequate understanding. To have a clearer idea of the level of adequate understanding, each respondent was categorized to only one of four groups depending on the top level codes (Table 2) where his/her answers to both CUT questions were coded. The detailed description of the categorization is presented in Table 3 and has been adapted from Grunert et al. (2011). The consumers labelled as “safe” represent those consumers who can be seen as adequately understanding the health claim as their answers are in line with the evidence behind the health claim, whereas those labelled as “risky” make inferences that go beyond the claim content. In the study by Grunert et al. (2011) there were only three groups of respondents, however, we added the “Restatements only” group in order to account for those respondents who only restate the entire claim or parts of it. The consumers who only restate the health claim or parts of it are difficult to categorize as their answer could be seen as safe, however, just restating the claim may just reflect lack of motivation to process the health claim instead of adequate understanding. At the same time these consumers do not make a risky or vague interpretation either.

Table 3. Consumer groups based on their answers to the CUT method

Consumer group	Description
Safe	This group contains those respondents whose answers were coded only as safe or as content inferences, or partly as safe or content inferences and partly as vague or other codes excepting the risky or unrelated health benefits
Risky	This group contains those respondents whose answers were coded at least in part as risky or unrelated health benefit, or whose answers were only vague but at least in part coded as vague benefit-related or those who only made unrelated ingredient inferences (e.g. product contains an unrelated ingredient)
Other	This group contains those respondents who gave no answer or whose answers were coded as vague only
Restatements only	This group contains those respondents whose answers were coded as restatements only

The results are presented for the data aggregated across the two carrier products, due to the limited sample size per claim-carrier combination.

4.4.2. Results

Types of inferences elicited

For each of the five wording versions of the beta-glucans health claim, a large portion of the inferences made by consumers were “safe” inferences or “vague” inferences (Figure 2). On the other hand, only a very small percentage of the inferences were “vague benefit-related” ones or inferences that the product contains a component other than the one claimed, namely “unrelated ingredients”. The “risky” inferences or the “unrelated health benefits” inferences referring to health benefits unrelated to the one claimed, represented only a small percentage of the total number of inferences per health claim version.

In relation to the authorised wording of the beta-glucans health claim, 37% of the inferences made were “safe” ones, while an additional 15% were inferences about the claimed component content of the product. The content inferences can be seen as safe since participants were not explicitly told that the product contained beta-glucans, thus, if they inferred from the claim that the product in fact contained the claimed component, then they made a correct interpretation of the health claim. The “safe” inferences represented the most frequent type of answer given to the CUT questions in relation to the authorised wording of the health claim. The second most

frequent type of inferences was the “vague” inferences. Furthermore, only 2% of the references represented “risky” inferences while a slightly higher percentage, 6%, were inferences regarding health benefits which were not mentioned in the health claim wording.

When a general claim was added to the authorised wording of the beta-glucans health claim, the highest percentage (37%) of the statements made in relation to this version of the health claim, were “vague” inferences. Only 19% of the statements made were “safe” inferences, a decrease compared to the authorised wording version of the health claim. There was also a decrease in the number of content inferences, however, the percentage of “risky” inferences increased to 12% and more of the inferences were about health benefits which were unrelated to the claimed benefit, compared to the authorised version of the health claim.

For the authorised wording with additional information version of the beta-glucans health claim, the “vague” inferences represented again the highest percentage (40%) of all inferences made in relation to this claim. In comparison to the authorised wording of the health claim there was still a lower percentage of “safe” inferences made and a higher percentage of “risky” inferences for this version of the health claim.

When both a general health claim and additional information were added to the authorised health claim, the highest percentage of the inferences were the “safe” ones, however, their prevalence was still lower than the one for the authorised version of the health claim. A slightly smaller percentage of the inferences were “vague” ones, but more of the inferences were about health benefits unrelated to the claimed benefit.

Finally, when comparing the re-worded version of the beta-glucans health claim to the authorised one, a smaller share of the statements were “safe” ones for the re-worded claim while a larger proportion of the inferences were “vague” or “risky” inferences.

Based on the proportions of the different types of inferences in the overall number of statements per health claim version, it seems that the authorised health claim was the one understood most adequately.

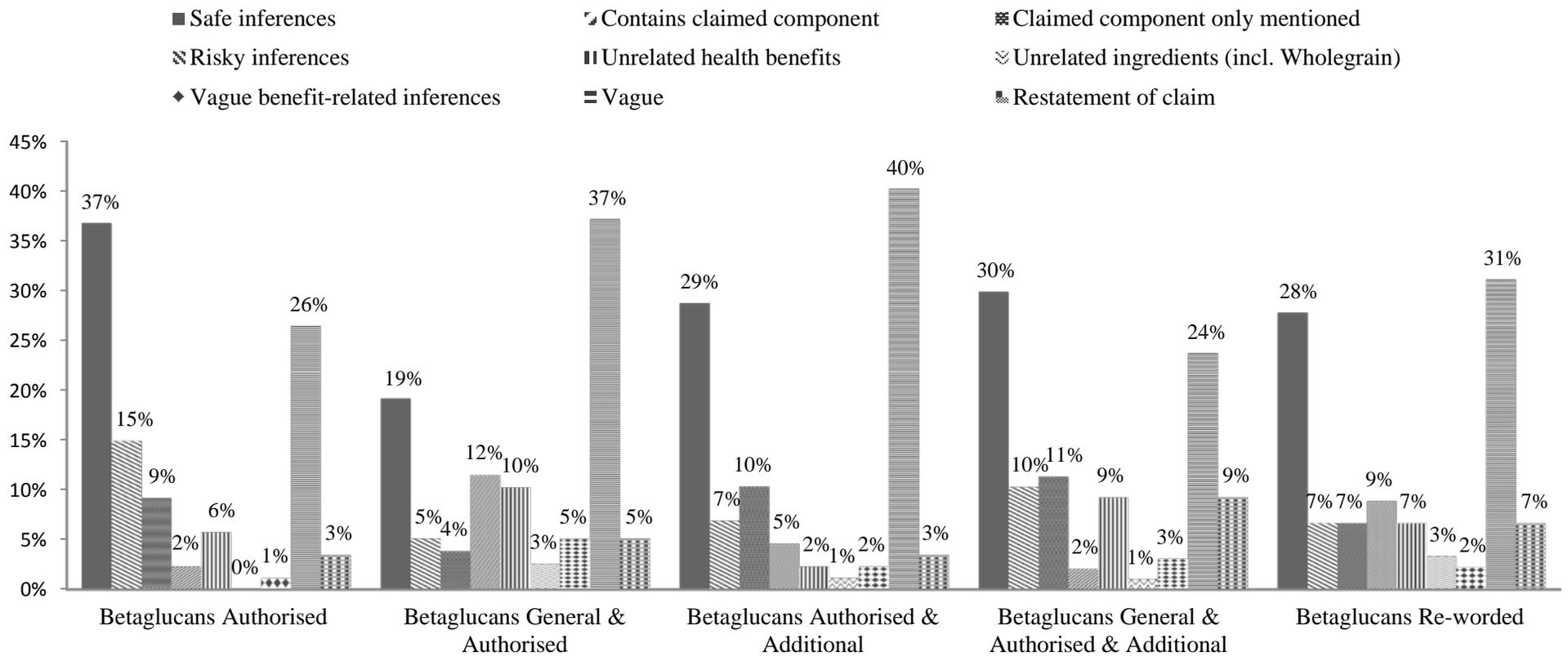


Figure 2. Types of inferences elicited by the CUT method and their frequency in the total number of inferences per health claim version

Note: The figures represent the percentage of statements categorized at each of the CUT codes per health claim version out of all statements made by the respondents who have been exposed to that particular wording of the health claim.

Extent of consumer adequate understanding of the health claim versions

More than half of those consumers who have been exposed to the authorised beta-glucans health claim on bread or yoghurt could be seen as “safe” in their interpretation of the health claim, less than a quarter were categorized as “risky” and about a quarter were in the “other” group (Figure 3). Given the distribution of respondents across the CUT groups, this health claim appears to be the one that the highest proportion of consumers understood adequately compared to the remaining wording versions, as for the authorised health claim there is the highest percentage of “safe” consumers and lowest of “risky” consumers.

The health claim version where a general claim was added to the authorised beta-glucans claim was understood least, as only about a fifth of consumers could be seen as “safe” consumers while almost a half could be seen as “risky”. The authorised health claim with additional information and the authorised version with both a general health claim and additional information were rather close in how well consumers understood them. There were slightly fewer “safe” consumers for these versions of the health claim and slightly more “risky” consumers compared to the authorised wording of the beta-glucans claim.

Finally, the re-worded version of the beta-glucans health claim did not seem to lead to improvements in understanding either, as there were fewer “safe” consumers and more “risky” consumers compared to the authorised version of the health claim.

Overall, the authorised version of the beta-glucans health claim was understood to the highest extent, however, the authorised wording with a general claim and additional information as well as the authorised wording with additional information had a similar distribution of respondents across the CUT groups. On the other hand, the authorised wording with a general claim and the re-worded version of the health claim were understood least.

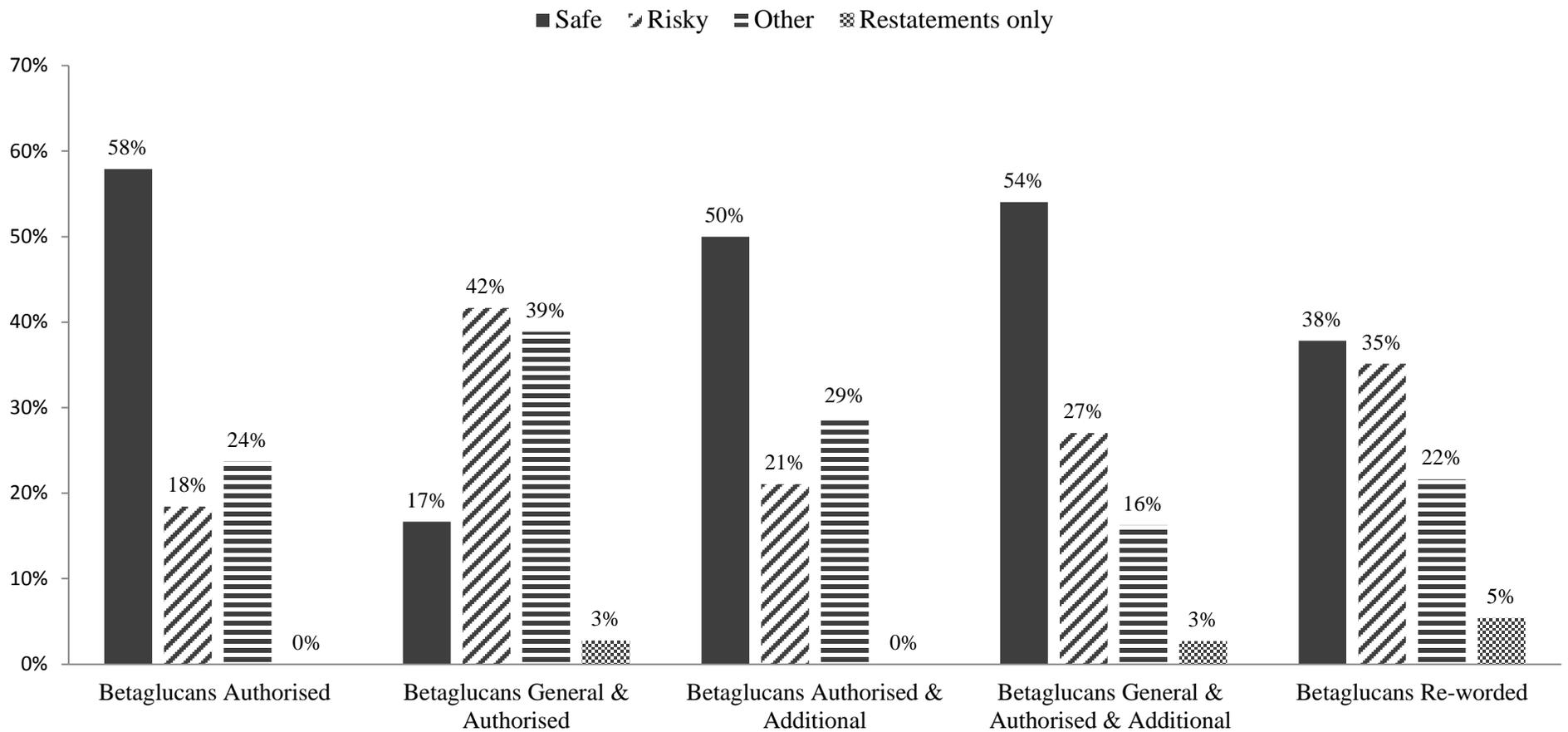


Figure 3. Percentage of respondents categorised in the four CUT groups per health claim version

Note: The figures represent the percentage of consumers categorized in each of the four CUT groups per health claim version out of all respondents who have been exposed to that particular wording of the health claim. The number of respondents per health claim version was between 34 and 40 as the data was combined for the two carriers under study.

4.4.3. Discussion

This study shows that when the inferences people make from products carrying health claims are compared to the scientific evidence behind the claim, many of the inferences can be seen as “safe”, meaning that they are in line with the evidence behind the claim. For some versions of the health claim under study, like the authorised version, this type of inferences was more prevalent compared to the version where a general claim was added to the authorised wording. On the other hand, the proportion of “risky” inferences, those statements made by consumers about perceived health benefits which are not in line with the scientific evidence behind the health claim, was much lower. This was especially the case for the authorised wording of the health claim, the authorised wording with additional information and the authorised wording with both a general claim and additional information. These results are in line with findings that consumers can make “safe” inferences from health claims (Grunert et al., 2011) and that exaggerations of expected benefits from products with health claims are limited (Bilman et al., 2012; Lähteenmäki et al., 2010). The extent to which people make different types of inferences was found to vary by version of the health claim, which is to be expected considering that stimulus characteristics are important in consumers’ processing of the information (Moorman, 1990).

Consumers were also found to make inferences about health benefits or components unrelated to the ones claimed, especially so for the authorised wording with a general claim, the authorised wording with a general claim and additional information and the re-worded version of the authorised beta-glucans health claim. These types of inferences, even though not very frequently mentioned, support the idea that the presence of a health claim on a product may have a magic bullet effect, meaning that consumers will associate inappropriate health benefits to the product (Roe et al., 1999).

We find that some consumers can be seen as adequately understanding the claims, the “safe” group, while others cannot, the “risky” group. However, we also find that many consumers were categorized as “other”. The consumers in the “other” group made only “vague” inferences namely statements which were not related to health benefits. This finding shows that understanding is not only about making inferences related to health benefits of the product which are in line or not with the scientific evidence behind the health claim, but a share of respondents

actually make no such inferences. Instead they give only vague answers, which can imply that they engage in low levels of information processing (Sujan, 1985). According to dual processing theories which postulate that motivation and ability are the main determinants of the extent of information processing (Petty & Cacioppo, 1986), those consumers who are not motivated or able to process the health claim may be the most likely ones to fall in the “other” group. It is rather challenging to say whether these consumers should be seen as being misled by the health claim as they actually do not expect any kind of health benefit from the product carrying a health claim.

Overall, Study 1 showed that the addition of a general claim to the authorised wording of the beta-glucans health claim may lead to lower understanding and a similar trend was found for the re-worded version of the authorised health claim. The other two versions, where either additional information or both additional information and a general claim were presented with the authorised health claim did not show a great potential to improve understanding but they performed close to the authorised version of the health claim.

The CUT method can show that the number of consumers who understood claims adequately differed somewhat between health claim versions as did the types of inferences made however, it cannot provide much insight into how these inferences occur. The laddering method can provide insights into the inferences that people made and the links between them. The associations between product attributes, their consequences and consumer values can help us understand why some of the versions of the health claim wording were better understood than others.

4.5. Study 2

The **objective** of this study was to elicit the hierarchical inferences that consumers make from products with health claims with a focus on those inferences that are relevant in a choice situation.

4.5.1. Method

This study was conducted between July and August 2014 in Denmark. The data were collected via face-to-face interviews using the laddering method. The data was collected in collaboration with the same market research agency as in Study 1. At the beginning of the interviews

participants were given a general introduction to the study and then were asked for consent to participate in the interview.

Each respondent was exposed to both carriers, each carrying a beta-glucans health claim. The order in which the carrier products (i.e. fruit yoghurt and wholegrain bread) were presented was randomized. The reported results are part of a bigger study where other stimuli were used as well, however, those results will not be reported here. More details on the design of this study can be found in Appendix 4.1.

Two interviewers, who were trained in the laddering method, conducted the face-to-face laddering interviews. The interviewers recorded respondents' answers using a laddering matrix form developed for the study. In addition, the interviews were audio recorded to facilitate the analysis in cases where the interviewer's notes were not clear. The interviews lasted between about 30 and 60 minutes.

Stimuli

The same stimuli as in Study 1 were used (see Table 1 and Figure 1). Additionally, a carrier product without health claim was used in this study. The stimuli were presented on laminated cards of the size 10.9 x 5.6 cm in the face-to-face interviews, which is close to the size of the pictures in Study 1 if converted from pixels to cm.

Laddering interviews

The laddering technique consists of two main steps. First, the relevant product attributes in relation to a set of choice options are elicited. Secondly, the respondents are asked a series of questions of the type "why is this important to you?", starting from each elicited attribute to uncover the relevant consequences and values (Reynolds & Gutman, 1988). The method has been previously applied to understand the reasons behind consumer's functional food choices (Urala & Lähteenmäki, 2003).

In the present study, participants were asked to rank products according to choice likelihood to elicit relevant attributes. Respondents were shown three versions of the same carrier product: one carrying a beta-glucans claim, one carrying another claim that the product could qualify for and

one with no health claim, and asked to rank the stimuli according to the likelihood that they would choose that product. Participants were given the option of a no claim product in order to increase the external validity of the task as then participants would not be forced to choose a product with health claim as their most likely choice. The three stimuli were shown in a random order. After the ranking task, participants were asked about their reasons for the ranking produced.

Subsequently, in the main laddering task, respondents were asked a sequence of “Why is that important to you?” type questions starting from the attributes elicited for each stimulus, each time using their answer in the next probing question. The questioning continued from the first consequence mentioned until reaching the values level or until respondents had no further input. Negative laddering was used when negative attributes or unwanted consequences were mentioned by the respondents in order to turn the discussion to positive consequences and values which are easier to talk about for respondents (Reynolds & Gutman, 2001). In the main laddering task forking was allowed. More specifically, if respondents mentioned two consequences when asked the probing question, the laddering questions were asked from both consequences mentioned one after the other. During the elicitation of attributes and the main laddering task, participants were able to look at the stimulus under discussion.

The elicitation of inferences task was conducted per carrier and the order of carriers was randomized. After finalizing the elicitation of inferences task, the respondents completed some background measures and socio-demographics. The background measures are not reported here as the focus of the present paper is on the elicitation of inferences.

Sample

In the laddering interviews 109 respondents (50% M, 50% F; mean age 41y old) were exposed to a bread carrying one of the five versions of the beta-glucans health claim and/or a yoghurt with one of the five versions of the beta-glucans claim. Each stimulus was seen by 16 respondents.

The same eligibility criteria as in Study 1 were used for sampling. The sampling was done by the market research agency in such a way as to ensure similarity in terms of age, gender and education of the respondents across the two studies.

Data analysis

The data recorded in the laddering matrices were content analysed following the guidelines by Reynolds and Gutman (1988). The audio recordings of the interviews were used if entries in the laddering matrices were unclear. The data were coded keeping in mind the level of abstraction, such that there were separate codes for attributes, consequences and values. Using the developed coding scheme, the ladders were entered into the MECAnalyst+ software for analysis.

