







The ambiguity of E-numbers: Consumer insights

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ABSTRACT

Aim. E-numbers can be seen as a way to regulate food additives and are typically avoided by consumers because they have negative attitudes towards them. There is currently little scientific research on what factors influence consumers' perceived and actual behaviour regarding E-numbers. Therefore, the aim of this research is to examine what factors influence Dutch consumers' attitudes and product choices regarding E-numbers. Ultimately, the goal is to provide helpful suggestions to the government and food producers for communicating E-numbers on nutrition labels, and to help consumers make informed food choices.

Methods. An online survey was performed to investigate what factors influence consumers' attitudes and taste expectations (*N* = 193). An eye tracking study was held to examine consumers' product choices and attention to nutrition labels regarding E-numbers (*N* = 20), in which participants chose one out of nine drink yogurt packages. Participants saw all packages, which differed in brand (Campina, Melkunie, Vifit) and nutrition label (E-number full out, E-number, no E-number).

Results. Results of the survey indicate that consumers have negative attitudes towards E-numbers, attitudes influence taste expectation, and trust in food producers influences attitudes. The more people one lives with in a household moderates the effect of concerns on attitudes. Results of the eye tracking study show that consumers avoid E-numbers. E-number full out labels and no E-number labels were chosen equal times by consumers, and most attention was paid to E-number full out labels.

Conclusions. Consumers' attitudes towards E-numbers remain negative and they continue to avoid E-numbers. Consumers' attitudes influence their taste expectations, and only half of them have correct knowledge regarding E-numbers. This makes it likely that consumers still base their knowledge regarding E-numbers on misconceptions. Consumers do not seem to fully understand nutrition labels, because they avoid E-number labels but do not avoid E-number full out labels.

Implications. Food producers should use the full out names of E-numbers on nutrition labels instead of E-numbers.

Keywords*: Consumer behaviour, consumers' attitudes, attention, eye tracking, food additives, E-numbers, nutrition labels, taste perception*

TABLE OF CONTENT

1. INTRODUCTION

E-numbers in food can be seen as a way to regulate food additives, and were introduced in 1988 to encourage "a free and fair market of safe food products" within the European Union (EU) (Haen, 2014, p. 28). Applying the E-number system to every country in the EU makes it possible to regulate food additives conveniently for all European food producers. Besides, E-numbers are a means to provide information about food additives to consumers by displaying E-numbers on nutrition labels (Haen, 2014). Food additives "are substances added to food to maintain or improve its safety, freshness, taste, texture, or appearance" (World Health Organization, 2018, para. 1). The difference between E-numbers and food additives is that food additives are always added to food, whereas E-numbers are labels for ingredients which can also exist in food naturally (Paans, 2013). Well-known E-number categories include: colourants, sweeteners, citric acid, glucose, flavour enhancers, and preservatives (Kayışoğlu & Coşkun, 2016; Shim et al., 2011). There are many different categories of E-numbers, because they can be used for various technological functions, such as "to colour, to sweeten, or to help preserve food" (EFSA, 2019, para. 1).

1.1. Consumers' attitudes towards E-numbers

Despite the beneficial functions of E-numbers, consumers usually view them as unnatural and artificial, and they tend to avoid them (Paans, 2013). A so-called boomerang effect has appeared: although E-numbers are regulated by the European Food Safety Authority (EFSA) and extensively tested by scientists, consumers' attitudes towards E-numbers are negative and they intend to avoid E-numbers anyway (Paans, 2013; Tarnavölgyi, 2003). As improving taste is one function of E-numbers (World Health Organization, 2018), it is also expected that consumers' negative attitudes towards E-numbers influence their taste expectation when they know the product contains E-numbers.

Consumer behaviour is constantly changing; nowadays consumers increasingly prefer healthy food (Nathalia, Kansius, Felicia, & Kalpikasari, 2017). Especially on online media, (un)healthy ingredients and their possible effects after consumption are frequently discussed. For example, the discussion whether consumers should eat red meat or not (AD, 2019), or whether or not processed foods are bad (Broersma, 2019; Seidell & Halberstadt, 2019). Therefore, it seems likely that consumers' increasing health involvement is one of the explanations why consumers have negative attitudes towards E-numbers. Although consumers do not believe E-numbers fit in a healthy lifestyle (Paans, 2013), there is no harm in consuming E-numbers because E-numbers are frequently tested by scientists before they are approved and therefore safe.

