Assisting sustainable food consumption: The effects of quality signals stemming from consumers and stores in online and physical grocery retailing

Valdimar Sigurdsson[1], Nils Magne Larsen[2], Mohammed Hussen Alemu[1,3], Joseph Karlton Gallogly[1], R. G. Vishnu Menon[4, 1], Asle Fagerstrøm[5]

[1]School of Business, Reykjavik University, Reykjavik, Iceland

[2] School of Business and Economics, UiT - The Arctic University of Norway, Havnegata 5, N-9405 Harstad, Norway

[3]Department of Economics and Business Economics, Aarhus University, Fuglesangs Allé 4, 8210 Aarhus V, Denmark

[4]Massey University, 63 Wallace Street, Mt Cook, Wellington 6021, New Zealand

[5]School of Economy, Innovation and Technology, Department of Technology, Kristania University College, Prinsensgate 7-9, 0107 Oslo, Norway

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Abstract

Increased fish consumption can contribute to a more sustainable food system. This paper explores how signaling affects consumer choices in fresh fish purchasing situations, both in traditional and online retail settings. We examined two different types of market signals; quality signals stemming from consumers as a social proof and authority signals coming from stores. Study 1 showed that quality signals from other consumers (product rating) had the highest importance score in an online setting when compared to traditional attributes in a conjoint experiment. Study 2 again confirmed the prominence of quality signals from consumers by extending the research over to brick and mortar retailing and top-selling items. Study 3 followed up with in-store experiments, using fresh cod fillets as the target product and fresh ground beef as a comparison. The experiments showed increased sales from both types of signaling, with an overall 41.5% increase for fish in our study.

Keywords: Signaling, food choice, popularity, fish, sustainable food system

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1. Introduction

Sustainable consumption and production patterns are one of the 17 goals in the UN's *Agenda for Sustainable Development* (United Nations, 2015). In the recently published Lancet Commission on healthy diets from sustainable food systems, fish, along with vegetables, fruit, legumes, whole grain, and nuts, is among the emphasized foods in the planetary health diet that the commission recommended (Willett et al., 2019). The Lancet Commission identifies a gap globally between existing dietary patterns and a recommended reference diet intake of fish, and it applies to all regions of the world except East Asia Pacific. Fish has the potential of replacing more unhealthy protein sources in consumers' diets and has a lower carbon footprint than beef, thereby contributing to a more sustainable food system. Thus, fish has an untapped potential for contributing to both a healthier planet and a healthier world population as more intake provides many health benefits for consumers, and contributes to their overall wellbeing (Willett et al., 2019). Research shows that fish intake is not associated with increased mortality (Abete, Romaguera, Vieira, Lopez de Munain & Norat, 2014) and is among the protein sources promoting reduced risk of cardiovascular disease because of its high content of omega-3 fatty acids (Mozaffarian & Rimm, 2006; Zheng et al., 2011). Fish intake is also considered essential for neurodevelopment (Oken & Bellinger, 2008).

This paper draws on signaling theory to test whether marketing techniques, generally used in traditional fields within e-commerce (such as hospitality), can aid the UN's Agenda for Sustainable Development. We test the effects of quality signals in the new and rising online grocery retailing sector and in traditional physical retailing. We specifically address the effects of quality signals stemming from other consumers as credible information working on choice behavior, both in terms of peers opinions (product ratings) and in terms of peers behavior (announcing the best-selling product in the category). We also test and compare an authority signal coming from the store (the store's recommended choice). Furthermore, we compare the importance and effects of each signaling technique against several salient product attributes used by consumers when selecting fish or food items.

We conducted three studies. The first two studies are choice-based conjoint experiments, resembling consumers' choice in an e-grocery setting (Study 1) and an actual store (Study 2). The aim was to understand how signaling affects consumer choice in fresh fish purchasing situations both in traditional and online retail settings. Both quality signals stemming from consumers as a social proof and authority signals coming from the store were examined. The results confirmed the importance of signaling on consumer preferences compared against other salient attributes. This was further tested in Study 3 conducted in a budget store to test the effectiveness on actual store sales. The three studies attempt to address three research questions. First, how will quality signals stemming from consumers (product rating and announcing the "Top seller") and authority signals coming from the store (the "Store's choice") influence consumer choice of fresh fish? Which type of signal has the strongest impact on consumer choice of fresh fish and how important are they compared to other important choice attributes? Second, do these signals work both online and in physical grocery retailing? Third, can these signals increase the sales of food items in a real grocery store?

Product rating has emerged as an important quality signal online, and Amazon has paved the way in using recommender systems and social commerce features that have the intention of communicating explicitly how peer-consumers behave in similar purchase situations (i.e., "bestseller," "customers who bought…also bought."). While product ratings inform new buyers about peer-consumers' perceptions of quality (Xie, Chen & Wu, 2016), signals that inform consumers about other consumers' behaviors draw on the phenomenon that other's behaviors reflect the correct behavior/choice in a given situation (Cialdini & Goldstein, 2004). Research points to differential effects of popularity signals across product types (i.e., Steinhart, Kamins, Mazursky, & Noy, 2014) but the underlying assumption is that other people have relevant and valuable information that the consumer does not possess (Banerjee, 1992). By relying on others' opinions and/or behaviors, the consumer can reach a better, quicker, or more effortless decision. Information on peer-consumer purchase is a signal of popularity, which again provides a strong signal of product quality that encourages consumers to follow others' purchasing behavior (Goldstein, Cialdini & Griskevicius, 2008; Lascu & Zinkhan, 1999). Research has found popularity signals to increase the perceived quality of a product (Dean, 1999), to make the customer more likely to buy the product (i.e., Castro, Morales & Nowlis, 2013; Myers & Sar, 2013), and to increase consumers' willingness to pay more for the product (Carare, 2012). However, the literature is underdeveloped in terms of the effects of quality signals in several settings. This includes their effectiveness for food items in general.

There is limited knowledge about their effectiveness in the growing e-commerce for fish as well as in physical retailing. The current paper, therefore, extends the literature on signaling theory by showing that product rating was not only a significant attribute in the choice criteria when consumers are selecting fish online, but that it was the most important factor out of the seven attributes tested; even more important than, for instance, price and delivery.

Popularity signals and store recommendations are recommended (Sorensen, 2016) and implemented, to some extent, in physical store environments; the most frequent approach being in-store posters and shelf-tags signaling top-selling products. Not much is known academically about the effectiveness of these signals. Such practices are said to add more "personal selling" into self-service stores at marginal costs. Sorensen (2016) calls it "the ghost in the shelf" since it does not rely on any contact between the consumer and store personnel, and he argues that physical retailers should use these tactics more, thereby imitating online practices. There is limited academic research on the effects of signals stemming from other consumer behaviors' applied to food products in physical stores (we identified only Castro et al. [2013] and Salmon et al. [2015]). We, therefore, add to this scarce literature by conducting an in-store experiment on how signaling popularity from peers ("Top seller") influences consumers' choice of fresh fish. We also test the effects of signaling the retailer's product choice. This is an authority-based signal (Huang & Benyoucef, 2013) that rests on the retailer's credibility rather than on social influence. The results from Study 3, an in-store experiment, show that the use of quality signals in physical retailing can increase sales of different food items (fish and beef) considerably.

Overall, the new knowledge is that our findings show that signaling techniques can be used to promote sustainable food items, such as fresh fish. This is in line with the general literature on signaling (e.g., Briggs et al., 2002; Cialdini, 2007; Cialdini & Rhoads, 2001; Goldsmith et al., 2000; Sparks et al., 2013; Sundar, et al., 2009), but our results reveal two main results of relevance to the promotion of sustainable food consumption and the literature on signaling theory. First, quality signals stemming from consumers and authority signals from retailers themselves can influence consumers' purchase behavior not only in online settings but also in physical store settings. Second, consumers seek product-related information in terms of price, country of origin, procurement method, and days until expiration to facilitate their purchase decision of fish products, but quality signals tended to have a stronger impact and were shown to be able to increase the sales in an actual store.

