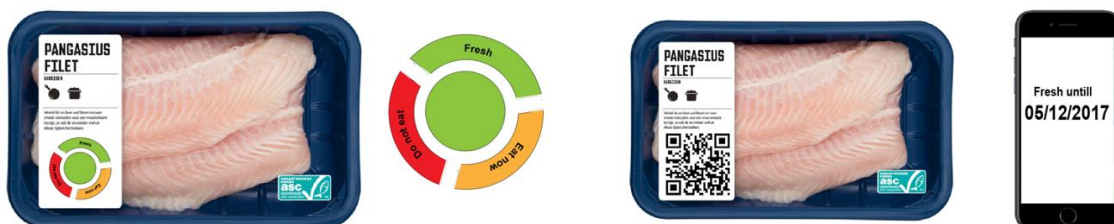


Bachelor Thesis
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Consumer Acceptance of Directly Visible and Digital Dynamic Shelf Life Indicators

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Abstract

Approximately 40% of all food wastage in Europe occurs at the consumers' side. Contemporary date labelling systems are one of the causes of food wastage at the consumer level, as they cause confusion at the consumers' side and often contain considerable margins in the shelf life date.

Dynamic shelf life indicators, which are a form of intelligent packaging might be able to reduce food wastage, as they offer real-time information about the quality of food products.

The aim of this study is to explore consumer acceptance of directly visible and digital dynamic shelf life indicators and to determine in which institution (the government, food manufacturers or food retailers) consumer trust is highest in relation to the development and regulation of dynamic shelf life indicators. A computer-based consumer questionnaire was used to determine the consumer acceptance of dynamic shelf life indicators and the consumer trust in institutions. The results show a higher consumer acceptance in directly visible dynamic shelf life indicators compared to digital dynamic shelf life indicators. Moreover, consumer trust in food manufacturers is higher than consumer trust in the government and food retailers. Therefore, it can be concluded that consumer acceptance of dynamic shelf life indicators is highest when the dynamic shelf life indicators are represented directly visible on labels and introduced by food manufacturers.

Preface

This bachelor thesis is written as part of the bachelor programme Food Technology at Wageningen University and Research. As a Food Technology student, I obviously have an interest in all things regarding the technology behind the development of food products. However, I also have a great interest in the consumers' side regarding the development of food products. Therefore, I have chosen to combine both my interests in the subject of my bachelor thesis: "Consumer acceptance in directly visible and digital dynamic shelf life indicators".

First, I would like to give special thanks to my supervisor Bea Steenbekkers. Bea has supported me extremely well during my entire thesis period. She always provided useful insights, feedback and recommendations for my bachelor thesis. Moreover, she helped me a lot in the switch in developing a "consumer mind set", instead of always thinking like a "technologist".

Also, I would like to thank my second supervisor Jenneke Heising. Although we did not have a lot of contact, she was always open for answering my questions regarding intelligent packaging and has offered me great insights regarding this subject.

It was a pleasure to complete this bachelor thesis. However, there were also some difficult moments that I encountered. From the entire process of writing my bachelor thesis I learned that sometimes I have to satisfy and make assumptions and that this is alright to do so. Moreover, throughout the process I have learned that I should have confidence in my opinions and decisions and not let one objection cause me to immediately change my mind. These are all points that I will definitely take into account in the future.

I hope you enjoy reading my bachelor thesis,

Jasmine Yeung

Wageningen, January 2018

Table of contents

Abstract	iii
Preface	iv
1 Introduction	1
1.1 Problem definition	2
1.2 Aim of this research	3
2 Theoretical background	4
2.1 Date labelling as a cause of food waste	4
2.2 Intelligent packaging and dynamic shelf life indicators	4
2.3 The provision of good quality information	6
2.4 Consumer acceptance of the two types of dynamic shelf life indicators	6
2.4.1 Conceptual model to study consumer acceptance	7
2.5 Perceived risk of dynamic shelf life indicators	8
2.6 Perceived visual attractiveness of dynamic shelf life indicators	9
2.7 Consumer trust in institutions	10
2.8 Moderating effects on consumer acceptance of dynamic shelf life indicators	12
2.8.1 Previous knowledge	12
2.8.2 Uncertainty avoidance	12
2.8.3 Technophobia	12
3 Methodology	14
3.1 Research demarcation	14
3.2 Research method	14
3.3 Research population	15
3.4 Research design	15
3.5 Data collection	16
3.5.1 Stimulus material	16
3.5.2 Measures	18
3.5.3 Procedure of the data collection	20
3.6 Data analysis	21
4 Results	22
4.1 Randomisation check for gender and age	22
4.1.1 Randomisation check for gender	22
4.1.2 Randomisation check for age	22
4.2 Moderating effects	22
4.2.1 Previous knowledge of the term "intelligent packaging"	22
4.2.2 Previous knowledge of the term "dynamic shelf life indicator"	23
4.2.3 Uncertainty avoidance	24
4.2.4 Technophobia	24
4.3 Consumer acceptance of the two types of dynamic shelf life indicators	25
4.3.1 Perceived visual attractiveness	25
4.3.2 Perceived usefulness	25
4.3.3 Perceived ease of use	26
4.3.4 Perceived risk	26
4.3.5 Consumer acceptance	26
4.3.6 Summary of the results of consumer acceptance	27
4.4 Consumer trust in the different institutions	28
4.4.1 Comparing consumer trust between the two conditions	28
4.4.2 Comparing consumer trust between the different institutions	29
4.4.3 Correlation matrix	30

4.5 Visual design of dynamic shelf life indicators-----	31
4.5.1 Visual design of the directly visible dynamic shelf life indicator -----	31
4.5.2 Visual design of the digital dynamic shelf life indicator -----	31
4.6 Willingness to receive extra information regarding a food product-----	32
5 Discussion of the results -----	33
5.1 Normality of the data -----	33
5.2 Moderating effects -----	33
5.3 Consumer acceptance of the two types of dynamic shelf life indicators -----	34
5.4 Consumer trust in the different institutions -----	35
5.5 Visual design of the dynamic shelf life indicator -----	36
5.6 Willingness to obtain extra information regarding a food product -----	37
6 Conclusion-----	39
7 Limitations and recommendations -----	40
7.1 Methodological limitations and further research -----	40
7.1.1 Significantly more respondents with previous knowledge of the term "dynamic shelf life indicator" in the directly visible condition -----	40
7.1.2 Research sample does not fully represent the research population-----	41
7.1.3 Participants mainly related to Wageningen University -----	42
7.1.4 Limitations of the research method-----	42
7.2 Theoretical contributions and suggestions for further research-----	42
References -----	44
Appendix 1: System Usability Scale (SUS) -----	49
Appendix 2: Consumer questionnaire of dynamic shelf life indicators, directly visible representation, in English-----	50
Appendix 3: Consumer questionnaire of dynamic shelf life indicators, digital representation, in English-----	60
Appendix 4: Consumer questionnaire of dynamic shelf life indicators, directly visible representation, in Dutch -----	72
Appendix 5: Consumer questionnaire of dynamic shelf life indicators, digital representation, in Dutch -----	82
Appendix 6: Scale reliability of the different constructs -----	94
Appendix 7: Normality test results (Shapiro-Wilk) -----	95

1 Introduction

Globally, about 1.3 billion tons of the food produced for human consumption is lost or wasted each year. This corresponds to roughly 1/3 of all food that is produced. This huge amount of food wastage means that the resources that were used for the food production were used in vain and that greenhouse gas emissions due to food production were also emitted in vain (Food and Agricultural Organisation, 2011). Moreover, food wastage increases the carbon footprint, blue water footprint and causes unnecessary occupation of land (Food and Agricultural Organisation, 2013). Since sustainability is a large global issue nowadays, it is desired to reduce food wastage as much as possible.

In Europe, approximately 40% of the food wastage occurs at the consumer level (European Commission, 2010). There are various causes for food wastage at the consumer level. Research suggests that decreased pricing for large units and price promotions for multi-item offers encourage the purchase of larger and more units, thus potentially contributing to over-purchasing and subsequently contributing to food waste. Moreover, lack of information on correct storage and bad product and package design in terms of portioning and storage are also causes of food waste (Aschemann-Witzel et al., 2016).

Previous research has also shown that food waste occurs due to date label confusion at the consumers' side, 20% of consumer food waste occurs because of date label confusion (Leib et al., 2016). Also, the THT labelling date often contains considerable margins to capture deviations from optimal handling in the food supply chain (Schut, 2013) and sometimes it is even done intentionally by food manufacturers to give the product a fresher impression (Soethoudt et al., 2012). Research has shown that 84% of consumers occasionally throw away food products after the THT date, even though the food products might still be of acceptable quality (Leib et al., 2016). Also, when buying products in stores, consumers often choose the product with the longest freshness date, causing the food products with the shortest shelf life dates to remain on the shelves and at a later stage to be discarded (Soethoudt et al., 2012; Tsiros & Heilman, 2005).

Less than half of the consumers understand the definition of the THT and TGT date (respectively 47% and 40%). This results in misunderstandings at the consumers' side, which might lead to uninformed decisions and potential risks that come with a lack of information or a lack of clarity (Hall-Phillips & Shah, 2017). Previous research has shown that confusion is linked to several adverse effects, such as dissatisfaction (Foxall, 1993), negative word of mouth (Turnbull et al., 2000) and reduced loyalty and trust (Foxman et al., 1990; Foxman et al., 1992).

Another issue with the current freshness labelling system is that the THT and TGT dates are static indicators, causing the freshness indication not to be accurate anymore if changes occur in environmental conditions in the supply chain.

Dynamic shelf life indicators, which are a form of intelligent packaging, might be a solution for these issues. Intelligent packaging materials are able to monitor the condition of a packaged food product or the environment surrounding the food product (European Commission, 2004).

A dynamic shelf life indicator offers real-time information on the quality of the food product by monitoring and communicating certain compounds or environmental conditions. This enables accurate shelf life indications and might reduce confusion amongst consumers (Silvestre et al., 2011), reduce date margins and thereby reduce food waste. Using a dynamic shelf life indicator is a trade-off between the potential in waste reduction and the food safety of the product (Soethoudt et al., 2012). Moreover, dynamic shelf life indicators can give consumers an increased feeling of empowerment, in the sense of consumers feeling more confident and satisfied in making their own decisions regarding the shelf life of food products (Kickbusch & Nutbeam, 1998).

1.1 Problem definition

Research has shown that 65% of consumers believe that scepticism of consumers towards solutions such as intelligent packaging might be a reason for discouraging consumers' choice for intelligent packaging (Barska & Wyrwa, 2016). This issue of scepticism of dynamic shelf life indicators could be dealt with by taking into account the consumers' viewpoint regarding dynamic shelf life indicators.

Previous research has shown that receiving information from dynamic shelf life indicators by a digital device, such as a mobile phone, is overall less wanted by consumers than dynamic shelf life indicators which directly communicate to consumers. However, this research also shows that consumers felt that a digital dynamic shelf life indicator offered more advantages compared to the directly visible dynamic shelf life indicator (Köster, 2017).

This previous study was only exploratory and qualitative in nature and focused on overall consumer perception of intelligent packaging. To our knowledge, no quantitative research that focuses specifically on consumer acceptance of directly visible and digital dynamic shelf life indicators has been done. By obtaining quantitative information on whether dynamic shelf life indicators should be directly visible on labels or digitally represented, an optimal version of a dynamic shelf life indicator from the consumers' viewpoint can be developed. This in turn might decrease consumer scepticism and increases the chance for successful implementation of dynamic shelf life indicators.

Previous research has also shown that consumers feel that dynamic shelf life indicators should be initiated and supported by a well-known and reliable institution (Köster, 2017). Consumer trust enables more favourable expectations of outcomes and thereby a more positive attitude (Saba & Messina, 2003). Therefore, in order for dynamic shelf life indicators to be successful it is also important to determine in which institution (the government, food manufacturers or food retailers) consumer trust is highest regarding the development and regulation of dynamic shelf life indicators, as the institution with the highest consumer trust should be the one introducing the dynamic shelf life indicators.

1.2 Aim of this research

The aim of this research is to explore the consumer acceptance of directly visible and digital dynamic shelf life indicators and to explore whether the consumer acceptance is different between the two types of representations. Moreover, the aim of the research is to determine in which of the following institutions (the government, food manufacturers or food retailers) consumer trust is highest regarding the development and regulation of dynamic shelf life indicators. This is approached by answering the following main research question and five sub research questions.

Main research question:

What is the consumer acceptance of directly visible and digital dynamic shelf life indicators?

Sub research questions:

1. Which variables influence the consumer acceptance of dynamic shelf life indicators?
2. What is the consumer acceptance of directly visible dynamic shelf life indicators?
3. What is the consumer acceptance of digital dynamic shelf life indicators?
4. Which variables influence the consumer trust in an institution regarding the development and regulation of dynamic shelf life indicators?
5. What is the level of consumer trust in the government, food manufacturers and food retailers regarding the development and regulation of dynamic shelf life indicators, and in which institution is consumer trust the highest?

2 Theoretical background

2.1 Date labelling as a cause of food waste

In the Netherlands, two different freshness labelling systems are used for pre-packed food products, which are the "ten minste houdbaar tot" (THT) labelling system and the "te gebruiken tot" (TGT) labelling system. The THT date is the date until which the manufacturer or seller guarantees the optimal quality of the food product and gives an indication about the quality of the food product (NVWA, 2017). The TGT date indicates the latest date at which a food product can still be consumed safely and is used for highly perishable foods, like fresh meat, fish, poultry and fresh-cut vegetables (NVWA, 2017). After the TGT date a food product is considered unsafe for human consumption. It is often believed that "unsafe" for human consumption means that it is bad for human health. This is however not always the case. Article 4 of regulation (EU) 1169/2011, Article 14 EU regulation 178/2002 states that a product can also be considered "unsafe" if it is unsuitable for human consumption, for example due to microbial spoilage or physiological quality loss (ageing). This is the case for fresh-cut vegetables, as the TGT date for this product is closer to a quality than a safety indicator. The manufacturer of the food product decides which type of freshness labelling system to use and what date to put on the freshness label (Soethoudt et al., 2012).

Previous research has shown that in Europe, 40% of the food waste occurs at the consumer level (European commission, 2010), out of which 20% of the consumer food waste occurs because of date label confusion (Leib et al., 2016). Food waste due to date labelling may be caused by various reasons. One reason is that the THT labelling date often contains considerable margins to capture deviations from optimal handling in the food supply chain (Schut, 2013) and sometimes it is even done intentionally by food manufacturers to give the product a fresher impression (Soethoudt et al., 2012). Previous research has also shown that 84% of consumers occasionally throw away food products after the THT date, even though the food product might still be of acceptable quality (Leib et al., 2016). Also, when buying products in stores, consumers often choose food products with the longest freshness date, causing the food products with the shortest shelf-life dates to remain on the shelves and at a later stage be discarded (Soethoudt et al., 2012; Tsiros & Heilman, 2005).

2.2 Intelligent packaging and dynamic shelf life indicators

Intelligent packaging is "a packaging system that is capable of carrying out intelligent functions (like detecting, sensing, recording, tracing, communicating and applying scientific logic) to facilitate decision-making, to extend shelf life, enhance safety, improve quality, provide information and warn about possible problems" (Yam et al., 2005, p2).

There are two different types of intelligent packaging which are used to monitor the quality of food products. The first type is called an indirect measurer and it measures environmental conditions, which influence the rate of reactions of the quality attributes in a food product. To use this type of measurer, it is important that the initial quality of the food product is constant and known. The second type is

called a direct measurer and measures quality attributes or quality indicator compounds of the food product itself. This type of measurement is more complex, as the compound(s) determining the final quality of the food product have to be determined first. Direct measures are used for food products of which the initial quality is unknown or highly variable (Heising et al., 2014).

Intelligent packaging has many benefits. First of all, it makes it possible to estimate quality attributes which are difficult to estimate for consumers or retailers (Dainelli et al., 2008). Therefore, it is possible to offer real-time information about the quality of food products to all actors in the food supply chain, such as wholesalers, retailers and consumers. It also offers the possibility to take logistic actions which are based on the shelf life that is indicated dynamically, making it possible to reduce food waste this way (Heising et al., 2014).

Intelligent packaging is profitable for food companies when the income from increased sales or reduced wastage of food products is higher than the increased cost of the package. So, the price and the expected shelf-life of a food product are the most important criteria for applying intelligent packaging. The food products that take the most advantage from intelligent packaging are foods that are expensive and highly perishable (Heising et al., 2014). To be successful on the market it is important that it is shown to the consumer how intelligent packaging can extend the time that a food product is still of good quality. This can be done by raising awareness about how intelligent packaging works or by conducting an intensive promotion via different channels of the media (Barska & Wyrwa, 2016).

Dynamic shelf life indicators are a form of intelligent packaging and can be represented in two different ways. The first way is by representing the dynamic shelf life indicators directly visible on labels, so that they are directly visible at food packages without the need of another device. The other possibility is to represent the dynamic shelf life indicators digitally, meaning that a QR-code is to be found at food packages, which should be scanned with a device and then the shelf life of the food product is present on the screen of the device. As compared to dynamic shelf life indicators which are represented directly visible on labels, the digitally represented shelf life indicators contain much more benefits and application possibilities (Köster, 2017). When using a digital dynamic shelf life indicator, it is possible to communicate the shelf life in precise numbers which also adjusts to changing environmental conditions. This is not possible for the dynamic shelf life indicators directly visible on labels, as only a colour change is then possible. Another benefit is that the shelf life information of the food products is always available for the consumer, as long as the consumer carries the device. For example, when consumers go grocery shopping, it is possible for them to look up the shelf life of food products stored in their home, as the device is able to save all information about the shelf life of the food products. Also, there is a possibility for the consumer to receive additional information regarding a food product. For example, additional information regarding the microbial profile, temperature profile and storage conditions of a food product.