Another possible explanation for consumers' negative attitudes is their lack of knowledge and the misconceptions they have regarding E-numbers (Tarnavölgyi, 2003). Misconceptions consumers have are likely based on online articles and blogs that are not supported by scientific

research, but do get a lot of media attention. It is possible that consumers base their knowledge on these common misconceptions, such as that E-numbers are toxic (Anilakumar, Gopalan, & Sharma, 2017; Kayışoğlu & Coşkun, 2016; Shim et al., 2011). However, providing more information regarding E-numbers to consumers is likely not enough. Prior research shows that consumers' attitudes and purchase intentions do not significantly change when consumers gain more information regarding E-numbers (Paans, 2013). Therefore, it is important to further investigate how to communicate E-numbers.

Other possible reasons for consumers' negative attitudes towards E-numbers are that E-numbers are ranked highly among consumers' food safety concerns (Behrens et al., 2010; Gunes & Deniz Tekin, 2006; Liu & Niyongira, 2017; Resurreccion, Galvez, Fletcher, & Misra, 1995), and that they have little trust in the government and food producers (Haen, 2014). The several food crises in the past years are expected to have caused these concerns and the lack of trust in the government and food producers (Brewer & Rojas, 2008; Rampl, Eberhardt, Schütte, & Kenning, 2012), which makes it evident that both the government and food producers play an important role in the context of E-numbers in food. Currently, food producers respond to consumers' preferences by increasingly leaving out E-numbers on nutrition labels. The full name of an additive is included instead, such as 'citric acid' instead of 'E330'. This phenomenon is known as a 'clean label' policy (Saltmarsh, 2015; Voedingscentrum, n.d.).

1.2. Consumers' product choice regarding E-numbers

Although consumers' food choices are not always made consciously (Ares, Mawad, Giménez, & Maiche, 2014), their attention is required to understand what is listed on nutrition labels (Walters & Long, 2012). Prior research shows that attention to nutrition labels mediates consumers' food product choices (Bialkova et al., 2014), but little is known about the influence of their attention to nutrition labels on their product choice with regard to E-numbers. This needs further research in order to improve communication regarding E-numbers on nutrition labels and is therefore included in this research. Another factor that influences consumers' product choices is familiarity with brands. If consumers' are familiar with the brand of a product, this will strongly influence their product choice (Ares et al., 2014, Bower et al, 2003, Carneiro et al., 2005, & Deliza & MacFie, 2001 in Paasovaara, Luomala, Pohjanheimo, & Sandell, 2012). The taste of products also needs to be taken into account when it comes to E-numbers as it is one main reason why E-numbers are added to food (World Health Organization, 2018), and consumers base their food choices on taste (Velema, Vyth, & Steenhuis, 2019). To my knowledge, differences in taste perception between products with and without E-numbers have not been studied before. Regardless of consumers' intention to buy or avoid

E-numbers, E-numbers are frequently used or even naturally present in food which makes it nearly impossible to avoid them all-together (Hartemink, 2010).

1.3. Expectations in this research

To sum up, this research aims to investigate what factors influence consumers' attitudes and behaviour in the context of E-numbers in food in The Netherlands. Therefore, two studies will be held in which two models will be tested: one for the survey and one for the eye tracking study. In the survey, consumers' attitudes towards E-numbers, taste expectation, and factors that influence these will be further investigated. Besides, what knowledge consumers have regarding E-numbers will be studied. In the eye tracking study, the focus will be on consumers' attention to nutrition labels, the actual product choices they make regarding E-numbers, and their taste perception. Performing these studies will help present useful suggestions to the government and food producers for communicating E-numbers on nutrition labels, and help consumers in making informed food choices. This leads us to the following main research questions:

'What factors influence consumers' attitudes and taste expectation, and what knowledge do they have in the context of E-numbers in food in The Netherlands? (survey)'

'To what extent do consumers base their product choices on attention to nutrition labels, how does this influence their taste perception, and how do consumers pay attention to nutrition labels in the context of E-numbers in food in The Netherlands? (eye tracking)'

2. THEORETICAL FRAMEWORK

This research aims to investigate perceptions consumers have towards E-numbers and the way consumers use E-number labels. The purpose is to provide helpful suggestions to the government and food producers for displaying nutrition information, and to help consumers in making informed food choices. To gain a better understanding of variables playing a role in consumer perceptions and behaviour in the context of E-numbers, a theoretical framework has been set up. First, the Elaboration Likelihood Model (ELM) and the Theory of Planned Behaviour (TPB) will be explained and combined in one model. Next, the gap between perceived and actual behaviour within the context of E-numbers will be elaborated on. To further investigate this gap in the context of E-numbers, the variables have been combined into a conceptual model which consists of two parts: (1) the environment in which attitudes towards E-numbers are formed, and (2) making an actual product choice. In these paragraphs, the variables and the relations between them will be explained.