2 Theoretical framework

2.1 Signaling theory

Signaling theory has its roots in information economics (Spence, 1973) and applies to market exchange situations where sellers and buyers possess asymmetric information (Boulding & Kirmani, 1993). These are situations where one party in the exchange has more or better information than the other, and where signaling works as a transfer of relevant information to the other party. Signaling theory is, as such, concerned with reducing information asymmetry between two parties (Connelly, Certo, Ireland & Reutzel, 2011). Spence (1973) introduced applicant signaling in hiring situations where firms cannot know the productive capability of an applicant at the time of hiring. He specifically discusses the situation when a job applicant acquires an education to signal productive capability (e.g., the ability to learn), and where signaling costs play a significant role. Consumers can face similar challenges when choosing among competing brands. Difficulties in evaluating the true quality of a product due to, for instance, a lack of expertise (Rao & Monroe, 1989) can make consumers uncertain about product quality. The presence of uncertainty is potentially highest for products and services containing unobservable properties that cannot be assessed objectively before consumption or experience (Boulding & Kirmani, 1993), or so-called experience goods. To help consumers form impressions of the quality of experience goods, firms can use various signals to communicate the unobservable qualities. Thus, a signal is an action the seller can take to transfer information credibly about unobservable product quality to the buyer (Rao, Qu & Ruekert, 1999).

All marketing mix elements can serve effectively as signals influencing consumers' perceptions of a product (Erdem & Swait, 1998). Signaling theory has, therefore, been used extensively in marketing as a theoretical foundation when examining how external characteristics of a product (extrinsic cues) can serve to influence consumers' perceptions of product quality. The most prevalent signals in marketing include price, brand names, brand advertising, retail reputation, and warranties (Dawar & Parker, 1994). For instance, studies show that price has an information role in relation to quality in the way that a high price signal superior quality (Erevelles, Roy & Vargo, 1999). Brand names are market signals that improve consumers' perceptions about brand attribute levels (Erdem & Swait, 1998), and studies consistently show that a reputable brand ally improves consumers' evaluation of an unknown brand (Gammoh, Voss & Chakraborty, 2006). A firm can also signal quality by selling through a reputable retailer and thus rent the reputation of the retailer (Chu & Chu, 1994). Warranties

can reduce the uncertainty consumers might feel about product quality in a specific product category and as such function as a credible signal in quality evaluations (Boulding & Kirmani, 1993), especially when the reputation of the manufacturer is good (Purohit & Srivastava, 2001). Advertising is considered a quality signal when consumers infer that firms will not waste such large expenditures (Nelson, 1974; Kirmani, 1990) and because high-quality products sell in higher quantities that allow advertising expenditures to be spread across more units (Kihlstrom & Riordan, 1984). Because consumers are likely to rely on cues to gauge quality, signals are fundamental to marketing (Dawar & Parker, 1994).

2.1.1 Quality signals stemming from consumers

Consumers appear to trust other consumers and follow their actions (Raafat, Chater & Frith, 2009). Signals stemming from other consumers' opinions and behaviors can, therefore, have a pronounced effect on consumers' quality impressions and how they choose among competing products. This is evident online where ratings and consumer reviews in recent years have emerged as important quality signals due to their ability to inform new buyers about peer-consumers' perceptions of quality (Xie, Chen & Wu, 2016). Cheung et al. (2014) categorize online ratings and reviews as opinion-based social information cues. These refer to peer-consumers' views of a product based on their experience. Other types of quality signals stemming from consumers are what Cheung et al. (2014) categorize as action-based social information. These signals are behavioral oriented as they focus more on transferring information on the purchase behavior of peer-consumers. A well-known online feature displaying action-based social information is Amazon's "customers who bought... also bought…". Research has demonstrated that revealing the actions of peer consumers in similar purchase situations can affect how people perceive the quality of a product (Dean, 1999; Jeong & Kwon, 2012). Consumers use the relative popularity of a product as an indicator of quality (Hanson & Putler, 1996). Through quality perceptions, popularity can thus encourage consumers to follow others' purchasing behavior (Goldstein, Cialdini & Griskevicius, 2008). This shows that popularity tends to be self-reinforcing. Research has found popularity signals to make consumers more likely to buy the product (i.e., Castro, Morales & Nowlis, 2013; Myers & Sar, 2013) and also to increase their willingness to pay more for the product (Carare, 2012). However, Wu & Lee's (2016) results suggest that consumers respond more favorably to popularity signals such as "bestseller" when purchasing products for others. Firms can signal peer-consumer purchase behavior through different means. They can display the number of sold items or volume next to the product, use a visual icon that indicates which are the best-

selling items, hot products, and so forth. Although such popularity cues are used more frequently in online store environments than in brick-and-mortar stores (Jeong & Kwon, 2012), the use of posters or shelf tags to define a product as a "Top seller" has become widespread also in physical retailing (i.e., in stores promoting sports equipment, furniture, and books). Recently Sorensen (2016) also recommended this as a viable option for food retailers.

Several studies examine the effectiveness of signaling peer-consumer behaviors in terms of online consumers' purchases. Hanson & Putler (1996) found that manipulating relative popularity of software programs on a large commercial online system affected consumer choice. Chen (2008) found consumers to use sales volume as a cue in making purchase decisions on an Internet bookstore. Jeong & Kwon (2012) found that popularity signals (e.g., '94% of consumers ultimately buy after viewing this item [USB flash drive]') had a direct effect on the online purchase intentions of subjects with a tendency of high-risk aversion. Further, Cheung et al. (2014) found peer-consumer purchases to influence consumer purchase decisions among online beauty enthusiasts, and more influential than peer-consumer reviews and ratings (i.e., the total number of ratings on products in a particular brand). On the other hand, there have been rather few studies on the effects of popularity signals on consumer purchase behavior in brick and mortar store environments. We were able to identify only two relevant studies. Castro et al. (2013) examine the effects of a single disorganized product on a shelf in combination with limited product quantity (signaling that other shoppers are buying the product) on the purchase likelihood of non-ingestible products, such as toothpaste, fabric softener, dishwashing liquid, and soap. They found consumers' purchase likelihood for unfamiliar brands to be greater when there is only one disorganized product left compared to a display fully stocked and organized. There was no effect for familiar brands. This points to the importance of product familiarity. Salmon et al. (2015) study the impact of a banner stating that a specific healthy low-fat cheese was the most sold cheese in the supermarket representing their experimental setting. They found that participants low in self-control were more likely to buy the low-fat cheese when this product was communicated as the most sold cheese, compared to when it was not.

2.1.2 Authority signals

According to the Merriam-Webster dictionary, authority is "the power to influence… behavior," "an expert" and "persuasive force." The authority principle is a fundamental social influence principle (Cialdini, 2001), and many studies demonstrate authority effects (e.g., Bickman, 1974; Michener & Burt, 1975). The controversial study by Milgram (1963) is

perhaps the most classical study on how far individuals will go to obey authority. Due to authority effects, people tend to follow the advice given in an authority-based context. Briggs, Burford, De Angeli & Lynch (2002), for instance, demonstrate that people follow advice on government and university websites more than advice on other websites, even if the content in all cases is the same. Studies also show that authority signals (firm credibility and endorser credibility) enhance attitudes toward brands and advertisements, and increases purchase intentions (Goldsmith, Lafferty & Newell, 2000). Authority signals are used extensively in marketing as a persuasion strategy, but as Jung & Kellaries (2007) note, marketing research has mostly examined celebrity endorser effects. The authority principle in terms of advertisements works such that the higher the level of authority portrayed in an ad, the more positive attitudes (toward the ads/brands) and purchase intentions there should be (Jung & Kellaries, 2007).

Used in the context of the current study, a source perceived as possessing credibility and expertise/competence should have a persuasive impact (Cialdini & Rhoads, 2001). The meta-study by Floyd, Freling, Alhoqail, Cho & Freling (2014) provides some evidence of source effects. They found higher sales elasticities for products evaluated by experts than for those evaluated by other consumers in online product reviews. By visiting and shopping at a retailer's physical stores, consumers acquire experiences with the retailer. Consumers use retailer attributes to form an overall evaluation that will affect their attitude toward the store as a whole (Semeijn, van Riel & Ambrosini, 2004) and potentially toward its information. Trust in a food retailer may help to decrease the complexity of and uncertainty about food choices (Lobb, Mazzocchi & Traill, 2007). Since trust develops through social relations, consumers form beliefs about retailers' integrity and competence by interacting with them (Kuan & Bock, 2007). Thus, retailers perceived as credible and competent possess persuasive force they can utilize to affect consumer choice (such as announcing the "Store's choice").