2.3 The provision of good quality information

Previous research has shown that consumers perceive a higher quality and a higher acceptance of food products when dynamic shelf life indicators are used compared to static shelf life indicators (Schut, 2013). Moreover, research has shown that consumers are willing to pay more for extra quality information on food products (Fortin et al., 2009; Latvala & Kola, 2004). As most quality properties of food products are considered to be credence characteristics, since consumers are not able to infer their quality before purchase and sometimes not even after purchase (Caswell & Mojduszka, 1996; Darby & Karni, 1973), dynamic shelf life indicators could be seen as a method of providing additional information not only by a shelf life date, but also by informing the consumers about the real-time product quality. The information provided by dynamic shelf life indicators should however not be amplified, biased, factual or proven wrong, as this destroys trust (Frewer et al., 1996) and the information provided by the dynamic shelf life indicators should meet the needs of the consumers.

It is often assumed that individuals are fully aware of all the options open to them, and that individuals are capable of weighting all the pros and cons of all the information they come into contact with. This is however not the case as it is impossible for individuals to collect, save and process all the information that is available (Simon, 1979), because individuals have limited cognitive capabilities. Some of the information provided to a consumer is of no interest for him or her because it does not correspond to the needs of the consumer. The other downfall of the unwanted type of information is that consumers have to spend more energy and time shifting through all available information in order to find the desired information. Over-information thus is a cost for consumers and therefore the dynamic shelf life indicator should communicate good quality information (Césaire & Salaün, 1995; Salaün & Flores, 2001).

2.4 Consumer acceptance of the two types of dynamic shelf life indicators

The consumer acceptance of the two different types of dynamic shelf life indicators was investigated using an extended version of the Technology Acceptance Model of Davis (1985). The original Technology Acceptance Model is shown in figure 1. The Technology Acceptance Model states that there are two major determinants influencing the attitude towards using the proposed technology, which in our case are dynamic shelf life indicators. These two major determinants are perceived usefulness and perceived ease of use. Perceived usefulness is defined as "the degree to which an individual believes that using a particular system would enhance his or her performance of a certain job" (Davis, 1985, p26). Perceived ease of use is defined as "the degree to which an individual believes that using a particular system would be free of physical or mental effort" (Davis, 1985, p26). The research shows that perceived ease of use has a significant effect on the perceived usefulness, as a technology system which is perceived as easier to use will result in increased performance (for example greater usefulness) for the individual (Davis, 1985).

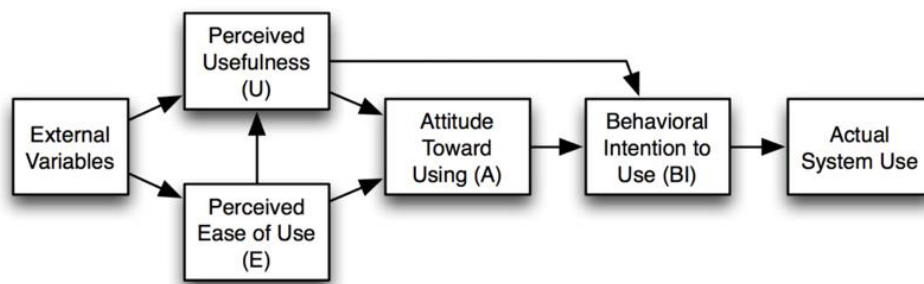


Figure 1 The Technology Acceptance Model (Source: Davis, 1985).

Previous research consistently showed that there is a high correlation between intention of use and actual system use (Szajna, 1996) and that the intention to behave is the main factor determining actual behaviour (Van der Heijden, 2003).

So, perceived usefulness and perceived ease of use both influence the attitude towards usage of the proposed technology, which in turn influences the behavioural intention to use and the actual use of the proposed technology by consumers. In this thesis, consumer acceptance is defined as the intention of actual system use of the proposed technology (behavioural intention to use), so that consumers have the intention to buy and use products containing the dynamic shelf life indicators when offered in stores.

Design features have a direct influence on the perceived usefulness and perceived ease of use (Davis, 1985). The design features are external variables and do not directly influence consumer acceptance. They only affect consumer acceptance indirectly through the perceived usefulness and perceived ease of use (Davis, 1985).

2.4.1 Conceptual model to study consumer acceptance

In order to answer the main research question, a conceptual model was created to study the expected relationships between the variables that influence consumer acceptance. The conceptual model is an extended version of the Technology Acceptance Model of Davis (1985) from figure 1, with the variables perceived risk, perceived visual attractiveness and consumer trust included. These variables were included as previous research shows that next to design features, these other factors also play an important role in the consumer acceptance of a new technology (Pavlou, 2003; Van der Heijden, 2003). The factors perceived visual attractiveness and consumer trust influence consumer acceptance indirectly, through the perceived usefulness and perceived ease of use. The perceived risk directly influences attitude towards use, and with that actual system use and consumer acceptance (Pavlou, 2003; Van der Heijden, 2003). Moreover, three moderating effects are expected to have an influence on the consumer acceptance of dynamic shelf life indicators, which are previous knowledge, uncertainty avoidance and technophobia (Oglethorpe & Monroe, 1987; Ronteltap et al., 2007; Schut, 2013). In figure 2 the conceptual model to study consumer acceptance is shown.

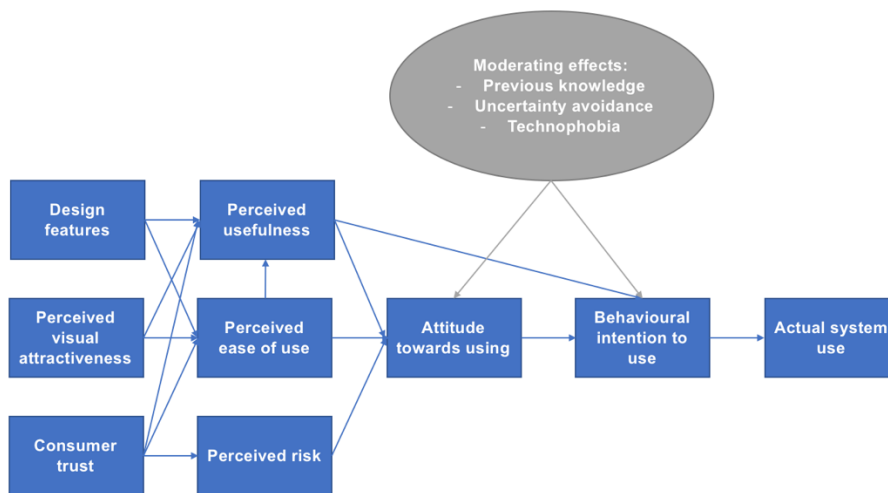


Figure 2: Conceptual model to study consumer acceptance, including design features, perceived visual attractiveness, consumer trust, perceived risk, perceived usefulness, perceived ease of use and the moderating effects, which all influence the attitude towards using, behavioural intention to use and with that actual system use of dynamic shelf life indicators.

2.5 Perceived risk of dynamic shelf life indicators

Perceived risk plays a central role in the perception of consumers in their evaluations, choices and behaviours (Dowling, 1999) and in the acceptance of new food technologies (Ronteltap et al., 2007; Siegrist, 2008). Perceived risk is often defined in terms of uncertainty and negative consequences. There is a positive relation between perceived risk and uncertainty, so that perceived risk increases with higher levels of uncertainty. The relation between perceived risk and negative consequences is also positive, as perceived risk increases with a higher chance of negative consequences (Oglethorpe & Monroe, 1987). Previous research has shown that perceived risk leads to wariness or risk aversion, which in turn lead to a variety of risk-handling activities (Bettman 1973; Dowling, 1999). Moreover, research has also found that perceived risk influences a variety of consumer behaviours, amongst others new product adoption (Erdem, 1998). Thus, perceived risk is expected to influence the consumer acceptance of dynamic shelf life indicators.

Perceived risk can be driven by two different factors, it can be technology-driven or relational-driven. Technology-driven risk is derived from the underlying infrastructure of the technology and relational-driven risk is a result from the organisational partner (Ring & Van de Ven, 1994). In this thesis, the technology-driven risk is considered and the relational-driven risk is not. The reason for this is that the relational aspect of the notion of trust, which in turn influences perceived risk (Pavlou, 2003), is already explored by studying consumer trust in the different organisational partners (the government, food manufacturers and food retailers), while this is not the case for the technology-driven aspect of risk.

2.6 Perceived visual attractiveness of dynamic shelf life indicators

The perceived visual attractiveness is defined as the degree to which a person believes that something is aesthetically pleasing to the eye (Van der Heijden, 2003).

Previous research has found that visual attractiveness plays an important role in new product development, marketing strategies and in the retail environment (Kotler & Rath, 1984; Russell & Pratt, 1980; Whitney, 1988). Also, it was found that visual attractiveness has a positive influence on the preference of an industrial product by consumers (Yamamoto & Lambert, 1994) and that visually more attractive presentations of a food product increases the liking of the flavour of the food product (Zellner et al., 2014). Therefore, it is assumed that the perceived visual attractiveness also plays a role in the decision to use (or not to use) a dynamic shelf life indicator. This assumption is also based on previous research from the field of marketing, where it was found that positive perceived visual appearance reactions are likely to carry over to actual purchase behaviour (Veryzer & Hutchinson, 1998). "The physical form or design of a product is an unquestioned determinant of its marketplace success" (Bloch, 1995, p.16). Also, individuals assume that if a new technology is perceived as visually more attractive, it will be easier to use (Tractinsky et al., 2000).

Based on the findings of these previous researches, it is assumed that consumers will associate the perceived visual attractiveness of a dynamic shelf life indicator with perceived usefulness and perceived ease of use. So that there is a positive relationship between these factors. The perceived visual attractiveness of a dynamic shelf life indicator refers to the attractiveness of its design features and influences the final acceptance of dynamic shelf life indicators indirectly, through the perceived usefulness and perceived ease of use (Van der Heijden, 2003).

The visual attractiveness can be divided into two types of aesthetics. The classical aesthetics represent classical notions of what constitutes visual attractive design (Johnson, 1994; Krufft 1994). Examples of terms defining classical aesthetics include clean, clear, pleasant and aesthetic (Lavie & Tractinsky, 2004). The expressive aesthetics correspond to the visual richness dimension (Nasar, 2016) and include the designer's character, the creativity and originality. Examples of terms defining expressive aesthetics are original, sophisticated, fascinating and creative (Lavie & Tractinsky, 2004).

2.7 Consumer trust in institutions

The definition of trust that is used in this thesis is the one proposed by Mayer et al. (1995, p712), which is "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party". In short, trust is frequently defined as a willingness to take risks (Johnson-George & Swap, 1982; Kee & Knox, 1970; Mayer et al., 1995; Williamson, 1993). Trust is dynamic and continuous and is warranted when the expected gain is higher than the expected risk (Williamson, 1993). Trust and distrust can exist at the same time (Lewicki et al., 1998). However, if a source of distrust exists, it might result in trust not fully developing (Fischer et al., 2007).

Trust is important because it is at some level a prerequisite for exchange (Luhmann, 1988). Previous research has shown that trust has a direct effect on the purchase intentions of consumers in multiple cultures (Jarvenpaa et al., 1999). Some researchers even argue that the notion of trust is the most important component in transactions between consumers and the market (Stewart et al., 2002). Trust is related to positive attitudes and is likely to influence the intention to transact favourably (Gefen, 1997; Jarvenpaa et al., 1999; Song & Zahedi, 2002). Also, trust reduces the uncertainty related to an institutions' actions when providing a new technology, which results in a perception of some control for consumers when they transact in an uncertain transaction (Pavlou, 2003).

Research showed that there is a positive effect of trust on the acceptance of gene technology by consumers (Rosati & Saba, 2000) and that trust can reduce the perceived risk on accepting gene technology (Siegrist, 2000). As this thesis focuses on another type of new technology, which also give consumers some feeling of perceived risk (Silvestre et al., 2011), consumer trust might in our case also have an effect on consumer acceptance of dynamic shelf life indicators.

Trust involves two different parties, namely the trustor and the trustee. The trustor is the trusting party, and the trustee is the party to be trusted (Mayer et al., 1995). Trust is influenced by one characteristic of the trustor and three characteristics of the trustee.

The characteristic of the trustor that influences trust is his or her propensity to trust. The propensity to trust is the "general willingness to trust others" (Mayer et al., 1995, p715). If the trustor's propensity to trust is higher, the trust for a trustee prior to any information available about the trustee is also higher (Mayer et al., 1995). The propensity to trust is influenced by amongst others personality type, developmental experiences, cultural background and other socioeconomic factors such as the education, age, income, religious affiliations and population density (Hofstede, 1980; Zerfu et al., 2008). Previous research has shown that income has a positive effect on trust (Glaeser et al., 2000; Johansson-Stenman et al., 2013; Karlan, 2005; Schechter, 2007). Studies have also shown that education has a positive effect on trust (Frewer et al., 1999; Lobb et al., 2007; Zerfu et al., 2008). However, one study gave contradictory results, that education shows negative effects on trust (Johansson-Stenman et al., 2013). Regarding the effect of age on trust, contradictory results were found (Huffman et al., 2004; Zerfu et al., 2009).

The three characteristics of the trustee that influence trust are driven by perception and are the perceived ability, perceived benevolence and perceived integrity of the trustee (Mayer et al., 1995). Perceived ability is "the group of skills, competencies and characteristics that enables a party to have influence within some specific domain" (Mayer et al., 1995, p717). Perceived benevolence is "the extent to which a trustee is believed to want to do good to the trustor, aside from an egocentric profit motive" (Mayer et al., 1995, p718). Perceived integrity is "the relationship between integrity and trust that involves the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable" (Mayer et al., 1995, p719). Perceived integrity is divided into two parts, namely personal integrity and moral integrity. Personal integrity involves the trustee to follow some set of principles and if that set of principles is considered as acceptable by the trustor, then moral integrity is also achieved. A lack in either the perceived ability, the perceived benevolence or the perceived integrity might already cause trust to be undermined (Mayer et al., 1995).

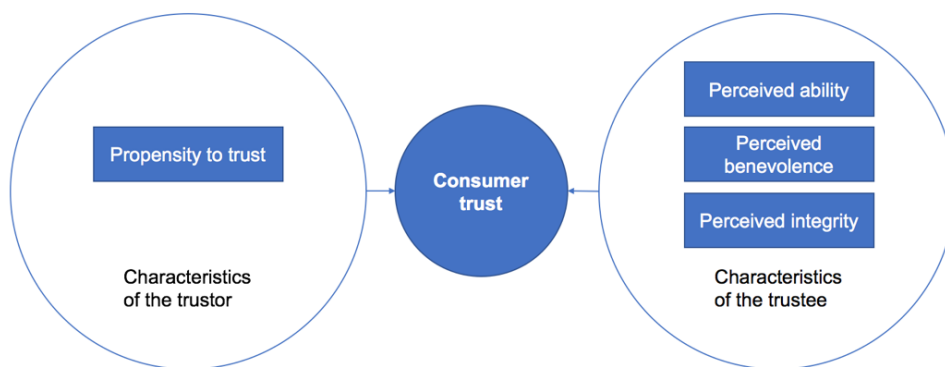


Figure 3: Model of consumer trust, derived from the research of Mayer et al. (1995), where consumer trust is influenced by one characteristic of the trustor (propensity to trust) and three characteristics of the trustee (perceived ability, perceived benevolence and perceived integrity)

Trust in institutions is defined here as the belief that consumers are willing to become vulnerable to the institution providing the dynamic shelf life indicators after taking the characteristics of the institution into account. The choice to study trust in the institution providing the dynamic shelf life indicators, instead of trust in the indicators themselves is based on the argument that consumer trust perceptions are influenced by the institutions providing the indicators, as it was found that consumers' confidence in institutions significantly and positively affected trust (Johansson-Stenman et al., 2003).

There are however differences in the general trust in institutions. Most consumers trust the public sector or institutions owned by the government more than the private sector (Kikulwe et al., 2011). However, compared to public authorities, trust in consumer organisations, doctors and scientists is even higher regarding food risks (Eurobarometer, 2006). Contradictory, research also suggests that expert messages from food authorities and government are not trusted by consumers in the United Kingdom and Europe (Coombes, 2005; Poppe & Kjaernes, 2003).

2.8 Moderating effects on consumer acceptance of dynamic shelf life indicators

There are three moderating effects that are expected to have an influence on the consumer acceptance of dynamic shelf life indicators, which are previous knowledge, uncertainty avoidance and technophobia.

2.8.1 Previous knowledge

Research has shown that the knowledge level has an influence on consumers' behaviour towards technology (Ronteltap et al., 2007). On the one hand, having more knowledge and expertise increases the risk perception of consumers for many different kinds of hazards, which in turn has a negative relation with consumer acceptance (Bouyer et al., 2001; Ronteltap et al., 2007). On the other hand, having previous knowledge could also have a positive effect on the attitude towards a certain type of technology, which for example is the case for gene technology (Siegrist, 1998; Verdurme & Viaene, 2001) and irradiation (Savadori et al., 2004). Moreover, research shows that a lack of knowledge at the consumers' side leads to scepticism regarding technological innovations (Wynne, 1991).

2.8.2 Uncertainty avoidance

Uncertainty avoidance is the extent to which individuals feel threatened by situations which are not clear and are undecided and then create beliefs to try to avoid these situations (Erdem et al., 2006). Uncertainty can be caused when individuals feel that situations are ambiguous, complex and unpredictable (Ronteltap et al., 2007). Uncertainty avoidance could lead to a lower consumer acceptance of dynamic shelf life indicators, as uncertainty avoidance has a positive relation with perceived risk (Oglethorpe & Monroe, 1987), which in turn has a negative relation with consumer acceptance. Consumers which are uncertainty avoidant will tend to stay with the current shelf life labelling systems, as they do not want to take the risk of using something new, which in our case are the dynamic shelf life indicators (Schut, 2013). The tendency to stay with the current shelf life labelling systems was however not taken into account in this study, as the focus of this study is on the two types of dynamic shelf life indicators.

2.8.3 Technophobia

Technophobia is described as the feelings of aversion or anxiety towards technology and products that are related to technology (Sinkovics et al., 2002). An aversion of technology could lead to a lower consumer acceptance of dynamic shelf life indicators, as dynamic shelf life indicators are a new kind of food technology. However, one research has found that technophobia did not have a moderating effect on consumer acceptance of the food products that are provided with a dynamic shelf life indicator (Schut, 2013). Therefore, in this thesis the effect of technophobia is not focused on consumer

acceptance of the food product, but focused on the consumer acceptance of the dynamic shelf life indicator (the technology).