2.1 Elaboration Likelihood Model (ELM)

The ELM can be used to predict and describe changes in attitudes. It focuses on persuasion and attitude change, for which two routes have been described (Petty & Cacioppo, 1986). The two routes are called the central and peripheral route. The central route is one that "likely resulted from a person's careful and thoughtful consideration of the true merits of the information presented in support of an advocacy" (Petty & Cacioppo, 1986, p. 125). For this route one's attention to information is required. The peripheral route is one "which more likely occurred as a result of some simple cue in the persuasion context, [and which] induced change without necessitating scrutiny of the true merits of the information presented" (Petty & Cacioppo, 1986, p. 125). For the second route, one may get distracted and as a result one may pay less attention to information. A difference between these two routes of persuasion is the consequences they have. As Petty and Cacioppo (1986) state: "attitude changes via the central route appear to be more persistent, resistant, and predictive of behaviour than changes induced via the peripheral route"(p. 191).

There are two important determinants when it comes to what extent the central and/or peripheral route are followed: motivation and ability (Petty & Cacioppo, 1986). Whether or not one's motivation is high, depends on one's personal relevance towards an issue. Personal relevance means that one is highly involved in an issue (Petty & Cacioppo, 1979). One's extent of ability relates to distractions and prior knowledge at the moment of decision-making (Petty & Cacioppo, 1986). Both motivation and ability influence what route is followed and therefore one's level of attention.

Applied to the context of E-numbers in food, motivation could translate to health involvement and ability could indicate accurate knowledge consumers have regarding E-numbers (see Figure 1). It is expected that as long as consumers are highly involved in their health, and have

accurate knowledge regarding E-numbers, they are more likely to follow the central route of persuasion resulting in a high level of attention (Celsi & Olson, 1988; Petty & Cacioppo, 1979). However, when consumers have a low level of health involvement and inaccurate knowledge regarding E-numbers, it is expected that they are more likely to follow the peripheral route of persuasion resulting in a low level of attention (Petty & Cacioppo, 1979). Based on the ELM, consumers are more likely to change their general attitudes towards E-numbers, which are currently negative (Tarnavölgyi, 2003), when their motivation and ability to process information is high (Petty & Cacioppo, 1979). As there is currently little scientific research on how consumers pay attention to E-numbers on nutrition labels, this research will contribute to filling this gap.

2.2. Theory of Planned Behaviour (TPB)

Whereas the ELM can help explain how consumers keep or change their attitudes towards E-numbers, the TPB has been added to focus on predicting consumers' actual behaviour as well. The TPB has been frequently used before to predict one's intention to perform behaviour, using the following three variables: one's attitude toward the behaviour, subjective norm, and perceived behavioural control (Ajzen, 1991). Attitudes are "the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p. 188). Ajzen (1991) states that "attitudes have significant impact on intentions" (p. 189), and multiple studies conclude that it is indeed an important predictor of behaviour (Ajzen, 1991; Bredahl, 2001; Saba & Vassallo, 2002; Wilcock, Pun, Khanona, & Aung, 2004). What directly influences one's attitude toward the behaviour are one's behavioural beliefs regarding that behaviour (Ajzen, 1991). Besides attitudes towards the behaviour, subjective norm influences one's behaviour. Subjective norm can be defined as "the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). According to the TPB, behaviour is influenced by one's perceived behavioural control, which is "the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles" (Ajzen, 1991, p. 188).