2.2 Product attributes influencing seafood consumption

With a growing and increasingly global seafood market, consumers are likely to seek adequate product-related information to facilitate their purchase decisions (Pieniak, Vanhonacker & Verbeke, 2013). Thus, it is important to examine consumers' preferences for product-related attributes of seafood to provide a comprehensive overview of consumers' purchase behavior. There is a rich body of literature showing that product-related attributes such as price, procurement method, place of origin, packaging, storage conditions, and certification influence consumers' purchase behavior of seafood (e.g., Gempesaw, Bacon,

Manalo & Wessellset, 1995; Jaffry, Pickering, Ghulam, Whitmarsh & Wattageet, 2004; Claret et al., 2012; Carlucci et al., 2015; Davidson, Pan, Hu & Poerwantoet, 2012; Loose, Peschel & Grebitus, 2013; Mauracher, Tempesta & Vecchiato, 2013; Sogn-Grundvåg, Larsen & Young, 2013; Nguyen, Haider, Solgaard, Ravn-Jonsen & Roth, 2015; Risius, Janssen & Hamm, 2017; Brayden, Noblet, Evans & Rickard, 2018). In this study, we conducted in-store interviews with consumers as well as an extensive literature review to identify relevant product-related attributes that influence seafood consumption in the actual market. The final list of product-related attributes in our conjoint analysis includes procurement method, place of origin, purchase state, delivery time, and price.

A growing world population coupled with increasing per capita consumption of fish continue to exert pressure on the wild-capture fishery production (FAO, 2016). Policymakers are faced with making competing decisions in terms of increasing the availability of fish to meet the growing demand versus maintaining the sustainability of fish resources. This has led to the introduction of aquaculture, a practice of fish farming, as a policy instrument to increase production of fish in a sustainable manner. While wild-caught fish production has already stabilized, aquaculture continues to increase, contributing around 53% of the total fish consumption in 2016 (FAO, 2016). With an increasing supply of farm-raised fish products in the market, consumers are confronted with choosing between farm-raised and wild-caught fish (Davidson et al., 2012). This caused the emergence of several studies investigating consumers' preferences for wild-caught versus farm-raised fish. The findings indicate that consumers prefer wild-caught fish to farm-raised (see Rickertsen et al., 2016 for review). However, such evidence is scanty in the e-commerce settings where consumers face not only product-related attributes but also other attributes, including social information (e.g., ratings and reviews). Therefore, we included the *procurement method* attribute, which indicates how the fish is obtained. This attribute has two levels: wild-caught fish and farm-raised fish.

In addition to information related to how the fish is obtained, consumers are interested in information concerning the country of origin of the fish products (Luomala, 2007; Pieniak et al., 2013; Uchida, Onozaka, Morita & Managi, 2014). Such information is of particular importance since it serves as a proxy for the overall quality of the product in terms of taste and food safety risks (Scarpa, Philippidis & Spalatro, 2005; Josling, 2006). Many studies indicate that the place of origin of fish products affects consumers' preferences. For instance, Rickertsen et al. (2017) found that French consumers prefer fish from developed countries relative to fish from developing countries. A related study by Asche & Guillen (2012) also shows that consumers in Barcelona have a strong preference for fish from Catalonia compared

with fish from Namibia. In terms of domestic or local versus imported fish, German consumers prefer locally produced fish products relative to the ones originating from Turkey and Poland, as shown by Risius et al. (2017). These authors reported that short distance of product transportation and trust are the main drivers of consumers' preferences for locally produced fish products. Despite the large number of such studies (see Rickertsen et al., 2017 for a review), there is lack of similar studies in the e-commerce setting where consumers across the globe face fish products from different places. To fill this gap, we include *country of origin* as an additional attribute in our study to investigate its influence on consumers' preferences for fresh fish originating from different countries.

Price, which is the cost of purchasing fish products, is one of the main drivers of consumers' purchase decisions. There is some evidence indicating that price is a limiting factor for fish consumption (e.g., Verbeke & Vackier, 2005; Brunsø, Verbeke, Olsen & Fruensgaard Jeppesen, 2009). On the other hand, price can signal expected quality and safety (Sigurdsson, Foxall & Saevarsson, 2010). Claret et al. (2012) found that consumers are willing to pay additional amounts for fresh fish, suggesting that price is used as a quality predictor by consumers. In line with standard economic theory, price is mostly expected to have a negative influence on consumers' valuation of products, but studies based on latent class analysis have shown that some groups of consumers have a positive sensitivity to price (Peschel, Grebitus, Alemu & Hughner, 2018). We include a *price* attribute with three levels in our study to investigate how consumers react to different price levels of fresh fish.

Consumers also utilize information related to the storage conditions of fish products to evaluate their freshness. A review by Carlucci et al. (2015) revealed that most consumers prefer fresh fish over frozen, canned, and smoked fish. According to this review, the driving factors for this recurring preference is that consumers associate freshness with taste, color, texture, and odor. However, it has been shown that consumers have difficulty in interpreting the meaning of *freshness*. For example, McManus, Hunt, Storey, McManus & Hilhorst (2014) reported that some consumers understood it as fish captured recently while others indicated fish which has not been frozen. Other authors also reported similar results (Birch, Lawley & Hamblin., 2012). This suggests that consumers' evaluation of the freshness of fish products can be mediated by their experience with and knowledge of fish consumption (Brunsø et al., 2009). Despite the importance of the storage conditions of fish for consumers, only a few studies have examined its influence (Carlucci et al., 2015). In this study, we intend to contribute to the literature by investigating the influence of the *storage conditions (or purchase state)* attribute on consumers' preferences for fish. It has two levels: Fresh and Frozen.

With the normalization and increasing popularity of e-commerce, retailers were focused on moving from offline to online retailing (Amblee & Bui, 2011). Today, we see the two forms converge into a "webby store", a store that uses online active retailing principles in a brick-and-mortar format (Sorensen, 2016). The universal nature of the web, along with advances in personal technology, such as smartphones, the increasing availability of high-speed data networks, and geolocation tools have allowed this convergence of old world and new world retailing styles (Amblee & Bui, 2011). This forms the basis for our motivation to examine consumers' purchase behavior integrating quality signals applied extensively in online retailing with product-related attributes.

3. Study 1: The importance of signaling on consumers' preferences in e-commerce

In an online environment, consumers need to form quality expectations by making inferences from different types of quality signals. This is different from physical retail environments where they can use their senses more actively (e.g., smell and touch). When it comes to mediated sales, Sorensen (2016) points to Amazon's marketing technique of bringing "personal selling" back to retailing by guiding the customer instead of relying on self-service retail. In this regard, Amazon combines product attributes and social information such as emphasizing delivery, 1-click patented purchase method, and social influence (capitalizing on what other consumers say and do). Marks and Spencer (www.marksandspencer.com) also relies heavily on providing social information by facilitating different versions, such as the average total review grade for a product, individual reviews for quality and value, number of reviewers as well as recommendations, and written comments. In line with their popularity in practice, the literature increasingly demonstrates that quality signals stemming from other consumers attitudes and behaviors impact consumer choice and preferences in an online purchase setting (e.g., KPMG, 2017), but this is an academically underdeveloped research area when it comes to food items. Therefore, Study 1 investigates the relative importance of quality signals stemming from consumers, authority signals coming from the store, and traditional product attributes when consumers purchase fresh fish online.