3 Methodology

In this chapter, the research methods that were used are discussed. This chapter includes information on the research demarcation, research method, research population, research design, data collection and data analysis. Given the nature of the study, it can be stated that this was a descriptive study. Descriptive studies are primarily concerned with finding out "what is" and to describe events (Knupfer & McLellan, 1996). A descriptive, quantitative research method was used to study the consumer acceptance of the different representations of dynamic shelf life indicators and the consumer trust in institutions. Moreover, the research was exploratory in nature, as it sought to generate information about both the direction and strength of the variables.

3.1 Research demarcation

For this consumer study, one research demarcation was set. It was chosen to study the consumer acceptance of the different types of dynamic shelf life indicators for the category of highly perishable food products. The reason for choosing the category of highly perishable foods was because these food products take the most advantage from intelligent packaging, especially if the consumers are not able to estimate their essential quality attributes (Heising et al., 2014). More specifically, fresh fish was chosen as this is a highly perishable food product with a high price per kilogram ratio and therefore will generate high income losses when the food product is wasted. Moreover, fresh fish has an initial quality that is highly variable and difficult to control and will therefore benefit a lot from dynamic shelf life indicators (Heising, 2014).

3.2 Research method

A quantitative research was conducted in order to determine the consumer acceptance of directly visible and digital dynamic shelf life indicators and the consumer trust in the different institutions. A quantitative research is especially effective in providing information regarding "what" and "how many". The reason for choosing a quantitative method was that it is time efficient, so that it was possible to collect a lot of data in a small timeframe (Koedam, 2015). As the aim of the research was to determine the consumer acceptance and consumer trust on a 7-point Likert scale, numerical data was needed, which is exactly what the focus of quantitative research is (Babbie, 2010; Muijs, 2010).

It was chosen to conduct a consumer questionnaire, which is a type of quantitative research, as the aim of the research was to study consumer acceptance and consumer trust, which are types of opinions, attitudes or preferences. When studying opinions, attitudes or preferences using a consumer questionnaire "it is possible to look for relations, significant differences or patterns" (Koedam, 2015, p7) between directly visible and digital dynamic shelf life indicators, which was very much desired in this research.

The questions regarding consumer acceptance and consumer trust were measured on a 7-point Likert scale. Previous research suggested the use of 5- to 7-point scales, as they enhanced reliability and

validity of the scale (Bloom et al., 2003; Lietz, 2010). The choice for a 7-point scale was because at lower levelled scales the neutral response option was chosen more often, whereas higher levelled scales were more likely to have an equal number of positive and negative options that were chosen (Matell & Jacoby, 1972). However, it should be taken into account that the more intervals the scale consisted of, the higher the chance that participants may not be able to process the meaning of the intervals, which could lead to a reduced reliability of the scale (Cook et al., 2001). A Likert-scale was used as Likert-categories were assumed to be very close to interval-level measurements (Blaikie's, 2003), which was the measurement level needed for doing most of the data analysis.

3.3 Research population

The research population that was chosen for this research consisted of Dutch individuals between the ages of 18-29 years. Research suggests that individuals at ages 18-29 are at a specific life stage called the emerging adulthood (Arnett et al., 2014).

One reason that this research population was chosen is that young professionals and young families are more often considered to be big generators of food waste. This can be explained as most young professionals and young families have poor home economics and food planning, resulting in impulsive decision-making and overbuying (Waste & Resources Action Programme, 2007). Also, millennials were more likely to view date labels as an indication of food safety and thus more likely to discard food products past their expiration date (Leib et al., 2016). Another reason that this research population was chosen is that younger adults frequently use a larger variety of technologies as compared to older adults. Moreover, as compared to older adults, younger adults are less selective and adopt a new technology faster (Olson et al., 2011).

In the survey, 191 respondents participated. Not completed questionnaires (36) and respondents outside the previously defined age range (8) were excluded from the data analysis. In total 148 respondents, 75 for the directly visible condition and 73 for the digital condition were used in the data analysis. The population consisted of 30 males, 117 females and 1 other, between the age range of 18 and 29 years ($M= 21.01$, $SD= 2.25$). Out of all the participants, 2.03% were colour-blind.

In table 1 an overview of the research population can be found.

Table 1: The research population, divided by gender and condition.

	Male	Female	Other
Condition 1: directly visible representation	13	62	0
Condition 2: digital representation	17	55	1

3.4 Research design

A 2 between subject x 1 within subject factorial design was used for this research, with the different types of dynamic shelf life indicators as a between subject factor and no difference in the within subject factor. So, a single factor-experiment was done. Respondents in the first condition were presented with the fresh fish packaging with a directly visible dynamic shelf life indicator, whereas

respondents in the second condition were presented with the fresh fish packaging with a digital dynamic shelf life indicator. Respondents were randomly assigned to either the directly visible dynamic shelf life indicator condition or the digital dynamic shelf life indicator condition.

3.5 Data collection

The questionnaire was conducted in the Dutch language, as the focus of this consumer study was on Dutch consumers.

3.5.1 Stimulus material

Representation of the dynamic shelf life indicators

The fresh fish product contained, depending on the condition, either a packaging with a directly visible or a digital dynamic shelf life indicator. In figure 4 an example of a fresh fish package containing a directly visible dynamic shelf life indicator is shown. In figure 5 a fresh fish package containing a digital dynamic shelf life indicator is shown. The design of the fresh fish packaging was obtained from the packaging of Albert Heijn Pangasius Filet (Albert Heijn, 2017). However, the characteristics of the fresh fish package were changed, so to keep the packaging neutral and to exclude preferences of the consumers for a certain store or brand (Schut, 2013).



Figure 4: Example of a fresh fish package containing a directly visible dynamic shelf life indicator.



Figure 5: Example of a fresh fish package containing a digital dynamic shelf life indicator.

Operation of the dynamic shelf life indicators

First, the respondents got an explanation about how dynamic shelf life indicators in general work. The explanation was as follows: "Dynamic shelf life indicators are indicators that measure the exact shelf life of a food product. If changes in for example the temperature occur, the indicator can measure this. Subsequently the shelf life of a food product will be adjusted so that it shows the exact quality."

For explaining how the directly visible dynamic shelf life indicator works, figure 4 was shown, accompanied with the following text: "A dynamic shelf life indicator can be directly visible on food packages. There is no need for a mobile phone to see the shelf life of the product. A colour change then occurs, which is an indication of the quality of the food product."

For explaining the workings of the digital dynamic shelf life indicator, figure 5 was used, accompanied with the following text: "A dynamic shelf life indicator can work in a digital way. A mobile phone is needed to obtain information about the shelf life. On the food packaging the shelf life is not directly shown, but a QR-code is shown. This code has to be scanned with a mobile phone, after which the shelf life will be represented on the screen of the mobile phone."

Visual design options for directly visible dynamic shelf life indicators

In the directly visible condition, respondents were asked in two questions to choose between two different visual design options of dynamic shelf life indicators. The figure of the first visual design question is shown in figure 6 and was regarding the shape of the design, option 1 was derived from an already existing visual design for time-temperature indicators (Insignia Technologies, 2013), option 2 was especially developed for this thesis. The second visual design question was regarding the choice of either a change of different colours or a gradual change of one colour. The second visual design question can be found in appendix 2.

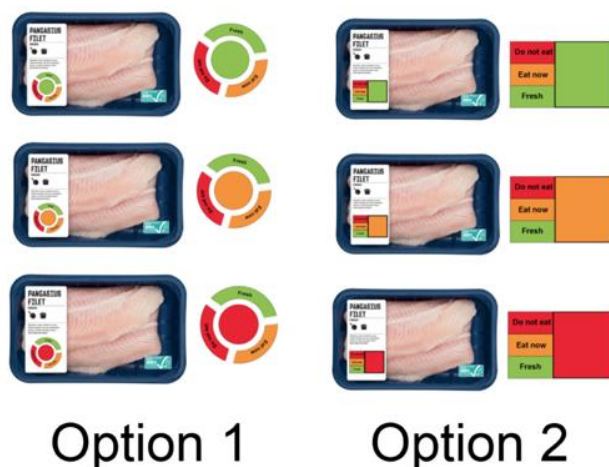


Figure 6: Visual design options in the directly visible condition regarding the shape of the design.

Visual design options for digital dynamic shelf life indicators

In the digital condition, respondents were asked in three questions to choose between two different visual design options of dynamic shelf life indicators. First, respondents were asked to choose

between two options of the representation of the shelf life date, which is shown in figure 7. Second, respondents were asked to choose between a visual display with no colour or a display with colour. The third visual design question was regarding the choice of either a change of different colours or a gradual change of one colour. The second and third visual design questions can be found in appendix 3.



Figure 7: Visual design options in the digital condition regarding the representation of the shelf life date.

3.5.2 Measures

Perceived visual attractiveness

The perceived visual attractiveness of the different types of dynamic shelf life indicators was measured using eight 7-point scale items ($\alpha = 0.810$). The end poles of the items were totally disagree and totally agree. The items measured were about the aspects of clear, pleasant, symmetrical, beautiful, original, sophisticated, fascinating and creative, regarding the dynamic shelf life indicator.

Perceived usefulness

The perceived usefulness of the different types of dynamic shelf life indicators was measured using the system usability scale (SUS) of Brooke (1996) ($\alpha = 0.802$), which is a ten-item scale that gives a general view of subjective assessment of the usability. The end poles of the items were totally disagree and totally agree. The exact measurement items of the system usability scale can be found in appendix 1. For measuring the perceived usefulness of the different types of dynamic shelf life indicators a 7-point Likert scale was used.

Perceived ease of use

The perceived ease of use of the different types of dynamic shelf life indicators was measured using six 7-point scale items of Davis (1989) ($\alpha = 0.769$), of which the end poles of the items were totally disagree and totally agree. The six items measured were regarding learning to operate the dynamic shelf life indicator, the ease of getting the dynamic shelf life indicator to do what it is supposed to do, the clearness and ease of understanding the interaction with the dynamic shelf life indicator, the flexibility of the interaction with the dynamic shelf life indicator, the ease to become skilful at using the dynamic shelf life indicator and the easiness to use the dynamic shelf life indicator.

Perceived risk

The perceived risk of the different types of dynamic shelf life indicators was measured using four 7-point scale items. These items were based on Campbell & Goodstein (2001) ($\alpha = 0.623$). The items were about the concern regarding the working of the technology of the dynamic shelf indicator, the importance of the information provided by the dynamic shelf life indicator, the risk associated with using the dynamic shelf life indicator and the worry associated with using the dynamic shelf life indicator. The end poles of these items were respectively not at all concerned and highly concerned, very unimportant and very important, extremely risk and extremely riskless, and very worried and very secure. The item concerning the importance of the information provided by the dynamic shelf life indicator was removed from the scale in order to improve the Cronbach's alpha value ($\alpha = 0.789$).

Consumer acceptance

The consumer acceptance of the different types of dynamic shelf life indicators was measured by combining the results of the perceived visual attractiveness, perceived usefulness, perceived ease of use and perceived risk ($\alpha = 0.746$). It was chosen not to include the consumer trust in the government, food manufacturers and food retailers, as the Cronbach's alpha value including these constructs was $\alpha = 0.658$. An alpha-value lower than 0.7 indicates questionable internal consistency and has a low reliability.

Consumer trust in institutions

The consumer trust in institutions providing the different types of dynamic shelf life indicators was measured for 3 different institutions, namely the government, food manufacturers and food retailers. To measure the consumer trust in institutions, a modified version of the scale to measure trust by Mayer et al. (1995) was used. The consumer trust in each institution was measured using fourteen 7-point scale items.

Five items were regarding the perceived ability. These items were about the capability of the institution in performing their job, the successfulness of the institution in the things they do, the knowledge of the institution about the work that they do, the confidence in the skills of the institution and the qualifications of the institution. Also, five items were regarding the perceived benevolence. These items were about the concern of the institution about the consumers' welfare, the importance of the consumers' needs and desires to the institution, whether the institution would knowingly do harm to the consumer, whether the institution would really look out for what is important to the consumer and whether the institution would go out of its way to help the consumer. Finally, four items were regarding the perceived integrity of the institution. These items were about the sense of justice of the institution, the fairness of the institution, the values of the institution and whether the institution's behaviour was guided by sound principles.

The end poles of the items were totally disagree and totally agree. The Cronbach's alpha values for the consumer trust in the government, food manufacturers and food retailers were respectively $\alpha = 0.937$, 0.919 and 0.922 .

Moderating effects

Three moderating effects on consumer acceptance were measured in this research.

The previous knowledge was measured using two binary items. The two items measured were previous knowledge of the term "intelligent packaging" and previous knowledge of the term "dynamic shelf life indicator".

The uncertainty avoidance was measured using four 7-point scale items of Erdem et al. (2006) ($\alpha = 0.768$). The end poles of the items were totally disagree and totally agree. The four items measured were about the consumer's desire to be safe regarding the shelf life of food products, the desire to be certain regarding food safety, the avoidance of risk and the importance of being sure in life.

Technophobia was measured using three 7-point scale items, by using the technology anxiety scale of Meuter et al. (2003) ($\alpha = 0.678$). The end poles of the items were totally disagree and totally agree. The items measured were about feeling afraid when using technology, willingness to try new things and the avoidance of the unknown. The item regarding willingness to try new things was removed from the scale in order to improve the Cronbach's alpha value ($\alpha = 0.796$).

3.5.3 Procedure of the data collection

For the consumer study, respondents were recruited from the database of consumer research from the chair group Food Quality and Design of Wageningen University. Respondents were also recruited using social media networks and by approaching individuals at different sport- and student associations. Respondents were randomly assigned to either the directly visible dynamic shelf life indicator condition or the digital dynamic shelf life indicator condition. The questionnaire took about 10 minutes to finish.

In the beginning a short explanation about the research was given. After this an explanation was given about dynamic shelf life indicators in general. Then, respondents were randomly assigned to one of the conditions (directly visible or digital) and further informed about the specific type of dynamic shelf life indicator and let to choose between a few types of visual designs of the dynamic shelf life indicator. Then the perceived visual attractiveness, perceived usefulness, perceived ease of use, perceived risk and consumer trust in institutions were measured on a 7-point Likert scale. After this, some general questions regarding the age and gender of the respondent were asked and in the end some questions regarding previous knowledge, uncertainty avoidance and technophobia of the respondents were asked. In the digital condition, respondents were also asked some questions regarding the willingness to obtain extra information from the dynamic shelf life indicator. Finally, the respondents were thanked for their participation and debriefed, in which the respondents were told that dynamic shelf life indicators are not yet on the Dutch market, but that there are many researches currently going on regarding dynamic shelf life indicators.

For the data collection Qualtrics was used, which is an online survey platform.

3.6 Data analysis

For the analysis of the obtained data the software programme SPSS version 23 was used.

First, all values were checked for outliers and missing values. Then, some Cronbach's alpha tests were executed to check the reliability of the scale of the variables visual attractiveness, perceived usefulness, perceived ease of use, perceived risk, consumer acceptance, consumer trust in the government, food manufacturers and food retailers, uncertainty avoidance and technophobia. The Cronbach's alpha values from this research are depicted in the measures section in the methods (3.5.2). Third, the success of randomisation of the variables gender and age between the two conditions was checked using a chi-square test for the gender variable and a univariate analysis of variance for the age variable.

Then the effect of the moderators on consumer acceptance was tested by using a regression analysis for the variables uncertainty avoidance and technophobia. For the variables of previous knowledge of the term "intelligent packaging" and "dynamic shelf life indicator" an independent samples t-test was conducted to test the moderating effect of it on consumer acceptance. For the moderators which showed a significant effect on consumer acceptance, further testing was done. A chi-square test was conducted for the previous knowledge and a univariate analysis of variance was conducted for technophobia in order to check for the success of randomisation between the two conditions.

Following, an independent samples t-test was conducted to compare the means of perceived visual attractiveness, perceived usefulness, perceived ease of use, perceived risk, consumer acceptance and consumer trust in the government, food manufacturers and food retailers, between the two different conditions. Also, a dependent samples t-test was conducted to compare the means of consumer trust between the government, food manufacturers and food retailers. Moreover, a correlation analysis was conducted to test whether the consumer trust in the government, food manufacturers and food retailers correlate with each other.

4 Results

4.1 Randomisation check for gender and age

4.1.1 Randomisation check for gender

A chi-square test of independence is conducted to examine the relation between gender and the condition. The relation between these two variables is not significant, $X^2(2, N=148) = 1.93, p > 0.05$. This indicates that males and females are as likely in the directly visible as in the digital condition. Randomisation of gender between the two conditions is thus successful.

Table 2: Results of the chi-square test between gender and condition.

Gender-Condition	N of valid cases	Value	df	Asymptotic significance (2-sided)
Pearson chi-square	148	1.93	2	0.38

4.1.2 Randomisation check for age

A univariate analysis of variance is conducted to examine the relation between the condition and the age of the respondents. There is no significant effect between the condition and the age of the respondents, $F(1, 146) = 2.37, p > 0.05, r = 0.13$. Randomisation of age between the two conditions is thus successful.

Table 3: Results of the univariate analysis of variance with condition as dependent variable and age as independent variable.

Age	df	F	Sig.
Condition	1	2.37	0.13

4.2 Moderating effects

4.2.1 Previous knowledge of the term "intelligent packaging"

In the directly visible condition, 58.7% of the respondents have and 41.3% of the respondents have not heard of the term "intelligent packaging" before. In the digital condition, 46.6% of the respondents have and 53.4% have not heard of the term "intelligent packaging" before.

For determining whether there is a significant difference in the consumer acceptance of respondents with and without previous knowledge of the term "intelligent packaging", an independent samples t-test is conducted. On average, the consumer acceptance of respondents with previous knowledge of the term "intelligent packaging" ($M = 5.47, SD = 0.59$) is higher than the consumer acceptance of respondents without previous knowledge of the term "intelligent packaging" ($M = 5.23, SD = 0.69$). This difference is significant $t(146) = 2.28, p < 0.05, r = 0.18$.