Taking the context of E-numbers in food into account, behaviour relates to making food choices (see Figure 1). Consumers can either buy or avoid food products with E-number labels. Currently, research indicates that consumers tend to avoid E-numbers (Paans, 2013), but little is known about what factors influence this behaviour. A possible explanation based on the TPB is the beliefs consumers have regarding E-numbers, which directly influence their attitudes towards E-numbers (Ajzen, 1991). Therefore, consumers' concerns regarding E-numbers and their trust in the government and food producers are included as variables in this research, which are expected to be partially responsible for forming their attitudes towards E-numbers. An example of subjective norm would be that a consumer does not buy a certain product because their relatives said it was a bad

product. Subjective norm is not included in this research, as this research focuses on consumers individually and because of that social pressure is not expected to be a main factor. An example of perceived behavioural control is shown if a consumer intends to avoid E-numbers, but still buys food products with E-numbers because they feel like they lack knowledge of E-numbers to make an informed food choice. As perceived behavioural control reflects past experience (Ajzen, 1991), familiarity with a food brand is included in this research as well. This research adds to prior research by studying what variables influence consumers' attitudes towards E-numbers, and what food choices consumers make regarding products with and without E-numbers. Figure 1 provides an overview of the included variables based on the ELM and the TPB.

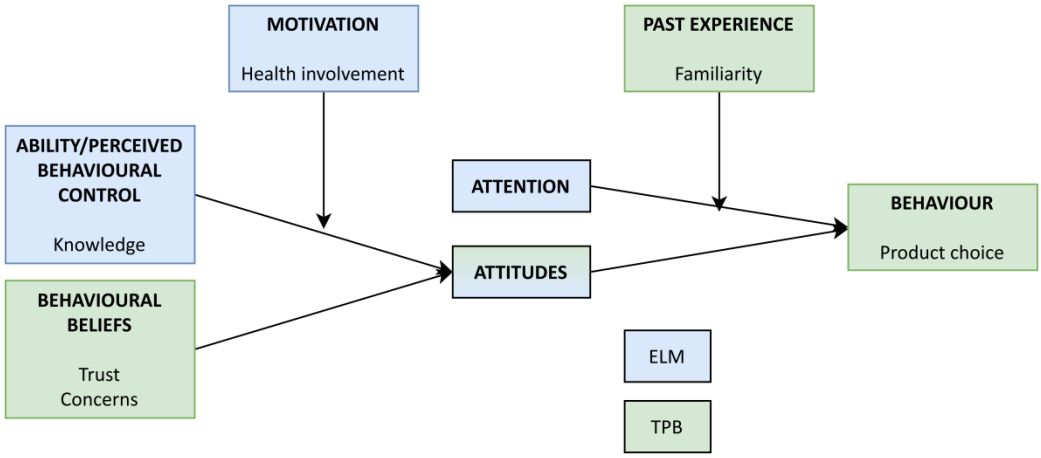

Figure 1. Visual representation of combining the ELM and TPB

2.3. The gap between perceived and actual behaviour within the context of E-numbers

The gap between attitudes and concerns regarding food choices, and making food choices has been identified in the food safety context before (Rimal, Fletcher, McWatters, Misra, & Deodhar, 2001). Consumers' negative attitudes towards E-numbers may make them reluctant to buy certain products, as one would expect based on the TPB. However, the same attitudes may also cause them to not change their behaviour at all (Rimal et al., 2001). For example, Ababio, Adi, and Amoah (2012) found that consumers in Ghana were concerned about buying expired products, but would still buy expired products. Possible explanations for the gap between attitudes and behaviour are "personal shortcomings such as a lack of time or money" (Worsfold & Griffith, 1997, as cited in Wilcock et al., 2004, p. 62), insufficient labelling on products, or lack of knowledge (Davies & Wright, 1994, as cited in Grujić, Grujić, Petrović, & Gajić, 2013). Other explanations for the gap between attitudes and behaviour could be consumers' lack of attention to nutrition labels and the influence of familiarity with food products, causing them not to properly think about their food choices. The possible gap between perceived and actual behaviour has not been studied before for Dutch consumers within the context of E-numbers, and is therefore included in this study.

2.4. The environment in which attitudes towards E-numbers are formed

2.4.1. Taste expectation

As one of the functions of E-numbers is to enhance the taste of products (World Health Organization, 2018), taste expectation is included in this research. Taste expectation is about the expectations consumers have regarding the taste of a product containing E-numbers, without actually tasting the product. Prior research indicates that consumers believe that E-numbers are usually present in unnatural and processed foods, which does not benefit their taste expectation of products (Haen, 2014). It is therefore expected that consumers expect products containing E-numbers to taste more artificial and unnatural than products without E-numbers. Because of consumers' negative attitudes towards E-numbers (Tarnavölgyi, 2003), it is expected that the more negative consumers' attitudes towards E-numbers are, the more negative their taste expectation is. It is also expected that if consumers have positive attitudes towards E-numbers, their taste expectation is more positive as well.