3.1 Method

3.1.1 Choice-based Conjoint Design

The Choice-based Conjoint Design (CBC) approach appeals to several researchers because it is based on well-tested consumer choice theory (McFadden, 1986; 2001), which

postulates that given a bundle of alternatives, consumers choose the alternative that maximizes their utility. It provides choice options that mimic purchase behavior in the actual market where consumers are faced with making choice decisions by making trade-offs between different attributes of products. This lends itself to the notion that utility is derived from the attributes of a product, not the product per se (Lancaster, 1966; Johnson, 1974). The CBC has been used to understand consumer's food choice behavior (e.g., Ding, Grewal & Liechty, 2005; Louviere & Islam, 2008; Tempesta et al., 2010). In the context of seafood, Claret et al. (2012) employed the CBC approach to estimate the relative importance of different attributes in influencing consumer preferences fish. Cox, Evans & Lease (2007) also used the same approach to estimate the average importance and utility values of attributes of farmed prawns. Furthermore, using the case of healthy food (fish) choices, Sigurdsson, Menon & Fagerstrøm (2017) showed the applicability of the CBC to analyze complex behavior that may not be easily tractable using other experimental approaches.

In this study, we also employed the CBC approach to investigate the relative importance of different attributes in driving consumers' preferences for fresh fish products in e-commerce settings. The CBC study was created using Sawtooth Software's Lighthouse Studio 9.6.1. In constructing and displaying choice tasks, a random task generation method that implemented a balanced overlap design was used, where some degree of level overlap (repeating levels within a choice task) was permitted. Such a design increased the precision of both main and interaction effects, and reduced biases due to order and learning effects. To test the design, a survey simulation was conducted using the same attributes and levels as specified in the main study. An aggregate logit (MNL) run was conducted based on the combined elements of design efficiency and sample size to estimate the precision of the parameter estimates. The simulation generated random (dummy) answers for 1,500 respondents, each with 11 tasks. The random answers estimate the efficiency of the design for respondents with heterogeneous and unknown preferences, and, therefore, considered to be a robust approach. The results showed that the levels within three-level attributes have standard errors around 0.013, while the levels within two-level attributes have standard errors around 0.009. The standard errors reflect the precision obtained for each parameter with lower error corresponding to greater precision. Both of the standard error values we obtained are below the threshold of 0.05, which showed the robustness of the design.

The product attributes were identified based on a literature review and a pre-study survey. Table 1 shows a description of the attributes, their corresponding levels, and their sources. In addition to the product-related attributes discussed in Section 2.2, we identified

product rating, delivery time, and item signage as relevant attributes that can drive consumers' preferences for fish online. Product rating refers to customers' evaluation of a product online based on their consumption experience and overall satisfaction. It can be expressed in the form of stars. Sigurdsson et al. (2017) found that the *product quality rating* attribute is the most important attribute for consumers in the case of healthy food choices. Other studies focusing on non-food products also reported the importance of prior customer rating in driving consumer preferences (e.g., Cheung et al., 2003; Decker & Trusov, 2010). *Delivery time* represents the time length between order placement and order delivery. In the context of e-commerce, speed, and timeliness of the distribution systems can influence consumers' preferences for purchasing products sold online (Sigurdsson et al., 2017; Nguyen, de Leeuw, Dullaert, & Foubert, in press). Thus, we included it in our CBC design to test its importance. As discussed in the previous sections, apart from examining the role of product rating, the main aim of this study is to investigate the role of attributes signaling peer customer purchase and store's recommendation in influencing consumers' preferences for fresh fish. This objective is achieved by including the *item signage* attribute.

The levels for the attributes described in Table 1 were chosen so that they reflect the actual market situation as much as possible. The country of origin attribute was operationalized at four levels, while price, item signage, delivery time, and product rating were operationalized at three levels. Finally, the procurement method and purchase state attributes were operationalized at two levels. In total, seven attributes and their corresponding levels constitute a 5x2x3x3x2x3x3 design.

--- Insert Table 1 here ---

Due to pricing differences between farmed and wild-caught salmon, conditional pricing was used to be in-line with a real-world online store setting. The levels in the price attribute were set at €18, €24, and €30 per kilogram for wild salmon, and €8, €14, and €20 for farmed salmon. This survey had 14 choice-based questions. Each question gave three product options. These options have a different level of each attribute and come together to make a product offering. These products are designed to mimic actual products that a customer may find online when purchasing fish. There is also a "none of these" option, which can increase the external validity of the study, as shoppers can choose not to purchase anything. An example of what a typical CBC question looked like can be seen in Figure 1.

--- Insert Figure 1 here ---

3.1.2 Data collection

For Study 1, an online survey was used to collect data using Amazon Mechanical Turk crowdsourcing service. Complete questionnaires were returned from 496 respondents. While 54% of the respondents are males, 46% of them are females; 43% of the respondents are in the age category of 25–34 years, while around 20% and 17% are in the age categories of 18–24 and 35–44 years, respectively. The other group of respondents includes the age categories of 45–54 years (13%), 55–64 (5%), and 65 or above (2%).

3.1.3 Results and discussion

Table 2 shows the utility estimates of the different levels of each attribute. A Hierarchical Bayes estimation model was used to estimate the utilities (for a review on HB models, see Allenby & Ginter, 1995, and Lenk, DeSarbo, Green & Young, 1996). From Table 2, we see that product rating, one of the quality signals stemming from other consumers, had the highest importance score of 24.27, followed by procurement method (17.9), country of origin (15.93), price (15.78), delivery (11.21), purchase state (9.34), and item signage (5.57).

--- Insert Table 2 here ---

Product rating being the most important attribute in this study is in line with findings reported by Cialdini & Goldstein (2002) and Jeong & Kwon (2012). It shows that quality signals stemming from other consumers' quality perceptions function as a guide for consumers' choices during online fresh fish purchase. In an online purchase situation, consumers are unable to sense the product physically (especially important when buying fish), and thus product rating has a relatively strong impact on consumer choices (Fagerstrøm, Ghinea & Sydnes, 2016). It is particularly interesting to see that item signage had the least impact on consumer choices, especially since such signages are common in an online marketplace. This could be due to the fact that the signage information is marked by the company whereas the product ratings are directly from the consumers, who usually do not receive monetary gains for rating products. When looking at traditional product attributes, the procurement method had the highest impact. This indicates that consumers preferred traditional wild fish over farmed fish, even though aquaculture supplies approximately 53% of fish to consumers across the globe (FAO, 2016).

This result is also in line with previous literature (Claret et al., 2012; Jaffry et al., 2004; Nguyen et al., 2015; Roheim, Sudhakaran, & Durham, 2012; Uchida et al., 2014), which shows that consumers prefer wild fish to farmed fish. Another reason for this preference could be the perceived health benefits, taste, and nutritious value attached to wild fish (Arvanitoyannis, Krystallis, Panagiotaki & Theodorou, 2004; Brunsø et al., 2009; Claret et al., 2014; Verbeke & Ward, 2006).

Study 1 suggests that when selecting fresh fish in online retailing, people prefer a positive quality signal from other consumers over other traditional salient attributes. The literature is underdeveloped in terms of the effects of quality signals for food items as the online grocery sector is still rather small, but the current findings indicate the primacy of these signals and that consumers are ready to generalize over from more established online sectors, such as the frequent use of ratings in traveling and tourism. Study 2 places consumers in a physical retail context where they are not as used to the practice of signaling of social information cues, as they traditionally rely on other attributes because they can use their senses more actively, such as touching or smelling the product.

4. Study 2: The importance of signaling on consumers' preferences in a traditional physical store

While online shopping is an up and coming way of grocery retailing, brick-and-mortar retailers are still the primary mode of purchase for consumers (Munson, Tiropanis, & Lowe, 2017). In brick-and-mortar retailing, one of the most convenient and cost-effective ways to promote products is by using in-store displays. In-store displays are a common way to change the setting of the store to increase sales (Chevalier, 1975; Wilkinson, Mason & Paksoy, 1982). Displays are manipulations that are considered point-of-purchase marketing communication channels (Sigurdsson, Engilbertsson & Foxall, 2010). These promotions can prompt an immediate marketing response (Kumar & Leone, 1988; Milligan & Hantula, 2006), whereas item signage communicates product attributes to customers (Sigurdsson et al., 2010). While the presence of item signage, which can include verbal signage, images, testimonials, and so forth, often are seen in-store, they have become enormously common in online retailing (Sorensen, 2016). Specifically, item signage signaling other consumers opinions and behaviors has become practically expected in the online retailing world. While such signals (e.g., announcing the "Top seller") are expected online, their effect on consumer choice in physical

retail environments, specifically in relation to healthy and sustainable food, has not been looked at closely.