Hierarchical value maps (HVMs)

The main outputs of laddering interviews are commonly presented as Hierarchical Value Maps (HVMs) (Reynolds & Gutman, 1988). An HVM represents an overview of the codes identified in the laddering analysis and the associations between them. The HVMs only show the most frequent associations between codes. This is achieved by specifying a cut-off level when creating the HVMs. The cut-off level represents the minimum frequency of an association between two codes in the ladders for it to be displayed in the HVM (Reynolds & Gutman, 1988). A clear indication of the strength of the association between two concepts is given in an HVM by the thickness of the line connecting them as the thickness of the line between two codes increases with the frequency of the association between those concepts in the ladders.

The data were analysed in MECAnalyst+. Separate HVMs were created for the different versions of the beta-glucans health claim. The HVMs illustrate the pattern of associations between the attributes, consequences and values elicited in the laddering interviews for the different wordings of the health claim under study. The cut-off level for the HVMs was selected based on the ratio of active codes and links retained in the HVM, while also trying to keep the number of codes reasonable to allow a clear overview. Furthermore, indirect links were used when making the HVMs. A cut-off level of 3 was selected for the HVMs of the different wordings of the beta-glucans health claim.

The differences between the HVM of the authorised version of the beta-glucans claim and the other versions can provide useful information in interpreting how the inferences that people make change when the wording of the health claim changes. This type of information can be helpful in understanding why in Study 1 some versions of the health claims were less understood

compared to the authorised version. In Study 1, the level of understanding differed most between plain authorised wording and authorised wording with an added general claim. Also the reworded version of the beta-glucans health claim differed from the authorised version of the health claim. Thus, only the HVMs of these three versions of the health claim and the differences between them will be interpreted in more depth in the following. The remaining HVMs are presented in Appendix 4.2.

The results are presented for the data aggregated across the two carrier products, due to the limited sample size per claim-carrier combination.

4.5.2. Results

The HVM for the authorised beta-glucans health claim (Figure 4) shows that the main attributes elicited were related to the claimed component, “beta-glucans”, or to the claimed benefit, “blood sugar”. The rest of the attributes were related to the health claim seen as information in general and not to its specific content. The most frequent associations elicited were between beta-glucans or blood sugar and general benefits for health, “good for health” type inferences, which were important for people as they were seen to lead to improved quality of life. Beta-glucans were also associated rather strongly to feelings of “reluctance towards the health claim” or to “not being willing to buy” the product containing the component. This finding is not surprising as consumers associated the beta-glucans content to “unfamiliarity”, “difficulty to understand” or “confusion regarding the information”. Lastly, some of the consequences closest linked to benefits for the blood sugar coded as “healthy for blood sugar” were linked to both the beta-glucans attribute and the blood sugar attribute.

In the HVM of the claim where a general claim was added to the authorised wording (Figure 5), the most frequent attribute was the “blood sugar” claimed benefit, while very few respondents mentioned the “beta-glucans”. When respondents did mention beta-glucans as an attribute, it was mainly to say that they were “not familiar” with this component. The main pattern of associations for this version of the health claim was that the claimed “blood sugar” benefit was important as it was “healthy for the blood sugar” which would lead to “good health” in general and thus “avoidance of sickness” which has a positive impact on people’s “quality of life”. Thus, the addition of the general claim seems to have drawn attention to the claimed benefit and more

people have mentioned the “healthy for blood sugar” type of consequence. This consequence is closely related to the general claim, thus, part of these could be seen as restatements. This can also be seen in Study 1 where for the general claim and authorised wording of the health claim, there were some consumers who made restatements only. Given that fewer people focus on the content of beta-glucans as an attribute and more talk about the general claim it is not surprising that we notice in the CUT measure from Study 1 a decrease in the percentage of consumers who can be seen as “safe”. Moreover, connections between blood sugar and some consequences like “avoid being uncomfortable or irritated” which can be seen as risky in relation to the health claim can explain why in the CUT measure in Study 1 there were more respondents categorized as “risky” for this version of the health claim. The rest of the additional consequences mentioned for this health claim, like better “management of everyday life”, can be seen as vague ones, thus in line with the increase in the percentage of consumers categorized as “other” in Study 1 for this version of the health claim as opposed to the authorised one.

Finally, in the HVM of the re-worded version of the health claim (Figure 6) most commonly respondents associated “beta-glucans” with “unfamiliarity”, which led to “reluctance” and “low motivation to purchase” such a product. Even though the claimed benefit, “blood sugar”, and the claimed component, “beta-glucans”, are mentioned as attributes these are not linked strongly to any of the consequences elicited. There is a path of association between “blood sugar” and “healthy for blood sugar”, thus, some people see the claimed benefit as important as they expect some specific benefits for their blood sugar but the link is not strong. Most of the additional consequences elicited for the re-worded wording as opposed to the authorised version of the health claim though cannot be seen as safe consequences of the product carrying the beta-glucans re-worded claim. In particular, some of the new consequences elicited could be even seen as risky, for example the perceived benefit for one’s “energy levels” or the “avoidance of feeling uncomfortable or irritated”. Moreover, there were low associations between the claimed benefit and component and consequences that could be seen as safe. These findings could explain why there were fewer respondents categorized as “safe” but more categorized as “risky” for the re-worded version of the health claim compared to the authorised version of the health claim in Study 1.



Figure 4. Interviews Hierarchical Value Map (HVM) for **beta-glucans authorised wording health claim** combined data for bread and yoghurt

Note: Within the boxes, “nr” reflects the number of respondents who mentioned the code while “sub” represents the percentage of respondents who mentioned the code from the total number of respondents who saw this health claim version

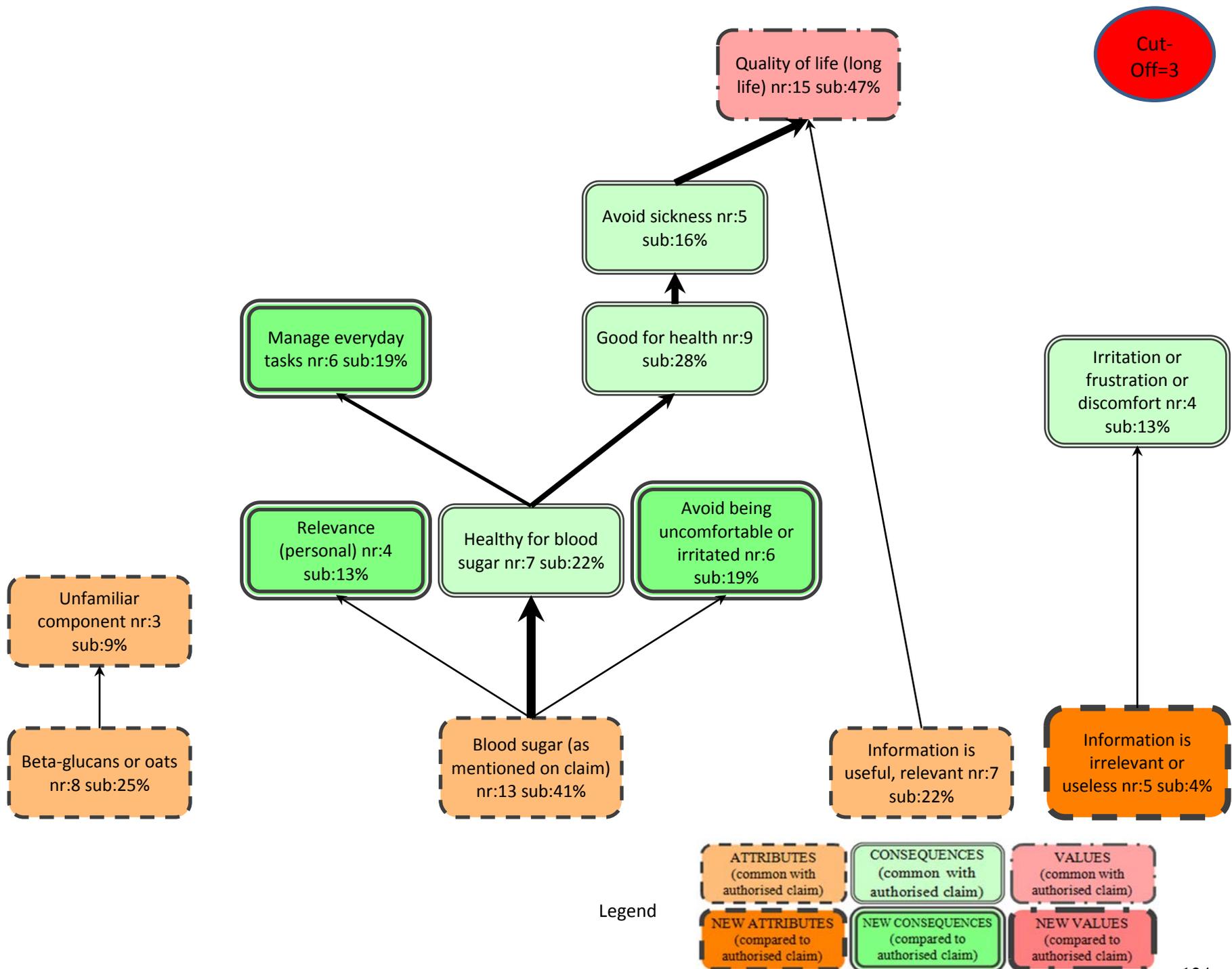


Figure 5. Interviews Hierarchical Value Map (HVM) for **beta-glucans authorised and general claim wording** combined data for bread and yoghurt
Note: Within the boxes, “nr” reflects the number of respondents who mentioned the code while “sub” represents the percentage of respondents who mentioned the code from the total number of respondents who saw this health claim version

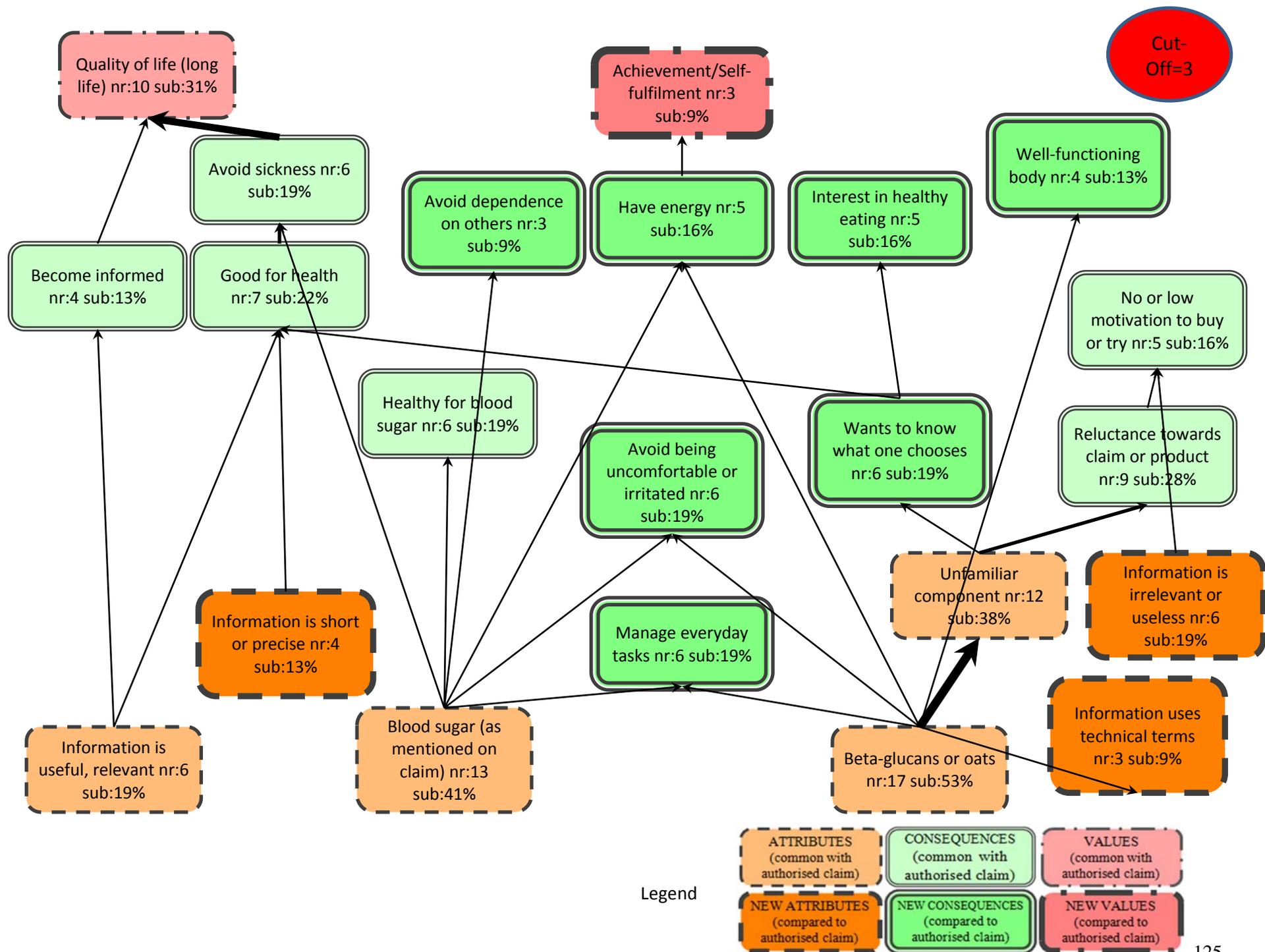


Figure 6. Interviews Hierarchical Value Map (HVM) for **beta-glucans re-worded version** combined data for bread and yoghurt

Note: Within the boxes, “nr” reflects the number of respondents who mentioned the code while “sub” represents the percentage of respondents who mentioned the code from the total number of respondents who saw this health claim version

4.5.3. Discussion

In the laddering interviews, people frequently mentioned content related attributes (i.e. the product contains the claimed component) and some of the most common consequences elicited were about health-related benefits of the products carrying health claims, however, there were also a significant number of consequences that can be seen as unrelated to health being thus similar to the “vague” inferences from Study 1. Even though in laddering it is to be expected that at higher levels of abstraction the named consequences will be less specific to the product (Reynolds & Gutman, 1988), some of the less abstract consequences were also unrelated to health, for instance when people talk about *being reluctant towards the health claim* or they see *the information as important* due to the fact that then they *become informed*.

For those versions of the health claims where a general claim was added to the authorised wording or where a re-worded version was used instead of the authorised claim, we find that consumers are better able to relate the products carrying these versions of the claims to consequences relevant for their everyday life like the “management of their everyday” as opposed to the authorised health claim version. Moreover the new inferences elicited for these versions of the health claim and the changes in the patterns of association show that people can link these versions to more health-related benefits even though some of these benefits are not related to the claimed one. These findings support the idea that re-wording a health claim or adding a general claim can lead to more inferences due to spreading activation (Anderson, 1983), which in turn can explain why these versions of the health claim were less well understood.

Finally, the results of laddering proved useful in providing further insights into why certain versions of the health claim did not seem to improve understanding compared to the authorised version of the health claim in Study 1.

4.6. General discussion

This study investigated the potential of different versions of a health claim on beta-glucans to improve consumers’ understanding by looking at the inferences that people made in relation to products carrying the different versions of the health claim. Two studies were carried out for this purpose. Study 1 used the Consumer Understanding Test (CUT) (Grunert et al., 2011) to elicit

inferences related to products with health claims and compare those inferences to the scientific evidence behind the health claim, while Study 2 used face-to-face laddering interviews (Reynolds & Gutman, 1988) to elicit the hierarchical inferences that are relevant to people in a choice situation.

Adequate understanding of the different versions of the health claim

The results presented in this study show that the addition of information (i.e. a general claim or additional explanatory information) or the re-wording of the authorised version of the health claim, both done with the aim to improve understanding, did not do much to improve the understanding of these health claims. Offering more information to consumers can be distracting (Ross & Creyer, 1992; Wansink et al., 2004), which could explain the lower levels of understanding found for the versions of the beta-glucans claims which offered additional information. It was, however, surprising that the re-worded version of the health claim did not seem to be better understood compared to the authorised version as the first one was shorter and used less technical terms, which based on prior findings would be expected to lead to better understanding (Wansink et al., 2004).

Even though surprising, these results can be explained by spreading activation theory (Anderson, 1983). People may have a more complex associative network for concepts that they are familiar with or that are more common. Thus, adding information that can be familiar to people or re-wording the health claims using more common terms instead of the technical ones normally used in authorised wordings of health claims may lead to activation and retrieval of more information stored in consumers' memory (Anderson, 1983). Therefore, the use of terms for which people may have a complex associative network can lead to activation of other concepts linked to those terms which can lead to inferences that are exaggerations in relation to the claim or that are not directly related to the claimed benefit. This was visible for example when adding the general claim which emphasized the benefits for blood sugar. For this version of the claim people expected benefits like avoiding feeling irritated or uncomfortable, while this was not the case for the authorised health claim. Other studies have found that previous knowledge has an impact on the inferences that people make, as for example people are found to interpret "no cholesterol" claims as "low fat" claims due to the strong link between fat and cholesterol in people's minds

(Andrews et al., 1998) or to associate health benefits to familiar nutrients (Lähteenmäki et al., 2010).

Advantages and disadvantages of the elicitation methods

The CUT method allows for elicitation of inferences in relation to products carrying health claims. Furthermore, the inferences elicited through CUT can be compared to the scientific evidence behind the claim in order to assess the extent to which these can be seen as justifiable. Following the CUT guidelines for data analysis, consumers can further be categorized based on their overall answers into different groups, of which the “safe” consumers are those who can be considered to understand the health claim adequately. However, while the method allows identifying those consumers who can be seen to adequately understand a certain health claim, it does not provide much insight into the process through which people arrived at those inferences. Therefore, this method would be recommended in cases where the interest is in finding out if people adequately understand a particular health claim, and especially if people misunderstand the benefits promised in the claim.

One of the main advantages of the laddering method is that it provides deeper insights into how inferences are made and how the pattern of associations between attributes, consequences and values elicited change when changing the wording of a health claim. In this way laddering is helpful in understanding why people end up making more risky inferences for some claims compared to other claims. Moreover, laddering provides some information on whether people find a health claim relevant by showing whether health claims are linked to consumers’ values which allows us to assume that health claims are instrumental for the achievement of their goals and thus personally relevant. On the other hand, the laddering interviews are rather difficult to conduct and analyse. Moreover, the data gathered through laddering interviews is less focused on the particular product carrying a health claim especially at higher levels of abstraction which makes the comparison of inferences elicited through laddering to the scientific evidence behind the claim less meaningful.

Overall, we find that the two methods used provide results that supplement each other well in providing a picture of the types of inferences that people make in relation to products with health claims.

Limitations

The present study has some limitations. The face-to-face laddering interviews were conducted with consumers living in one particular region of Denmark, while the CUT method was completed by respondents from all areas of Denmark. However, the samples for the two studies were similar in terms of age, gender and education which should allow for comparison of the results.

The size of the samples is relatively small which is not uncommon in exploratory studies, yet it imposed some limitations on the analyses as for example the data could not be analysed by carrier due to the low number of respondents per stimulus. Future research using larger samples is thus warranted.