H1: Attitudes towards E-numbers positively influence taste expectation of a product with E-numbers.

2.4.2. Knowledge regarding E-numbers

Knowledge can be defined as "the sum of what is known" (Merriam-Webster, n.d.-b, para. 2). Consumer knowledge can help "prevent developing the general fear of food additives" (Tarnavölgyi, 2003, p. 193). Currently, E-numbers are one of consumers' main food safety concerns (Behrens et al., 2010; Gunes & Deniz Tekin, 2006; Liu & Niyongira, 2017; Resurreccion et al., 1995), for which a possible explanation is that consumers' knowledge regarding E-numbers is based on misconceptions, for instance derived from online media. Common misconceptions are that E-numbers are toxic and can cause allergies (Anilakumar et al., 2017; Kayışoğlu & Coşkun, 2016; Shim et al., 2011). Prior studies have shown that consumers have insufficient knowledge of food additives (Ismail, Fuchs, & Siraj Funtua, 2017; Lee et al., 2014; Shim et al., 2011). For instance, British consumers tended to answer questions about food additives with 'I do not know' (Ismail et al., 2017), which shows their lack of knowledge regarding food additives. Korean consumers did not know how food additives are regulated by the government and how to read nutrition labels (Lee et al., 2014). Moreover, Korean consumers lack information of preservatives (one E-number category), and feel the need for more information regarding food additives in general (Shim et al., 2011). Consumers' lack of knowledge and their misconceptions regarding E-numbers could contribute to consumers' negative attitudes towards E-numbers. Prior research therefore suggests to form education programs in order to provide more adequate information to consumers (Lee et al., 2014; Shim et al., 2011), which could help consumers to make better informed food choices. However, Paans (2013) found that even when knowledge regarding E-numbers of Dutch consumers was increased, there were no significant

changes in consumers' attitudes and purchase intentions regarding food products containing E-numbers. Research thus suggests that providing information to consumers might not be the ultimate solution. Because little is known about what knowledge Dutch consumers have regarding E-numbers, knowledge is included as a variable in this research. As "attitudes and beliefs are shaped by knowledge" (Ishak & Zabil, 2012, p. 109), consumers' knowledge regarding E-numbers could help explain why consumers' attitudes towards E-numbers are negative (Tarnavölgyi, 2003), and why consumers avoid E-numbers. It is thus expected that correct knowledge positively influences consumers' attitudes towards E-numbers, whereas knowledge based on misconceptions negatively influences their attitudes towards E-numbers.

H2: Knowledge regarding E-numbers positively influences attitudes towards E-numbers.

2.4.3. Moderator: Health involvement

Because of consumers' negative attitudes towards E-numbers (Tarnavölgyi, 2003), and their increasing preference for healthy food (Nathalia et al., 2017), consumers might think that E-numbers do not fit in a healthy diet or lifestyle. Consumers' knowledge of nutrition influences their ability to understand nutrition labels (Walters & Long, 2012), and consumers thus need accurate knowledge in order to make well-informed food choices. Health involvement has been defined as "the personal relevance and importance attached to health issues, based on inherent needs, values and interests" (Zaichkowsky, 1985, as cited in Pieniak, Verbeke, Scholderer, Brunsø, & Olsen, 2008). Involvement can be linked to knowledge and information searching, as a higher level of consumers' involvement leads to a higher amount of time spent on information (Celsi & Olson, 1988, as cited in Drichoutis, Lazaridis, & Nayga, 2005). Health involvement has also been positively linked before to food consumption and attitudes towards food (Altintzoglou, Vanhonacker, Verbeke, & Luten, 2011). Hence, it is expected that when consumers' health involvement is high, the effect of knowledge on attitudes regarding E-numbers will be even more positive.

H3: The effect of knowledge regarding E-numbers on attitudes towards E-numbers will be more positive when health involvement is high.