4.1 Method

4.1.1 Design

Similar to Study 1, Study 2 used the CBC approach to examine the role of attributes, including quality signals stemming from consumers and an authority signal coming from the retailer, in determining consumers' preferences for fresh fish in the traditional physical store settings. To ensure that the selected attributes reflect the attributes that consumers value in the actual market, an in-store survey was conducted before the main conjoint study. This survey enabled us to identify five relevant attributes and their levels that are likely to be associated with buying fresh fish in physical stores. We also conducted a literature review to support the findings of the in-store survey in terms of corroborating the importance of the attributes in driving consumers' preferences (see Table 3). We also utilized visible information cues that consumers saw in stores to identify other potential attributes. The type of fish, item signage, days until expiration, and price were operationalized at three levels, and the attribute purchase state was operationalized at two levels. The different levels were assumed to have varying impact on purchase behavior. Five attributes and their corresponding levels constitute a 3x3x2x3x3 design.

The study was designed using Sawtooth Discover, a web-based platform for choice-based conjoint analysis. The study consisted of 11 tasks, and each task consisted of three product concepts and a none alternative. The none option in CBC tasks reflects the real-world scenario since buyers are not required to choose products that do not satisfy them (Orme, 2010).

--- Insert Table 3 here ---

4.1.2 Data collection and analysis

A questionnaire was developed and distributed online through Facebook groups which consisted of a diverse group of people in terms of the basic socio-demographic characteristics such as age and gender. This study was conducted in Iceland and was distributed only to people residing in Iceland. This was done in an attempt to mimic the in-store buying environment that is seen in Study 3. Study 3 takes place in an Icelandic grocery store with Icelandic labels and

products, so it is fitting that Study 2 focuses on typical shoppers of this type of store. Fully completed questionnaires were returned from 204 respondents. Out of the total sample, 71% were females. In line with Study 1, most respondents (40%) fall in the age category of 25–34 years in comparison to the other age categories. Those respondents in the age categories of 18–24 and 35–44 years account for 29% and 14%, respectively, of the total sample. The rest of the respondents falling in the age group of 45–54, 55–64, and 65 or above account for 17% of the sample. The questionnaire had two parts. The first part consisted of the traditional CBC analysis to examine the utility and importance of the attributes that were used in the study. The second part included respondent-specific demographic and shopping behavior questions.

4.1.3 Results and discussion

The results from the conjoint analysis are presented in Table 4. The utilities were estimated using maximum likelihood estimation via individual-level logit, and the choice data was augmented using empirical Bayes (Bart, Eckert, Geweke, & Louviere, 2014). From Table 4, we see that expiration date had the highest impact with a score of 23.72, followed by item signage (23), price (19.59), type of fish (19.05), and finally purchase state (14.64).

--- Insert Table 4 here ---

The results indicate that item signage in terms of announcing the “Top seller” is almost equally important as fish freshness where announcing the “Top seller” has the largest effect on consumer utility. This supports previous research indicating the importance of signaling other consumers choices in brick and mortar grocery retail (Salmon et al., 2015; Sigurdsson et al., 2017; Sorensen, 2016). The high importance of the “Top seller” signal can be attributed to the fact that people who are uncertain in particular situations look for indications from others on appropriate behavior (Cialdini and Goldstein, 2002, 2004). Price falls third in importance in this study. This is in line with Sorensen (2016), where price alone often adds little to the value of item promotion. With type of fish and purchase state falling in as the fourth and fifth, respectively, in importance, it is interesting to note that the physical characteristics of fish in this study can be less important to the consumer than cues on quality. Study 3 follows with an in-store experiment in a physical store to test the effectiveness of the item signage on consumer buying behavior.

5. Study 3: The effect of signaling on fresh food product purchase: Evidence from in-store experiments

Studies 1 and 2 showed that different forms of quality signals stemming from consumers could increase consumer utility in the two conjoint studies, both online and in physical stores. Based on this, we wanted to test whether the effectiveness of signaling peer-consumer purchases (the best-selling product) could go beyond utility and preference and increase sales of the announced healthy and sustainable food item in a grocery store. In general, there is a need for more in-store experimentation to test the effectiveness of in-store marketing on buying behavior directly and in real non-experimental settings (Sigurdsson, Larsen & Fagerstrøm, 2015). Factors that may alter the consumption of healthy and sustainable food include the locations of the food products within stores, availability and shelf facings, access to nutrition information, and the price of food (e.g., Areni, Duhan & Kiecker, 1999; Sigurdsson, Larsen & Gunnarsson, 2011a, 2011b; Yeh et al., 2008), but knowledge on the effectiveness of signaling peer consumer purchases in physical grocery stores is an underdeveloped research area.

Some studies have tested the effectiveness of in-store advertisements with an authoritative message, but consumer-to-consumer oriented information, such as top sellers, despite being used heavily in online commerce and somewhat in a store environment, are non-existing in the literature. An example of an authoritative in-store experiment on food items is Sigurdsson, Larsen & Gunnarsson (2014), who tested the effectiveness of a message from the store stating that "Dried fish is good for your health, builds up your muscles, and helps to keep you in shape." The message was based on the results of consumer focus groups and surveys, but despite that, it was not successful in increasing sales. To examine the effects of quality signals stemming from other consumers' behaviors and authority signals coming from the retailer in an actual retail environment, we performed two in-store experiments. While one experiment tested the sales effects of announcing the "Top seller" and the "Store's choice" in the fresh fish category, another experiment tested the sales effects of similar signals in the red meat category, as a comparison.

5.1 Method

5.1.1 Participants, setting and product

The in-store experiments were conducted in a budget store in Reykjavik, Iceland. The best-selling fish product was unflavored fresh cod fillets. The identification of this "Top seller"

was based on historical sales data two weeks before the experiment start date. To increase the comparable ability as well as the generalization, another fresh item was chosen in a comparable category, though not the same as fish. In the meat category, located across the aisle from the fish cooler, fresh ground beef was identified as the bestseller. Unlike fresh cod fillets, the top-selling ground beef item is sold in uniform packages, with virtually no variability between each item.

5.1.2 Response definition and measurement

The dependent variable was the relative sales of the products in question. It was calculated as the total sales of the target product divided by the total sales in the respective product category. For the ground beef experiment, the period was Sunday through Saturday, whereas for the cod it was Tuesday through Monday. These periods were set as weeklong segments to account for any specific fluctuations in purchasing behavior because of the day of the week. For example, more fish could be purchased on a Friday before the weekend, or fish sales could slump mid-week. This makes the sales data much more reliable and gives the intervention considerable time to be noticed.

5.1.3 Experimental design and procedure

We used an established repetitive measures reversal experimental design (A-B-C-B-C) structure to reduce unintended effects (e.g., Johnston & Pennypecker, 1993). Existing sales data was taken to set a control for the percentage of units sold. This was the A baseline. The B intervention was a “Top seller” shelf tag (signage), and the C stimuli was the “Store’s choice” shelf tag. For the latter, we mentioned the store name explicitly in the shelf-tag and not “Store’s.” The latter is used in the paper in order to keep the specific retail store anonymous. As the experiments were conducted in a store in Reykjavik, the tags were translated to the Icelandic language. In line with the tradition in behavioral analytical research (the experimental analysis of behavior), we rely more on descriptive statistics than inferential statistics; such as measures of central tendency (average) and variation (the span). As the experiments contain only a few weeks of data, they lack statistical power and, therefore, we combine the data from both target products (fish and beef) when testing also for significance (for the pros and cons of the use of inferential statistics in behavior analysis see an introduction to six articles in Baron, 1999, see also Hopkins, Cole & Mason, 1998).

5.1.4 Procedure

The in-store experiments were conducted between October 10, 2018, and December 3, 2018. Researchers visited the store every day to ensure that the experiment ran smoothly. This involved taking pictures to check the correct placement and to identify any external factors other than the tags ("Top seller" and "Store's choice") that might affect the experimental outcome. We also ensured that a sufficient supply of the target products was maintained throughout the experimental period.