A chi-square test of independence is conducted to examine the relation between previous knowledge of the term "intelligent packaging" and the condition. The relation between these two variables is not significant, $\chi^2 (1, N= 148) = 2.17, p > 0.05$. Indicating that respondents with, and without previous knowledge of the term "intelligent packaging" are as likely in the directly visible as in the digital condition. Results from the independent samples t-test and chi-square test can be found in respectively tables 4 and 5.

4.2.2 Previous knowledge of the term "dynamic shelf life indicator"

In the directly visible condition, 46.7% of the respondents have and 53.3% of the respondents have not heard of the term "dynamic shelf life indicator" before. In the digital condition, 30.1% of the respondents have and 69.9% of the respondents have not heard of the term "dynamic shelf life indicator" before.

For determining whether there is a significant difference in the consumer acceptance of respondents with and without previous knowledge of the term "dynamic shelf life indicator", an independent samples t-test is conducted. On average, the consumer acceptance of respondents with previous knowledge of the term "dynamic shelf life indicator" ($M= 5.51, SD= 0.57$) is higher than the consumer acceptance of respondents without previous knowledge of the term "dynamic shelf life indicator" ($M= 5.26, SD= 0.68$). This difference is significant $t (146)= 2.27, p < 0.05, r= 0.18$.

A chi-square test of independence is conducted to examine the relation between previous knowledge of the term "dynamic shelf life indicator" and the condition. The relation between these two variables is significant, $\chi^2 (1, N= 148) = 4.27, p < 0.05$. Indicating that respondents with and without previous knowledge of the term "dynamic shelf life indicator" are not as likely in the directly visible as in the digital condition. Significantly more respondents in the directly visible condition have previous knowledge of the term "dynamic shelf life indicator". Results from the independent samples t-test and chi-square test can be found in respectively tables 4 and 5.

Table 4: Results of the independent samples t-test, with previous knowledge of the term "intelligent packaging" as independent variable and consumer acceptance as dependent variable in the first row, and previous knowledge of the term "dynamic shelf life indicator" as independent variable and consumer acceptance as dependent variable in the second row.

	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Previous knowledge of the term "intelligent packaging"	2.50	0.12	2.28	146	0.02*
Previous knowledge of the term "dynamic shelf life indicator"	3.84	0.052	2.27	146	0.03*

* $\alpha < 0.05$

Table 5: Results of the chi-square test between previous knowledge of the term "intelligent packaging" and condition, and previous knowledge of the term "dynamic shelf life indicator" and condition.

Pearson chi-square	N of valid cases	Value	df	Asymptotic significance (2-sided)
Previous knowledge of the term "intelligent packaging"	148	2.17	1	0.14
Previous knowledge of the term "dynamic shelf life indicator"	148	4.27	1	0.04*

* $\alpha < 0.05$

4.2.3 Uncertainty avoidance

A low value on the scale (1) indicates a high uncertainty avoidance, a high value (7) on the scale indicates a low uncertainty avoidance. The uncertainty avoidance of the respondents in the directly visible condition ranges from 1.00 to 6.25, with a mean value of 2.76 ($SD= 1.06$). The uncertainty avoidance of the respondents in the digital condition ranges from 1.00 to 6.25, with a mean value of 2.87 ($SD= 1.02$).

A simple linear regression is calculated to predict consumer acceptance based on uncertainty avoidance. The regression equation that is found is not significant ($F(1, 146) = 0.41, p > 0.05$), with an R^2 of 0.003.

Table 6: Results of the linear regression analysis, to predict consumer acceptance based on uncertainty avoidance.

Uncertainty avoidance	R^2	df	F	Sig.
Regression	0.003	1	0.41	0.52
Residual		146		

4.2.4 Technophobia

A low value (1) on the scale indicates high technophobia, a high value (7) on the scale indicates low technophobia. The technophobia of the respondents in the directly visible condition ranges from 2.50 to 7.00, with a mean value of 6.05 ($SD= 0.97$). The technophobia of the respondents in the digital condition ranges from 2.50 to 7.00, with a mean value of 6.31 ($SD= 0.81$).

A simple linear regression is calculated to predict consumer acceptance based on technophobia. The regression equation that is found is significant ($F(1, 146) = 21.65, p < 0.001$), with an R^2 of 0.13. Participants' predicted consumer acceptance is equal to $3.758 + 0.259 \cdot (\text{level of technophobia})$.

Table 7: Results of the linear regression analysis, to predict consumer acceptance based on technophobia.

Technophobia	R^2	df	F	Sig.	B (constant)	B (construct technophobia)
Regression	0.13	1	21.65	0.000***	3.758	0.259
Residual		146				

*** $\alpha < 0.001$

A univariate analysis of variance is conducted to examine the relation between the condition and the technophobia of the respondents. There is no significant effect between the condition and the technophobia of the respondents, $F(1, 146) = 3.17$, $p > 0.05$, $r = 0.15$. Randomisation of technophobia of the respondents is thus successful between the two conditions.

Table 8: Results of the univariate analysis of variance with condition as independent variable and technophobia as dependent variable.

Technophobia	df	F	Sig.
Condition	1	3.17	0.08

4.3 Consumer acceptance of the two types of dynamic shelf life indicators

For determining whether there is a significant difference in the means of the perceived visual attractiveness, perceived usefulness, perceived ease of use, perceived risk and consumer acceptance in the two different conditions, an independent samples t-test is conducted.

4.3.1 Perceived visual attractiveness

A low value on the scale (1) indicates a low perceived visual attractiveness, a high value (7) on the scale indicates a high perceived visual attractiveness. On average, the perceived visual attractiveness of the directly visible dynamic shelf life indicator ($M = 5.55$, $SD = 0.81$) is higher than the perceived visual attractiveness of the digital dynamic shelf life indicator ($M = 5.27$, $SD = 0.86$). This difference is significant $t(146) = 2.07$, $p < 0.05$, $r = 0.16$.

Table 9: Results of the independent samples t-test with condition as independent variable and perceived visual attractiveness as dependent variable.

Perceived visual attractiveness	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	0.89	0.35	2.07	146	0.04*

* $\alpha < 0.05$

4.3.2 Perceived usefulness

A low value on the scale (1) indicates a low perceived usefulness, a high value (7) on the scale indicates a high perceived usefulness. On average, the perceived usefulness of the directly visible dynamic shelf life indicator ($M = 5.63$, $SD = 0.64$) is higher than the perceived usefulness of the digital dynamic shelf life indicator ($M = 5.17$, $SD = 0.84$). This difference is significant $t(134.55) = 3.79$, $p < 0.001$, $r = 0.30$.

Table 10: Results of the independent samples t-test with condition as independent variable and perceived usefulness as dependent variable.

Perceived usefulness	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances not assumed	4.85	0.03	3.79	134.55	0.000***

*** $\alpha < 0.001$

4.3.3 Perceived ease of use

A low value on the scale (1) indicates a low perceived ease of use, a high value (7) on the scale indicates a high perceived ease of use. On average, the perceived ease of use of the directly visible dynamic shelf life indicator ($M = 5.87$, $SD = 0.69$) is higher than the perceived ease of use of the digital dynamic shelf life indicator ($M = 5.66$, $SD = 0.74$). This difference is not significant $t(146) = 1.85$, $p > 0.05$, $r = 0.15$.

Table 11: Results of the independent samples t-test with condition as independent variable and perceived ease of use as dependent variable.

Perceived ease of use	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	0.47	0.49	1.85	146	0.07

4.3.4 Perceived risk

A low value on the scale (1) indicates a high perceived risk, a high value (7) on the scale indicates a low perceived risk. On average, the perceived risk of the directly visible dynamic shelf life indicator has a higher value ($M = 4.93$, $SD = 1.06$) compared to the perceived risk of the digital dynamic shelf life indicator ($M = 4.76$, $SD = 1.07$). However, this means that the perceived risk of the directly visible dynamic shelf life indicator is lower for the directly visible indicator compared to the digital dynamic shelf life indicator, as a high value for perceived risk indicates a low perceived risk of the dynamic shelf life indicator. This difference is not significant $t(146) = 0.98$, $p > 0.05$, $r = 0.08$.

Table 12: Results of the independent samples t-test with condition as independent variable and perceived risk as dependent variable.

Perceived risk	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	0.05	0.83	0.98	146	0.33

4.3.5 Consumer acceptance

A low value on the scale (1) indicates a low consumer acceptance of the dynamic shelf life indicator, a high value on the scale (7) indicates a high consumer acceptance of the dynamic shelf life indicator.

On average, the consumer acceptance of the directly visible dynamic shelf life indicator ($M= 5.50$, $SD= 0.59$) is higher than the consumer acceptance of the digital dynamic shelf life indicator ($M= 5.21$, $SD= 0.68$). This difference is significant $t(146)= 2.73$, $p< 0.01$, $r= 0.22$.

Table 13: Results of the independent samples t-test with condition as independent variable and consumer acceptance as dependent variable.

Consumer acceptance	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	1.41	0.24	2.73	146	0.007**

** $\alpha < 0.01$

4.3.6 Summary of the results of consumer acceptance

In table 14, the mean and standard deviation values in the directly visible and digital condition can be found for the perceived visual attractiveness, perceived usefulness, perceived ease of use, perceived risk and consumer acceptance. Moreover, it is indicated whether the difference between the mean values is significant and the significance values are given.

Table 14: Mean, standard deviation and significance values in the directly visible and digital condition for perceived visual attractiveness, perceived usefulness, perceived ease of use, perceived risk and consumer acceptance, measured on a 7-point scale.

	N= 75		N= 73		Sig. (2-tailed)
	Mean value directly visible condition	SD directly visible condition	Mean value digital condition	SD digital condition	
Perceived visual attractiveness	5.55	0.81	5.27	0.86	0.04*
Perceived usefulness	5.63	0.64	5.17	0.84	0.000***
Perceived ease of use	5.87	0.69	5.66	0.74	0.07
Perceived risk	4.93	1.06	4.76	1.07	0.33
Consumer acceptance	5.50	0.59	5.21	0.68	0.007**

* $\alpha < 0.05$ ** $\alpha < 0.01$ *** $\alpha < 0.001$

4.4 Consumer trust in the different institutions

4.4.1 Comparing consumer trust between the two conditions

For determining whether there is a significant difference in the means of the consumer trust in the government, food manufacturers and food retailers in the two different conditions, an independent samples t-test is conducted.

4.4.1.1 Consumer trust in the government

A low value on the scale (1) indicates a low consumer trust in the government, a high value on the scale (7) indicates a high consumer trust in the government. On average, the consumer trust in the government in the directly visible condition ($M= 4.62$, $SD= 0.90$) is higher than the consumer trust in the government in the digital condition ($M= 4.53$, $SD= 0.87$). This difference is not significant $t(146)= 0.61$, $p> 0.05$, $r= 0.05$.

Table 15: Results of the independent samples t-test with condition as independent variable and consumer trust in the government as dependent variable.

Consumer trust in the government	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	0.06	0.80	0.61	146	0.55

4.4.1.2 Consumer trust in food manufacturers

A low value on the scale (1) indicates a low consumer trust in food manufacturers, a high value on the scale (7) indicates a high consumer trust in food manufacturers. On average, the consumer trust in food manufacturers in the directly visible condition ($M= 4.91$, $SD= 0.90$) is higher than the consumer trust in food manufacturers in the digital condition ($M= 4.78$, $SD= 0.79$). This difference is not significant $t(146)= 0.996$, $p> 0.05$, $r= 0.08$.

Table 16: Results of the independent samples t-test with condition as independent variable and consumer trust in food manufacturers as dependent variable.

Consumer trust in food manufacturers	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	0.09	0.76	0.996	146	0.32

4.4.1.3 Consumer trust in food retailers

A low value on the scale (1) indicates a low consumer acceptance in food retailers, a high value on the scale (7) indicates a high consumer acceptance in food retailers. On average, the consumer trust in food retailers in the directly visible condition ($M= 4.69$, $SD= 0.96$) is higher than the consumer trust in

food retailers in the digital condition ($M= 4.60$, $SD= 0.71$). This difference is not significant $t(146)= 0.68$, $p> 0.05$, $r= 0.06$.

Table 17: Results of the independent samples t-test with condition as independent variable and consumer trust in food retailers as dependent variable.

Consumer trust in food retailers	Levene's test for equality of variances		t	df	Sig. (2-tailed)
	F	Sig.			
Equal variances assumed	3.08	0.08	0.68	146	0.50

In table 18 a summary of the results of consumer trust in the different institutions can be found. The mean, standard deviation and significance values are depicted.

Table 18: Mean, standard deviation and significance values in the directly visible and digital condition for the consumer trust in the government, consumer trust in food manufacturers and consumer trust in food retailers, measured on a 7-point scale.

	N= 75		N= 73		Sig. (2-tailed)
	Mean value directly visible condition	SD directly visible condition	Mean value digital condition	SD digital condition	
Consumer trust in the government	4.62	0.90	4.53	0.87	0.55
Consumer trust in food manufacturers	4.92	0.90	4.78	0.79	0.32
Consumer trust in food retailers	4.69	0.96	4.60	0.71	0.50

4.4.2 Comparing consumer trust between the different institutions

For determining whether there is a significant difference between the means of consumer trust in the government and food manufacturers, the government and food retailers, and food manufacturers and food retailers, a paired samples t-test is conducted.

Comparing consumer trust in the government and food manufacturers

On average, the consumer trust in food manufacturers ($M= 4.85$, $SD= 0.85$) is higher than the consumer trust in the government ($M= 4.58$, $SD= 0.88$). This difference is significant $t(147)= -3.81$, $p< 0.001$, $r= 0.30$.

Comparing consumer trust in the government and food retailers

On average, the consumer trust in food retailers ($M= 4.65$, $SD= 0.84$) is higher than the consumer trust in the government ($M= 4.58$, $SD= 0.88$). This difference is not significant $t(147)= -0.95$, $p> 0.05$, $r= 0.08$.

Comparing consumer trust in food manufacturers and food retailers

On average, the consumer trust in food manufacturers ($M= 4.85$, $SD= 0.85$) is higher than the consumer trust in food retailers ($M= 4.65$, $SD= 0.84$). This effect is significant $t(147)= 3.32$, $p= 0.001$, $r= 0.26$.

Table 19: Results of the dependent samples t-test for consumer trust in the government and food manufacturers, the government and food retailers, and food manufacturers and food retailers.

	t	df	Sig. (2-tailed)
The government-Food manufacturers	-3.81	147	0.000***
The government-Food retailers	-0.95	147	0.35
Food manufacturers-Food retailers	3.32	147	0.001**

*** $\alpha < 0.001$ ** $\alpha = 0.001$

4.4.3 Correlation matrix

In table 48, the correlation matrix of consumer trust in the government and food manufacturers, the government and food retailers, and food manufacturers and food retailers can be found.

Consumer trust in the government is positively related to consumer trust in food manufacturers, with a coefficient of $r= 0.51$, which is also significant at $p < 0.001$. Consumer trust in the government is also positively related to consumer trust in food retailers, with a coefficient of $r= 0.46$, which is also significant at $p < 0.001$. Also, consumer trust in food manufacturers is positively related to consumer trust in food retailers, with a coefficient of $r= 0.63$, which is also significant at $p < 0.001$.

Table 20: Correlation matrix between consumer trust in the government and food manufacturers, the government and food retailers, and food manufacturers and food retailers.

		Trust in the government	Trust in food manufacturers	Trust in food retailers
Trust in the government	Pearson correlation	1	0.51	0.46
	Sig. (2-tailed)		0.000***	0.000***
Trust in food manufacturers	Pearson correlation	0.51	1	0.63
	Sig. (2-tailed)	0.000***		0.000***
Trust in food retailers	Pearson correlation	0.46	0.63	1
	Sig. (2-tailed)	0.000***	0.000***	
	N	148	148	148

*** $\alpha < 0.001$

4.5 Visual design of dynamic shelf life indicators

4.5.1 Visual design of the directly visible dynamic shelf life indicator

In the directly visible condition, 69.3% out of all respondents choose design option 1 with a change in different colours as visually more attractive, 18.7% out of all respondents choose design option 1 with a gradual change of one colour as visually more attractive, 9.3% choose design option 2 with a change in different colours as visually more attractive and 2.7% choose design option 2 with a gradual change of one colour as visually more attractive. The results of the visual design in the directly visible condition are also depicted in figure 8.

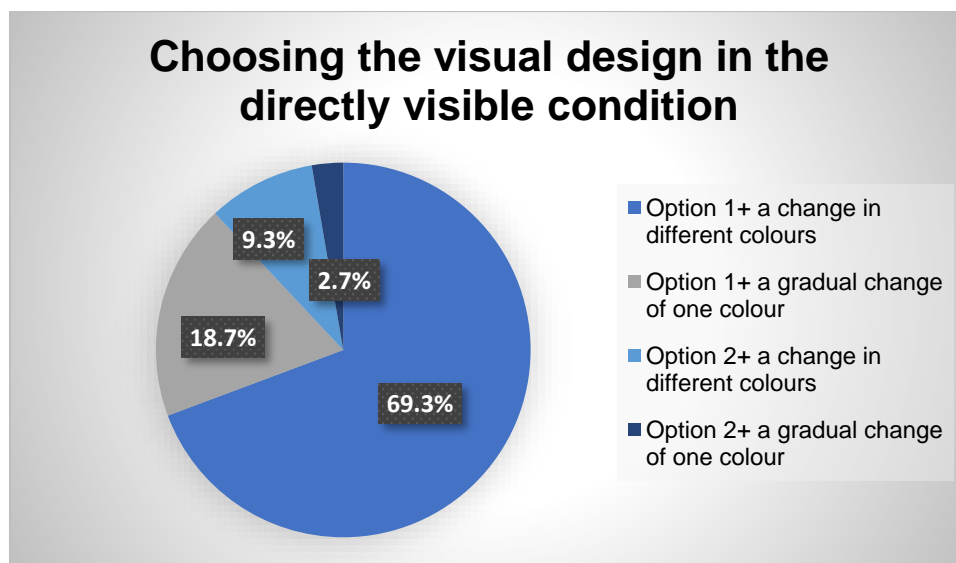


Figure 8: Percentages of respondents in the directly visible condition choosing option 1 with a change in different colours, option 1 with a gradual change of one colour, option 2 with a change in different colours and option 2 with a gradual change of one colour.