Future research

The present exploratory study provided a better understanding of the types of inferences that consumers may make regarding health claims on food products as well as insights into the changes in the pattern of inferences depending on the wording of the health claim. In order to find out to what extent people adequately understand health claims, further quantitative studies are needed to assess the prevalence of the types of inferences identified in this study among consumers. Moreover, we do not find any indication that adding information or re-wording the health claims would lead to improvements in adequate understanding, thus, future quantitative studies to confirm this finding could be highly relevant.

A significant share of respondents made only vague interpretations, meaning that they cannot be seen as understanding the health claim adequately but neither can we conclude that they are misled by the health claim. Future studies could investigate how these respondents differ from those who make health-related inferences and how these consumers differ in their behaviour towards the products carrying health claims. Such insights could allow making judgements on whether these consumers could still be seen as belonging to the target audience of the products carrying health claims. If consumers with vague inferences are highly interested in choosing products with health claims, the lack of understanding could be regarded as a potential risk factor, even when no direct misunderstanding can be detected.

Moreover, consumer characteristics may play a role in the types of inferences that consumers make as can be expected based on dual processing theories (Petty & Cacioppo, 1986) and prior studies on consumer responses to health claims (Lähteenmäki, 2013), therefore, future studies could investigate such impacts. Furthermore, it would be relevant to study the subsequent effects of the different types of inferences on consumer responses to products carrying health claims, as this could show which types of inferences help or hinder informed choices.

Finally, more studies are needed using other health claims than the ones reported in the present study. As stimulus characteristics are important in information processing (Moorman, 1990) it would be interesting to compare different types of health claims in terms of understanding in future studies. Similarly, the carrier product may have an important role in consumer understanding (Lähteenmäki, 2013), however, the present exploratory study did not focus on investigating potential differences between carriers due mostly to sample size limitations. Thus, future quantitative studies investigating such impacts would be interesting.

Implications

As understanding of health claims is an important issue in the context of the EU regulation, there are some attempts to encourage better understanding by consumers. For example, there are some guidelines on the flexibility of wording of health claims that have been agreed upon by 17 EU countries in order to help consumers understand health claims adequately. While health claims using simpler words may facilitate information processing, our findings suggest that there is some danger that health claims using less technical terms may not be better understood. This happens because consumers will use their prior knowledge to interpret the claim and thus the use of more common words may lead to activation of more information in consumers' minds which might not be in line with a safe interpretation of the health claims. Providing a general claim or some explanatory information together with the authorised version of the health claims or rewording the authorised claim proved to have little potential to improve understanding. Thus, a lot of care should be put into rephrasing health claims if the purpose is to help consumers understand the health claims adequately.

When it comes to methods for elicitation of inferences to assess understanding of health claims, the CUT method would be recommended in cases where the interest is in finding out if people

understand a particular health claim adequately, due to its focus on the product carrying a health claim and the guidelines in analysing the data. This method would provide the most concrete answer to the question of whether people understand a particular health claim as consumers can be categorized into “safe”, “risky”, “other” or “restatements only” groups based on their overall answers to the two open-ended CUT questions, and the “safe” consumers can be regarded as those closest to understanding the health claim adequately.

The laddering method is most useful in identifying how inferences related to foods with health claims occur and how the pattern of associations changes when changing the wording of a health claim. Therefore, if the purpose of a study would be to change the wording of health claims in order to improve consumer understanding or avoid misunderstanding then the laddering method would be very useful as it can show how the associations related to the product carrying a health claim change when the wording changes. The use of laddering can also give insights into the relevance of the tested health claims by showing the values or goals in people’s lives that the product carrying a particular health claim contributes to.

4.7. Conclusion

Consumer understanding of health claims is important from a public policy perspective as it is expected to help consumers make informed choices. Efforts to improve understanding should be done with care as there is potential for consumers to attribute fewer safe benefits to products with health claims when they are faced with a re-worded version of the authorised claim using less technical terms or with additional information together with the authorised claim. Tests of adequate understanding would, thus, be recommended on a case by case basis before changing the authorised wording of health claims. The selected methods used in the present study for elicitation of inferences that consumers make in relation to products carrying health claims have proven useful in identifying different types of inferences made by consumers. Moreover, it was found that the Consumer Understanding Test (CUT) method is mostly useful in determining whether consumers understand a health claim adequately, while the laddering method is useful in identifying changes in the patterns of associations related to the health claims induced by changes in wording.

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Appendix 4.1

Details on study design

Study 1: CUT method

The data presented here are part of a larger study where some additional stimuli to the ones reported were used and some background measures were taken after the elicitation of inferences. The reported results refer only to the stimuli carrying beta-glucans health claims.

The background measures were not reported in the present thesis as the focus here was on elicitation of inferences from health claims.

The larger study contained the following stimuli:

- Carrier 1: mackerel in tomato sauce which could carry either a salt related claim or a vitamin D related claim.
- Carrier 2: fruit yoghurt which could carry either a beta-glucans related claim or a vitamin D related claim.
- Carrier 3: wholegrain bread which could carry either a beta-glucans related claim or a salt related claim.

Each of the health claims had eight versions of wording, of which only five are reported in the present thesis. The versions that were not reported are: the re-worded version with an unspecific claim, the re-worded version with additional information and the re-worded claim with both an unspecific claim and additional information. These were excluded from the analyses as they were variations on the re-worded claim and not the authorised one. Given that there were three carriers and each could carry one of two health claims of which each had eight versions, there were sixteen stimuli per carrier product in the larger study design. Each respondent was shown three stimuli, one for each carrier, displayed in a random order. The health claim present on each carrier was always different, thus, an individual would either see a wholegrain bread with a salt related claim, a fruit yoghurt with a beta-glucans related claim and a mackerel in tomato sauce with a vitamin D related claim or he/she would see a wholegrain bread with a beta-glucans related claim, a fruit yoghurt with a vitamin D claim and a mackerel in tomato sauce with a salt

related claim. Finally, the version of the health claim shown on each carrier was randomly selected from the eight possible versions of the health claim for that carrier.

Study 2: Laddering method

The data presented here are part of a larger study where some additional stimuli to the ones reported were used and some background measures were taken after the elicitation of inferences. The reported results refer only to the stimuli carrying beta-glucans health claims. The background measures were not reported in the present thesis as the focus here was on elicitation of inferences from health claims.

The larger study contained the following stimuli:

- Carrier 1: mackerel in tomato sauce which could carry a salt related claim, a vitamin D related claim or no claim.
- Carrier 2: fruit yoghurt which could carry a beta-glucans related claim, a vitamin D related claim or no claim.
- Carrier 3: wholegrain bread which could carry a beta-glucans related claim, a salt related claim or no claim.

Each respondent was exposed to nine stimuli in the laddering interview, three per carrier product. The laddering interviews were carried out for each carrier product in turn and the order of the carriers was randomized and balanced so that each carrier was presented first, second or last the same number of times. For each carrier, there were sixty-four possible combinations between the eight versions of the two possible health claims for the carrier. Thus, each participant saw one of the sixty-four combinations between the two health claims plus a no health claim carrier. The combination was drawn at random (the randomization was done in blocks) and the three stimuli per carrier (the two health claims or no claim) were also shown in a random order.

Appendix 4.2

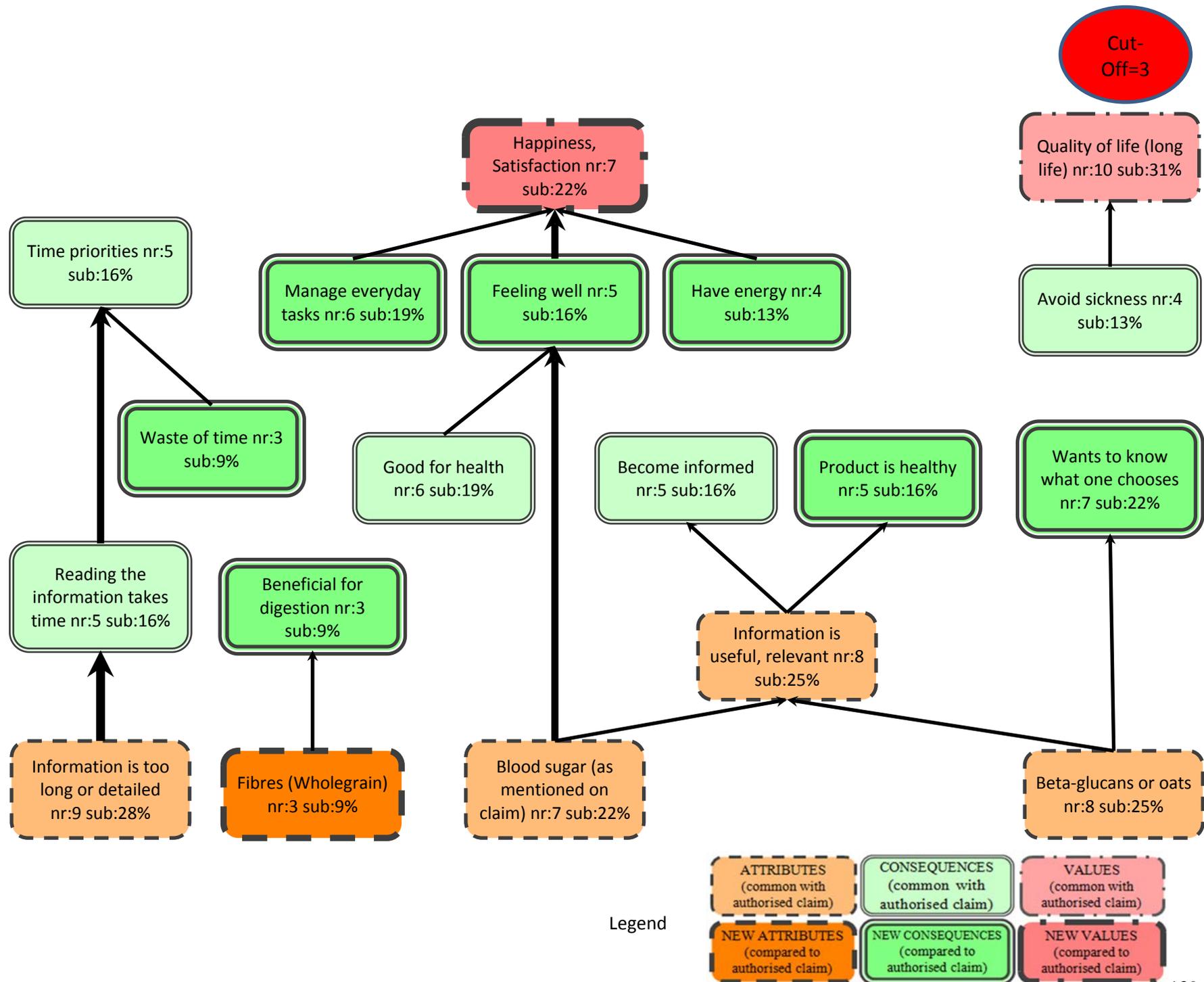


Figure 7. Interviews Hierarchical Value Map (HVM) for **beta-glucans authorised and additional information wording** combined data for bread and yoghurt
Note: Within the boxes, “nr” reflects the number of respondents who mentioned the code while “sub” represents the percentage of respondents who mentioned the code from the total number of respondents who saw this health claim version



Figure 8. Interviews Hierarchical Value Map (HVM) for **beta-glucans authorised and general claim and additional information wording** combined data for bread and yoghurt

Note: Within the boxes, “nr” reflects the number of respondents who mentioned the code while “sub” represents the percentage of respondents who mentioned the code from the total number of respondents who saw this health claim version

Chapter 5. The role of time constraints in consumer understanding of health claims¹

Abstract

The growing market for healthy foods has contributed to increased interest in communicating the health-related benefits of food products. Health claims are becoming an increasingly used instrument to communicate such benefits. In the European Union, consumer understanding of health claims was set as condition for use in order to protect consumers against misleading claims. However, consumer understanding of health claims has received little attention so far compared to consumer perceptions of claims. The aim of this study was to examine the effect of time constraints on consumer understanding of health claims in addition to factors related to the claim or the carrier. Furthermore, the potential link between misunderstanding and intention to buy was explored. A survey conducted among respondents in Denmark (N=2236) used a time constraint manipulation and varied the health claim shown to respondents in addition to a no claim control condition when assessing consumer understanding of health claims. The results showed that consumers' objective understanding of health claims is lower under time constraint, but the factors related to the claim or the carrier have no impact. These findings were cross-validated with a second measure of understanding. Inferences representing misunderstanding of the health claims were associated with increased intention to buy, while objective understanding had no impact. Implications for public policy and food industry are discussed.

Keywords: health claims; understanding; ability to process; time constraints

¹ **This chapter is prepared for submission as:** Stancu, Violeta; Lähteenmäki, Liisa; Grunert, Klaus G. The role of time constraints in consumer understanding of health claims.

5.1. Introduction

The global market for health and wellness food products has increased in recent years (Nielsen, 2015). Further growth is expected in the healthy food and drinks categories over the coming years (Euromonitor International, 2012). Health is proven to play an important role in motivating consumers' food choices (Steptoe, Pollard, & Wardle, 1995) and a recent report from the global market research company Nielsen, shows that consumers are increasingly relying on lifestyle changes to take responsibility for their health (Nielsen, 2015). Consumers' increased health awareness and interest has been fuelling the demand for healthy products (Nielsen, 2015).

Manufacturers of food products with health-related benefits can communicate the benefits of their products by using various means. They can choose to explicitly provide information through claims (e.g. health claims, nutrition claims) or front-of-pack nutrition labelling (e.g. traffic lights system, keyhole logo, etc.). Moreover, they can provide information on process characteristics of the product, e.g., organic production, expecting that this will lead consumers to believe that the product is healthier (Bech-Larsen & Scholderer, 2007; Chrysochou, 2010; Storcksdieck genannt Bonsmann et al., 2010). In addition, package design elements that communicate healthiness more implicitly, like healthy imagery or colours can be used (Chrysochou & Grunert, 2014; Karnal, Machiels, Orth, & Mai, 2016).

Health claims are messages claiming a link between a food or one of its constituents and health-related benefits (Regulation (EC) No 1924/2006). Health claims are becoming a widely used instrument to communicate the health benefits of food products and they are increasingly prevalent in the EU market (Hieke et al., 2016). However, there are some country-wise differences in the incidence of health claims (Hieke et al., 2016; Kaur et al., 2016; Lalor, Kennedy, Flynn, & Wall, 2010).

Health claims can accommodate consumers' increased health interest and help them make informed choices (Leathwood, Richardson, Sträter, Todd, & van Trijp, 2007; Nocella & Kennedy, 2012). Use of health claims can potentially contribute to improvements in public health (Ippolito & Mathios, 1991, 1994) due to promotion of healthier choices (Barreiro-Hurlé, Gracia, & de-Magistris, 2010) and eating (Williams, 2005). For the food industry the use of health claims can lead to growth and increased revenues (Aschemann-Witzel & Hamm, 2010;

Nielsen, 2015). Recently, it has been shown that the use of nutrition claims has a positive impact on stock market performance and sales; however, using a varied range of claims across a company's offerings could be detrimental to its performance (Cao & Yan, 2016).

Regulation (EC) No 1924/2006 covers the harmonized rules at the European Union level for use of health claims on food products. One of the conditions for use of health claims laid down by regulation is that the average consumer "can be expected to understand the beneficial effects as expressed in the claim" (Art. 5.2.). This condition was set to protect consumers against misleading claims. However, there is no suggestion of how to assess or define consumer understanding of health claims in the regulation.

There is some evidence that consumers may misunderstand health claims due to overgeneralization (Andrews, Netemeyer, & Burton, 1998). More specifically, consumers may perceive products carrying a health claim as superior in terms of health attributes that are not stated in the claim resulting in the so-called halo effect. Or consumers may attribute inappropriate health benefits to products carrying claims, which is known as a magic bullet effect (Roe, Levy, & Derby, 1999). However, other studies have not found evidence for such effects (Lähteenmäki et al., 2010; Orquin & Scholderer, 2015). Other studies have focussed on assessing objective understanding of health claims, namely the extent to which consumers interpret claims in accordance with the scientific evidence behind the claimed effect. Such studies show that most consumers can be seen as safe in their understanding (Grunert, Scholderer, & Rogeaux, 2011) or that over-interpretations are limited (Bilman, Kleef, Mela, Hulshof, & van Trijp, 2012). However, there is a lack of studies on how consumer understanding is affected by characteristics of the claim and by the conditions under which consumers process the health claim information.

Claim-related factors, i.e. the wording or type of claim, and individual differences in terms of motivation or ability to process information have been linked to consumer understanding of health claims (Andrews et al., 1998; Bilman et al., 2012; Grunert et al., 2011). Other factors, like the carrier product, have been shown to make an important impact on consumer perceptions of health claims (Lähteenmäki, 2013), yet their impact on understanding has not received much attention. The range of factors linked so far to consumer understanding of health claims is limited.

Consumers use limited time in store to look at products before making food choices. Even though purchase decisions are made in a short time, consumer decisions do not seem to rely only on habit, as they still take time to look at products (Grunert, Fernández-Celemín, Wills, Bonsmann, & Nureeva, 2010). A study on nutrition labelling found that when consumers are confronted with time constraints, their attention to nutrition labels and their use of such information may decrease, even though some types of labels may be affected less (van Herpen & Trijp, 2011). Thus, it can be inferred that time constraint may have an impact on the meanings that consumers attach to health claims. This is in line with dual processing theories of information processing, yet surprisingly this effect has not received attention in prior literature. Evidence regarding the effect of time constraint is especially relevant as consumers do not have unlimited time when making food purchases. Thus, both for regulators and for the food industry it would be important to understand whether the time available to attend to the health claim affects consumer understanding.

The purpose of the present study was twofold. The first aim was to assess the effect of time constraints on consumer understanding of health claims in addition to factors related to the claim and carrier. Additionally, the study examined the link between consumers' understanding, including specific types of misunderstanding, and their intention to buy products bearing health claims.

The paper is structured as follows. The next section gives an overview of the background of this study. Then, the method of the study is presented and the results of the data analyses are described. The last section contains discussions and implications for future research and public policy.

5.2. Background and hypotheses

Consumer understanding of health claims can be seen from the perspective of information processing theories (Grunert et al., 2011; Leathwood et al., 2007). When confronted with information, like health claims, consumers attach meaning to this information by linking it to prior knowledge stored in their memory (Graeff & Olson, 1994).

The way consumers process health claims can be analysed using the semantic network approach to memory and spreading activation theory. From this perspective, people's memory can be viewed as a network of associations formed of concepts that are linked based on relationships between them (Anderson, 1983). Activation of a concept in this network, by for example exposure to certain terms in a health claim, causes activation of other concepts linked to it. This process is known as "spreading activation" (Anderson, 1983). Due to "spreading activation" during elaboration of the information presented in a health claim, consumers can make inferences which go beyond what is manifestly stated in the claim (Andrews et al., 1998; Graeff & Olson, 1994; Leathwood et al., 2007). In particular, when consumers are exposed to a health claim on a food product, their prior associations regarding potential benefits of the carrier product can be activated during processing and result in inferences that are related to the carrier product, but are not specific to the health claim. We expect that such inferences, which are not specific to the claim, will be weaker for the product carrying a claim compared to people's perceived benefits of the base product without claim. Thus, while some misunderstandings of health claims may be based on consumers' prior associations with the base product, the presence of the health claim will focus consumers towards the claimed benefit to some extent. This leads us to our first hypothesis:

H1: Consumers exposed to a product with a health claim score on average lower on inferences representing benefits not specific to the claim as opposed to consumers who are exposed to the same product without a claim.