5.1.5 Results and discussion

The relative sales of cod fillets in the baseline period varied between 3.10% and 4.43% (M = 3.83%). When the tag "Top seller" was introduced, the mean relative sales increased (range, 4.67 to 5.38, M = 5.04%) by 31.59% compared to the baseline period. The introduction of the "Store's choice" tag resulted in a 51.17% increase in mean relative sales (range, 3.52% to 8.07%, M = 5.79) compared to the baseline period. The results were also similar in terms of the relative sales of fresh ground beef, but with smaller effects. By introducing the "Top seller", the relative sales (range, 22.48% to 28.20%, M = 25.34%) increased by 19.81% as compared to the baseline period (range, 19.74% to 29.49%, M = 21.15%). The "Store's choice" tag display intervention led to an increase in mean relative sales (range, 23.17% to 31.88%, M = 27.47%) by 29.88% as compared to the baseline period.

The results reveal that the interventions in terms of "Top seller" and the "Store's choice" boosted sales experimentally, with an overall 41.5% increase for the fresh cod fillets. To test the results further, the sales data from the two interventions ("Top seller" and the "Store's choice') were merged and tested against the combined baseline sales data using a paired-sample t-test (see Table 5).

There was a significant increase in sales for fish from the baseline ($M = 3.83$, $SD = 2.72$) to the item signage intervention (M = 5.42, SD = 3.45), ($t(24) = -1.73$, $p < 0.10 = 0.098$).

--- Insert Table 5 here ---

There was also a significant increase in sales for ground beef from the baseline (M = 21.15, SD = 13.11) to the item signage intervention (M = 27.47, SD = 8.97), $t(27) = 2.37$, $p < 0.05$ (two-tailed). Adhering to the standard practice of reporting effect sizes in the experimental intervention literature, we also report similar information to provide a better understanding of

our results in terms of showing how effective the item signage interventions are. The results reveal that the interventions led to medium effects (Cohen's d is 0.51 and 0.56 for fish and beef, respectively), according to Cohen's (1988) effect size convention. These results suggest that announcing the "Top seller" or the "Store's choice" through in-store shelf tags boosts the sales of fresh cod fillets and fresh ground beef.

6. General discussion

In this section, we discuss the main findings from the three studies with a particular emphasis on the significance of the results of the work, managerial implications, and limitations.

6.1 Research implications

In our first choice-based conjoint design study, we signaled other consumers' quality impressions by giving participants information about product rating. We found this attribute to be the most important one compared to more traditional product-related attributes, including procurement method and country of origin and price. This result is important because unlike the previous literature within consumers' preferences for fish, which focused mostly on product-related attributes by neglecting social influence attributes (see Carlucci et al., 2015 for a review), it provides a comprehensive overview of consumers' purchase reactions when they are exposed to both types of attributes. This exposition is also important because consumers are faced with both types of attributes in the actual market situation, enhancing the external validity of our results. However, deviating from the above type of literature, our finding that product rating is important as a quality signal in the retail industry is in line with previous findings in non-food contexts (e.g., Cialdini, 2007; Goldstein et al., 2008; Myers & Sar, 2013; Floyd et al., 2014). What makes our study important is that it adds to the body of such findings in the sustainable healthy food choice and social influence literature, where there is a lack of similar studies, except for Salmon et al. (2015) who investigated the role of information cues in promoting healthy food choices.

While the "item signage" attribute is the least important attribute in the e-commerce setting (Study 1), it is one of the most important attributes together with "days until expiration" in the physical store setting (Study 2). Research shows that the freshness of fish products is a key determinant of consumers' purchase behavior (Carlucci et al. 2015). In our study, this can be related to the "days until expiration" attribute, which indicates the time lapse before losing quality. The finding that a "Top seller" sign is as important as the quality of the fish is

imperative because it suggests that signals stemming from other consumers behaviors are useful for promoting fish products in physical stores. Moreover, the influence of announcing the "Top seller" is more pronounced in physical stores than online when looking at the magnitudes of the estimated utility levels for this attribute.

Given that in-store experiments are conducted in realistic shopping environments, consumers are likely to make their purchase decision truthfully giving rise to high external validity (Lusk, Fox, Schroeder, Mintert & Koohmaraie, 2001; Sigurdsson et al., 2010). Thus, using in-store experiments (Study 3), we test the effects of announcing the "Top seller" on sales of fresh cod fillets. Our main argument regarding quality signals stemming from consumers purchase behavior is that consumers who are unfamiliar with a particular product may nevertheless buy the item signaled as, for instance, the "Top seller,' thinking that its popularity reflects other buyers' (favorable) information about the product's quality. There is established evidence in the literature on the effects on consumer choice from signaling popularity in online choice situations (e.g., Wu & Lee, 2016; Cheung et al. 2014; Carare, 2012; Jeong & Kwon, 2012; Chen, 2008; Hanson & Putler, 1996). Evidence from signaling popularity in physical stores points in the same direction (Castro et al., 2013; Salmon et al., 2015), but this literature is rather scarce. Our results contribute to this scarce literature. We found item signage in our choice-based conjoint Study 2 to be among the most important attributes for consumers in a traditional physical store environment. A "Top seller" signal further increased the sales of the target products in the in-store experiments in Study 3. These results demonstrate that quality signals stemming from other consumers purchase behaviors have the potential also in physical retail settings to increase sales of products containing unobservable properties of importance for assessing product quality.

Additionally, since the "Store's choice" boosted the volume of sales as compared to the baseline situation, this experiment reveals that authority-based signals also are useful in influencing consumers' purchase behavior in physical stores. Such evidence has been lacking in the food literature. Despite the presence of evidence in the non-food literature indicating that authority-based signals can enhance attitudes toward brands, advertisements, and purchase intentions, the results seem to be inconclusive as this depends on the credibility of the company in question (e.g., Grewal et al., 1994; Lafferty & Goldsmith, 1999; Goldsmith et al., 2000; Cialdini & Rhoads, 2001). Moreover, attitudes and purchase intentions do not directly represent actual behavior by themselves, but they are rather precursors of behavior (Ajzen, 1991). Thus, notwithstanding the existence of the above evidence in the non-food literature, the relationship between authority-based signals and consumers' purchase behavior seems to

be poorly understood. Against this backdrop, as indicated above, we focus on measures of actual purchase behavior in terms of weekly sales to enhance our understanding of the influence of authority-based signals on consumers purchase behavior, and to provide results that are more reliable in this regard. We do this in an in-store (field) setting to increase the reliability and external validity of our results further because, to the best of our knowledge, similar authority signals as moderators of purchase behavior have been investigated only in laboratory settings (Sundar, Xu & Oeldorf-Hirsch, 2009; Sparks, Perkins & Buckley, 2013).

While information related to other consumers' experiences and behaviors is important for consumers, they also seek product-related information when purchasing fish in physical stores as well as online. In line with the recurring finding in the literature (see Carlucci et al., 2015 for review), consumers in our study attach a high preference to price, country of origin, procurement method, and days until expiration. The increased consumption of unhealthy foods is partly associated with the fact that consumers have easy access to various information (Kearney, 2010). Our results suggest that this should be the way to promote the purchase and consumption of healthy, sustainable food. Easy access to product-related information is likely to increase consumers' knowledge, which has an important implication for their engagement with the fishery retail industry.

6.2 Managerial implications

In a highly competitive and increasingly complex food market, companies are likely to seek effective marketing strategies that would enable them to increase their market share. While the emergence of health and environmentally conscious consumers presents fish selling companies with a great opportunity, they face stiff competition from other companies selling unhealthy foods. Such foods are usually associated with taste and convenience in terms of saving time and effort enticing consumers to increase their consumption (Brunner, van der Horst & Siegrist, 2010). The success of unhealthy foods in terms of capturing a significant market share is not limited to taste and convenience factors; it is also an outcome of aggressive advertising (Bublitz & Paracchio, 2015), and the use of in-store tactics. Therefore, it is of great importance that healthy, sustainable food is promoted using similar strategies. Furthermore, increasing consumers' access to different information at low search cost, thereby reducing information asymmetry between companies and consumers, is pivotal in promoting healthy food, including fish (Biswas, 2004). The results in the current study show that consumers also have a strong tendency to seek product-related information such as country of origin, procurement method, price, and storage conditions.