4.5.2 Visual design of the digital dynamic shelf life indicator

In the digital condition, 31.5% out of all respondents choose the number of days left display option with a change in different colours as visually more attractive, 20.5% out of all respondents choose the number of days left display option with a gradual change of one colour as visually more attractive, 34.2% out of all respondents choose the freshness date display option with a change in different colours as visually more attractive and 13.8% out of all respondents choose the freshness date display option with a gradual change of one colour as visually more attractive. The results of the visual design in the digital condition are also depicted in figure 9.

24.7% and 16.4% out of all respondents in the digital condition in respectively the number of days left display option and freshness date display option find no change in colour visually more attractive than a change in colour (which include either a change in different colours or a gradual change of one colour).

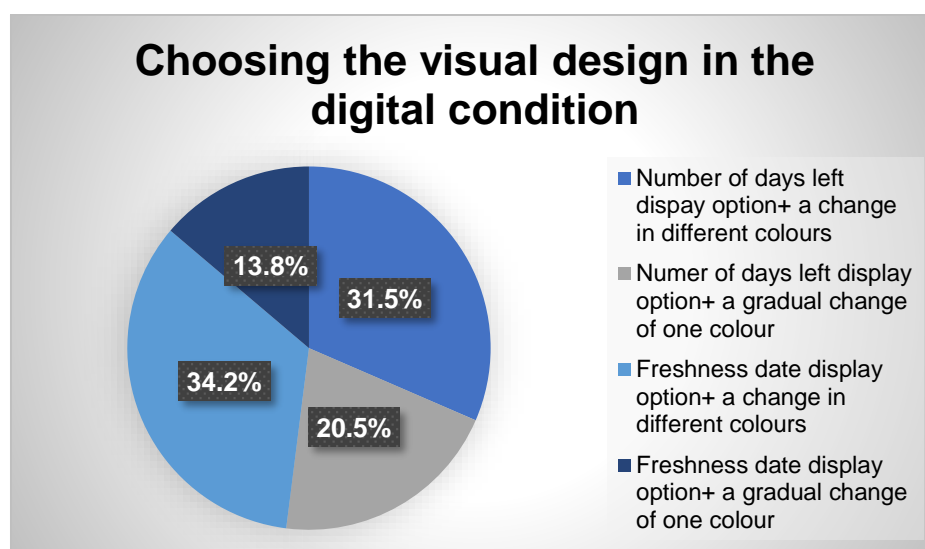


Figure 9: Percentages of respondents in the digital condition choosing the number of days left display option with a change in different colours, number of days left display option with a gradual change of one colour, freshness date display option with a change in different colours and freshness date display option with a gradual change of one colour.

4.6 Willingness to receive extra information regarding a food product

A low value on the scale (1) indicates a low willingness to receive extra information from the digital dynamic shelf life indicator regarding the food product, a high value on the scale (7) indicates a high willingness to receive extra information. The willingness in obtaining extra information from low to high willingness: regarding the temperature profile of a food product ($M= 4.37$, $SD= 1.74$), alerts when the shelf life is 3 days or less ($M= 4.58$, $SD= 2.02$), microbial quality of a food product ($M= 4.86$, $SD= 1.70$), recipes with the food product ($M= 5.23$, $SD= 1.50$) and storage conditions of a food product ($M= 5.88$, $SD= 1.09$).

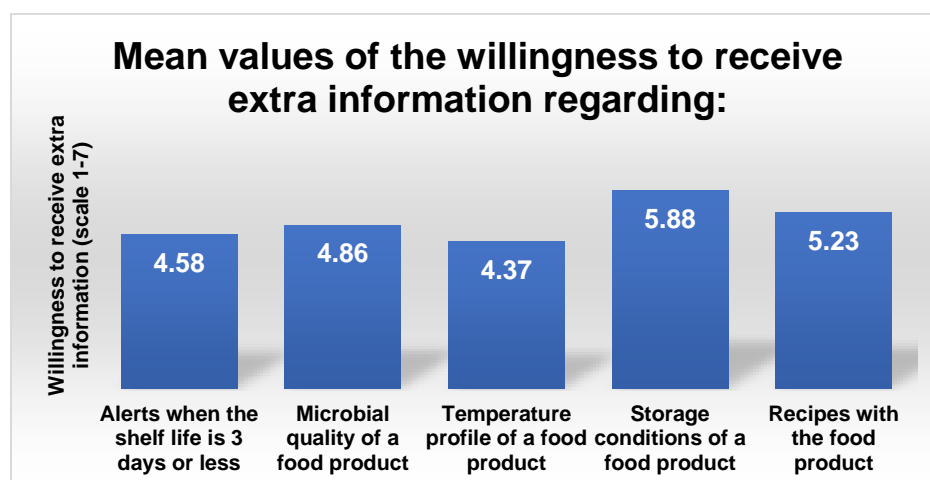


Figure 10: Mean values of the willingness of respondents to receive extra information regarding alerts when the shelf life is 3 days or less, the microbial quality of a food product, temperature profile of a food product, storage conditions of a food product and recipes with the food product, measured on a 7-point scale.

5 Discussion of the results

5.1 Normality of the data

From the central limit theorem, it is known that if the sample data are more or less normally distributed, then the sampling distribution will also be normally distributed (Field, 2009; Fischer, 2010). From this theorem it is also known that if the sample size is large, the sample distribution tends to be normal regardless of the shape of the data that is actually collected. A sample size of 30 or more is considered large enough for this theorem to hold (Field, 2009). In our case, the sample size is 148. The larger the sample size gets, the higher the confidence in the assumption that the sampling distribution is normally distributed (Field, 2009). Therefore, the sample distribution is assumed to be normally distributed in this study.

5.2 Moderating effects

Respondents with previous knowledge of one of the terms "intelligent packaging" and "dynamic shelf life indicator" have significantly higher levels of consumer acceptance of dynamic shelf life indicators compared to respondents without previous knowledge of one of these terms. Previous knowledge level thus has a moderating effect on consumer acceptance. On the one hand, this result corresponds with previous research, where it was found that consumers with more knowledge about the new technology have a higher acceptance of the technology (Ronteltap et al., 2007; Schut, 2013). On the other hand it also contradicts with previous research, where it was found that having more knowledge and expertise increased the risk perception, which in turn has a negative relation with consumer acceptance (Bouyer et al., 2001; Ronteltap et al., 2007).

The level of uncertainty avoidance has no predicting effect on consumer acceptance and thus is not a moderator on the consumer acceptance of dynamic shelf life indicators.

The level of technophobia also influences consumer acceptance, with a lower level of technophobia resulting in a higher level of consumer acceptance. Technophobia thus has a moderating effect on consumer acceptance of dynamic shelf life indicators. Previous research has found that technophobia did not have a moderating effect on the consumer acceptance of a food product provided with a dynamic shelf life indicator (Schut, 2013). The focus of the previous research is on the influence of technophobia on consumer acceptance of the food product and not the technology, whereas the focus of this research is on the influence of technophobia on consumer acceptance of the dynamic shelf life indicator (the technology itself), which explains the difference.

To prevent confounding, it is important that the previous knowledge of the term "intelligent packaging", previous knowledge of the term "dynamic shelf life indicator" and technophobia are equally randomised between the two conditions as these variables have a moderating effect on consumer

acceptance. This was the case, except for the variable previous knowledge of the term "dynamic shelf life indicator". In limitations section 7.1.1 a more extensive explanation on the unsuccessful randomisation of the previous knowledge of the term "dynamic shelf life indicator" is given.

5.3 Consumer acceptance of the two types of dynamic shelf life indicators

The consumer acceptance of the dynamic shelf life indicator is significantly higher for the directly visible than for the digital dynamic shelf life indicator. Consumer acceptance is a combination of the variables perceived visual attractiveness, perceived usefulness, perceived ease of use and perceived risk. For all these variables, the mean values of consumer acceptance are higher in the directly visible condition compared to the digital condition, out of which some differences are significant.

The perceived visual attractiveness is significantly higher for dynamic shelf life indicators in the directly visible condition compared to the digital condition. The directly visible dynamic shelf life indicator contains different shapes and the design is composed of different parts, whereas the digital dynamic shelf life indicator is composed of only one shape and one part. The visual attractiveness of dynamic shelf life indicators is not only determined by classical aesthetics (Johnson, 1994; Krufft 1994), but also by expressive aesthetics (Nasar, 2016), which include creativity, sophistication and originality (Lavie & Tractinsky, 2004). Respondents might perceive a dynamic shelf life indicator with different shapes and parts as more sophisticated and creative, which might be one explanation as to why the directly visible dynamic shelf life indicator has a higher perceived visual attractiveness.

The perceived usefulness is significantly higher for dynamic shelf life indicators in the directly visible condition compared to the digital condition. However, the perceived ease of use is not significantly higher for the directly visible dynamic shelf life indicator.

On the one hand, it is expected that the perceived ease of use for the directly visible dynamic shelf life indicator will be higher, as in this case there is no need for an additional device to obtain information about the shelf life of a food product. It is expected that consumers will perceive the need for an additional device as burdensome, which then results in lower perceived ease of use. However, this effect is not significant. As the perceived ease of use influences the perceived usefulness (Davis, 1985), it is expected that also perceived usefulness will be higher for the directly visible dynamic shelf life indicator (first expectation). On the other hand, it is expected that the perceived usefulness for the digital dynamic shelf life indicator will be higher (second expectation), as the digital dynamic shelf life indicator is able to offer many more functions (Köster, 2017), for example the provision of extra information about a food product, which in turn might result in higher perceived usefulness because the respondents are able to use the dynamic shelf life indicator in more situations.

The second expectation is not supported by the results, as the digital dynamic shelf life indicator has a lower perceived usefulness compared to the directly visible one. The first expectation is also not supported by the results, as the perceived ease of use did not significantly differ, whereas the

perceived usefulness did. One reason as to why the perceived usefulness significantly differs can be because consumers are already familiar with a shelf life label that is directly visible on food packages, whereas they are not yet familiar with food packages of which the shelf life cannot be seen directly. Familiarity results in more favourable and positive attitudes, which might have influenced the perceived usefulness of the directly visible dynamic shelf life indicator positively (Bornstein & D'agostino, 1992; Imamoğlu & Imamoğlu, 2006; Zajonc, 1968).

The perceived risk is not significantly higher for dynamic shelf life indicators in the digital condition compared to the directly visible condition. The perceived risk for the digital dynamic shelf life indicator is expected to be higher, as in this situation also the issue with privacy and hacking of the dynamic shelf life indicator can be an issue. This effect however is not significant and one explanation for this can be that the respondents themselves did not yet come up with the possibility of the risk of hacking and privacy in the digital dynamic shelf life indicators.

Overall, in both situations participants are moderately positive about dynamic shelf life indicators, as the consumer acceptance in both situations ranged between neutral and positive.

5.4 Consumer trust in the different institutions

No difference in the consumer trust in the three institutions between the two different conditions is expected, as consumer trust is mainly influenced by the willingness to trust of the trustor and the perceived ability, benevolence and integrity of the trustee (Mayer et al., 1995). This is also supported by the results, as there is no significant difference in the level of consumer trust for either the government, food manufacturers and food retailers between the two different conditions.

In this research, the consumer trust in food manufacturers is significantly higher than the consumer trust in the government and in food retailers. This contradicts with the results of previous research found, which states that most consumers trust government-owned institutions more than the private sector (Kikulwe et al., 2011). One possible reason for this contradiction might be that the respondents might have interpreted the consumer trust not regarding the development and regulation of dynamic shelf life indicators, but regarding the provision of an accurate shelf life of food products. However, as it is stated in the questionnaire that the questions on consumer trust were regarding the institutions' development and regulation of dynamic shelf life indicators, this explanation does not hold very strongly. The focus of this research on consumer trust in relation to the development and regulation of dynamic shelf life indicators might be another possible reason as to why the results differ from the research from Kikulwe et al. (2011). According to European legislation, the primary safety of food products are a responsibility of food manufacturers and not of the government nor food retailers (Van Wagenberg & Mihaylov, 2012). Food manufacturers are also the institution that will actually produce the dynamic shelf life indicators on their food products (if implemented in the future). Thus, consumers can perceive food manufactures as more trustworthy because food manufacturers are the ones who

will actually implement the dynamic shelf life indicators and are thus also the ones who have to take responsibility if an error occurs.

Overall, in both situations respondents are neutral to slightly positive about the institutions, as the consumer trust is ranged only slightly above a neutral consumer trust.

There is a significant positive correlation between the consumer trust in the government, food manufacturers and food retailers. This is as expected, as trust on the side of the trustor is mainly influenced by the trustor's willingness to trust (Hofstede, 1980; Zerfu et al., 2008). The willingness to trust in turn is only influenced by characteristics of the trustor and as each respondent is regarded as one trustor whom answered questions for all institutions, the consumer trust in the different institutions is expected to have a positive relation with each other.

5.5 Visual design of the dynamic shelf life indicator

Even though the participants are asked in the consumer study to choose between the visual design options based on visual attractiveness, from the feedback of participants it is known that many have chosen the visual design options not only based on visual attractiveness, but also based on ease of interpretation of the visual design.

In the directly visible condition, visual design option 1 with a change in different colours is most often chosen as visually more attractive. Following, visual design option 1 with a gradual change of one colour, visual design option 2 with a change in different colours and visual design option 2 with a gradual change of one colour are chosen as visually more attractive visual design. Visual design option 1 is a design that already exists on the market (Insignia Technologies, 2013), whereas visual design option 2 is a design option that is first introduced in this thesis. As on average in the directly visible condition, more than 50% of the participants have previous knowledge of the terms "intelligent packaging" and "dynamic shelf life indicator" it might be a possibility that participants have come across visual design option 1 before. Previous research shows that familiarity seems to predict a more favourable and positive attitude and that familiarity increases amongst others the positivity, liking, attractiveness, appeal, preference and pleasantness, so that familiarity might be the cause as to why more participants choose visual design option 1 as visually more attractive (Bornstein & D'agostino, 1992; Imamoğlu & Imamoğlu, 2006; Zajonc, 1968).

Also, a change in different colours is overall more wanted than a gradual change of one colour. This can also be explained by participants' familiarity with the green-red-orange system, as many countries already use the green-red-orange system (also called traffic light system) to indicate the healthiness and nutritional values of a food product (Sacks et al., 2008; Schuldt, 2013). Moreover, a green-red-orange system is easier to interpret, as each of the colours has a specific association of which the meaning is already known by the participants. However, that participants choose a change in different colours as visually more attractive might therefore not only be because participants find a change in different colours visually more attractive, but because the participants especially prefer the change of

the colour set (green-orange-red) due to their familiarity with it and the ease of interpretation of this specific set of colours.

In the digital condition, the freshness date display option with a change in different colours is most often chosen as visually more attractive. Following, the number of days left display option with a change in different colours, number of days left display option with a gradual change of one colour and freshness date display option with a gradual change of one colour are chosen as visually more attractive. The choice between the date display options was quite similar. One reason why participants choose the freshness display option as visually more attractive is that this is similar to the contemporary method that is used to display shelf life date (NVWA, 2017). Therefore, the familiarity of the visual design might be the reason for participants to choose a certain visual design, as familiarity predicts more favourable and positive attitudes (Bornstein & D'agostino, 1992; Imamoğlu & Imamoğlu, 2006; Zajonc, 1968). One reason why participants choose the number of days left display option as visually more attractive is that with this option the participants do not need to have knowledge of the exact date, so especially for participants having no knowledge of exact dates this is convenient. Therefore, this makes interpretation of the number of days left design option easier and as participants have also chosen the visual design options based on ease of interpretation, this might be a reason why participants choose this option. Reasons why participants in the digital condition choose a change in different colours as visually more attractive is the same as in the directly visible condition, because of familiarity and ease of interpretation of the green-orange-red display.

Out of all participant, 2.03% are colour-blind. Most individuals whom are colour-blind cannot distinguish between the colours red and green because there is a reduced sensitivity to green light (also called deuteranomaly) (Mellott et al., 1999; Ridgen, 1999). As the visual design with a change in different colours contained the colours red and green, it is expected that participants with deuteranomaly will not choose the option with a change in different colours as visually more attractive. However, as 8.0% of Caucasian men and 0.4% of Caucasian women are colour-blind (Ridgen, 1999), participants with colour-blindness are not excluded from the study to better represent the research population.

5.6 Willingness to obtain extra information regarding a food product

Participants are most willing to obtain extra information regarding the storage conditions of a food product. Previous research has shown that a large part of consumers do not store their fresh food products properly, which amongst others is caused by the fact that consumers store their food products for too long, kept open when products should be closed, not in the correct place or at incorrect temperatures (Redmond & Griffith; 2003; Terpstra et al., 2005). Thus, there is an information gap between the proper storage conditions and consumers' knowledge, which might be a reason why participants are most willing to receive extra information regarding the storage conditions of a food

product. However, many consumers believe that their knowledge regarding the storage conditions of a food product is correct, even when this is not the case (Terpstra et al., 2005).

Participants then would like to receive extra information regarding recipes with the food product, following with extra information regarding the microbial quality of a food product.

Alerts when the shelf life is 3 days or less and information regarding the temperature profile of a food product are overall less wanted by the participants. One reason why receiving alerts when the shelf life is 3 days or less is less wanted is that consumers do not want to receive messages from the dynamic shelf life indicator, but want the information available whenever it is wanted (Köster, 2017).

Regarding the information about the temperature profile, one reason as to why this is less wanted is that the term "temperature profile" is not an everyday term for consumers and the term is more often used by scientists. Therefore, consumers are not familiar with it, which might be the reason for the low willingness to receive extra information regarding the temperature profile.

6 Conclusion

The research aim is to explore the consumer acceptance of directly visible and digital dynamic shelf life indicators and to explore whether the consumer acceptance is different between these two types of representations. Moreover, the aim of the research is to determine in which of the following institutions (the government, food manufacturers or food retailers) consumer trust is highest regarding the development and regulation of dynamic shelf life indicators.

The consumer acceptance of dynamic shelf life indicators is mainly determined by 4 different variables, namely the perceived visual attractiveness, perceived usefulness, perceived ease of use and perceived risk of the dynamic shelf life indicator. Also, design features and consumer trust indirectly influence consumer acceptance.