Dual processing theories, like the Elaboration Likelihood Model or the Heuristic-Systematic Model, posit that there are two main modes of information processing that consumers engage in, namely deep processing (i.e. central route or systematic processing) and shallow processing (i.e. peripheral route or heuristic processing) (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). Deep processing involves using a considerable amount of time and effort to elaborate on the available information, while shallow processing involves little time and effort as it relies mainly on learned associations or simple rules of thumb to process the information as fast as possible (Chen & Chaiken, 1999; Petty & Cacioppo, 1986).

The mode of processing that consumers' engage in when confronted with information like health claims is mainly determined by their motivation and ability to process the information (Petty & Cacioppo, 1986; Petty & Wegener, 1998). Higher motivation is expected to increase attention to relevant information and elaboration (Celsi & Olson, 1988; Moorman, 1990). Similarly, higher ability to process the information would lead to higher elaboration. Additionally, ability is seen as necessary in order for the information to be interpreted and understood by consumers (Celsi & Olson, 1988; Moorman, 1990). An important factor closely linked to the ability to process the information is time pressure. Time constraints are expected to lead to shallow information processing; even when motivation to process the information is high (Chaiken, Liberman, & Eagly, 1989; Suri & Monroe, 2003). Based on this we expect that under time constraint consumers may rely more on learned associations to attach meaning to a health claim which can lead to interpretations that are not in line with the scientific evidence behind the claim. This leads to our second hypothesis:

H2: Consumer understanding of health claims is lower on average under time constraint as opposed to under no time constraint.

Consumer understanding of health claims may differ between health claims. The extent to which people over-interpret health claims was found to vary by wording of health claims (Bilman et al., 2012). Most of the authorised health claims in the EU use scientific or technical terms which can be seen as difficult to understand by consumers. Re-wording of health claims to use more common terms may facilitate consumer understanding as common terms can reduce the difficulty to process information and thereby increase consumers' ability and motivation. The provision of explanatory information or emphasizing the claimed benefit could have similar effects. However, longer claims could also be less appealing to consumers and too much information can be distracting (Wansink, Sonka, & Hasler, 2004). Use of more common terms or provision of more information could facilitate activation of terms that are not linked to the claim, especially so under time constraint when consumers rely on fast associations. We expect that consumer understanding can be facilitated through re-wording or addition of information, yet under time constraint this might not be the case.

H3: Versions of health claims using common terms or providing additional pieces of explanatory information to facilitate understanding will result in higher consumer understanding. Yet, this effect is most likely when consumers are not under time constraint.

The carrier product is an important factor in consumers' perceptions of health claims (Lähteenmäki, 2013). Moreover, consumers prefer certain combinations of ingredients and carriers (Krutulyte et al., 2011). Combinations perceived as natural, for example between yoghurts and vitamins or fibre and bread, are seen as most attractive by consumers (Krutulyte et al., 2011). Consumers could, thus, be more motivated to process the natural combination and could have higher ability to process the information due to prior knowledge of the fit between the carrier and component. We expect that a health claim found on a product that is naturally rich in the claimed component may be better understood compared to when it is found on a carrier that does not naturally contain the component. However, under time pressure, consumers' increased motivation to process the claim referring to the natural combination might not lead to better understanding due to reliance on rules of thumb and learned associations.

H4: Consumer understanding of a health claim will be on average higher when the claim is carried by a product that naturally contains the claimed component as opposed to a product that does not have a natural content of the component.

Finally, some findings in prior literature imply that when consumers misunderstand health claims this may lead to a higher likelihood to buy products with those claims. Making inferences which go beyond the literal meaning of health claims has been related to higher intentions to buy (Harris, Thompson, Schwartz, & Brownell, 2011). Moreover, consumers with positive attitudes towards foods with health benefits were more likely to make interpretations of health claims that were not in line with the scientific evidence behind the claims (Grunert et al., 2011). These consumers are also the most likely ones to buy products with health claims due to their positive attitudes. We, thus, expect that inferences representing misunderstanding of health claims will be positively associated with willingness to buy. Perceived relevance of health claims has been associated with increased perceived benefit of products with claims and higher intention to buy (Dean et al., 2012; Howlett, Burton, Tangari, & Bui, 2012; Wong et al., 2013). Consumers who attach exaggerated meanings to health claims may be especially likely to buy such products

when the health claim is perceived as relevant to them. Thus, consumers' perceived relevance of the claim could moderate the relationship between understanding and intention.

H5a: Consumers' intention to buy a product with a health claim is stronger when consumers perceive benefits from this product. This goes both for benefits that are objectively correct and for benefits that are misunderstandings.

H5b: Perceived relevance of a health claim moderates the relationship between perceived benefits and intention to buy, so that the relationship is significant at high levels of perceived relevance.

5.3. Method

5.3.1. Procedure and Design

Data were collected by means of an online cross-sectional survey with a between-subjects experimental design. The study was conducted in the period September-November 2016. The data reported in this paper are part of a larger survey on foods with health claims², the remainder of the data will be reported elsewhere as it is outside the purpose of this paper.

Target and control groups

Consumers in the target group were exposed to product stimuli carrying health claims. The control group was shown product stimuli without health claims.

Time constraints

When completing the understanding task (explained under Measures), both in the target group and in the control group, respondents were randomly assigned to one of two groups according to the time available to complete the task. The "no time constraint" group was allowed unlimited time to complete the task. The "time constraint" group was given a limited time to complete the

² The larger survey contained, in addition to the reported measures, few psychographic measures that were stimulus-specific, one additional measure of understanding using closed-ended questions and some background measures. The additional psychographic and background measures were not included in the reported results due to the focus of the paper on the effect of time constraints on consumer understanding. Finally, the third measure of understanding was not reported due to space constraints.

understanding task. The time limit given to this group was set to the 40th percentile of the time it took respondents (N=195) in a pilot test to complete this task. In the pilot test, the timing used by respondents to complete the understanding task across two health claims and a selection of different versions per claim was measured and the 40th percentile of the aggregated timing was then set as the time available in the “time constraint” group. In the “time constraint” group there was a statement before the understanding question stating the average time it takes people to fulfil the task and that the respondent has only a certain number of second (which was lower than the average) to complete the task. Moreover, on the same screen there was a countdown timer.

In both target and control groups, the time spent by consumers on the understanding task was recorded. After completing the understanding measures respondents were asked to report how they perceived the time when answering the questions, using the following three items adapted from prior literature (Suri & Monroe, 2003): “no time pressure” (1) to “too much time pressure” (7), “more than adequate time available” (1) to “not adequate time available” (7) and “need lot more time to do this task” (1) to “need no more time to do this task” (7). The last item was reversed so that higher values on all items represent higher perceived time pressure. A composite score was computed for this measure by averaging the scores on the three items (Cronbach’s alpha>.90). The perceived time pressure was used as manipulation check to make sure that respondents in the “time constraint” group felt more time pressed than those in the “no time constraint” group.

Stimuli

Two health claims were used in the development of stimuli for the purpose of this study, one referring to the benefit of vitamin D for muscle function and the other regarding the link between beta-glucans and blood glucose levels. Furthermore, two carrier products were selected, a fruit yoghurt and a wholegrain bread. The first product was chosen due to its category popularity as carrier of health claims in prior studies (e.g. Ares, Giménez, & Deliza, 2010; Lähteenmäki et al., 2010; Saba et al., 2010), while the second product was selected because it is a common everyday product that can naturally have the content of beta-glucans to carry a claim. Based on the selected claims and carriers, three product-claim combinations were tested in this study: 1)

yoghurt with the vitamin D health claims; 2) bread with the beta-glucans health claims and 3) yoghurt with the beta-glucans health claims.

Each of the two health claims had five possible versions of wording (Table 1). The versions of wording were created starting from the authorised wording of the claim, by using the following elements: a) a re-worded version of the authorised wording of the health claim aimed to facilitate consumer understanding; b) a general (i.e. unspecific) claim regarding the health benefit claimed; and c) additional explanatory information regarding the component and/or benefit claimed. These elements were developed by The Danish Food and Drink Federation in cooperation with The Meal Partnership in Denmark (a public-private partnership between representatives from Danish authorities and business- and trade organizations) (Peetz-Schou, 2014). The five tested versions of each health claim were intended to be in line with the Regulation (EC) No 1924/2006 on health claims. For example, according to the regulation, a general (i.e. unspecific) health claim is allowed only when an authorised health claim is present on the product. Furthermore, the flexibility of wording guidelines which have been agreed upon by several Member States in the EU, were used when developing the re-worded versions of the health claims; thus, the re-worded version could be seen as a substitute for the authorised wording.

Table 1. Wording versions of the two health claims

Health claim versions	Wording for beta-glucans and blood glucose claim	Wording for vitamin D and muscle function claim
1 Authorised wording	Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal.	Vitamin D contributes to normal muscle function.
2 General (unspecific) claim + Authorised wording	Good for your blood sugar. Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal.	Healthy muscles. Vitamin D contributes to normal muscle function.
3 Authorised wording + Additional information	Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal. It is normal that your blood sugar rises after a meal. How much it rises	Vitamin D contributes to normal muscle function. Vitamin D is a fat-soluble vitamin that occurs naturally

		depends, amongst others, of what you eat. It is good for the body if the fluctuations are not too large. Beta-glucans are a special type of dietary fibre. They are soluble in water and are found in the bran of the grain varieties barley and oat, amongst others.	in fatty fish. Another important source of vitamin D in the summer is sunlight that causes the vitamin to be produced in the skin.
4	General (unspecific) claim + Authorised wording + Additional information	Good for your blood sugar. Consumption of beta-glucans from oats or barley as part of a meal contributes to the reduction of the blood glucose rise after that meal.	Healthy muscles. Vitamin D contributes to normal muscle function.
		It is normal that your blood sugar rises after a meal. How much it rises depends, amongst others, of what you eat. It is good for the body if the fluctuations are not too large. Beta-glucans are a special type of dietary fibre. They are soluble in water and are found in the bran of the grain varieties barley and oat, amongst others.	Vitamin D is a fat-soluble vitamin that occurs naturally in fatty fish. Another important source of vitamin D in the summer is sunlight that causes the vitamin to be produced in the skin.
5	Re-worded wording	A meal with beta-glucans from oats limits blood sugar fluctuations afterwards.	Vitamin D contributes to normal muscles.

The combinations of carriers and claims used in the present study are feasible and lawful (yoghurt would have to be enriched with the claimed components), yet they were not existent on the market at the time of the study. Therefore, the stimuli tested can be seen as product concepts. Consumers were shown stimuli which consisted of the name of the product, a drawing of the product category of the carrier and one version of the health claim. In the control group, the stimulus material did not contain a health claim but only the name of the product and a drawing of the product category. The black and white stimuli were presented on screen in the online survey in the size of 413x213 pixels. Figure 1 shows an example of a stimulus containing a health claim (used in target group) and one without a health claim (used in control group).

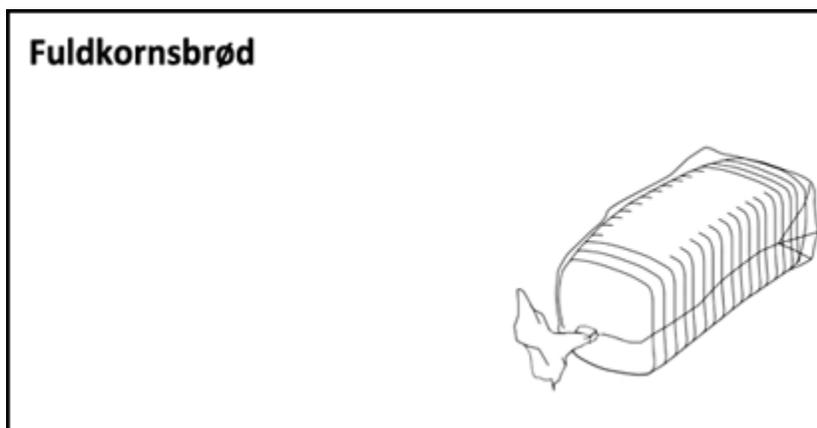
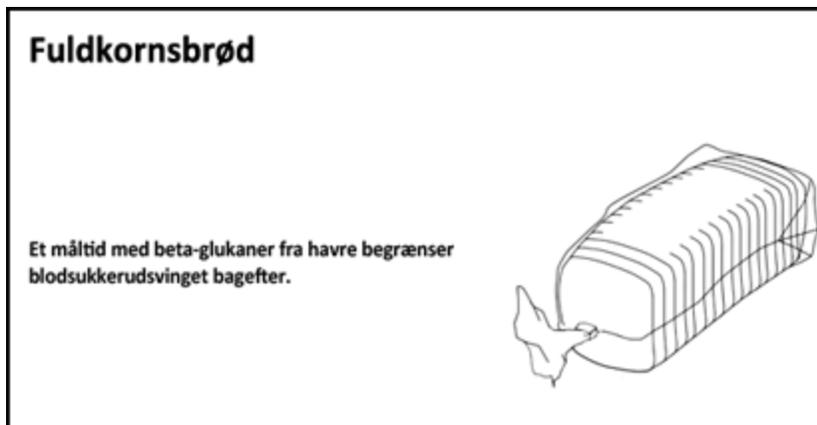


Figure 1. Wholegrain bread with the re-worded version of the beta-glucans health claim stimulus (up) and wholegrain bread with no health claim stimulus (down) (in Danish)

5.3.2. Participants

The sample was drawn from the panel members of a market research agency in Denmark. The survey was sent to a representative sample of the Danish population based on age, gender, education and region. Across experimental conditions a total of 2236 respondents completed the study (1795 target group; 441 control group). After the introduction to the study all participants were asked for their informed consent to participate in the survey.

Participants had to meet several eligibility criteria to participate in the study. First, participants had to be above 18 years old and responsible to some extent for food shopping in their household. Secondly, they had to be users and buyers of the carrier product categories (i.e. bread and yoghurt). Finally, respondents were asked to rate how important is the healthiness of food for them when shopping on a 7-point rating scale ranging between “not at all important” (1) and

“extremely important” (7), and only those whose answers were above two were eligible for the study as they could be seen to have at least some interest in health when shopping.

There were slightly more females in the sample compared to males (55% target group; 52% control group) and most consumers were medium or highly educated (48% medium & 40% high education in target group; 46% medium and 48% high education in control group). Consumers were on average around 50 years old in the target and control group. The number of consumers in the different experimental groups can be seen in Appendix 5.1.

5.3.3. Measures

Consumer understanding of health claims

The assessment of consumer understanding of health claims involved rating of pre-formulated statements representing potential interpretations of the two health claims under study. In the target group where respondents were exposed to products with claims, they were given the instruction to imagine they are out shopping and seeing the stimulus product (see Figure 1) with the specified information on its package. Under the stimulus picture the sixteen statements to be rated were displayed in a random order and respondents were asked to rate each statement according to how well they think it reflects the meaning of the product’s claim on a 7-point scale ranging between “does not reflect at all” to “reflects very well”. In the control group where respondents saw products with no claims, the instruction was to imagine they are out shopping and seeing the stimulus product. Then respondents were asked to rate the same statements as in the target group according to how well they think the statement reflects a benefit of the product using the same rating scale as in the target group.

The statements representing potential interpretations of the two health claims were based on a qualitative study involving open-ended questions and laddering interviews carried out in Denmark. These qualitative studies will be reported in more detail elsewhere. The statements represent different types of inferences that consumers make from products with health claims, namely: a) safe inferences (i.e. statements that are in line with the scientific evidence behind the health claim), b) vague inferences (i.e. statements that reflect a vague notion, e.g. the product is healthy, or that is unrelated to health, e.g. product is tasty), c) vague benefit-related inferences

(i.e. statements representing an unspecific benefit related to the claimed one), d) risky inferences (i.e. statements that are not in line with the scientific evidence behind the health claim), e) claim unrelated inferences about health benefits (i.e. statements about health benefits of the product other than the one claimed). The statements were developed in collaboration with researchers with a background in nutrition. The sixteen statements used and the type of interpretations they represent can be seen in Table 2.

Each respondent was exposed to the following stimuli in the understanding task in the target group: a) one fruit yoghurt carrying one of the five versions of the vitamin D health claim (selected at random) and one wholegrain bread bearing one of the five versions of the beta-glucans health claim (allocated at random) or b) one fruit yoghurt with one of the five versions of the beta-glucans health claim (selected at random). In the control group the design was similar, as follows: a) one fruit yoghurt with no claim where consumers rated the understanding statements related to the vitamin D claim; and one wholegrain bread with no claim where consumers rated the understanding statements related to the beta-glucans claim or b) one fruit yoghurt with no claim where consumers rated the understanding statements related to the beta-glucans claim³.

The same design was followed in the “time constraint” and “no time constraint” conditions. Under “time constraint” respondents were given 66 seconds per stimulus in the target group and 46 seconds in the control group to complete this measure (instruction: “On average it takes people 83 seconds [55s in control] to answer this question. You have only 66 seconds [46s in control] to answer the question”).

For further analyses, an objective understanding index was computed as the difference between the average score on items that can be seen as correct and the average score on items that can be seen as incorrect, as follows:

- mean of safe, vague and vague benefit-related items – mean of risky and claim unrelated benefit items

³ People who saw option a) in this measure were shown option b) in an understanding task using a different way to assess understanding. Similarly those who saw option b) here were exposed to option a) in an understanding task using a different way to assess understanding. One of the different measures was use of the check all that apply method. A summary of findings based on this second measure of understanding are presented under the Cross-validation section in the Results.

Higher values on the understanding index, thus, represent a higher degree of objective understanding of the health claim.

In addition, five composite variables were used to represent the types of inferences under study. Each composite variable was computed as the mean of scores on the statements measuring it (see Table 2). The scores on the understanding index and the composite variables by type of inferences were pooled across the health claim versions per product-claim combination.

Table 2. Understanding statements and their objective categorization

Types of inferences	Beta-glucans and blood glucose claim (used on fruit yoghurt or wholegrain bread)	Vitamin D and muscle function claim (used on fruit yoghurt)
	<i>This product...</i>	<i>This product...</i>
Safe⁽¹⁾	Helps to keep blood sugar levels stable or in balance Helps to keep blood sugar levels low Helps to reduce blood sugar fluctuations Contains beta-glucans	Helps to maintain muscle mass Helps to maintain normal muscle function Helps to strengthen the muscles Contains vitamin D
Vague⁽¹⁾	Is healthy Is tasty	Is healthy Is tasty
Vague benefit-related⁽¹⁾	Is good for the blood sugar Does something for the blood sugar	Is good for the muscles Does something for the muscles
Risky⁽²⁾	Lowers the blood sugar levels Ensures that the blood sugar levels do not rise Prevents sugar rush Reduces the risk of diabetes	Helps to build muscles Prevents all muscle problems Removes negative (harmful) substances from the muscles Reduces the risk of muscle problems (e.g. muscular atrophy)
Claim benefit unrelated⁽²⁾	Is good for the bones Is good for the immune system Is good for the gut or digestion Keeps one full (maintains satiety)	Is good for the bones Is good for the immune system Is good for the gut or digestion Keeps one full (maintains satiety)

(1) seen to be in line with the scientific evidence behind the health claim to an extent

(2) seen as not in line with the scientific evidence behind the health claim, thus, represent misunderstanding

Intention to buy products with health claims

Consumers' reported intention to buy was measured after the understanding task; however, they had to answer some questions about socio-demographics and other measures related to attitudes towards the products and claims in-between. Each respondent rated intention to buy only for those stimuli that he/she had seen in the understanding task. First, consumers were instructed to imagine being out shopping and seeing the stimulus product (see Figure 1) with the specified extra information on its package. Below the stimulus picture, three items displayed in a random order asked about consumers' buying intention. The order in which consumers did the rating for the different stimulus pictures was randomized.