Another important managerial implication is to use signaling as an influence technique in physical stores to encourage the purchase of healthy, sustainable food. Retailers can capitalize on signaling peer consumer purchases such as announcing the “Top seller”. With the freshness of the fish products being a key determinant of consumers purchase behavior, promoting fish in stores is more likely to succeed than in online contexts as consumers prefer to evaluate the products physically and instantly. On the other hand, fish selling companies can introduce product rating services to boost their sale of fish online. In relation to this, evidence suggests that such services can be used to realize targeted and personalized marketing (Cheung et al., 2003), which implies that the aforementioned companies can use them to deliver fish products that can satisfy each consumer's preference as much as possible according to how they rate the specific product of interest. Successfully implementing all these managerial implications can serve as a bridge to sustainable food system transformation.

6.3 Limitation and further research

As with any other research, our studies are not without limitations. Results from the two interventions that use different shelf tags (“Top seller” and “Store’s choice”) were merged when testing whether there are differences in sales of fresh cod fillets between the intervention and baseline periods when dealing with inferential statistics. Therefore, we recommend more and longer experimentation to detect better the separate effect of the authority-based cue and the action-based informational cue. Furthermore, we did not control for cultural differences and, therefore, there are opportunities for further research work on the generalization of the findings across different cultures.

We focus on fish as a food product to give first-hand information regarding the role of signaling in promoting the purchase and consumption of healthy, sustainable food. However, our results may not be generalized to other healthy, sustainable food categories. Future studies may test this for other healthy food alternatives such as fruits and vegetables, as mentioned in the Lancet Commission’s report (see Willett et al., 2019). Another interesting area of future research would be to examine the effectiveness of signaling in relation to shopping trip type and shopping trip goals. Sorensen et al. (2017) showed that most consumers make short shopping trips where few items are bought. It would be important to investigate the effects of consumer knowledge and involvement and whether signaling works differently depending on the type and length of the shopping trip.

Based on the results from Studies 1 and 2, one could expect the “Store’s choice” tag to have a negative impact on the sale of fresh fish. However, the authority-based signal triggered

an increase in sales in the in-store experiments (Study 3). It is difficult to know whether this authority signal, which in Study 3 carried the store logo, was treated by the consumer in the same way in the real in-store environment as in the conjoint experiments. It is possible that consumers in the chosen store were buying more of the recommended fresh fish fillets due to bonds they have built with the retailer over years. In contrast to Study 3, the "Store's choice" attribute in Study 1 was nonspecific (not referring to a particular retailer) and thus less likely to evoke feelings of trust based on retailer reputation and authority. In Study 2, participants were asked to imagine that they were in one of the stores of the same retailer as in Study 3, but we do not know whether the participants have past experiences with this retailer. In connection with this, the divergence in the results across the studies concerning the impact of the 'Store's choice' tag can be related to some methodological issues. In retrospect, we should probably have considered splitting the 'item signage' attribute into two as *'Top seller'* and *'Store's choice'* instead of presenting it as one attribute in the conjoint design. This would have enabled us to disentangle the effects of the 'Store's choice' from that of the 'Top seller', and provide more plausible results to determine its effectiveness in driving consumers' preferences and sales of fresh fish in different purchase settings. Based on this we recommend splitting these interventions both in terms of conjoint and in-store experiments in future research.

7. Conclusion

In line with the purpose of the INEKA Special Issue, we show that increased consumption of sustainable food can be achieved by using quality signals at the point of purchase, contributing to healthier protein sources and lower carbon footprints. We draw on signaling theory to test if marketing techniques, generally used in traditional fields within e-commerce (such as hospitality), can aid the UN's Agenda for a more Sustainable Development, by increasing the sales of fresh fish, both in traditional and online retail settings.

Effective quality signals can come in different forms; they can be more attitude-based (product rating), based on consumer behavior (top seller), or can come from authority. The effects of these different quality signals are academically unknown in terms of fish (food) selection. The current research compared different quality signals against each other and specifically addressed the effects of quality signals stemming from other consumers as credible information working on choice behavior, both in terms of peers opinions (product ratings) and in terms of peers behavior (announcing the best-selling product in the category). We also tested and compared an authority signal coming from the store (the store's

recommended choice). We discussed the limited literature on the effectiveness of quality signals on food choices, but the current research shows that it is possible to use quality signals, both stemming from other consumers as well as authority signals, to assist a more sustainable food consumption.

Study 1 and 2 were conjoint experiments where the effects of quality signals were tested against traditional salient attributes used by consumers when selecting fish. The results show that quality signals were among the most important value adding attributes for fish purchasing, both in physical retailing and e-tailing settings. We tested their effectiveness in an actual retail store (Study 3) and show that the use of quality signals in grocery retailing can increase sales of fish considerably, adding to the seafood value chain and contributing to sustainable food consumption.

Study 1 showed that quality signals from other consumers (product rating) had the highest importance score and effects on consumer utility in an online buying setting when compared to traditional attributes. Study 2 again confirmed the prominence of quality signals from consumers by extending the research over to brick and mortar retailing and top selling items. The results from the conjoint experiments (Study 1 and 2) show that the value altering effects in the conjoint experiments stemming from quality signals were stronger when the signal came from other consumers compared to authority signals from the store. The third study followed with an in-store experiment, conducted over a period of six weeks, on the sales of fresh cod fillets, but also on fresh ground beef as a comparison. This showed that both types of signaling can increase sales for both food items, with overall 41.5% increase for fish in our study.

There is a divergence in the results across the studies concerning the impact of the 'Store's choice' tag that can be related to some methodological issues. Study 1 shows the prominence of product rating as an attribute, but an item signage either stating 'top seller', 'store's choice or 'no signage' is not deemed important compared to other attributes (although 'Top seller' is deemed to be the level with the highest consumer utility). In retrospect, we should probably have considered splitting the 'item signage' attribute into two as 'Top seller' and 'Store's choice' instead of presenting it as one attribute in the conjoint design. This would have enabled us to disentangle the effects of the 'Store's choice' from that of the 'Top seller', and provided more plausible results to determine its effectiveness in driving consumers' preferences. This interpretation is further strengthened when looking at the results from the in-store experiment (Study 3), where we test both 'top seller' as well as 'store's choice' in isolation. Both interventions reveal considerable sales increases for both

fish and beef, where sales from the authority based signal were higher. As discussed in the section on limitations, it is possible that consumers in the experimental store were buying more of the recommended fresh fish fillets compared to the conjoint experiments, due to differences in such intermediaries as store attachment, age, product knowledge etc. The current research has focused on the main effects but future studies could aim to identify significant intermediaries on the effectiveness of quality signals on food choices.

The results presented here have significant implications for the whole seafood value chain, especially grocery retailers. They extend the literature on economic signaling theory and sustainable food consumption and should stimulate future research.