The perceived visual attractiveness and the perceived usefulness are significantly higher for the directly visible dynamic shelf life indicator compared to the digital dynamic shelf life indicator. The perceived ease of use and perceived risk show no significant differences between the two conditions. The consumer acceptance of the directly visible dynamic shelf life indicator is significantly higher than the digital dynamic shelf life indicator. Overall, the respondents are moderately positive about dynamic shelf life indicators, as the consumer acceptance in both the directly visible and the digital condition is ranged between neutral and positive consumer acceptance of dynamic shelf life indicators.

Consumer trust is influenced by the willingness to trust of the trustor and by the perceived ability, benevolence and integrity of the trustee. The consumer trust in the government, food manufacturers and food retailers show no significant difference when the dynamic shelf life indicator is represented either directly visible on labels or digitally. However, the consumer trust in food manufacturers is significantly higher than the consumer trust in the government and in food retailers. Overall, respondents are neutral to slightly positive about their trust in the government, food manufacturers and food retailers, as the consumer trust is ranged only slightly above a neutral consumer trust.

It can thus be concluded that dynamic shelf life indicators obtain highest consumer acceptance when they are represented directly visible on labels. Moreover, dynamic shelf life indicators should be introduced by food manufactures, as consumer trust is highest in them.

7 Limitations and recommendations

7.1 Methodological limitations and further research

7.1.1 Significantly more respondents with previous knowledge of the term "dynamic shelf life indicator" in the directly visible condition

First, the randomisation of the respondents' previous knowledge of the term "dynamic shelf life indicator" between the two conditions is not successful. Significantly more respondents in the directly visible condition have previous knowledge of the term "dynamic shelf life indicator" compared to respondents in the digital condition.

In this research, the effect of the unsuccessful randomisation of the respondents' previous knowledge of the term "dynamic shelf life indicator" does have an effect on the consumer acceptance of dynamic shelf life indicators. This is because the results show that previous knowledge of the term "dynamic shelf life indicator" results in higher consumer acceptance of dynamic shelf life indicators.

However, the effect of the unsuccessful randomisation of the previous knowledge of the term "dynamic shelf life indicator" on the consumer acceptance of dynamic shelf life indicators is expected to be small. The first reason for this is that the variable of previous knowledge consists of two parts, namely previous knowledge of the term "intelligent packaging" and previous knowledge of the term "dynamic shelf life indicator", and the previous knowledge of the term "intelligent packaging" is successfully randomised between the two conditions. So that the overall randomisation of the respondents' previous knowledge is only by one part unsuccessful. Moreover, there are also other variables that have an influence on the result of consumer acceptance, such as age, gender and technophobia. These variables are also well randomised between the two conditions, so the effect of one out of all variables to be unsuccessfully randomised is expected to be small on the outcome of consumer acceptance of dynamic shelf life indicators. Therefore, that the respondents in the directly visible condition have more previous knowledge of the term "dynamic shelf life indicator" is expected to not have an effect on the main conclusion drawn: that the consumer acceptance of dynamic shelf life indicators is significantly higher in the directly visible condition compared to the digital condition.

There are some methods that can be used in future research to correct or prevent the unsuccessful randomisation of the respondents' previous knowledge of the term "dynamic shelf life indicator". One often used method for balancing out the differences of a variable in two conditions is by adding a covariate into the data analysis. In this thesis however, it was chosen not to add a covariate. This is because the covariate (in our case previous knowledge of the term "dynamic shelf life indicator") and the treatment effect (in our case the condition) are not independent of each other. Previous research shows that when the covariate and treatment effect are not independent, putting previous knowledge

of the term "dynamic shelf life indicator" as covariate into the data analysis will not "balance out" the differences in the two conditions (Field, 2009; Lord, 1967; Lord, 1969).

By changing the research design from an independent samples design into a repeated measures design, the unsuccessful randomisation could have been prevented, as the same participant then answers questions for both conditions and thus the participants are exactly equal in both conditions (Field, 2009). However, this research design was not chosen in this study as there are drawbacks to it. The largest drawback is known as the order effect (Schuman & Presser, 1996). The order effect is related to the order in which the two conditions are represented to the respondent and are not caused by the different conditions. The score values might decrease due to boredom or might increase due to a preceding condition that the respondent interprets very negatively. There are however also solutions to control for order effects, for example counterbalancing (Campbell & Stanley, 1963; William et al., 2012), in which all possibilities of the treatment are randomly assigned to the participants in all possible orders (Kooiken et al., 2017). So, if counterbalancing the order is done successfully, doing a repeated measurement research might be a method to prevent the unsuccessful randomisation of the respondents' previous knowledge of the term "dynamic shelf life indicator" between the two conditions.

Moreover, in further research it is recommended to make a construct for the "previous knowledge" of the respondents. This way, the previous knowledge of respondents can be better studied, as all statements regarding previous knowledge which relate to dynamic shelf life indicators are then combined and all taken into account in one construct.

7.1.2 Research sample does not fully represent the research population

Second, the research sample does not fully represent the research population, as most participants in the research are students at a higher educational level and the gender of the research sample consists of 79.1% female, 20.3% male, 0.7% other gender (compared to 50.4% female and 49.6% male, which is approximately the gender distribution in The Netherlands (CBS, 2018)). For further research, it is recommended to conduct the consumer research at a larger scale and with a more diverse range of participants. Another possibility is to assign weights to each respondent, by using auxiliary information for the calibration. Participants in the under-represented group (in our case males) are weighted larger than 1, and participants in the over-represented group (in our case females) are weighted smaller than 1. By doing this weighting, the participants are made to represent the population better (Johnson, 2008).

7.1.3 Participants mainly related to Wageningen University

Third, the participants are recruited from either a database of Wageningen University or through social media networks, where a lot of participants are also from Wageningen University.

Overall, students and staff members from Wageningen are more concerned and familiar with novel food technologies and the environment, compared to individuals living in other cities in The Netherlands. Therefore, it can be that the acceptance of dynamic shelf life indicators is influenced by this, as individuals living in Wageningen are expected to generally hold a more open attitude towards new food technologies as they are more familiar with them, which would lead to a higher consumer acceptance. On the other hand, it can also be that due to this familiarity with new food technologies, individuals living in Wageningen are also more critical towards these technologies, which then has the opposite effect as just mentioned. For further research, it is therefore important to mainly focus the consumer research on individuals from other cities, and only recruit a few participants from Wageningen.

7.1.4 Limitations of the research method

Finally, the research method also has some limitations. By doing a quantitative research the results of this thesis are limited to provide only numerical descriptions about the dynamic shelf life indicators rather than detailed information and the data might thus not reflect on what the participant really feels about the dynamic shelf life indicator (Koedam, 2015). The results of quantitative research provide less detailed information regarding the behaviours, opinions and preferences of the respondents (Babbie, 2010). Moreover, it is important to realise that respondents self-report their opinion regarding dynamic shelf life indicators when using consumer questionnaires, so that "the answers from a consumer questionnaire do not always reflect actual behaviour" (Koedam, 2015, p10).

7.2 Theoretical contributions and suggestions for further research

This thesis extends on previous literature since it focuses on whether consumer acceptance is higher for directly visible or digital dynamic shelf life indicators, which to our knowledge has not been done before. Previous research is amongst others focused on product acceptance and perceived quality when using food products with a dynamic shelf life indicator (Schut, 2013), what information consumers wish to receive with intelligent packaging (Köster, 2017), consumers' willingness to pay for dynamic indication (Latvala & Kola, 2004), dynamic product quality based pricing for perishable food products (Li et al., 2006; Wang & Li, 2012) and the development of dynamic shelf life indicators to monitor the shelf life of food products (Brizio & Prentice, 2015; Brizio et al., 2015).

Acquiring knowledge on what factors influence consumer acceptance of dynamic shelf life indicators, which type of dynamic shelf life indicator has a higher consumer acceptance and which institution has the highest consumer trust regarding the development and regulation of dynamic shelf life indicators will be valuable information for researchers currently working on the development of dynamic shelf life

indicators. This because they can also take into account the consumers' side regarding dynamic shelf life indicators and by doing this the chance of successfully implementing dynamic shelf life indicators in the market increases. It is important that dynamic shelf life indicators are successfully introduced on the market as dynamic shelf life indicators are able to reduce confusion amongst consumers (Silvestre et al., 2011), reduce date margins and thereby reduce food waste, which is an important sustainability issue nowadays (Food and Agriculture Organisation, 2011).

This research focuses on dynamic shelf life indicators for highly perishable food products, as these products will benefit most from dynamic shelf life indicators (Heising et al., 2014). Highly perishable food products are currently labelled using a TGT labelling system, which consumers often see as an indicator of food safety (NVWA, 2017). However, it would also be highly interesting to study consumer acceptance of dynamic shelf life indicators for products which are currently labelled using a THT labelling system (for example milk or yoghurt). Consumer acceptance of dynamic shelf life indicators for THT products might differ from TGT products as consumers associate THT date labelling less with food safety, but with food quality (Soethoudt et al., 2012). This is expected to have an influence on the perceived risk of dynamic shelf life indicators, as food safety and food risk are very much related. Therefore, it would be highly interesting to see whether this will also influence consumer acceptance of dynamic shelf life indicators.

It will also be interesting to focus more deeply on the visual design of dynamic shelf life indicators in future research, as the visual attractiveness positively influences the consumer preference of an industrial product (Yamamoto & Lambert, 1994). In this research, only few visual designs are developed as an example to give consumers some idea about how dynamic shelf life indicators can visually look like. For further research, it is therefore highly interesting to focus the research only on the design aspect of dynamic shelf life indicators, as this, to our knowledge has not been done before. This way more creative, original and fascinating designs can be developed, which are terms that are positively related to visual attractiveness and therefore might influence consumer acceptance positively (Lavie & Tractinsky, 2004).

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Appendix 1: System Usability Scale (SUS)

The ten items of the system usability scale of Brooke (1996) are as follows:

1. I think that I would like to use this system frequently
2. I found the system unnecessarily complex
3. I thought the system was easy to use
4. I think that I would need the support of a technical person to be able to use this system
5. I found the various functions in this system were well investigated
6. I thought there was too much inconsistency in this system
7. I would imagine that most people would learn to use this system very quickly
8. I found the system very cumbersome to use
9. I felt very confident using the system
10. I needed to learn a lot of things before I could get going with this system

Appendix 2: Consumer questionnaire of dynamic shelf life indicators, directly visible representation, in English

Thank you for participating in my research. For my bachelor thesis for Wageningen University I am looking at alternatives for the shelf life date on packages of highly perishable foods. These alternatives are called dynamic shelf life indicators. The study will take about 10 minutes. Participating in this study is completely anonymous and you can stop your participation at any moment. If you have any questions regarding this study, you can contact jasmine.yeung@wur.nl.

By clicking on "I understand", you acknowledge that you have read the text above and will participate in this research.

- I understand

The questionnaire can be answered both with a computer as well as with a mobile phone. It is however recommended to fill in this questionnaire with a computer or laptop, as the images are clearer then.

For this study, packages of fresh fish will be shown. The dynamic shelf life indicators can however be applied for various types of highly perishable food products, not only for fresh fish.

In the next section, you will get a short explanation about dynamic shelf life indicators. Please read this information carefully.

Dynamic shelf life indicators are indicators that measure the exact shelf life of a food product. If changes in for example the temperature occur, the indicator can measure this. Subsequently the shelf life of a food product will be adjusted so that it shows the exact quality.

A dynamic shelf life indicator can be directly visible on food packages. There is no need of a mobile phone to see the shelf life of the product. A colour change then occurs, which is an indication of the quality of the food product.



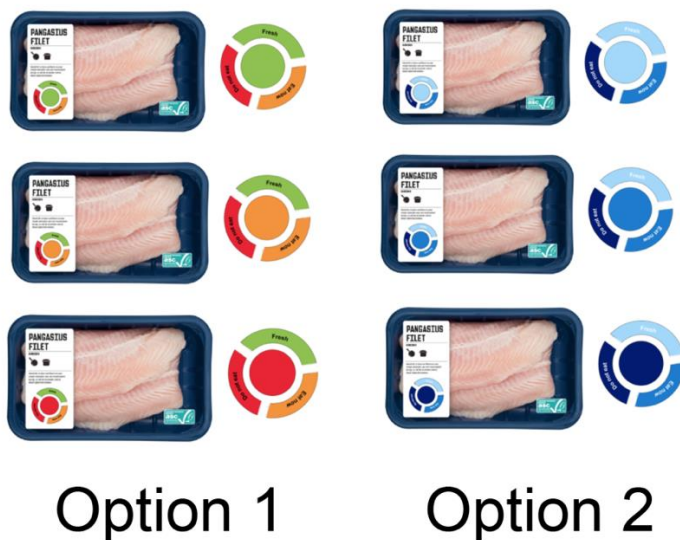
Q1: Imagine that today is **1 December 2017**. The fresh fish has a certain shelf life, after which it may not be consumed anymore.

Dynamic shelf life indicators can vary in their design. Please indicate which one of the following options you find visually more attractive.



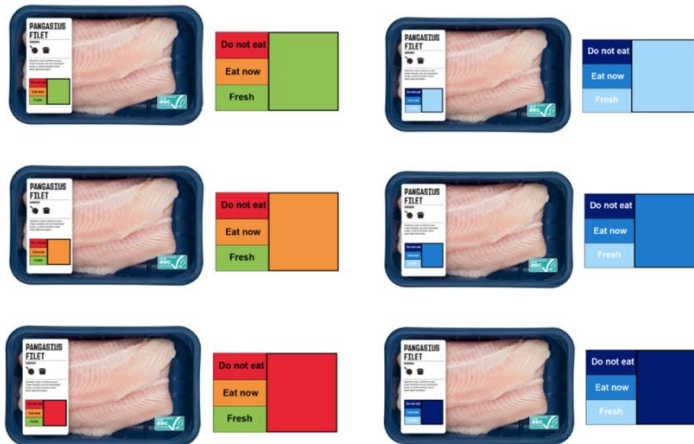
- Option 1
- Option 2

Q2a: Please indicate which one of the following options you find visually more attractive.



- Option 1: Display in different colours
- Option 2: A gradual change of one colour

Q2b: Please indicate which one of the following options you find visually more attractive.



Option 1

Option 2

- Option 1: Display in different colours
- Option 2: A gradual change of one colour

Imagine that the options that you have chosen are achieved.

Answer the following questions for the options that you have chosen.

Q3: Rate on a 7-point scale the following statements:

The dynamic shelf life indicator is

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Clear							
Pleasant							
Symmetrical							
Beautiful							
Original							
Sophisticated							
Fascinating							
Creative							

Q4: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
I think that I would like to use the dynamic shelf life indicator frequently							
I find the dynamic shelf life indicator unnecessarily complex							
I think the dynamic shelf life indicator will be easy to use							
I think that I would need the support of a technical person to be able to use the dynamic shelf life indicator							
I find that the various functions in the dynamic shelf life indicator are well investigated							
I think there is too much inconsistency in the dynamic shelf life indicator							
I will imagine that most people will learn to use the dynamic shelf life indicator very quickly							
I find the dynamic shelf life indicator very cumbersome to use							
I feel very confident using the dynamic shelf life indicator							
I need to learn a lot of things before I can get going with the dynamic shelf life indicator							

Q5: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Learning to operate the dynamic shelf life indicator will be easy for me							
I find it easy to get the dynamic shelf life indicator to do what it is supposed to do							
Interacting with the dynamic shelf life indicator will be clear and understandable							
Interacting with the dynamic shelf life indicator will be flexible							
It will be easy for me to become skilful at using the dynamic shelf life indicator							
I find the dynamic shelf life indicator easy to use							

Q6: Rate on a 7-point scale the following statement:

A dynamic shelf life indicator as information source of the shelf life of food products makes me feel:

Not at all concerned	Unconcerned	More or less unconcerned	Neither concerned nor unconcerned	More or less concerned	Concerned	Highly concerned

Q7: Rate on a 7-point scale the following statement:

The type of information provided about the shelf life of food products is:

Very unimportant	Unimportant	More or less unimportant	Neither important nor unimportant	More or less important	Important	Very important

Q8: Rate on a 7-point scale the following statement:

I think that a dynamic shelf life indicator is:

Extremely risky	Risky	More or less risky	Neither risky nor riskless	More or less riskless	Riskless	Extremely riskless

Q9: Rate on a 7-point scale the following statement:

Using a dynamic shelf life indicator regarding the shelf life of food products makes me feel:

Very worried	Worried	More or less worried	Neither secure nor worried	More or less secure	Secure	Very secure

Q10: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators:**

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
The government is very capable of performing its job							
The government is known to be successful at the things it does							
The government has much knowledge about the work that they do							
I feel very confident about the government's skills							
The government is well qualified							
The government is very concerned about my welfare							
My needs and desires are very important to the government							
The government would not knowingly do anything to harm me							
The government really looks out for what is important to me							
The government will go out of its way to help me							
The government has a strong sense of justice							
The government tries hard to be fair							
I like the government's values							
Sound principles seem to guide the government's behaviour							

Q11: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators**:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Food manufacturers are very capable of performing their job							
Food manufacturers are known to be successful at the things they do							
Food manufacturers have much knowledge about the work that they do							
I feel very confident about the food manufacturers' skills							
Food manufacturers are well qualified							
Food manufacturers are very concerned about my welfare							
My needs and desires are very important to food manufacturers							
Food manufacturers would not knowingly do anything to harm me							
Food manufacturers really look out for what is important to me							
Food manufacturers will go out of their way to help me							
Food manufacturers have a strong sense of justice							
Food manufacturers try hard to be fair							
I like the values of food manufacturers							
Sound principles seem to guide food manufacturers' behaviour							

Q12: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators:**

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Food retailers/ supermarkets are very capable of performing their job							
Food retailers/ supermarkets are known to be successful at the things they do							
Food retailers/ supermarkets have much knowledge about the work that they do							
I feel very confident about the food retailers' / supermarkets' skills							
Food retailers/ supermarkets are well qualified							
Food retailers/ supermarkets are very concerned about my welfare							
My needs and desires are very important to food retailers/ supermarkets							
Food retailers/ supermarkets would not knowingly do anything to harm me							
Food retailers/ supermarkets really look out for what is important to me							
Food retailers/ supermarkets will go out of their way to help me							
Food retailers/ supermarkets have a strong sense of justice							
Food retailers/ supermarkets try hard to be fair							
I like the values of food retailers/ supermarkets							
Sound principles seem to guide food retailers' / supermarkets' behaviour							

Q13: What is your age?