Consumers' buying intentions were assessed with three items adopted from prior literature: "How likely is it that you would buy this product?" rated on a 7-point scale ranging from "very little" to "very much"; "I would intend to buy this product" and "I would be willing to buy this product" both rated on 7-point scale ranging between "strongly disagree" and "strongly agree" (Dean et al., 2012; van Trijp & van der Lans, 2007). Scores on the intention to buy items were pooled across the five versions of the health claim per product-claim combination. A composite measure per product-claim combination was computed for the intention to buy by averaging the scores on the three items assessing it (Cronbach's alpha per product-claim combination > .95). Higher values represent higher intentions to buy the product carrying the health claims.

Perceived relevance of the health claims

Consumers' perceived relevance of the health claims under study was rated with twelve items (Table 3), some of which were adopted from prior literature (Zaichkowsky, 1994). Consumers were exposed only to the text of a health claim and instructed to imagine seeing the health claim on a food product. The twelve items were displayed in a random order below the stimulus material. The assessment of perceived relevance was done after the understanding task, but there were some socio-demographic measures in-between. Respondents were asked to rate only those health claims that they had been exposed to in the understanding task. Scores on the perceived relevance measure were pooled across the different health claim versions per product-claim combination. A composite measure was computed by averaging the scores on the twelve items per product-claim combination (Cronbach's alpha > .80). The negatively framed items were

reversed when computing the composites, so that higher values reflect higher perceived relevance.

Table 3. Perceived relevance of health claims items

This health claim:

is important to me (1) *to* is unimportant to me (7)*
 is boring to me (1) *to* is interesting to me (7)
 is relevant to me (1) *to* is irrelevant to me (7)
 is exciting to me (1) *to* is unexciting to me (7)*
 means nothing to me (1) *to* means a lot to me (7)
 is appealing to me (1) *to* is unappealing to me (7)*
 is directed towards me (1) *to* is not directed towards me (7)
 is beneficial for me (1) *to* is not beneficial for me (7)
 is talking to people like me (1) *to* is not talking to people like me (7)
 will contribute to my quality of life (1) *to* will not contribute to my quality of life (7)
 will contribute to my happiness or satisfaction in life (1) *to* will not contribute to my happiness or satisfaction in life (7)
 will contribute to my family's wellbeing (1) *to* will not contribute to my family's wellbeing (7)

(1) the first six items were adopted from Zaichkowsky (1994), details regarding the development of the scale and its validity are planned to be published elsewhere

*these items were translated in Danish using "is not..." for the right end of the scale (e.g. is not important to me) as it was not suitable to directly translate the English wording

Data Analyses

Data analyses were conducted using SPSS 24. Those respondents who finished the survey in less than the 2nd percentile of the overall time to complete the survey (299 sec. target group and 221 sec. in the control group) were excluded from further analyses (N=35 in target group and N=8 in control group) as it was considered that they did not take enough time to read the information and instructions. Furthermore, those respondents who reported having not seen the stimulus in the understanding task or the product evaluation measures were excluded from the analyses involving those measures (Target group: understanding analyses N=142 (control N=40), understanding and intention to buy analyses N=167). The final number of respondents used in the different analyses can be seen under descriptive statistics in Appendix 5.1.

ANOVA analyses were used to test the effect of the "health claim" (control vs. target group), the "time constraint" or the "health claim version" conditions on consumer understanding of health claims. The target and control groups were compared in terms of vague and claim unrelated

benefit inferences. These two types of inferences were deemed suitable for this comparison as they were not specific to the health claim, thus, were the same across the health claims groups. All other analyses focused on the target group and used mainly the understanding index for comparisons. When necessary the composite variables for the five types of inferences (see Table 2) were used as well to provide a clearer picture of the effects. Regression analyses were conducted to assess the impact of understanding on intention to buy and the potential moderating role of perceived relevance of health claims in this relationship.

All analyses were run separately per product-claim combination, namely fruit yoghurt with Vitamin D claim, wholegrain bread with beta-glucans claim and fruit yoghurt with beta-glucans claim, except the analysis testing the effect of the carrier product on consumer understanding. Only those respondents who answered the understanding questions were included in the analyses.

Overall, there were no significant differences between the experimental groups (compared in the ANOVA analyses) in terms of gender, education or region, with the following two exceptions. There was a significant difference between the target and control groups in education (Pearson Chi-square=15.34, $p < .001$). There were slightly fewer (7% vs. 12%) lower educated respondents and slightly more (48% vs. 40%) highly educated respondents in the control group as opposed to the target group. Additionally, there was a small difference in age between the two “carrier” groups, so that consumers who saw the yoghurt as carrier were slightly younger on average than those who were exposed to bread as carrier (when looking at the age groups 18-35, 35-50, 50-74 there were no significant differences between the groups exposed to each carrier though).

Descriptive statistics for the understanding measures, perceived relevance of health claims and willingness to buy products with health claims are displayed in Appendix 5.1.

5.4. Results

Time constraint manipulation check

The time constraint manipulation worked as expected. A two-way between-subjects ANOVA was conducted to test the effect of “time constraint” groups and “health claim” groups on perceived time pressure. The only statistically significant result was the main effect of “time

constraint” ($F_{(1,2189)}=1536.9, p<.001$)⁴. Consumers in the “time constraint” group reported significantly higher perceived time pressure (mean=5.22, SD=1.56) compared to those in the “no time constraint” group (mean=2.31, SD=1.27).

Consumer inferences from products with claims versus no claims

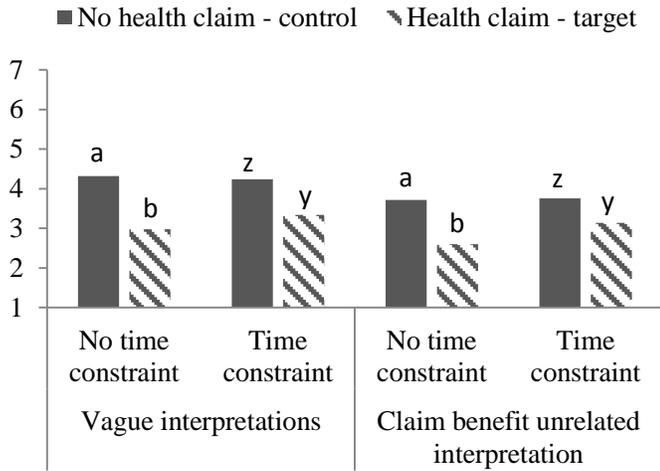
ANOVA analyses per product-claim combination were used to test the effect of the “health claim” group (control - product with no health claim vs. target - product with health claim) and “time constraint” groups (no time constraint vs. time constraint) on consumers’ scores on the **vague** and **claim benefit unrelated** inferences. The analysis showed a significant main effect of the “health claim” group for all product-claim combinations (Figures 2 & 3). Additionally, there was a significant interaction between the “health claim” group and the “time constraint” group for the bread with beta-glucans (Figure 3). Finally, there was no significant main effect of the “time constraint” groups across the product-claim combinations.

Overall, for the yoghurt with vitamin D or with beta-glucans claims, consumers exposed to the products with no health claims (control group) scored higher on the **vague** inferences and **claim benefit unrelated** inferences as opposed to those respondents who were exposed to products with health claims (target group) (Figure 2). For the bread with beta-glucans, consumers in the control group scored higher on the **vague** inferences compared to the target group (Figure 3). Additionally, respondents in the control group rated higher the **claim benefit unrelated** inferences compared to the target group, but only when they were exposed to the “no time constraint” condition this effect was statistically significant. Finally, among respondents in the target group, those exposed to the “time constraint” condition scored higher on the **vague** inferences and **claim benefit unrelated** inferences as opposed to those in the “no time constraint” group.

Overall, we found that consumers exposed to a product with a health claim made vague and claim unrelated benefits to a lower extent compared to those consumers seeing the same product without a claim, which is consistent with hypothesis H1.

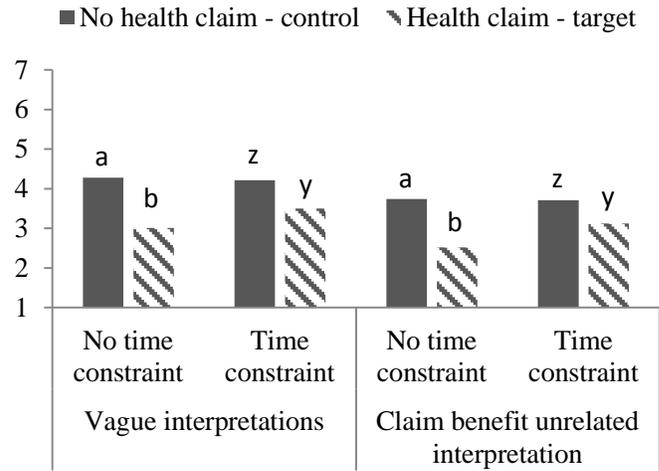
⁴ As Levene’s test of homogeneity of variance was significant at $p<.05$ for this analysis, a non-parametric test was conducted to assess the effect of the “time constraint” group on the perceived time pressure. In the Mann-Whitney U test, the differences found in the ANOVA analyses were confirmed as significant at $p<.001$.

Yoghurt with vitamin D claim



(1) means with different superscript letters within each “time constraint” group by type of interpretation are significantly different ($p < .05$); (2) *Vague interpretations*: Main effect of “health claim” group ($F_{(1,580)}=38.81$, $p < .001$, $\eta^2=.063$)⁵, main effect of “time constraint” group ($F_{(1,580)}=.61$, $p=.435$, $\eta^2=.001$), interaction effect ($F_{(1,580)}=1.39$, $p=.238$, $\eta^2=.002$); (3) *Claim benefit unrelated interpretations*: Main effect of “health claim” group ($F_{(1,569)}=24.51$, $p < .001$, $\eta^2=.041$)⁵, main effect of “time constraint” group ($F_{(1,569)}=2.70$, $p=.101$, $\eta^2=.005$), interaction effect ($F_{(1,569)}=2.00$, $p=.157$, $\eta^2=.004$)

Yoghurt with beta-glucans claim

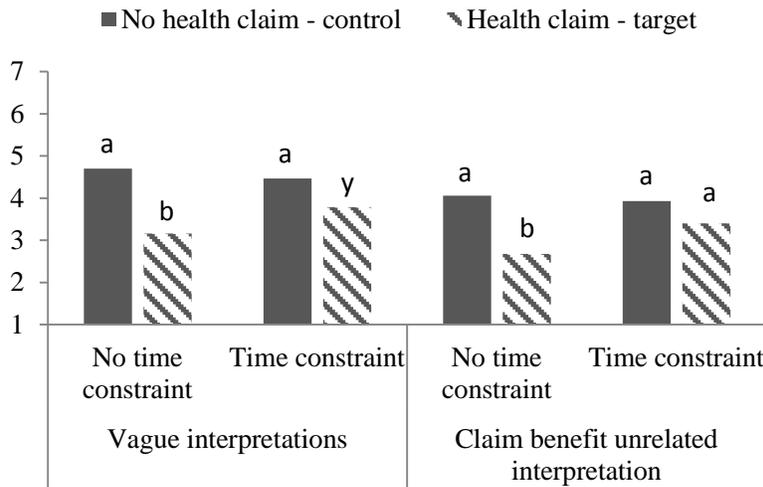


(1) means with different superscript letters within each “time constraint” group by type of interpretation are significantly different ($p < .05$); (2) *Vague interpretations*: Main effect of “health claim” group ($F_{(1,554)}=30.83$, $p < .001$, $\eta^2=.053$), main effect of “time constraint” group ($F_{(1,554)}=1.42$, $p=.233$, $\eta^2=.003$), interaction effect ($F_{(1,554)}=2.39$, $p=.123$, $\eta^2=.004$); (3) *Claim benefit unrelated interpretations*: Main effect of “health claim” group ($F_{(1,522)}=23.13$, $p < .001$, $\eta^2=.042$), main effect of “time constraint” group ($F_{(1,522)}=2.19$, $p=.140$, $\eta^2=.004$), interaction effect ($F_{(1,522)}=2.80$, $p=.95$, $\eta^2=.005$)

Figure 2. Effect of “health claim” group and “time constraint” group on scores of vague or claim benefit unrelated interpretations

⁵ As Levene’s test of homogeneity of variance was significant at $p < .05$ for this analysis, a non-parametric test was conducted to assess the effect of the “health claim” groups on the vague and claim unrelated benefit interpretations. In the Mann-Whitney U test, the differences were confirmed as significant at $p < .001$.

Bread with beta-glucans claim



(1) means with different superscript letters within each “time constraint” group by type of interpretation are significantly different ($p < .05$); (2) means with different superscript letters within each “health claim” group by type of interpretation are significantly different ($p < .05$); (3) *Vague interpretations*: Main effect of “health claim” group ($F_{(1,572)}=36.97, p < .001, \eta^2=.061$)⁵, main effect of “time constraint” group ($F_{(1,572)}=1.23, p=.267, \eta^2=.002$), interaction effect ($F_{(1,572)}=5.47, p=.020, \eta^2=.009$); (4) *Claim benefit unrelated interpretations*: Main effect of “health claim” group ($F_{(1,540)}=27.75, p < .001, \eta^2=.049$)⁵, main effect of “time constraint” group ($F_{(1,540)}=2.73, p=.099, \eta^2=.005$), interaction effect ($F_{(1,540)}=5.58, p=.019, \eta^2=.010$)

Figure 3. Interaction between “health claim” and “time constraint” on scores of vague or claim benefit unrelated inferences for bread with beta-glucans claim.

Effect of time constraint on consumer understanding of health claims

The effect of the “time constraint” group on consumers’ understanding of health claims was further tested by means of ANOVA analysis per each product-claim combination in the target group only, as these consumers were exposed to products with health claims. The dependent variables used were the understanding indexes per product-claim combination.

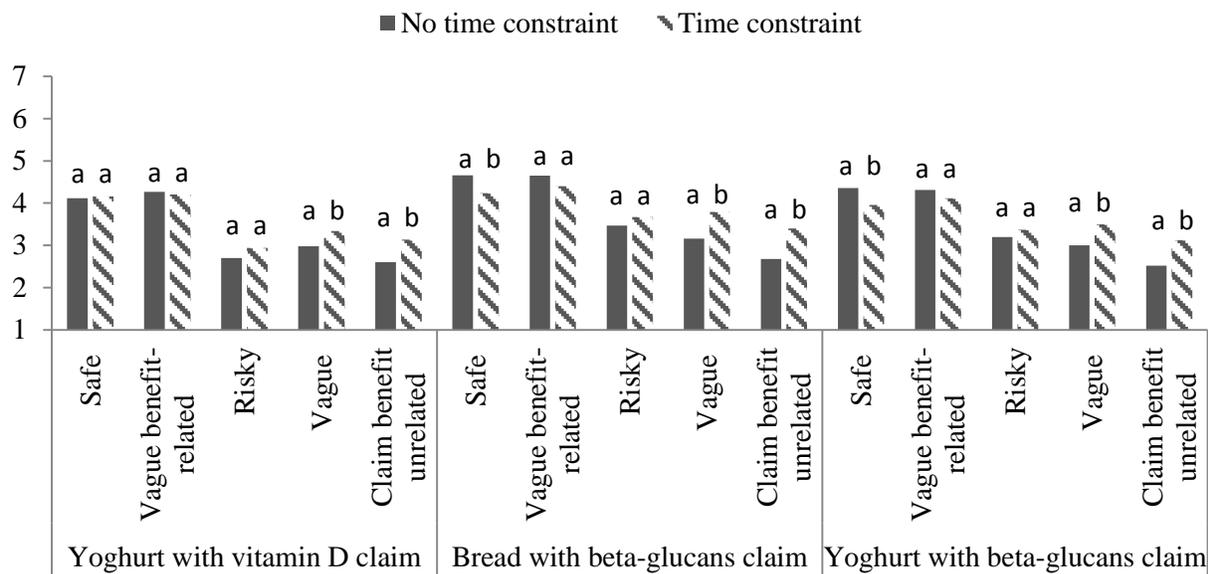
The ANOVA analyses revealed that consumers in the “no time constraint” group understood the health claims to a higher extent compared to those consumers in the “time constraint” group, for all three carrier-claim combinations (Table 4)⁶.

⁶ As Levene’s test of homogeneity of variance was significant at $p < .05$ for these ANOVAs, non-parametric test were run to confirm the effects of the “time constraint” group. In the Mann-Whitney U test, the differences found in the ANOVA analyses were confirmed as significant at $p < .01$.

Table 4. Understanding index based on scientific evidence behind health claims by “time constraint” group

	No time constraint		Time constraint		F-value	p	η^2
	Mean (SD)	N	Mean (SD)	N			
<i>Yoghurt with vitamin D claim</i>	1.23 (1.22)	273	.89 (1.04)	163	$F_{(1,434)}=8.79$	.003	.020
<i>Bread with beta-glucans claim</i>	1.21 (1.08)	273	.60 (.93)	143	$F_{(1,414)}=32.51$	<.001	.073
<i>Yoghurt with beta-glucans claim</i>	1.14 (1.15)	270	.49 (.80)	126	$F_{(1,394)}=33.34$	<.001	.078

When looking at the specific types of inferences (i.e. safe, vague, vague benefit-related, risky and claim benefit unrelated) consumers in the “time constraint” group scored significantly lower on the statements representing **safe** interpretations of the health claims for the yoghurt with beta-glucans claim and the bread with beta-glucans claim as opposed to the “no time constraint” group (Figure 4). In addition, for all three product-claim combinations consumers in the “time constraint” group rated the statements representing **vague** and **claim benefit unrelated** statements significantly higher than those respondents in the “no time constraint” group.



(1) means with different superscript letters within a type of inference and product-claim combination are significantly different ($p < .05$); (2) *Yoghurt with vitamin D claim*: Safe - $F_{(1,462)}=.08$, $p=.776$, $\eta^2=.000$; Vague benefit-related - $F_{(1,476)}=.14$, $p=.708$, $\eta^2=.000$; Risky - $F_{(1,460)}=2.95$, $p=.086$, $\eta^2=.006$; Vague - $F_{(1,471)}=5.10$, $p=.024$, $\eta^2=.010$; Claim benefit unrelated - $F_{(1,462)}=12.15$, $p < .001$, $\eta^2=.025$; (3) *Bread with beta-glucans claim*: Safe - $F_{(1,439)}=8.32$, $p=.004$, $\eta^2=.018$; Vague benefit-related - $F_{(1,459)}=2.59$, $p=.108$, $\eta^2=.005$; Risky - $F_{(1,454)}=2.08$, $p=.150$, $\eta^2=.004$; Vague - $F_{(1,460)}=14.78$, $p < .001$, $\eta^2=.031$; Claim benefit unrelated - $F_{(1,436)}=20.58$, $p < .001$, $\eta^2=.045$; (4) *Yoghurt with beta-glucans claim*: Safe - $F_{(1,431)}=5.33$, $p=.021$, $\eta^2=.012$; Vague benefit-related - $F_{(1,453)}=1.34$, $p=.248$, $\eta^2=.002$; Risky - $F_{(1,427)}=1.38$, $p=.240$, $\eta^2=.003$; Vague - $F_{(1,449)}=9.85$, $p=.002$, $\eta^2=.021$; Claim benefit unrelated - $F_{(1,425)}=13.68$, $p < .001$, $\eta^2=.031$.