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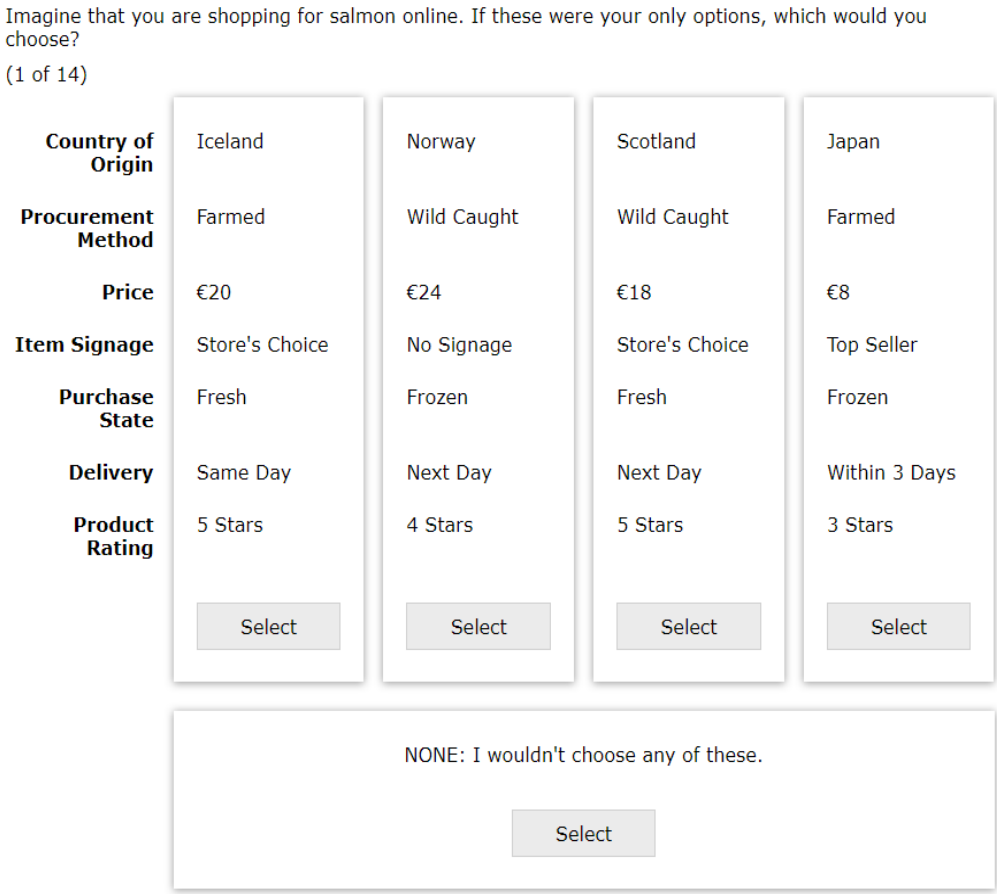
Table 1: Attributes and levels used in the choice-based conjoint analysis design.

Attribute name	Attribute description	Levels	Examples of references
Country of origin	Indicates the geographical origin of the fish product. Evidence shows that consumers use it to evaluate the quality and food safety risks of fish products.	Norway Scotland Alaska Japan Iceland	Uchida et al. (2014) Risius et al. (2017) Rickertsen et al. (2017)
Procurement method	Indicates fish production sources. Research shows the relevance of this attribute as an increasing number of consumers are interested in knowing how the fish is produced. Consumers tend to judge the taste of the fish products using this attribute. Consumers are increasingly interested in sustainability and ethical issues	Wild Caught Farmed	Verbeke, Vanhonacker, Sioen, Camp, & Henauw (2007) Davidson et al. (2012) Nguyen et al., (2015) Rickertsen et al. (2017)
Purchase state	Represents the storage conditions of the fish product when it is purchased. Consumers use this attribute to evaluate the intrinsic quality, healthiness, nutritional value, naturalness, and food safety nature of the product.	Fresh Frozen	Brunsø et al. (2009) Risius et al. (2017) Carlucci et al. (2015)
Delivery time	Represents the time length between order placement and order delivery. It has been associated with consumers' online shopping experience.	Same day Next day Within 3 days	Schaupp & Belanger (2005) Chen et al. (2010) Sigurdsson et al. (2017) Nguyen et al. (in press)
Product rating	Indicates how other consumers rated the fish product online and signals their overall level of satisfaction with the product. Consumers who have information constraint can use such product ratings as an indicator of other customers' preferences.	3 stars 4 stars 5 stars	Cheung et al. (2003) Decker & Trusov (2010) Sigurdsson et al. (2017)
Item signage	Indicates whether the product is announced as Top seller, Store's choice, or not. It signals peer consumer purchase of the fish product or store's recommendation or none of these.	Top seller Store's choice No signage	Goldsmith et al. (2000) Cheung et al. (2014)
Price	Represents the cost of a kg of salmon product in Euros.	€18, €24, and €30 for wild salmon, and €8, €14, and €20 for farmed salmon.	Verbeke & Vackier (2005) Claret et al. (2012)

Figure 1: Example of a choice-based conjoint question in an ecommerce setting.



Imagine that you are shopping for salmon online. If these were your only options, which would you choose?

(1 of 14)

Country of Origin	Iceland	Norway	Scotland	Japan
Procurement Method	Farmed	Wild Caught	Wild Caught	Farmed
Price	€20	€24	€18	€8
Item Signage	Store's Choice	No Signage	Store's Choice	Top Seller
Purchase State	Fresh	Frozen	Fresh	Frozen
Delivery	Same Day	Next Day	Next Day	Within 3 Days
Product Rating	5 Stars	4 Stars	5 Stars	3 Stars
	Select	Select	Select	Select

NONE: I wouldn't choose any of these.

Select

Table 2: Conjoint utility estimates and attribute importance scores in an ecommerce setting.

Attribute	Levels	Utility Estimates	Importance Score (%)	Lower 95% CI	Upper 95% CI
Country of Origin	Alaska	29.04	15.93	14.98	16.89
	Iceland	3.47			
	Norway	0.61			
	Scotland	-4.48			
	Japan	-28.63			
Procurement Method	Wild Caught	5.31	17.9	16.73	19.07
	Farmed	-5.31			
Price	Low	42.78	15.78	14.89	16.66
	Medium	4.3			
	High	-47.08			
Item signage	Top seller	6.6	5.57	5.22	5.92
	Store's choice	-0.25			
	No signage	-6.35			
Purchase state	Fresh	26.09	9.34	8.66	10.02
	Frozen	-26.09			
Delivery	Same day	21.83	11.21	10.49	11.93
	Next day	8.96			
	Within 3 days	-30.79			
Product rating	5 Stars	65.1	24.27	23	25.54
	4 Stars	14.14			
	3 Stars	-79.24			
None of these		-163.08			

Table 3: Attributes and their levels for the conjoint analysis in a traditional physical store.

Attribute name	Attribute description	Levels	Examples of reference
Type of fish	Indicates the type of the fish species from which the product is derived. Consumers evaluate different fish species differently due to, among others, unique intrinsic value associated with certain species.	Salmon Haddock Cod	Davidson et al. (2012) Rickertsen et al. (2017) Nguyen et al. (2015)
Item signage	Indicates whether the product is announced as Top seller, Store's choice, or not. It signals peer consumer purchase of the fish product or store's recommendation or none of these.	NA Top seller Store's choice	Same as Study 1
Purchase state	Represents the storage conditions of the fish product when it is purchased. Consumers use this attribute to evaluate the intrinsic quality, healthiness, nutritional value, naturalness, and food safety nature of the product.	Frozen Fresh	Same as Study 1
Days until expiration	Indicates the number of days until the fish product expires. There is evidence indicating that consumers use the information on expiry date to inspect the quality of fish products.	1 2 3 4	Verbeke et al. (2007) Pieniak, Verbeke, Scholderer, Brunsø, & Olsen (2007)
Price	Represents the cost of a kg of salmon product in the Icelandic currency (Króna).	1898 [~€13.7] 2298 [~€16.6] 2598 [~€18.7]	Same as Study 1

Table 4: Conjoint utility estimates and attribute importance score in a traditional physical store.

Attribute	Levels	Utility estimate	Standard error	Importance score
Type of fish	Salmon	3.01	0.66	19.05
	Cod	1.27		
	Haddock	-4.28		
Item signage	Top seller	28.47	0.70	23
	N/A	2.77		
	Store's choice	-31.24		
Purchase state	Fresh	3.41	0.66	14.64
	Frozen	-3.41		
Days until expiration	1	19.67	0.65	23.72
	2	-4.51		
	3	-15.16		
Price	1898	14.09	0.75	19.59
	2298	-4.66		
	2598	-9.45		
None of these		-46.63		

Table 5: Mean, standard deviations and effect sizes for baseline and item signage for fish and beef.

	Mean (SD)		
Food item	Baseline	Item signage	Effect size (d)
Fresh fish fillet	3.83 (2.72)	5.42 (3.45)	0.51
Fresh ground beef	21.15 (13.11)	27.47 (8.97)	0.56