Q14: What is your gender?

- Male
- Female
- Other

Q15: Are you colour blind?

- Yes
- No

Q16: Have you heard of the term "intelligent packaging" before?

- Yes
- No

Q17: Have you heard of the term "dynamic shelf life indicator" before?

- Yes
- No

Q18: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
I would rather be safe than sorry when it comes to the shelf life of food products							
I want to be sure about the safety of a food product before I eat something							
I avoid risky things							
Being sure is an important concern in my life							
I feel apprehensive (afraid) about using technology							
I like to try new and different things							
I have avoided technology because it is unfamiliar to me							

This questionnaire is executed as part of my bachelor thesis at Wageningen University. Are you already registered at the database of FQD-consumer research of Wageningen University?

- Yes
- No

If you would like to participate in consumer research of Wageningen University in the future, please leave your e-mail address behind.

This is the end of the questionnaire. Thank you very much for participating in this research. At the moment, dynamic shelf life indicators are not yet available in The Netherlands. There is however much research going on regarding dynamic shelf life indicators.

Appendix 3: Consumer questionnaire of dynamic shelf life indicators, digital representation, in English

Thank you for participating in my research. For my bachelor thesis for Wageningen University I am looking at alternatives for the shelf life date on packages of highly perishable foods. These alternatives are called dynamic shelf life indicators. The study will take about 10 minutes. Participating in this study is completely anonymous and you can stop your participation at any moment. If you have any questions regarding this study, you can contact jasmine.yeung@wur.nl.

By clicking on "I understand", you acknowledge that you have read the text above and will participate in this research.

- I understand

The questionnaire can be answered both with a computer as well as with a mobile phone. It is however recommended to fill in this questionnaire with a computer or laptop, as the images are clearer then.

For this study, packages of fresh fish will be shown. The dynamic shelf life indicators can however be applied for various types of highly perishable food products, not only for fresh fish.

In the next section, you will get a short explanation about dynamic shelf life indicators. Please read this information carefully.

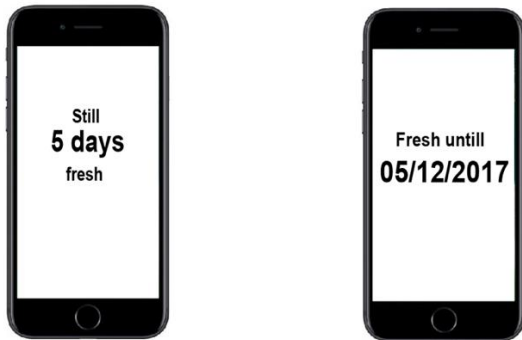
Dynamic shelf life indicators are indicators that measure the exact shelf life of a food product. If changes in for example the temperature occur, the indicator can measure this. Subsequently the shelf life of a food product will be adjusted so that it shows the exact quality.

A dynamic shelf life indicator can work in a digital way. A mobile phone is needed to obtain information about the shelf life. On the food packaging the shelf life is not directly shown, but a QR-code is shown. This code has to be scanned with a mobile phone, after which the shelf life will be represented on the screen of the mobile phone.



Q1: Imagine that today is **1 December 2017**. The fresh fish has a certain shelf life, after which it may not be consumed anymore.

Dynamic shelf life indicators can vary in their design. Please indicate which one of the following options you find visually more attractive.



- Option 1: days left display option
- Option 2: freshness date display option

Q2a: Please indicate which one of the following options you find visually more attractive.

- Option 1: Display with colour



- Option 2: Display without colour



Q2b: Please indicate which one of the following options you find visually more attractive.

- Option 1: Display with colour



- Option 2: Display without colour

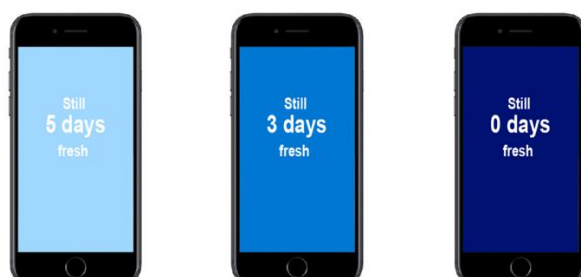


Q3a: Please indicate which one of the following options you find visually more attractive.

- Option 1: Display in different colours



- Option 2: A gradual change of one colour



Q3b: Please indicate which one of the following options you find visually more attractive.

- Option 1: Display in different colours



- Option 2: A gradual change of one colour



Imagine that the options that you have chosen are achieved.

Answer the following questions for the options that you have chosen.

Q4: Rate on a 7-point scale the following statements:

The dynamic shelf life indicator is

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Clear							
Pleasant							
Symmetrical							
Beautiful							
Original							
Sophisticated							
Fascinating							
Creative							

Q5: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
I think that I would like to use the dynamic shelf life indicator frequently							
I find the dynamic shelf life indicator unnecessarily complex							
I think the dynamic shelf life indicator will be easy to use							
I think that I would need the support of a technical person to be able to use the dynamic shelf life indicator							
I find that the various functions in the dynamic shelf life indicator are well investigated							
I think there is too much inconsistency in the dynamic shelf life indicator							
I will imagine that most people will learn to use the dynamic shelf life indicator very quickly							
I find the dynamic shelf life indicator very cumbersome to use							
I feel very confident using the dynamic shelf life indicator							
I need to learn a lot of things before I can get going with the dynamic shelf life indicator							

Q6: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Learning to operate the dynamic shelf life indicator will be easy for me							
I find it easy to get the dynamic shelf life indicator to do what it is supposed to do							
Interacting with the dynamic shelf life indicator will be clear and understandable							
Interacting with the dynamic shelf life indicator will be flexible							
It will be easy for me to become skilful at using the dynamic shelf life indicator							
I find the dynamic shelf life indicator easy to use							

Q7: Rate on a 7-point scale the following statement:

A dynamic shelf life indicator as information source of the shelf life of food products makes me feel:

Not at all concerned	Unconcerned	More or less unconcerned	Neither concerned nor unconcerned	More or less concerned	Concerned	Highly concerned

Q8: Rate on a 7-point scale the following statement:

The type of information provided about the shelf life of food products is:

Very unimportant	Unimportant	More or less unimportant	Neither important nor unimportant	More or less important	Important	Very important

Q9: Rate on a 7-point scale the following statement:

I think that a dynamic shelf life indicator is:

Extremely risky	Risky	More or less risky	Neither risky nor riskless	More or less riskless	Riskless	Extremely riskless

Q10: Rate on a 7-point scale the following statement:

Using a dynamic shelf life indicator regarding the shelf life of food products makes me feel:

Very worried	Worried	More or less worried	Neither secure nor worried	More or less secure	Secure	Very secure

Q11: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators:**

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
The government is very capable of performing its job							
The government is known to be successful at the things it does							
The government has much knowledge about the work that they do							
I feel very confident about the government's skills							
The government is well qualified							
The government is very concerned about my welfare							
My needs and desires are very important to the government							
The government would not knowingly do anything to harm me							
The government really looks out for what is important to me							
The government will go out of its way to help me							
The government has a strong sense of justice							
The government tries hard to be fair							
I like the government's values							
Sound principles seem to guide the government's behaviour							

Q12: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators**:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Food manufacturers are very capable of performing their job							
Food manufacturers are known to be successful at the things they do							
Food manufacturers have much knowledge about the work that they do							
I feel very confident about the food manufacturers' skills							
Food manufacturers are well qualified							
Food manufacturers are very concerned about my welfare							
My needs and desires are very important to food manufacturers							
Food manufacturers would not knowingly do anything to harm me							
Food manufacturers really look out for what is important to me							
Food manufacturers will go out of their way to help me							
Food manufacturers have a strong sense of justice							
Food manufacturers try hard to be fair							
I like the values of food manufacturers							
Sound principles seem to guide food manufacturers' behaviour							

Q13: Rate on a 7-point scale the following statements **in relation to the development and regulation of dynamic shelf life indicators**:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
Food retailers/ supermarkets are very capable of performing their job							
Food retailers/ supermarkets are known to be successful at the things they do							
Food retailers/ supermarkets have much knowledge about the work that they do							
I feel very confident about the food retailers' / supermarkets' skills							
Food retailers/ supermarkets are well qualified							
Food retailers/ supermarkets are very concerned about my welfare							
My needs and desires are very important to food retailers/ supermarkets							
Food retailers/ supermarkets would not knowingly do anything to harm me							
Food retailers/ supermarkets really look out for what is important to me							
Food retailers/ supermarkets will go out of their way to help me							
Food retailers/ supermarkets have a strong sense of justice							
Food retailers/ supermarkets try hard to be fair							
I like the values of food retailers/ supermarkets							
Sound principles seem to guide food retailers' / supermarkets' behaviour							

Q14: A dynamic shelf life indicator also offers other possibilities than the communication of the shelf life of a food product on your mobile phone.

Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
I would like to receive alerts from my mobile phone if the shelf life of a food product is less than 3 days							
I would like to receive extra information regarding the microbial quality of a food product.							
I would like to receive extra information regarding the temperature history of a food product.							
I would like to receive extra information regarding the storage conditions of a food product.							
I would like to receive extra information regarding recipes with a food product.							

Q15: What is your age?

Q16: What is your gender?

- Male
- Female
- Other

Q17: Are you colour blind?

- Yes
- No

Q18: Have you heard of the term "intelligent packaging" before?

- Yes
- No

Q19: Have you heard of the term "dynamic shelf life indicator" before?

- Yes
- No

Q20: Rate on a 7-point scale the following statements:

	Totally disagree	Disagree	More or less disagree	Neither agree nor disagree	More or less agree	Agree	Totally agree
I would rather be safe than sorry when it comes to the shelf life of food products							
I want to be sure about the safety of a food product before I eat something							
I avoid risky things							
Being sure is an important concern in my life							
I feel apprehensive (afraid) about using technology							
I like to try new and different things							
I have avoided technology because it is unfamiliar to me							

This questionnaire is executed as part of my bachelor thesis at Wageningen University. Are you already registered at the database of FQD-consumer research of Wageningen University?

- Yes
- No

If you would like to participate in consumer research of Wageningen University in the future, please leave your e-mail address behind.

This is the end of the questionnaire. Thank you very much for participating in this research. At the moment, dynamic shelf life indicators are not yet available in The Netherlands. There is however much research going on regarding dynamic shelf life indicators.

Appendix 4: Consumer questionnaire of dynamic shelf life indicators, directly visible representation, in Dutch

Fijn dat u wilt meewerken aan mijn onderzoek. Voor mijn bachelor scriptie van Wageningen University doe ik onderzoek naar alternatieven voor de houdbaarheidsdatum op verpakkingen van zeer bederfelijke producten. Deze alternatieven worden dynamische houdbaarheid indicatoren genoemd. Het onderzoek duurt ongeveer 10 minuten. Deelname aan dit onderzoek is volledig anoniem en indien gewenst kan er op elk moment gestopt worden met de deelname. Als u vragen heeft over dit onderzoek, kunt u jasmine.yeung@wur.nl contacteren.

Door te klikken op "Ik begrijp het", geeft u aan dat de bovenstaande tekst gelezen is en u graag wilt deelnemen aan dit onderzoek.

- Ik begrijp het

De vragenlijst kan zowel via de computer als op een mobiele telefoon beantwoord worden. Echter wordt het aangeraden de vragenlijst op een computer of laptop uit te voeren, omdat de afbeeldingen dan beter zichtbaar zijn.

Voor dit onderzoek worden verpakkingen van verse vis getoond. De dynamische houdbaarheid indicatoren kunnen echter gebruikt worden voor verschillende zeer bederfelijke producten, niet alleen voor verse vis.

In het volgende gedeelte krijgt u eerst een korte uitleg over dynamische houdbaarheid indicatoren. Lees deze uitleg zorgvuldig.

Dynamische houdbaarheid indicatoren zijn indicatoren die exact de houdbaarheid van een voedingsproduct meten. Als er veranderingen in bijvoorbeeld de temperatuur optreden, kan de indicator dit meten. Vervolgens wordt de houdbaarheid van een voedingsmiddel zodanig aangepast dat het exact de kwaliteit weergeeft.

Een dynamische houdbaarheidsindicator kan direct zichtbaar zijn op voedselverpakkingen. Er is hiervoor geen mobiele telefoon nodig om de houdbaarheid van het product te zien. Een kleurverandering treedt dan op, die een maat is voor de kwaliteit van het voedselproduct.



Q1: Stelt u zich voor dat het vandaag **1 December 2017** is. De verse vis heeft een bepaalde houdbaarheid, daarna mag hij niet meer geconsumeerd worden.

Dynamische houdbaarheid indicatoren kunnen verschillen in hun design. Geef aan welke van de volgende opties u visueel aantrekkelijker vindt.



Optie 1

Optie 2

- Optie 1
- Optie 2

Q2a: Geef aan welke van de onderstaande opties u visueel aantrekkelijker vindt.

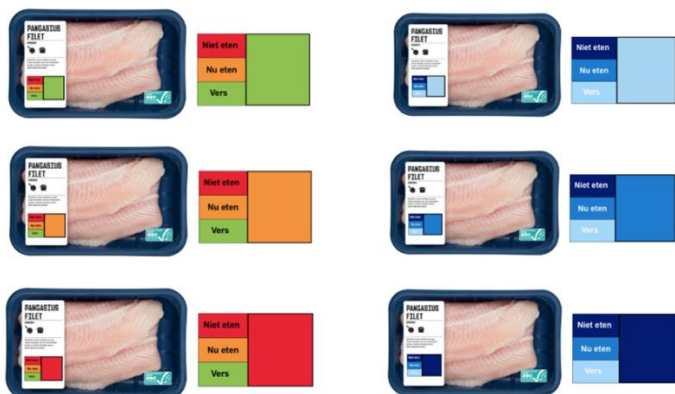


Optie 1

Optie 2

- Optie 1: Weergave in verschillende kleuren
- Optie 2: Een geleidelijke verandering van één kleur

Q2b: Geef aan welke van de onderstaande opties u visueel aantrekkelijker vindt.



Optie 1

Optie 2

- Optie 1: Weergave in verschillende kleuren
- Optie 2: Een geleidelijke verandering van één kleur

Stelt u zich voor dat de door u gekozen opties verwezenlijkt worden.

Beantwoord de volgende vragen voor de door u gekozen opties.

Q3: Beoordeel op een 7-puntenschaal de volgende uitspraken:

De dynamische houdbaarheid indicator is

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Duidelijk							
Aangenaam							
Symmetrisch							
Mooi							
Origineel							
Geavanceerd							
Fascinerend							
Creatief							

Q4: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Ik denk dat ik graag vaak de dynamische houdbaarheid indicator zou willen gebruiken							
Ik denk dat de dynamische houdbaarheid indicator onnodig ingewikkeld is							
Ik denk dat de dynamische houdbaarheid indicator makkelijk te gebruiken is							
Ik denk dat ik ondersteuning van een technisch persoon nodig heb om de dynamische houdbaarheid indicator te kunnen gebruiken							
Ik denk dat de functies in de dynamische houdbaarheid indicator goed onderzocht zijn							
Ik denk dat er te veel inconsistentie is in de werking van de dynamische houdbaarheid indicator							
Ik denk dat het leren gebruiken van de dynamische houdbaarheid indicator voor de meeste mensen snel zal gaan							
Ik denk dat de dynamische houdbaarheid indicator erg lastig te gebruiken is							
Ik voel mij zeker in het gebruik van de dynamische houdbaarheid indicator							
Ik moet veel dingen leren voordat ik aan de slag kan gaan met de dynamische houdbaarheid indicator							

Q5: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Leren om de dynamische houdbaarheid indicator te gebruiken zal voor mij gemakkelijk zijn							
Ik vind het gemakkelijk om de dynamische houdbaarheid indicator zijn functie te laten doen							
Interacteren met de dynamische houdbaarheid indicator zal duidelijk en begrijpelijk zijn							
Interacteren met de dynamische houdbaarheid indicator zal flexibel zijn							
Het zal voor mij gemakkelijk zijn om bekwaam te worden in het gebruik van de dynamische houdbaarheid indicator							
Ik vind de dynamische houdbaarheid indicator gemakkelijk in gebruik							

Q6: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Een dynamische houdbaarheid indicator als informatiebron over de houdbaarheid van voedingsproducten geeft me het volgende gevoel:

Helemaal niet bezorgd	Niet bezorgd	Een beetje onbezorgd	Noch bezorgd noch onbezorgd	Een beetje bezorgd	Bezorgd	Heel erg bezorgd

Q7: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Het type informatie dat wordt gegeven over de houdbaarheid van voedingsproducten is:

Helemaal niet belangrijk	Niet belangrijk	Een beetje onbelangrijk	Noch belangrijk noch onbelangrijk	Een beetje belangrijk	Belangrijk	Heel erg belangrijk

Q8: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Ik vind het toepassen van een dynamische houdbaarheid indicator:

Heel erg riskant	Riskant	Een beetje riskant	Noch risiceloos noch riskant	Een beetje risiceloos	Risiceloos	Helemaal risiceloos

Q9: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Het toepassen van een dynamische houdbaarheid indicator voor het aangeven van de houdbaarheid van voedingsproducten geeft me het volgende gevoel:

Heel erg ongerust	Ongerust	Een beetje ongerust	Noch gerust noch ongerust	Een beetje gerust	Gerust	Heel erg gerust

Q10: Beoordeel op een 7-puntenschaal de volgende uitspraken **in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:**

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
De overheid is erg bekwaam in de uitvoering van hun werk							
De overheid staat bekend als succesvol in de dingen die ze doet							
De overheid heeft veel kennis over het werk dat zij doet							
Ik ben erg zeker over de vaardigheden van de overheid							
De overheid is goed gekwalificeerd							
De overheid is erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de overheid							
De overheid zou niet bewust iets doen om mij te schaden							
De overheid houdt rekeningen met wat belangrijk is voor mij							
De overheid doet echt moeite om mij te helpen							
De overheid heeft een sterk gevoel van gerechtigheid							
De overheid doet zijn best om eerlijk te zijn							
Ik vind de normen en waarden van de overheid goed							
Fatsoenlijke principes lijken het gedrag van de overheid te leiden							

Q11: Beoordeel op een 7-puntenschaal de volgende uitspraken in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Producenten van levensmiddelen zijn erg bekwaam in de uitvoering van hun werk							
Producenten van levensmiddelen staan bekend als succesvol in de dingen die ze doen							
Producenten van levensmiddelen hebben veel kennis over het werk dat zij doen							
Ik ben erg zeker over de vaardigheden van de producenten van levensmiddelen							
Producenten van levensmiddelen zijn goed gekwalificeerd							
Producenten van levensmiddelen zijn erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de producenten van levensmiddelen							
Producenten van levensmiddelen zouden niet bewust iets doen om mij te schaden							
Producenten van levensmiddelen houden rekening met wat belangrijk is voor mij							
Producenten van levensmiddelen doen echt moeite om mij te helpen							
Producenten van levensmiddelen hebben een sterk gevoel van gerechtigheid							
Producenten van levensmiddelen doen hun best eerlijk te zijn							
Ik vind de normen en waarden van de producenten van levensmiddelen goed							
Fatsoenlijke principes lijken het gedrag van producenten van levensmiddelen te leiden							

Q12: Beoordeel op een 7-puntenschaal de volgende uitspraken in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
De retail sector/ supermarkten zijn erg bekwaam in de uitvoering van hun werk							
De retail sector/ supermarkten staan bekend als succesvol in de dingen die ze doen							
De retail sector/ supermarkten hebben veel kennis over het werk dat zij doen							
Ik ben erg zeker over de vaardigheden van de retail sector/ supermarkten							
De retail sector/ supermarkten zijn goed gekwalficeerd							
De retail sector/ supermarkten zijn erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de retail sector/ supermarkten							
De retail sector/ supermarkten zouden niet bewust iets doen om mij te schaden							
De retail sector/ supermarkten houden rekeningen met wat belangrijk is voor mij							
De retail sector/ supermarkten doen echt moeite om mij te helpen							
De retail sector/ supermarkten hebben een sterk gevoel van gerechtigheid							
De retail sector/ supermarkten doen hun best om eerlijk te zijn							
Ik vind de normen en waarden van de retail sector/ supermarkten goed							
Fatsoenlijke principes lijken het gedrag van de retail sector/ supermarkten te leiden							

Q13: Wat is uw leeftijd?