Figure 4. Effect of time constraint by types of inferences

These results show that consumers' understanding of health claims is lower when they are under time pressure. The lower understanding is due to lower scores on safe interpretations but mainly to higher scores on vague and claim unrelated inferences. Thus, these findings provide support for the effect of time constraint predicted in H2, namely that under time constraint consumer understanding is lower compared to no time constraint.

Consumer understanding of different versions of health claims

Consumers were presented with one of five versions of an authorised health claim per understanding task. One was the currently authorised version of the health claims in the European Union, and the other four represented variations of wording of the authorised health claim developed with the aim to improve consumer understanding.

The effect of the health claim versions on consumer understanding of the health claims as measured with the understanding index was examined through ANOVA analyses per product-claim combination.

In the case of the yoghurt with beta-glucans health claim and bread with the beta-glucans health claim, the "health claim version" had no significant effect (Table 5). Only for yoghurt with vitamin D claim there was a significant interaction between the "health claim version" group and the "time constraint" group (Figure 5). The authorised version of the health claim was understood to a higher extent than the general+authorised and the general+authorised+additional versions but only for those respondents in the "time constraint" group. In these two versions of the health claim consumers in the "time constraint" group scored lower on the understanding index compared to those in the "no time constraint" group.

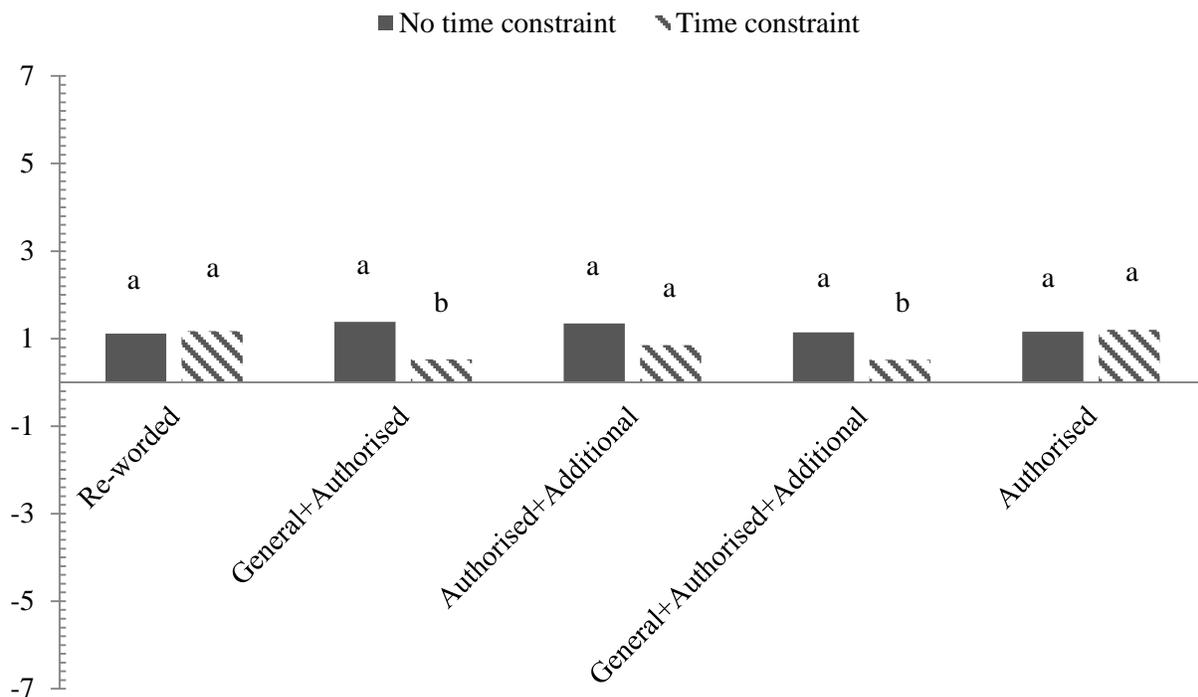
We can thus conclude that the version of the health claim does not have an important role in understanding and we find only very limited support for H3.

Table 5. Effects of “health claim version” and “time constraint” on understanding index⁽¹⁾

	Yoghurt with vitamin D claim			Bread with beta-glucans claim			Yoghurt with beta-glucans claim		
	<i>F-value</i>	<i>p</i>	η^2	<i>F-value</i>	<i>p</i>	η^2	<i>F-value</i>	<i>p</i>	η^2
Main effect "health claim versions"	$F_{(4,426)}=1.25$	.29	.012	$F_{(4,406)}=2.26$	.062	.022	$F_{(4,386)}=.59$	.673	.006
Main effect "time constraints"	$F_{(1,426)}=10.72$	.001	.025	$F_{(1,496)}=35.26$	<.001	.080	$F_{(1,386)}=32.64$	<.001	.078
Interaction effect	$F_{(4,426)}=2.64$	.034	.024	$F_{(4,406)}=1.64$	.163	.016	$F_{(4,386)}=1.05$	.384	.011

(1) Levene’s test for homogeneity of variances was significant in these analyses. Non parametric tests per independent variable confirmed the significance or respectively lack of significance of the main effects. However, the interaction effect could not be tested in these analyses.

Yoghurt with vitamin D claim



(1) means with different superscript letters within a version of the health claim are significantly different ($p < .05$); (2) means with different superscript letters within a time constraint group are significantly different ($p < .05$)

Figure 5. Interaction effect of “health claim version” and “time constraint” on understanding index for Yoghurt with vitamin D claim

Effect of carrier product on consumer understanding of health claims

The effect of the carrier product on consumer understanding of health claims was assessed for the beta-glucans health claim which was shown to consumers on fruit yoghurt or on wholegrain bread. An ANOVA analysis tested the impact of the “carrier” and “time constraint” on consumers’ understanding of the health claim.

Consumers’ understanding was slightly lower for the beta-glucans health claim when it was shown on yoghurt; however, the effect did not reach statistical significance (Table 6) in either “no time constraint” and “time constraint” group. Thus we find no support for H4, which predicted a significant impact of the carrier product on consumer understanding.

Table 6. Understanding index of beta-glucans claim⁽¹⁾ by “time constraint” group and “carrier”

Carriers	No time constraint		Time constraint	
	Mean (SD)	N	Mean (SD)	N
Bread	1.21 (1.08)	273	.06 (.93)	143
Yoghurt	1.14 (1.14)	270	.49 (.80)	126

(1) Understanding index scores pooled across the two carriers; (2) Main effect “time constraint” $F_{(1,808)}=65.89$, $p<.001$, $\eta^2=.075$; Main effect “carrier” $F_{(1,808)}=1.34$, $p=.247$, $\eta^2=.002$; Interaction $F_{(1,808)}=.09$, $p=.765$, $\eta^2=.000$ ⁷

Consumer understanding of health claims and intention to buy

The link between consumer understanding of health claims and intention to buy was assessed through regression analyses conducted per product-carrier combination. Furthermore, the role of perceived relevance of the health claim as moderator of this relationship was assessed (Table 7).

The understanding index showing correct understanding of health claims did not significantly contribute to intention to buy products with claims nor was there a significant interaction with the perceived relevance of health claims. Further analyses showed that the scores on the **risky** and **claim benefit unrelated** types of interpretations did positively impact consumers’ reported intention to buy products carrying health claims. As these types of inferences represent exaggerated interpretations or attribution of inappropriate health benefits to the health claim,

⁷ As Levene’s test of homogeneity of variance was significant at $p<.05$ for this ANOVA, non-parametric test were run to confirm the effects of the “carrier” and “time constraint” group. In the Mann-Whitney U test run per independent variable, the main effects found in the ANOVA analyses were confirmed.

they can be seen to represent misunderstanding. Thus, higher misunderstanding was associated with higher intention to buy. For the yoghurt with vitamin D claims there was also a significant interaction between the **claim unrelated benefit** interpretations and perceived relevance of the claim. The impact of claim unrelated benefit interpretations on intention to buy was not significant, if the claim relevance was low (below -1.72), but there was a significant positive effect otherwise. Thus, making claim unrelated benefit inferences leads to intention to buy only for those consumers for whom the health claim is somewhat relevant.

Results presented in Table 7 show that the safe interpretations, vague benefit-related and risky were also associated to intention to buy to some extent. Even though misunderstanding (as measured with the risky and claim unrelated benefits) was linked to intention, so were the statements representing correct understanding. Thus, it seems that expecting any type of benefit from the product increases intention to buy. We could not, however, test the relative effect of the different types of inferences as they were quite highly correlated and could not be analysed together in a regression analysis. Hypothesis H5a regarding the relationship between consumer understanding and intention to buy is partly supported as specific types of inferences which can be seen as misunderstandings were separately related to intention to buy. We found very little support for H5b, which predicted that perceived relevance of the health claim will moderate the relationship between understanding and intention to buy.

Table 7. Effects of consumer understanding and perceived relevance of the claim on intentions to buy products with health claims

	Yoghurt with vitamin D claim				Bread with beta-glucans claim				Yoghurt with beta-glucans claim			
	b	p	N	R ²	b	p	N	R ²	b	p	N	R ²
Constant	3.29	<.001	431	.23	3.95	<.001	410	.27	3.05	<.001	392	.29
Understanding index (centered)	-.09	.18			-.07	.29			-.12	.06		
Perceived relevance of claim (centered)	.53	<.001			.59	<.001			.58	<.001		
Interaction	-.05	.23			.04	.39			.04	.39		
Constant	3.27	<.001	458	.23	3.92	<.001	435	.28	3.06	<.001	429	.32
Safe (centered)	.14	.01			.14	.01			.20	<.001		
Perceived relevance of claim (centered)	.49	<.001			.54	<.001			.51	<.001		
Interaction	.03	.30			.05	.11			.05	.08		
Constant	3.26	<.001	467	.28	3.99	<.001	455	.29	3.07	<.001	446	.33
Vague (centered)	.23	<.001			.19	<.001			.29	<.001		
Perceived relevance of claim (centered)	.46	<.001			.54	<.001			.47	<.001		
Interaction	.04	.06			-.02	.41			.00	.88		
Constant	3.24	<.001	472	.23	3.95	<.001	455	.27	3.02	<.001	451	.30
Vague benefit-related (centered)	.10	.02			.12	.01			.19	<.001		
Perceived relevance of claim (centered)	.49	<.001			.55	<.001			.50	<.001		
Interaction	.03	.21			.02	.53			.05	.05		
Constant	3.26	<.001	457	.26	3.92	<.001	449	.29	3.04	<.001	425	.36
Risky (centered)	.22	<.001			.17	<.001			.38	<.001		
Perceived relevance of claim (centered)	.47	<.001			.55	<.001			.45	<.001		
Interaction	.03	0.27			.04	.22			.02	.52		
Constant	3.24	<.001	458	.30	4.00	<.001	432	.31	3.06	<.001	422	.35
Claim unrelated benefit (centered)	.21	<.001			.23	<.001			.32	<.001		
Perceived relevance of claim (centered)	.49	<.001			.52	<.001			.47	<.001		
Interaction	.06	.01			-.04	.22			-.01	.72		

(1) The analyses were conducted using the Process macro 2.16 written by Andrew F. Hayes (<http://processmacro.org/>)

Cross-validation of findings: CATA (check-all-that-apply) method

The study used a second measure of consumer understanding of health claims in order to corroborate the findings of the measurement using rating of pre-formulated statements representing potential interpretations of the health claims. The same design as for the rating measures was used. The results for the CATA method relating to consumer understanding and the impact of time constraint on their understanding are summarized below.

Measurement of consumer understanding with CATA method

In the CATA measure respondents were asked to select all the statements that in their opinion reflect the meaning of the product's health claim, whereas in the control condition they were asked to select all the statements that in their opinion reflect benefits of the product. The same statements as in the rating measure (Table 2) were used, plus a "none of the above" option. The statements were displayed in a random order. In the "time constraint" condition respondents had 39 seconds in the target group and 23 seconds in the control group to answer the understanding questions per stimulus (instruction: "On average it takes people 45 seconds [30s in control] to answer this question. You have 39 seconds [23s in control] to answer the question").

For further analysis an objective understanding index based on this measure was computed as:

- number of selected items of the safe, vague or vague benefit-related statements – number of selected items of the risky and claim unrelated benefit statements

Higher values on this index represent higher objective understanding of the health claim. Scores were pooled across the health claim versions per product-claim combination.

In addition, a dichotomous variable was computed per type of inferences, where 1 represented that the respondent had selected at least one of the statements measuring the specific type of inference and 0 otherwise. Each variable contained the scores pooled across the health claim levels per product-claim combination.

Consumer inferences from products with claims versus products with no claims

Logistic regressions per product-claim combination tested the effect of the “health claim” group (target versus control) and “time constraint” group (no time constraint versus time constraint) on the likelihood that consumers would select at least one of the vague interpretations of the health claim. The same analyses were conducted for the likelihood of selecting at least one of the claim unrelated benefit interpretations (Appendix 5.2 Table 8).

Overall, it was found that consumers exposed to the products without claims (control) were more likely to select at least one vague or claim unrelated benefit statement as opposed to those who saw products with health claims (target).

Effect of time constraint on consumer understanding of health claims

The effect of the “time constraint” condition on consumers’ understanding of health claims was tested through ANOVA analyses per product-claim combination. Consumers in the “time constraint” group scored significantly lower on the understanding index compared to respondents in the “no time constraint” condition (Appendix 5.2 Table 9). Thus, when consumers were under time pressure their objective understanding of the health claims was lower as opposed to those consumers who had no time pressure.

Consumer understanding of different versions of health claims

The role of “health claim version” and “time constraint” in consumer understanding was tested using ANOVA analyses run per product-claim combination. The health claim version that consumers were shown did not have any significant impact on consumers’ scores on the understanding index (Appendix 5.2 Table 10). Thus, consumers’ understanding did not differ by health claim version.

Effect of carrier product on consumer understanding of health claims

ANOVA analyses tested the impact of the “carrier” (yoghurt versus bread) and “time constraint” on consumers’ scores on the understanding index for the beta-glucans claim. It was found that the carrier has no significant impact on consumer understanding of the beta-glucans health claim (Appendix 5.2 Table 11).

5.5. Discussion

The use of health claims on food products can help consumers make more informed choices and thereby lead to better performance of companies offering products with health claims (Cao & Yan, 2016; Nocella & Kennedy, 2012). In the European Union the regulation requires that approved health claims can be understood by the average consumer in order to protect consumers against misleading claims. Little is known, however, regarding consumer understanding of health claims. We lack evidence on factors that affect consumers' understanding as well as whether consumers are likely to act on their misunderstanding and buy products from which they expect exaggerated benefits.

This study investigated the effect of time constraint on consumer understanding of health claims and whether re-wording or addition of information can improve consumer understanding of health claims. Additionally, the link between misunderstanding and intention to buy was examined.

Consumers were found to believe to some extent that the product with health claims has benefits which were not specific to the claim. This finding is consistent with the halo effect, when people expect the product to be healthier overall, or magic bullet effect, when people expected the products to bring health benefits unrelated to the claimed one (Roe et al., 1999). However, consumers scored higher on the inferences which were not specific to the claim when they rated the carrier product without a claim as opposed to when there was a claim. Thus, this seems to suggest that consumers make inferences that are vague or refer to benefits unrelated to the claimed one mainly due to prior knowledge and beliefs of potential benefits of the carrier product. This effect is in line with spreading activation theory (Anderson, 1983). The addition of a claim seems to lead to weaker inferences about vague or claim unrelated benefits. This finding can be interpreted from the perspective of dual processing theories, as adding a health claim can encourage deep processing for some consumers resulting in lower general or unspecific inferences (Petty & Cacioppo, 1986). Expecting consumers to understand health claims adequately, if defined as making only those inferences that are in line with the scientific evidence behind the claim, can be seen as unrealistic in light of these findings.

The results regarding the impact of the time constraint show that being under time pressure leads to less understanding of health claims. In particular, people will make more vague or claim unrelated benefit inferences and in some cases they will make less safe inferences. This is to be expected based on dual processing theories, as consumers will rely more on learned associations and use rules of thumb to process the information as fast as possible (Chen & Chaiken, 1999). This leads them to rely more on prior knowledge about the product and to attend less to the relevant information, which then results in inferences that are not specific to the claim.

The different versions of the authorised health claim aimed at improving consumer understanding did not have the expected effect. For the beta-glucans health claim on yoghurt or bread there was no difference between the authorised version of the claim and the other versions, no matter whether consumers were under time pressure or not. This finding is not entirely surprising as the wording of health claims has played only a minor role in consumer perceptions of health claims in earlier studies as well (Lähtenmäki, 2013). Some studies who found an important impact of wording on consumer understanding have used stronger variations of wording of claims (e.g. benefit worded as keeps one going between meals vs. helps you want to eat less, Bilman et al., 2012).

The only significant impact of the different versions of a health claim was found for the yoghurt with vitamin D claims, though the effect was small. Consumer understanding of the authorised claim differed only as opposed to the claims providing an unspecific claim (with or without additional information) under time pressure. When people were under time pressure they may have not processed all the available information according to dual processing theories (Petty & Cacioppo, 1986). For the two claim versions providing an unspecific claim, consumers may have placed higher emphasis on the unspecific claim (which was also presented on top) and thus made more abstract or general inferences which contributed to lower understanding of the claim. Consumer understanding of the remaining types of claims (i.e. authorised, re-worded and authorised with additional information) in the case of the vitamin D claim did not differ by time constraint. It could be that people are more familiar with the vitamin D claim and that is why the time pressure makes no difference when the amount of information is similar.

The carrier product did not have a significant impact on consumer understanding of the claim. While people may be more attracted to natural combinations of carrier and functional ingredient (Krutulyte et al., 2011), e.g. the bread with beta-glucans health claim, they could also be more surprised by the new combinations, e.g. yoghurt with beta-glucans health claim, which could lead to deeper processing of the information (Petty & Cacioppo, 1986). Some studies show that consumers are more favourable towards enrichment of less healthy options (as the fruit yoghurt) compared to already healthy foods (e.g. wholegrain bread) (Bech-Larsen & Grunert, 2003), thus this could result in higher motivation to process the health claim on fruit yoghurt.

Regarding the link between consumer understanding and intention to buy, specific types of inferences representing misunderstanding were positively linked to intention to buy across product-claim combinations. However, at the same time making inferences which can be seen as safe was also linked to intention. This is plausible, as people could be more motivated to buy products from which they expect more benefits. This is also in line with prior literature showing that inferences that consumers make from products with claims are linked to intention to buy, but mostly so when more benefits are expected (Harris et al., 2011).

Overall, perceived relevance of the health claims was strongly associated to intention to buy, which supports the findings from prior literature (Dean et al., 2012; Howlett et al., 2012; Wong et al., 2013). Perceived relevance of the claim did not play a role as moderator of the relationship between misinterpretations (or objective understanding) and intention to buy, except for the vitamin D claim on yoghurt. In this case, there was a link between inferences about benefits unrelated to the claim and intention, but only for consumers with high perceived relevance of the claim. It could be that in this case relevance of the claim was due to the vitamin D content, as many people in the Nordic countries have a vitamin D deficit. Therefore, expecting benefits other than the one mentioned in the claim could be linked to intention for these people, as some of the claim unrelated benefits could be related to benefits of vitamin D, e.g. good for bones or the immune system. Consumers who do not lack vitamin D may not have seen any of the benefits (the claimed one or those claim unrelated ones) as valuable. Overall though, consumers for whom the health claim is relevant do not seem to be more vulnerable to the effects of misunderstanding as compared to those with low relevance.