2.4.4.Trust in the government and food producers

Overall, consumers need to trust several actors in food production in order to feel confident about food safety (De Jonge et al., 2004; Poortinga & Pidgeon, 2005, as cited in Behrens et al., 2010). Some of the most important actors in case of securing food safety are the government and food producers (Wilcock et al., 2004). Trust in the government and food producers is important because consumers rely on them for their food safety (Brom, 2000). Nevertheless, food producers and governments cannot fully take away the risks of eating certain food, they can only minimise the risks by using rules

and regulations (Brom, 2000). The increased number of food scandals, consumers' increased attention to ingredients, and new production process technologies unfamiliar to consumers are what caused the current decreased level of trust in food (Rampl et al., 2012). As behavioural beliefs directly influence consumers' attitudes (Ajzen, 1991), low levels of trust in the government and food producers are expected to negatively influence consumers' attitudes. Besides, it is expected that if consumers do trust the government and food producers, they feel confident about their food consumption, and are therefore more likely to trust E-numbers in food products resulting in more positive attitudes towards E-numbers.

H4a: High levels of trust in the government positively influence attitudes towards E-numbers.

H4b: High levels of trust in food producers positively influence attitudes towards E-numbers.

2.4.5. Concerns regarding E-numbers

Concerns can be described as "a matter that causes feelings of unease, uncertainty, or apprehension" (Merriam-Webster, n.d.-a, para. 2), in this case with regard to health and safety issues regarding E-numbers. Generally, consumers are concerned about food safety and food additives (Rimal et al., 2001; Shim et al., 2011). Concerns consumers have regarding E-numbers vary from E-numbers being toxic, that E-numbers cause allergies, or that there is insufficient information available about E-numbers (Anilakumar et al., 2017; Ismail et al., 2017; Kayışoğlu & Coşkun, 2016; Shim et al., 2011). From a scientific perspective, these concerns are invalid, because E-numbers have been tested extensively and only safe amounts are used in food. However, from a social perspective, these concerns might be valid, as it is the way consumers perceive E-numbers. There is little scientific research about Dutch consumers' concerns regarding E-numbers, hence concerns are included in this study. As consumers' concerns about food safety are "directly related to the strength of attitudes towards food safety" (Wilcock et al., 2004, p. 58), it is expected that concerns regarding E-numbers have a negative influence on consumers' attitudes towards E-numbers.

H5: Concerns regarding E-numbers negatively influence attitudes towards E-numbers.

2.4.6. Demographic moderators: Gender, family situation, and education

Demographic variables could explain why one consumer is more concerned regarding E-numbers than another. For instance, men generally perceive themselves as healthier than women (Whiteford, 2002), and it seems that females experience higher levels of concerns regarding food safety than men (Liu & Niyongira, 2017). Therefore, it is expected that women have more concerns regarding E-numbers than men. This has not been established for Dutch consumers yet, hence gender is included in this research. Besides, as food safety concerns relate directly to the intensity of

consumers' attitudes (Wilcock et al., 2004), it is expected that the effects of concerns regarding E-numbers on attitudes towards E-numbers will be more negative for women than for men.

H6: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be more negative for women than for men.

Another example of the influence of demographic factors on concerns is that prior research shows that younger people are less concerned about food safety than older people, although the differences were not that impactful (Liu & Niyongira, 2017). This influence of age has actually been attributed to the influence of family situation, because younger people usually live alone, whereas older people live with their families (Liu & Niyongira, 2017). Therefore, instead of age, family situation is included in this research. Research in the Chinese consumer market indicates that the more people are involved in one household, especially when children or elderly are involved, the more concerns consumers have regarding food safety (Liu & Niyongira, 2017). It is therefore expected that consumers who live with a large family in one household, especially when that household includes elderly and children, have more concerns regarding E-numbers than consumers in smaller families without elderly and children. This has not been investigated for Dutch consumers yet and is therefore included in this research. As consumers' attitudes are directly influenced by food safety concerns (Wilcock et al., 2004), the expectation is that the effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when family size is larger, and when elderly and children are involved in one household.

H7a: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when family size is larger.

H7b: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when elderly are involved in one household.

H7c: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when children are involved in one household.

Education is an additional demographic factor that might influence consumers' concerns regarding E-numbers. Although the lower educated are generally less concerned about food safety than the higher educated (Liu & Niyongira, 2017), prior research shows that the higher the level of education of consumers is, the better they understand food additives and nutrition labels (Kayışoğlu & Coşkun, 2016; Mehmeti & Xhoxhi, 2014). It is expected that the higher educated have more knowledge regarding E-numbers, which leads to more positive attitudes towards E-numbers. Another expectation is that the higher educated have less concerns regarding E-numbers, which also results in

more positive attitudes towards E-numbers, as food safety concerns directly influence consumers' attitudes (Wilcock et al., 2004).