.....

Q14: Wat is uw geslacht?

- Man
- Vrouw
- Anders

Q15: Bent u kleurenblind?

- Ja
- Nee

Q16: Heeft u eerder van de term 'intelligente verpakking' gehoord?

- Ja
- Nee

Q17: Heeft u eerder van de term 'dynamische houdbaarheidsindicator' gehoord?

- Ja
- Nee

Q18: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Ik speel liever op zeker als het gaat over de houdbaarheid van voedingsproducten							
Ik wil zeker zijn over de veiligheid van een voedingsproduct voordat ik iets eet							
Ik vermijd riskante dingen							
Zeker zijn is belangrijk in mijn leven							
Ik voel me bevreesd (bang) over het gebruik van technologie							
Ik vind het leuk om nieuwe en verschillende dingen te proberen							
Ik ontwijk technologie omdat het onbekend is voor mij							

Deze vragenlijst is uitgevoerd als onderdeel van mijn bachelor scriptie bij Wageningen University. Staat u al ingeschreven bij de database van FQD-consumentenonderzoek van Wageningen University?

- Ja
- Nee

Als u ook graag aan andere consumentenonderzoeken van Wageningen University mee wilt doen, laat dan hier uw mailadres achter.

.....

Dit is het einde van de vragenlijst. Heel erg bedankt voor de deelname aan dit onderzoek. Op dit moment zijn dynamische houdbaarheid indicatoren nog niet op de Nederlandse markt verkrijgbaar. Er wordt echter momenteel veel onderzoek verricht naar dynamische houdbaarheid indicatoren.

Appendix 5: Consumer questionnaire of dynamic shelf life indicators, digital representation, in Dutch

Fijn dat u wilt meewerken aan mijn onderzoek. Voor mijn bachelor scriptie van Wageningen University doe ik onderzoek naar alternatieven voor de houdbaarheidsdatum op verpakkingen van zeer bederfelijke producten. Deze alternatieven worden dynamische houdbaarheid indicatoren genoemd. Het onderzoek duurt ongeveer 10 minuten. Deelname aan dit onderzoek is volledig anoniem en indien gewenst kan er op elk moment gestopt worden met de deelname. Als u vragen heeft over dit onderzoek, kunt u jasmine.yeung@wur.nl contacteren.

Door te klikken op "Ik begrijp het", geeft u aan dat de bovenstaande tekst gelezen is en u graag wilt deelnemen aan dit onderzoek.

- Ik begrijp het

De vragenlijst kan zowel via de computer als op een mobiele telefoon beantwoord worden. Echter wordt het aangeraden de vragenlijst op een computer of laptop uit te voeren, omdat de afbeeldingen dan beter zichtbaar zijn.

Voor dit onderzoek worden verpakkingen van verse vis getoond. De dynamische houdbaarheid indicatoren kunnen echter gebruikt worden voor verschillende zeer bederfelijke producten, niet alleen voor verse vis.

In het volgende gedeelte krijgt u eerst een korte uitleg over dynamische houdbaarheid indicatoren. Lees deze uitleg zorgvuldig.

Dynamische houdbaarheid indicatoren zijn indicatoren die exact de houdbaarheid van een voedingsproduct meten. Als er veranderingen in bijvoorbeeld de temperatuur optreden, kan de indicator dit meten. Vervolgens wordt de houdbaarheid van een voedingsmiddel zodanig aangepast dat het exact de kwaliteit weergeeft.

Een dynamische houdbaarheid indicator kan op een digitale manier werken. Hierbij is een mobiele telefoon nodig om de informatie te kunnen lezen. Op een voedselverpakking staat dan niet direct de houdbaarheid van het product, maar een QR-code. Deze code moet gescand worden met een mobiele telefoon, waarna op het scherm van de telefoon de houdbaarheid weergegeven wordt.



Q1: Stelt u zich voor dat het vandaag **1 December 2017** is. De verse vis heeft een bepaalde houdbaarheid, daarna mag hij niet meer geconsumeerd worden.

Dynamische houdbaarheid indicatoren kunnen verschillen in hun design. Geef aan welke van de volgende opties u visueel aantrekkelijker vindt.



Optie 1



Optie 2

- Optie 1: aantal dagen houdbaar weergave optie
- Optie 2: houdbaarheidsdatum weergave optie

Q2a: Geef aan welke van de volgende opties u visueel aantrekkelijker vindt.

- Optie 1: Weergave met kleur



- Optie 2: Weergave zonder kleur



Q2b: Geef aan welke van de onderstaande opties u visueel aantrekkelijker vindt.

- Optie 1: Weergave met kleur



- Optie 2: Weergave zonder kleur



Q3a: Geef aan welke van de volgende opties u visueel aantrekkelijker vindt.

- Optie 1: Weergave in verschillende kleuren



- Optie 2: Een geleidelijke verandering van één kleur



Q3b: Geef aan welke van de volgende opties u visueel aantrekkelijk vindt.

- Optie 1: Weergave in verschillende kleuren



- Optie 2: Een geleidelijke verandering van één kleur



Stelt u zich voor dat de door u gekozen opties verwezenlijkt worden.

Beantwoord de volgende vragen voor de door u gekozen opties.

Q4: Beoordeel op een 7-puntenschaal de volgende uitspraken:

De dynamische houdbaarheid indicator is

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Duidelijk							
Aangenaam							
Symmetrisch							
Mooi							
Origineel							
Geavanceerd							
Fascinerend							
Creatief							

Q5: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Ik denk dat ik graag vaak de dynamische houdbaarheid indicator zou willen gebruiken							
Ik denk dat de dynamische houdbaarheid indicator onnodig ingewikkeld is							
Ik denk dat de dynamische houdbaarheid indicator makkelijk te gebruiken is							
Ik denk dat ik ondersteuning van een technisch persoon nodig heb om de dynamische houdbaarheid indicator te kunnen gebruiken							
Ik denk dat de functies in de dynamische houdbaarheid indicator goed onderzocht zijn							
Ik denk dat er te veel inconsistentie is in de werking van de dynamische houdbaarheid indicator							
Ik denk dat het leren gebruiken van de dynamische houdbaarheid indicator voor de meeste mensen snel zal gaan							
Ik denk dat de dynamische houdbaarheid indicator erg lastig te gebruiken is							
Ik voel mij zeker in het gebruik van de dynamische houdbaarheid indicator							
Ik moet veel dingen leren voordat ik aan de slag kan gaan met de dynamische houdbaarheid indicator							

Q6: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Leren om de dynamische houdbaarheid indicator te gebruiken zal voor mij gemakkelijk zijn							
Ik vind het gemakkelijk om de dynamische houdbaarheid indicator zijn functie te laten doen							
Interacteren met de dynamische houdbaarheid indicator zal duidelijk en begrijpelijk zijn							
Interacteren met de dynamische houdbaarheid indicator zal flexibel zijn							
Het zal voor mij gemakkelijk zijn om bekwaam te worden in het gebruik van de dynamische houdbaarheid indicator							
Ik vind de dynamische houdbaarheid indicator gemakkelijk in gebruik							

Q7: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Een dynamische houdbaarheid indicator als informatiebron over de houdbaarheid van voedingsproducten geeft me het volgende gevoel:

Helemaal niet bezorgd	Niet bezorgd	Een beetje onbezorgd	Noch bezorgd noch onbezorgd	Een beetje bezorgd	Bezorgd	Heel erg bezorgd

Q8: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Het type informatie dat wordt gegeven over de houdbaarheid van voedingsproducten is:

Helemaal niet belangrijk	Niet belangrijk	Een beetje onbelangrijk	Noch belangrijk noch onbelangrijk	Een beetje belangrijk	Belangrijk	Heel erg belangrijk

Q9: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Ik vind het toepassen van een dynamische houdbaarheid indicator:

Heel erg riskant	Riskant	Een beetje riskant	Noch risicoloos noch riskant	Een beetje risicoloos	Risicoloos	Helemaal risicoloos

Q10: Beoordeel op een 7-puntenschaal de volgende uitspraak:

Het toepassen van een dynamische houdbaarheid indicator voor het aangeven van de houdbaarheid van voedingsproducten geeft me het volgende gevoel:

Heel erg ongerust	Ongerust	Een beetje ongerust	Noch gerust noch ongerust	Een beetje gerust	Gerust	Heel erg gerust

Q11: Beoordeel op een 7-puntenschaal de volgende uitspraken **in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:**

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
De overheid is erg bekwaam in de uitvoering van hun werk							
De overheid staat bekend als succesvol in de dingen die ze doet							
De overheid heeft veel kennis over het werk dat zij doet							
Ik ben erg zeker over de vaardigheden van de overheid							
De overheid is goed gekwalificeerd							
De overheid is erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de overheid							
De overheid zou niet bewust iets doen om mij te schaden							
De overheid houdt rekeningen met wat belangrijk is voor mij							
De overheid doet echt moeite om mij te helpen							
De overheid heeft een sterk gevoel van gerechtigheid							
De overheid doet zijn best om eerlijk te zijn							
Ik vind de normen en waarden van de overheid goed							
Fatsoenlijke principes lijken het gedrag van de overheid te leiden							

Q12: Beoordeel op een 7-puntenschaal de volgende uitspraken **in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:**

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Producenten van levensmiddelen zijn erg bekwaam in de uitvoering van hun werk							
Producenten van levensmiddelen staan bekend als succesvol in de dingen die ze doen							
Producenten van levensmiddelen hebben veel kennis over het werk dat zij doen							
Ik ben erg zeker over de vaardigheden van de producenten van levensmiddelen							
Producenten van levensmiddelen zijn goed gekwalificeerd							
Producenten van levensmiddelen zijn erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de producenten van levensmiddelen							
Producenten van levensmiddelen zouden niet bewust iets doen om mij te schaden							
Producenten van levensmiddelen houden rekening met wat belangrijk is voor mij							
Producenten van levensmiddelen doen echt moeite om mij te helpen							
Producenten van levensmiddelen hebben een sterk gevoel van gerechtigheid							
Producenten van levensmiddelen doen hun best eerlijk te zijn							
Ik vind de normen en waarden van de producenten van levensmiddelen goed							
Fatsoenlijke principes lijken het gedrag van producenten van levensmiddelen te leiden							

Q13: Beoordeel op een 7-puntenschaal de volgende uitspraken **in relatie tot de ontwikkeling van, en de regelgeving over dynamische houdbaarheid indicatoren:**

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
De retail sector/ supermarkten zijn erg bekwaam in de uitvoering van hun werk							
De retail sector/ supermarkten staan bekend als succesvol in de dingen die ze doen							
De retail sector/ supermarkten hebben veel kennis over het werk dat zij doen							
Ik ben erg zeker over de vaardigheden van de retail sector/ supermarkten							
De retail sector/ supermarkten zijn goed gekwatificeerd							
De retail sector/ supermarkten zijn erg bezorgd over mijn welzijn							
Mijn behoeftes en verlangens zijn erg belangrijk voor de retail sector/ supermarkten							
De retail sector/ supermarkten zouden niet bewust iets doen om mij te schaden							
De retail sector/ supermarkten houden rekeningen met wat belangrijk is voor mij							
De retail sector/ supermarkten doen echt moeite om mij te helpen							
De retail sector/ supermarkten hebben een sterk gevoel van gerechtigheid							
De retail sector/ supermarkten doen hun best om eerlijk te zijn							
Ik vind de normen en waarden van de retail sector/ supermarkten goed							
Fatsoenlijke principes lijken het gedrag van de retail sector/ supermarkten te leiden							

Q14: Een dynamische houdbaarheid indicator biedt ook andere mogelijkheden, dan het aangeven van de houdbaarheid van het voedingsproduct op uw mobiele telefoon.

Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Ik zou graag alerts willen ontvangen op mijn mobiele telefoon als de houdbaarheidsdatum van het voedingsmiddel minder dan 3 dagen is							
Ik zou graag extra informatie willen ontvangen over de microbiologische kwaliteit van het voedingsmiddel							
Ik zou graag extra informatie willen ontvangen over de temperatuurhistorie van het voedingsmiddel							
Ik zou graag extra informatie willen ontvangen over de optimale bewaarcondities van het voedingsmiddel							
Ik zou graag extra informatie willen ontvangen over recepten met het voedingsmiddel							

Q15: Wat is uw leeftijd?

.....

Q16: Wat is uw geslacht?

- Man
- Vrouw
- Anders

Q17: Bent u kleurenblind?

- Ja
- Nee

Q18: Heeft u eerder van de term 'intelligente verpakking' gehoord?

- Ja
- Nee

Q19: Heeft u eerder van de term 'dynamische houdbaarheidsindicator' gehoord?

- Ja
- Nee

Q20: Beoordeel op een 7-puntenschaal de volgende uitspraken:

	Helemaal mee oneens	Oneens	Een beetje oneens	Noch eens noch oneens	Een beetje eens	Eens	Helemaal mee eens
Ik speel liever op zeker als het gaat over de houdbaarheid van voedingsproducten							
Ik wil zeker zijn over de veiligheid van een voedingsproduct voordat ik iets eet							
Ik vermijd riskante dingen							
Zeker zijn is belangrijk in mijn leven							
Ik voel me bevreesd (bang) over het gebruik van technologie							
Ik vind het leuk om nieuwe en verschillende dingen te proberen							
Ik ontwikkel technologie omdat het onbekend is voor mij							

Deze vragenlijst is uitgevoerd als onderdeel van mijn bachelor scriptie bij Wageningen University. Staat u al ingeschreven bij de database van FQD-consumentenonderzoek van Wageningen University?

- Ja
- Nee

Als u ook graag aan andere consumentenonderzoeken van Wageningen University mee wilt doen, laat dan hier uw mailadres achter.

.....

Dit is het einde van de vragenlijst. Heel erg bedankt voor de deelname aan dit onderzoek. Op dit moment zijn dynamische houdbaarheid indicatoren nog niet op de Nederlandse markt verkrijgbaar. Er wordt echter momenteel veel onderzoek verricht naar dynamische houdbaarheid indicatoren.

Appendix 6: Scale reliability of the different constructs

Construct	Cronbach's alpha	Number of items
Visual attractiveness	0.810	8
Perceived usefulness	0.802	10
Perceived ease of use	0.769	6
Perceived risk (before improvement)	0.623	4
Perceived risk (after improvement)	0.789	3
Consumer acceptance (with consumer trust)	0.658	7
Consumer acceptance	0.746	4
Consumer trust in the government	0.937	14
Consumer trust in food manufacturers	0.919	14
Consumer trust in food retailers	0.922	14
Uncertainty avoidance	0.768	4
Technophobia (before improvement)	0.678	3
Technophobia (after improvement)	0.796	2

Appendix 7: Normality test results (Shapiro-Wilk)

Construct	Condition	Statistic	df	Sig.
Perceived visual attractiveness	Directly visible	0.825	75	0.000***
	Digital	0.902	73	0.000***
Perceived usefulness	Directly visible	0.973	75	0.112
	Digital	0.986	73	0.589
Perceived ease of use	Directly visible	0.971	75	0.082
	Digital	0.961	73	0.025*
Perceived risk	Directly visible	0.952	75	0.006**
	Digital	0.959	73	0.019*
Consumer acceptance	Directly visible	0.975	75	0.148
	Digital	0.987	73	0.636
Consumer trust in the government	Directly visible	0.972	75	0.096
	Digital	0.970	73	0.082
Consumer trust in food manufacturers	Directly visible	0.970	75	0.076
	Digital	0.970	73	0.082
Consumer trust in food retailers	Directly visible	0.914	75	0.000***
	Digital	0.987	73	0.669
Uncertainty avoidance	Directly visible	0.966	75	0.042*
	Digital	0.967	73	0.055
Technophobia	Directly visible	0.830	75	0.000***
	Digital	0.773	73	0.000***

* $\alpha < 0.05$ ** $\alpha < 0.01$ *** $\alpha < 0.001$