The present study used two methods to assess consumer understanding of health claims. The results from the two methods proved to be largely in accordance. This suggests that the results were not due to the method selected. The recommendation by Leathwood et al. (2007) was followed in measuring understanding, namely that consumers' inferences from foods with health claims were elicited in a previous study (Stancu, Grunert, & Lähteenmäki, 2016) and quantified in the present study. Given that many of our findings are in line with prior literature and with the theoretical background of the study, we can say that our measures show some nomological validity. This brings support for the recommendation of the two-step approach to measure understanding (Stancu, Grunert, & Lähteenmäki, 2016).

Limitations

First, the study used self-reported measures from an online survey and these could be biased to some extent. Secondly, we had different sample sizes across the experimental groups, which can have an impact on the robustness of the F statistics in Anova analyses. There were some departures from normality in our measures which can also impact the F statistic. When the homogeneity of variances assumption was not met in the analyses we have conducted non-parametric tests to confirm the significance of the results. Some of the consumers in the time constraint condition have not completed the understanding task, which has contributed to the unbalanced sample sizes. Furthermore, due to some respondents not completing the understanding task under time pressure, some of the groups when comparing the target and control groups or the health claim versions groups are small under time pressure. Thus, some of the results should be interpreted with caution.

The survey containing the products with health claims (target) was conducted separately from the one containing the products with no claim (control) due to the complexity of the first survey. Both surveys were targeted towards the same population using the same eligibility criteria resulting in similar socio-demographic respondent groups. There was, however, a small difference between the control and target group in terms of education. The presence of slightly fewer low educated consumers and slightly more highly educated ones in the control group may mean that those consumers may have been more able to process information. However, in the

control group consumers were not confronted with claims to process, thus, we expect a limited impact of this difference on our results.

Future research

In the present study we did not find much evidence for a beneficial effect of re-wording of health claims or addition of information on consumer understanding. Future studies could explore other ways to improve understanding, for example educational campaigns aiming to help consumers differentiate between justified and unjustified interpretations from products with claims would be a possibility.

In the present study we found some differences in the results for the yoghurt with vitamin D as opposed to the carriers with beta-glucans. It could be that some of the differences may be given by people's familiarity with the claims, as familiarity has an impact on how claims are perceived (Lähteenmäki, 2013). Future studies could investigate whether claims varying in familiarity have different effects on consumer understanding when the carrier is kept constant. In addition to familiarity, other potential moderators of the relationship between misunderstanding and intention to buy would be of interest, such as consumers' attitude to the product or strength of the health orientation in food choices.

Finally, an interesting avenue for future research would be to investigate understanding of health claims on real-life products. We have tested product concepts, yet in a real-life product other elements of communication may have a role in consumers' understanding of the health claim.

Implications

Consumers were found to attach some meanings to health claims which were benefits of the carrier product even though they were not mentioned in the health claim. However, the health claim decreased consumers' focus on inferences that are unspecific to the health claim. This finding implies that expecting people to only make inferences which are in line with the scientific dossier of the health claim is an unrealistic goal, as their prior knowledge will play a role as well. In order to know whether unjustified inferences stem from the claim or the carrier product as such, studying understanding of health claims needs to be done against the baseline of the carrier without a claim in order to get the claim effect separated.

When consumers process health claims under time constraint, their objective understanding of health claims is lower. This implies that in a shopping situation consumers' understanding of health claims may differ from assessments made under no time constraint, for example at home. Therefore, evidence of consumer understanding should consider the impact of such context factors. However, the effect of time pressure seems to hold only for some versions of the health claims. It could be that for more familiar claims the time pressure makes little difference. Yet, further evidence is needed to confirm the latter.

There have been some efforts from public policy and actors from food industry to develop health claims that improve consumer understanding. For example there are guidelines on the flexibility of wording of health claims and in Denmark, following these guidelines variations of health claims starting from the authorised one have been developed aiming to make claims easier to understand. Efforts to alter the wording of health claims in line with these initiatives do not seem to lead to the desired improvement in understanding. The acceptable changes to wording are rather conservative and this could explain their lack of effect. However, less conservative changes to wording could eventually lead to lower understanding as people might make more vague and exaggerated interpretations. Efforts aimed at increasing consumers' objective claim-relevant knowledge could lead to better understanding by limiting unjustified inferences.

There is concern from the public policy point-of-view that consumers might be misled by health claims. Our study shows that, indeed certain inferences are linked to intentions to buy the product carrying a health claim; however, the overall objective understanding has no impact on intentions. Furthermore, the "misleading" inferences were more common in products that carried no claim. It seems overall that consumers expecting any kind of benefit will be more willing to buy products with claims.

For the food industry, the effect of time pressure suggests that different communication strategies could be beneficial depending on the context. In time-pressured shopping situations consumers need messages that are processed with little effort, whereas more information could be useful after purchase when using the product in no time pressure situation at home.

5.6. Conclusion

Consumer understanding of health claims is an important issue for public policy as there is concern that consumers may be misled by health claims. The present study shows that consumers transfer some of the perceived benefits of the carrier product to the meaning of the health claims indifferent of whether they are under time pressure or not. Moreover, we find that consumer understanding of products with health claims is lower when consumers are time pressed. The wording of the health claims or the carrier product category did not have a major impact on consumer understanding of the health claims. Finally, misunderstandings as well as other types of inferences that can be seen as correct are associated to intention to buy, yet people's objective overall understanding does not play a role.

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Appendix 5.1

Descriptive statistics for variables used in the Rating measure of understanding

Yoghurt with vitamin D

	No time constraint						Time constraint					
	N	Min	Max	Mean	Skewness	Kurtosis	N	Min	Max	Mean	Skewness	Kurtosis
Understanding index ⁽²⁾	273	-1	4.75	1.23	.439	-.668	163	-.63	3.63	.89	.799	-.466
Safe ⁽³⁾	273	1	7	4.12	-.17	-.70	191	1	7	4.16	-.374	-.489
Vague ⁽³⁾	273 (68)	1	7	2.98 (4.32)	.553	-.512	200 (43)	1	7	3.34 (4.24)	.072	-1.135
Vague benefit-related ⁽³⁾	273	1	7	4.23	-.261	-1.024	205	1	7	4.21	-.333	-.888
Risky ⁽³⁾	273	1	7	2.7	.728	-.093	189	1	7	2.94	.328	-.598
Claim benefit unrelated ⁽³⁾	273 (68)	1	7	2.60 (3.72)	.706	-.603	191 (41)	1	7	3.14 (3.76)	.099	-1.2
Health claim version ⁽⁴⁾												
<i>Re-worded</i>	55	-1	4.13	1.11	.374	-.815	36	-.5	3.38	1.17	.442	-.788
<i>General+Authorised</i>	54	-.25	3.75	1.38	.357	-.863	31	-.25	2.38	.52	1.098	.364
<i>Authorised+Additional</i>	52	0	3.75	1.35	.409	-1.011	35	-.5	3.63	.85	.94	-.242
<i>General+Authorised+Additional</i>	58	-.88	4.38	1.14	.663	-.60	25	-.63	3.25	.52	1.616	2.125
<i>Authorised</i>	54	-.88	4.75	1.16	.551	-.197	36	-.38	3.25	1.2	.31	-1.196
Intention to buy ⁽⁵⁾	530	1	7	3.29	.328	-.803						
Perceived relevance ⁽⁵⁾	530	1	7	4.02	-.292	-.418						

(1) where applicable descriptives for control group are shown in brackets

(2) computed as difference between average scores on the safe, vague and vague benefit-related items and average scores of the risky and claim benefit unrelated items (see Table 2)

(3) computed as average of scores on the items in the respective category (items and their respective category can be found in Table 2)

(4) the N reported here is based on the completes for the understanding index, similar numbers are found for the different types of inferences

(5) all respondents who have seen one of the versions of the vitamin D claim under time constraint or no time constraint

Bread with beta-glucans

	No time constraint						Time constraint					
	N	Min	Max	Mean	Skewness	Kurtosis	N	Min	Max	Mean	Skewness	Kurtosis
Understanding index ⁽²⁾	273	-1.5	4.5	1.21	.231	-.439	143	-.75	4	.60	1.409	1.429
Safe ⁽³⁾	273	1	7	4.66	-.526	-.371	168	1	7	4.24	-.444	-.346
Vague ⁽³⁾	273 (68)	1	7	3.16 (4.7)	.416	-.755	189 (46)	1	7	3.79 (4.46)	-.189	-1.09
Vague benefit-related ⁽³⁾	273	1	7	4.65	-.422	-.53	188	1	7	4.4	-.332	-.718
Risky ⁽³⁾	273	1	7	3.47	.154	-.568	183	1	7	3.68	-.269	-.726
Claim benefit unrelated ⁽³⁾	273 (68)	1	7	2.68 (4.06)	.641	-.597	165 (38)	1	7	3.4 (3.93)	-.051	-1.08
Health claim version ⁽⁴⁾												
<i>Re-worded</i>	55	-1.38	3.5	1.15	-.118	-.885	32	-.25	3	.76	.939	-.002
<i>General+Authorised</i>	54	-.25	4	1.21	.541	.296	27	-.75	3	.38	1.64	2.374
<i>Authorised+Additional</i>	53	-.63	3.13	1.34	.016	-.797	31	-.5	4	.50	2.402	6.381
<i>General+Authorised+Additional</i>	56	-1.5	4.5	1.09	.523	-.035	23	-.38	1.5	.23	1.464	1.883
<i>Authorised</i>	55	-.25	3.5	1.26	.494	-.7	30	-.25	3.13	1.03	.67	-.904
Intention to buy ⁽⁵⁾	530	1	7	4	-.099	.885						
Perceived relevance ⁽⁵⁾	530	1	7	3.9	-.196	-.584						

(1) where applicable descriptives for control group are shown in brackets

(2) computed as difference between average scores on the safe, vague and vague benefit-related items and average scores of the risky and claim benefit unrelated items (see Table 2)

(3) computed as average of scores on the items in the respective category (items and their respective category can be found in Table 2)

(4) the N reported here is based on the completes for the understanding index, similar numbers are found for the different types of inferences

(5) all respondents who have seen one of the versions of the beta-glucans claim under time constraint or no time constraint

Yoghurt with beta-glucans

	No time constraint						Time constraint					
	N	Min	Max	Mean	Skewness	Kurtosis	N	Min	Max	Mean	Skewness	Kurtosis
Understanding index ⁽²⁾	270	-1	4.38	1.14	.458	.74	126	-.63	3.25	.49	1.362	1.385
Safe ⁽³⁾	270	1	7	4.36	-.471	-.723	163	1	7	3.96	-.179	-.61
Vague ⁽³⁾	270 (65)	1	7	3 (4.28)	.517	-.636	181 (42)	1	7	3.5 (4.21)	-.083	-.693
Vague benefit-related ⁽³⁾	270	1	7	4.31	-.399	-.84	185	1	7	4.12	-.332	-.427
Risky ⁽³⁾	270	1	7	3.2	.165	-.751	159	1	7	3.37	-.106	-.544
Claim benefit unrelated ⁽³⁾	270 (65)	1	7	2.52 (3.74)	.858	-.371	157 (34)	1	7	3.12 (3.71)	.124	-.97
Health claim version ⁽⁴⁾												
<i>Re-worded</i>	53	-1	3.5	1.05	.384	-.377	29	-.38	2.88	.63	1.067	.075
<i>General+Authorised</i>	58	-.75	3	1.21	.021	-1.397	20	-.63	3.25	.62	1.103	.736
<i>Authorised+Additional</i>	52	-.38	4.38	1.35	.534	-.923	27	-.5	2.25	.27	1.927	6.00
<i>General+Authorised+Additional</i>	55	-.5	3.63	.93	.619	-.514	25	-.38	2.5	.39	1.668	2.025
<i>Authorised</i>	52	-.5	3.88	1.18	.469	.782	25	-.63	2.63	.57	1.201	1.937
Intention to buy ⁽⁵⁾	542	1	7	3.09	.368	-.9						
Perceived relevance ⁽⁵⁾	542	1	7	3.7	.015	-.729						

(1) where applicable descriptives for control group are shown in brackets

(2) computed as difference between average scores on the safe, vague and vague benefit-related items and average scores of the risky and claim benefit unrelated items (see Table 2)

(3) computed as average of scores on the items in the respective category (items and their respective category can be found in Table 2)

(4) the N reported here is based on the completes for the understanding index, similar numbers are found for the different types of inferences

(5) all respondents who have seen one of the versions of the beta-glucans claim under time constraint or no time constraint

Appendix 5.2

Results of analyses using the CATA measure of consumer understanding of health claims

Table 8. Predictors of likelihood to selected at least one of the vague or claim unrelated benefit interpretations

	Yoghurt with vitamin D claim				Bread with beta-glucans claim				Yoghurt with beta-glucans claim			
	b	p	N	R ² (Nagelkerke)	b	p	N	R ² (Nagelkerke)	b	p	N	R ² (Nagelkerke)
Vague interpretations												
Constant	2.34	<.001	591	.18	1.74	<.001	598	.13	1.93	<.001	593	.20
"Health claim" group (control vs. target)	-2.89	<.001			-2.06	<.001			-2.63	<.001		
"Time constraint" group	-1.08	.063			-.85	.078			-.16	.774		
Interaction	1.23	.043			.63	.220			.56	.341		
Claim unrelated benefit interpretations												
Constant	1.03	.001	591	.11	2.4	<.001	598	.17	1.45	<.001	593	.13
"Health claim" group (control vs. target)	-1.48	<.001			-2.78	<.001			-2.26	<.001		
"Time constraint" group	.36	.442			-.93	.118			-.94	.033		
Interaction	-.34	.499			1.02	.104			1.45	.002		

(1) The two significant interactions showed that under time constraint the effect of the control versus target group was weaker (as resulted from analyses run on the split sample by time constraint group)

Table 9. The effect of “time constraint” on consumer understanding index as assessed with the CATA method

	No time constraint		Time constraint		<i>F</i> -value	<i>p</i>	η^2
	Mean (SD)	<i>N</i>	Mean (SD)	<i>N</i>			
<i>Yoghurt with vitamin D claim</i>	1.90 (1.92)	251	1.38 (1.83)	245	F _(1,494) =9.28	.002	.018
<i>Bread with beta-glucans claim⁽¹⁾</i>	2.14 (1.91)	257	1.10 (1.77)	233	F _(1,488) =39.74	<.001	.075
<i>Yoghurt with beta-glucans claim⁽¹⁾</i>	2.08 (2.03)	251	1.07 (1.60)	231	F _(1,480) =36.57	<.001	.070

(1) Levene's test of homogeneity of variances was significant for these analyses, however non-parametric tests showed the same significant effects

Table 10. The effect of “health claim version” and “time constraint” on consumer understanding index as assessed with the CATA method

	Yoghurt with vitamin D claim			Bread with beta-glucans claim			Yoghurt with beta-glucans claim ⁽¹⁾		
	<i>F</i> -value	<i>p</i>	η^2	<i>F</i> -value	<i>p</i>	η^2	<i>F</i> -value	<i>p</i>	η^2
<i>Main effect "health claim versions"</i>	F(4,486)=1.37	.243	.011	F(4,480)=.67	.616	.006	F(4,472)=.53	.716	.004
<i>Main effect "time constraints"</i>	F(1,486)=33.17	.002	.019	F(1,480)=38.73	<.001	.075	F(1,472)=37.06	<.001	.073
<i>Interaction effect</i>	F(4,486)=1.51	.787	.004	F(4,480)=.39	.817	.003	F(4,472)=1.94	.103	.016

(1) Levene's test of homogeneity of variances was significant for this analysis, however non-parametric tests on each independent variable showed the same effects but the interaction effect could not be tested

Table 11. The effect of “carrier” and “time constraint” on consumer understanding index as assessed with the CATA method

Carriers	No time constraint		Time constraint	
	<i>Mean (SD)</i>	<i>N</i>	<i>Mean (SD)</i>	<i>N</i>
Bread	2.14 (1.91)	257	1.09 (1.77)	233
Yoghurt	2.08 (2.02)	251	1.07 (1.60)	231

(1) Main effect "carrier" $F(1,968)=.36$, $p= 0.745$, $\eta^2=.000$.; Main effect "time constraints" $F(1,968)=76.26$, $p < .001$, $\eta^2=.073$.; Interaction effect $F(1,968)=.12$, $p= 0.853$, $\eta^2=.000$.

(2) Levene's test of homogeneity of variances was significant for this analysis, however non-parametric tests on each independent variable showed the same effects but the interaction effect could not be tested

Chapter 6. Overall discussion and conclusion

Health claims are a widely used instrument to communicate the health benefits of food products. Their use is expected to impact consumer behaviour to some extent, yet little is known about how consumers interpret these claims and why some people are more prone to misunderstand them. This thesis aimed to study consumer understanding of health claims on food products and its potential antecedents, while at the same time to evaluate several selected methods to assess consumer understanding.

The theoretical background provided by dual processing theories (Chen & Chaiken, 1999; Petty & Cacioppo, 1986) (see Chapter 1) has been used in studying consumer understanding of health claims in this thesis. In the context of this theory, motivation and ability-related factors were considered as main potential antecedents of understanding in addition to claim- and carrier-related factors, due to their role as main influencers of the amount of processing that consumers engage in (Chen & Chaiken, 1999; Petty & Cacioppo, 1986). The lack of an agreed-upon method to assess understanding, both in the regulatory context and in consumer research literature, has supported the use of several selected methods in this thesis. The four empirical studies reported in the three research papers in this thesis have used a broad range of methods, from laddering interviews to open-ended questions in online surveys and cross-sectional surveys with experimental designs, to provide a comprehensive answer to the research questions set in this thesis (see Chapter 1). This is in line with prior literature suggesting that a good approach to study consumer understanding of health claims is by using a mix of qualitative methods and quantitative ones (Leathwood, Richardson, Sträter, Todd, & van Trijp, 2007).

The three research papers provide important contributions to prior literature in the area of consumer understanding and responses to health claims. The first study has contributed to broaden our knowledge regarding factors that play a role in consumer understanding of health claims. The second study has contributed with knowledge on ways to improve consumer understanding of health claims. Finally, the third study has contributed to the understanding of the impacts of time availability on consumer understanding of health claims. In addition, all three studies have provided important insights regarding different methods to assess consumer

understanding of health claims. The main findings and contributions of each study are summarized below.

6.1. Summary of main findings and contributions of the three research papers

The first paper investigated the relationship between motivation and ability-related factors and consumer understanding of health claims and evaluated two selected methods (one using open-ended questions and the other using closed-ended ones) to assess understanding of claims. In the two countries under investigation, Denmark and Italy, few respondents made openly risky (i.e. not in line with the scientific evidence behind the claim) interpretations of the health claims used as stimuli in the open-ended questions. Yet, many consumers only made vague interpretations of the health claims (i.e. the product is healthy). In the closed-ended questions on understanding of health claims, participants reported, on average, stronger agreement with the safe (i.e. in line with the scientific evidence behind the claim) interpretations rather than the risky ones. Overall, consumers' understanding differed by claim and country though. Similar to prior studies (e.g. Wong et al., 2013), the claim seen had a large impact on consumers' understanding. This was followed by effects of individual differences. Low education and higher claim familiarity were consistently associated with lower understanding of the health claims. Several other factors played a role, yet their effect varied by method of measuring understanding. Overall, this study made two important contributions. First, it broadened our knowledge of antecedents of consumer understanding of health claims due to the inclusion of additional motivation and ability-related factors, like claim familiarity, compared to prior literature. Second, it provided some evidence for the nomological validity of the methods used to assess consumer understanding of health claims and insights into advantages and disadvantages of applying these selected methods.

The second paper aimed to study the inferences that people make from different versions of a health claim to provide insights into how to improve consumers' understanding of claims. Two sub-studies were carried out for this purpose, one using laddering interviews face-to-face and the second using open-ended questions in an online survey. People made different types of interpretations, the most frequent types being the safe (i.e. in line with the scientific evidence behind the claim), content inferences (concluding that the carrier product contains the claimed component) or vague inferences (expressing a vague notion about the product or statements that

were irrelevant in relation to the claim). The study showed that adding information or re-wording the European authorised version of the studied health claim did not lead to improvements in consumer understanding. These findings highlight the potential detrimental effects of attempts to help consumers understand health claims by provision of extra information or re-wording. These results are consistent with those in paper 1 where claim familiarity was found to be associated with lower understanding. In this study the re-wording of the authorised health claim was done to avoid technical terms, thus, the used terms may have been more familiar to people which allowed them to make more inferences based on their prior knowledge and in turn resulted in lower understanding. This study contributed with an understanding of the types of interpretations that consumers make from health claims; it showed that the addition of information or re-wording of authorised health claims may not be the best ways to improve consumer understanding, and finally it provided some input regarding the selected methods for elicitation of inferences. The results of this paper are relevant for public policy where efforts to develop more understandable health claims are undertaken as well as for the food industry where decisions on communication of food healthfulness are made.

The third paper took a closer look at an ability-related factor, namely time availability, and investigated its effects on consumer understanding of health claims. Consumers' understanding of various versions of health claims was assessed in an online survey using a time constraint manipulation. Additionally, consumers' beliefs regarding benefits of the carrier products with no claim were addressed. In their understanding of products with health claims, consumers made to some extent interpretations which were not specific to the claim. It was found that consumers transfer some of the perceived benefits of the base product to the meaning of the health claims, regardless of the time constraint condition. When consumers were under time constraint, their understanding of health claims was significantly lower compared to those consumers who had no time constraint. Similar to findings in paper 2, there was no supporting evidence that re-wording of an authorised health claim or addition of an unspecific claim and/or explanatory information has any potential to improve consumer understanding. The health claims were understood similarly regardless of their carrier. The second measure of understanding used in this study has provided similar findings. Finally, misunderstandings but also interpretations that were in line with the scientific evidence behind the claim were associated to intention to buy, yet objective understanding was not. The results of this paper have relevance for public policy and the food

industry as consumer understanding may differ by context (e.g. when shopping, understanding could be lower due to time constraints as opposed to when using the product in the household when there could be more time available).

6.2. Limitations

While the papers reported in this thesis make some important contributions, there are some limitations of the studies as discussed in the following. Some of the limitations which were specific to each paper are not covered again here.

The samples used in the studies were close to representative of the general population; this was ensured by collaboration with market research agencies in data collection. One of the limitations related to the samples was, though, that the respondents were mostly from Denmark. However, the first paper did report results from two countries, namely Denmark and Italy. There were some country-wise differences between the two samples which imply that future studies in other countries than the ones included in this thesis could provide relevant insights. The second limitation related to the samples is that the sample size in the qualitative studies in paper 2 was rather small. While this is common in qualitative studies using methods like laddering interviews, the size of the sample imposed some small limitations on the data analysis. Nevertheless, findings of paper 2 were consistent with those of the quantitative studies where a large sample was used.

Health claims represent one of the means to communicate the healthfulness of food products. The interpretations that consumers attach to health claims may vary depending on other context elements (e.g. organic label, imagery on pack) (Chrysochou & Grunert, 2014; Orquin & Scholderer, 2015; Saba et al., 2010). In the reported studies only the carrier product was considered as context element, given that it is one of the main factors to influence consumers' responses to health claims (Lähtenmäki, 2013). The study of how other context elements influence consumer understanding of health claims represents an interesting avenue for future research. Some prior studies have used a nutrition facts panel in their stimuli together with the health claim under study (e.g. Grunert, Scholderer, & Rogeaux, 2011; Wong et al., 2013). Yet, given that prior research shows that the effect of the health claims and the nutrition panel are

independent (Ford, Hastak, Mitra, & Ringold, 1996), it is not expected that the exclusion of the nutrition facts panel, as done in this thesis, would have an impact on the results.

Moreover, using real-life products as stimuli could increase the external validity of the findings. However, the combinations of claims and carrier products studied in this thesis were product concepts that are realistic, e.g. yoghurt enriched with beta-glucans, although such products were not existent on the market. Finally, other means of communication than product label elements can be used in the study of consumer understanding of health claims (e.g. Grunert et al., 2011), yet the studies reported in this thesis focused on the health claims as packaging information. The effect of the means of communication (e.g. food label vs. advertisement) on consumer understanding could be investigated in future research.

6.3. Overall contribution and discussion

Consumer understanding of health claims is a complex process where consumers use their prior knowledge to attach meaning to the stimulus information. Based on their prior knowledge, consumers make inferences which go beyond what is stated in the health claims. Therefore, the assessment of adequate understanding is rather complex. Some of the interpretations that consumers make are in line with what the claim is supposed to communicate while others are not; thus, one cannot give a clear cut “yes” or “no” answer to whether consumers understand a certain claim adequately. Several methods have been evaluated in this thesis, and they provide some evidence into the prevalence of consumers who can be seen as understanding certain claims adequately. However, there is some subjectivity in the assessments of adequate understanding as one has to make judgements regarding which of the inferences that consumers make can be seen as justifiable and which cannot.

The present thesis has showed that consumers make several types of interpretations in relation to health claims, e.g. safe, risky, vague, unrelated to the claimed benefit, and has thus expanded the types of inferences studied in prior research (e.g. Bilman, Kleef, Mela, Hulshof, & van Trijp, 2012; Grunert et al., 2011). Prior studies have looked mostly at specific inferences related to the health claim benefit in their assessments of understanding (e.g. Bilman et al., 2012). In the studies reported in this thesis, it was found that a sizeable share of consumers make only vague interpretations of health claims on food products, i.e. those statements not linked to the health

claims which only express a vague idea like the product is tasty or the product is healthy. These people had low motivation to process health claims, yet they were users of the carrier product categories. Due to their low motivation to process health claims, it could be expected that these consumers would be less willing to purchase foods with health claims. It is thus unclear if such consumers should be seen as meeting the “average consumer” definition set by the European Union regulation on the use of health claims. One prior study had identified consumers who make only vague inferences from health claims (Grunert et al., 2011); however, the prevalence of such consumers was lower as opposed to the studies in this thesis. That could be the case because the previous study used real-life product packaging as well as an ad for the product as stimulus. Therefore, consumers may have been more motivated to process the information in more detail.

The studies in this thesis contribute to broaden our knowledge of levels of consumer understanding for the health claims authorised in the European Union. Such knowledge was lacking as many previous studies have used health claims which are no longer allowed in the European Union. The findings reported in this thesis can contribute to setting threshold levels of understanding for the authorised health claims.

Overall, it was found that consumer understanding differs considerably between health claims. This calls for a case-by-case assessment of consumer understanding of health claims to support the provision of evidence in line with the requirement of the EU regulation. Consumer understanding of health claims varied by other factors as well, for instance motivation and ability to process the health claims. The findings were consistent with prior literature on consumer responses to health claims (Lähteenmäki, 2013) and expectations based on dual processing theories (Petty & Cacioppo, 1986). Therefore, the studies reported in this thesis bring support for the appropriateness of this theoretical background for the study of consumer understanding of health claims.

Among the ability-related factors, time constraint had a significant impact on consumer understanding of health claims. Being under time constraint leads to lower consumer understanding. More specifically, consumers will believe more strongly that the product with a claim has vague or claim unrelated benefits and in some cases will score lower on the safe

interpretations. The findings are in line with dual processing theories (Chen & Chaiken, 1999), as time constraints are expected to lead to shallow processing and thus higher reliance on learned associations and less attendance to the relevant information which subsequently can result in interpretations that are not specific to the provided information. These findings imply that consumer understanding will vary by time availability; thus, tests of consumer understanding should account for this factor.

The finding that claim familiarity leads to lower understanding of health claims (see research paper 1) and that use of common terms in health claims instead of the current technical ones or addition of explanatory information does not contribute to improve consumer understanding (research papers 2 and 3) sets some challenges for attempts to improve consumer understanding of health claims. Yet, this finding can be explained by the spreading activation theory (Anderson, 1983) (see Chapter 1). Consumers may have more prior knowledge regarding familiar claims or common terms used in health claims, resulting in a more complex associative network for familiar claims or claims with additional information or common terms. Therefore, such claims may activate other concepts in consumers' minds when they process the information which may lead to interpretations that do not reflect the scientific evidence behind the claim. The findings referring to the role of antecedents of understanding contribute to broaden our knowledge regarding the groups of consumers who may be more vulnerable to be misled by health claims.

The qualitative or mixed methods used to assess consumer understanding in this thesis provided relevant input regarding consumers' understanding of health claims on food products; however, their suitability varies by purpose of the study, as detailed in Chapters 3 and 4. For example, for studies aiming to identify how health claims can be re-worded to improve consumer understanding, laddering interviews could be useful to unveil the changes in the types and sequence of inferences starting from the claim and finishing with consumers' values which occur when the wording of a health claim is changed.

Furthermore, the quantitative methods used were suitable for quantifying objective understanding of health claims, as shown in Chapters 3 and 5. The two methods (rating of pre-formulated statements representing potential meanings of health claims or check all that apply (CATA) of the pre-formulated statements) provided similar results in Study 4 which brings

support to their validity. Both methods were useful in quantifying the prevalence of different types of inferences and of objective understanding. Moreover, the methods allow examination of relationships between understanding and other factors. As most of the findings presented in this thesis are in line with theory and prior literature, this brings support for the use of the two-step approach to measure understanding, as suggested originally by Leathwood et al. (2007). Therefore, the thesis contributes with insights referring to suitability of methods for various purposes.

Implications for future research

The findings reported in this thesis show that a considerable share of consumers make only vague interpretations of health claims on food products. These consumers make interpretations that are mainly unrelated to the health claims. It remains thus unclear whether these consumers could be seen as being misled by health claims. These consumers were found to have lower motivation to process health claims which could imply that they would not see health claims as relevant for their choices. Future research could provide further insights into this group of consumers and how their behaviour differs from those who make inferences related to the claims.

Several selected methods were employed in the studies covered in this thesis. Some of the methods were quantitative while others were qualitative or mixed. While the findings reported in this thesis support the validity and reliability of the selected methods to assess understanding, more studies are needed to further investigate the methods' robustness. Moreover, the methods used in this thesis, namely the quantitative ones, varied mainly on the type of rating scale used. While this is interesting, future research could investigate how changes in the items used may impact measures of consumer understanding of health claims.

A series of potential antecedents of understanding of health claims were studied with results providing important insights regarding the consumers who could be more prone to understand or misunderstand health claims. An important avenue for future research, though, is to develop a scale of objective knowledge of the relationship between food and health. The results reported in this thesis show that education is an important determinant of understanding, and even though no evidence of a relationship between subjective knowledge and understanding was found, the

effect of education could imply that people's objective knowledge may play a role in the likelihood that they will adequately understand a health claim. There are some existing scales to assess nutrition knowledge, yet they are focused at large on the knowledge regarding nutrient or calorie content of foods and are rather long (Dickson-Spillmann, Siegrist, & Keller, 2011; Parmenter & Wardle, 1999). An objective measure of knowledge focused on the relationship between food and functions of the body or health conditions would be needed in studies of consumer understanding of health claims. Some nutrition knowledge scales include a number of items regarding the link between certain nutrients and certain health problems (Parmenter & Wardle, 1999) that could be useful in developing an objective measure of knowledge regarding the relationship between food and health.

Claim familiarity was linked to lower understanding in Study 1, and Studies 2 to 4 showed that adding information or re-wording authorised health claims by using more common terms instead of technical ones to make them more understandable does not contribute to a better understanding. As the market for products with health claims could be expected to increase given the expected increase in the health and wellness food market (Nielsen, 2015), health claims will become more prevalent which could translate into higher familiarity with health claims. Future studies could investigate how the understanding of health claims changes with the increase of the prevalence of foods with health claims over time.

Implications for public policy and industry

Consumer understanding of health claims was found to vary considerably by claim. Therefore, generalizing the findings from one health claim to another is challenging. This implies that a case-by-case assessment of understanding is necessary in order to provide any evidence of consumer understanding. Moreover, as consumer understanding of a health claim is negatively impacted by claim familiarity, separate assessments of understanding should be carried out for markets differing in prevalence of health claims. The findings that consumer understanding differs by health claim and individual-related factors further imply that it is to some extent unrealistic to expect that consumers adequately understand all the authorised health claims. Thus, some more lenient requirements for consumer understanding, which for instance set certain

thresholds for the prevalence of understanding per health claim among consumers, would be advisable.

The findings regarding antecedents of consumer understanding provide relevant input to support identification of those consumer groups that are more prone to misunderstand health claims. Consumers who have lower education or those who are highly familiar with a certain claim are most likely to misunderstand the claim. Due to the increase in foods carrying health claims consumers may become more and more familiar with certain health claims. Subsequently, this could translate into more associations in consumers' minds with those claims that are more prevalent and thus to more inferences which are not in line with what the claim is intended to communicate. Efforts from public policy to help consumers differentiate between unjustified and justified interpretations of health claims would be beneficial. It was also found that consumers with low motivation to process health claims were less likely to understand health claims. However, lack of motivation to process claims may mean that for these consumers, the claim is not relevant in making food choices, thus it would be unlikely that these people would be misled by claims.

Consumer understanding was affected by their time availability, as shown in Chapter 5. Consumers who were under time constraint understood the health claims significantly worse. It could be expected that when consumers make their everyday food choices in store they would be under time constraints. Even if in a context without time pressure, they would be able to understand the health claims adequately, the time pressure may not allow them to do so. This may impact the ability of health claims to facilitate informed choices at the point of purchase. This finding may imply that the food industry should consider different communication strategies by context.

There are some attempts from public policy and industry representatives to make health claims more understandable to the average consumer. While such attempts are commendable, it should be taken into account that there are potential drawbacks when trying to improve understanding. The use of more common words in health claims instead of the technical ones currently used or the addition of information may lead to activation of more information in consumers' minds when they interpret the health claims and thus some of the interpretations they could make may

not be in line with the evidence behind the claim. Therefore, empirical evidence should support changes in wording or addition of explanatory information to health claims. However, making the claims more understandable may lead to higher motivation to attend to the claim, even though understanding could decrease to some extent, which in turn could translate to purchase. This could lead to higher benefits for consumers' health at the detriment of loss of adequate understanding. However, the extent to which this could happen should be investigated further.

Assessments of consumer understanding could use methods tested in this thesis. While all methods are useful, depending on the purpose of the study, some methods may be more beneficial than others, as detailed in the individual studies reported in Chapters 3 to 5. The CUT method (open-ended questions) is particularly suitable to investigate the prevalence of consumers who can be seen to have adequately understood certain health claims. The laddering method is useful in investigating how changes in wording of claims impact the types and sequence of hierarchical inferences starting from the claim and finishing at consumer values level that people make. The rating method and CATA method are especially useful to quantify the prevalence of inferences and to examine relationships between understanding and other factors of interest. The different methods used have provided similar results that are in line with theory and previous literature. This brings support for the validity of the methods and the recommendation to use a two-step approach (elicitation of inferences followed by quantification of their prevalence) when measuring understanding of health claims.

6.4. Conclusion

Consumer understanding of health claims is challenging to assess as it is a complex phenomenon at the interplay between consumers' prior knowledge and the stimulus information to which they are exposed. Several methods proved to be useful in assessing understanding, yet their appropriateness for use in future studies depends on the purpose of the study. Consumer understanding of health claims is influenced by motivation- and ability-related factors, in addition to claim, product and socio-demographic ones. Efforts to improve consumer understanding by changes in the wording of health claims should be supported by empirical evidence as there are drawbacks in re-wording or addition of information.

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Co-author statements



Declaration of co-authorship

Full name of the PhD student: **Violeta Stancu**

This declaration concerns the following article/manuscript:

Title:	Consumer understanding of health claims: Motivation and ability related antecedents
Authors:	Stancu, Violeta; Contini, Caterina; Grunert, Klaus G.; Lähteenmäki, Liisa; Juhl, Hans Jørn; Casini, Leonardo; Romano, Caterina; Scozzafava, Gabriele

The article/manuscript is: Published Accepted Submitted x In preparation

If published, state full reference:

If accepted or submitted, state journal: Food Policy

Has the article/manuscript previously been used in other PhD or doctoral dissertations?

No x Yes If yes, give details:

The PhD student has contributed to the elements of this article/manuscript as follows:

- A. Has essentially done all the work
- B. Major contribution
- C. Equal contribution
- D. Minor contribution
- E. Not relevant

Element	Extent (A-E)
1. Formulation/identification of the scientific problem	C
2. Planning of the experiments/methodology design and development	B
3. Involvement in the experimental work/clinical studies/data collection	C
4. Interpretation of the results	B
5. Writing of the first draft of the manuscript	A
6. Finalization of the manuscript and submission	A

Signatures of the co-authors

Date	Name	Signature
1/8-2016	Contini, Caterina	
10/8-2016	Grunert, Klaus G	
3/8-2016	Lähteenmäki, Liisa	
12/8-2016	Juhl, Hans Jørn	
1/8-2016	Casini, Leonardo	

In case of further co-authors please attach appendix

Date: 31/8/2016

Signature of the PhD student



Appendix

Signatures of the remaining co-authors

Date	Name	Signature
1/8-2016	Romano, Caterina	Caterina Romano
1/8-2016	Scozzafava, Gabriele	G. Scozzafava



Declaration of co-authorship

Full name of the PhD student: Violeta Stancu

This declaration concerns the following article/manuscript:

Title:	Consumer inferences from different versions of a beta-glucans health claim
Authors:	Stancu, Violeta; Grunert, Klaus G.; Lähteenmäki, Liisa.

The article/manuscript is: Published Accepted Submitted In preparation x

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- D. Minor contribution
- E. Not relevant

Element	Extent (A-E)
1. Formulation/identification of the scientific problem	B
2. Planning of the experiments/methodology design and development	B
3. Involvement in the experimental work/clinical studies/data collection	A
4. Interpretation of the results	B
5. Writing of the first draft of the manuscript	A
6. Finalization of the manuscript and submission	E

Signatures of the co-authors

Date	Name	Signature
26/8	Klaus Grunert	
26/8	Liisa Lähteenmäki	

In case of further co-authors please attach appendix

Date: 26/8/2016

Signature of the PhD student



Declaration of co-authorship

Full name of the PhD student: Violeta Stancu

This declaration concerns the following article/manuscript:

Title:	The role of time constraints in consumer understanding of health claims
Authors:	Stancu, Violeta; Lähteenmäki, Liisa; Grunert, Klaus G.

The article/manuscript is: Published Accepted Submitted In preparation

If published, state full reference:

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- B. Major contribution
- C. Equal contribution
- D. Minor contribution
- E. Not relevant

Element	Extent (A-E)
1. Formulation/identification of the scientific problem	B
2. Planning of the experiments/methodology design and development	B
3. Involvement in the experimental work/clinical studies/data collection	A
4. Interpretation of the results	A
5. Writing of the first draft of the manuscript	A
6. Finalization of the manuscript and submission	E

Signatures of the co-authors

Date	Name	Signature
23.11.2016	Liisa Lähteenmäki	
25.11.2016	Klaus G. Grunert	

In case of further co-authors please attach appendix

Date: 25. 11. 2016

Signature of the PhD student