H8: The effect of knowledge regarding E-numbers on attitudes towards E-numbers will be more positive when education is high.

H9: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be more positive when education is high.

2.5. Making an actual product choice

2.5.1. Attention to nutrition labels

Attention is "the degree to which consumers focus on specific stimuli within their range of exposure" (Bialkova et al., 2014, p. 67), and has been shown to mediate consumers' food choices when it comes to nutrition labels (Bialkova et al., 2014). Currently, little is known about how consumers pay attention to nutrition labels with E-numbers. Nutrition labels within this study either consist of an E-number label, an E-number full out label, or a no E-numbers label. Displaying 'E330' on a nutrition label is an example of an E-number label, whereas an E-number full out label would display 'citric acid'. Both labels mean the same, but are displayed in a different way. The no E-number label contains no E-numbers on the label at all.

Prior research indicates that consumers prefer well-known ingredients over relatively unknown ingredients (Aschemann-Witzel, Varela, & Peschel, 2019), and it has been stated that this phenomenon "might ultimately be related to that greater interest and attention is paid to ingredients which have a benefit for the consumer" (Aschemann-Witzel et al., 2019, p. 126). It seems likely that consumers have a lower level of attention to reading nutrition labels containing E-numbers, because they generally perceive them as negative and not beneficial (Tarnavölgyi, 2003). The expectation is that consumers pay more attention to and choose the no E-number label rather than the E-number and E-number full out label, because the no E-number label consists of ingredients that are likely more well-known to consumers. Based on the TPB (Ajzen, 1991), attitudes are expected to influence product choice, meaning that if consumers have negative attitudes regarding E-numbers, they are more likely to avoid food products with E-number labels (Paans, 2013). Therefore, it is expected that consumers with a higher level of attention to nutrition labels will choose the no E-number label especially when attitudes towards E-numbers are negative.

H10: Consumers with a higher level of attention to nutrition labels will choose the no E-number label rather than the E-number or E-number full out label.

H11: Consumers with a higher level of attention to nutrition labels will choose the no E-number label especially when their attitudes towards E-numbers are negative.

2.5.2. Taste perception

Taste enhancement is one reason why E-numbers are added to products (World Health Organization, 2018), and investigating consumers' actual taste perception provides insights in how consumers use E-number labels. Taste is an important factor for consumers' food choices (Velema et al., 2019). Therefore, differences in taste perception between products with and without E-numbers are studied in this research. Taste perception can be defined as the actual tasting of a product and then giving one's opinion about it. Prior research shows that consumers perceive products with E-numbers as more artificial and unnatural than products without E-numbers (Haen, 2014).Therefore it is expected that consumers find a product with an E-number label less tasteful than a product with a no E-number label, especially when their attitudes towards E-numbers are negative. This requires consumers' attention to nutrition labels. However, when consumers pay less attention to the nutrition labels, it is expected that the nutrition label type does not influence taste perception. The expectation is that consumers with a higher level of attention will choose the product with the no E-number label, resulting in a positive taste perception of the product.

H12: Only consumers' high level of attention to nutrition labels, which results in choosing the no E-number label, will positively influence taste perception.

H13: Consumers find products with E-number and E-number full out labels less tasteful than products with a no E-number label, especially when their attitudes towards E-numbers are negative.

2.5.3. Moderator: Familiarity with a food brand

Prior research shows that consumers' familiarity with a brand can strongly influence their food product choices (Ares et al., 2014, Bower et al, 2003, Carneiro et al., 2005, & Deliza & MacFie, 2001 in Paasovaara, Luomala, Pohjanheimo, & Sandell, 2012). The focus of familiarity within this research is whether or not a consumer recognizes the product type and accompanying brand. If consumers are familiar with a brand, it is expected that they are more likely to choose this brand (Paasovaara et al., 2012). A reason for this is that consumers attribute quality to a brand that is familiar to them (Bredahl, 2004 in Paasovaara et al., 2012). As consumers usually make their product choices habitually, it is expected that they are less likely to pay attention to nutrition labels when the product is familiar to them (Paasovaara et al., 2012).

H14: Consumers with a high level of familiarity with one of the brands will pay less attention to reading the nutrition labels of this brand, but do choose this brand.

2.6. Conceptual model

Below, a visual presentation of the conceptual model for both (1) the survey and (2) the eye tracking study can be found (see Figure 2).

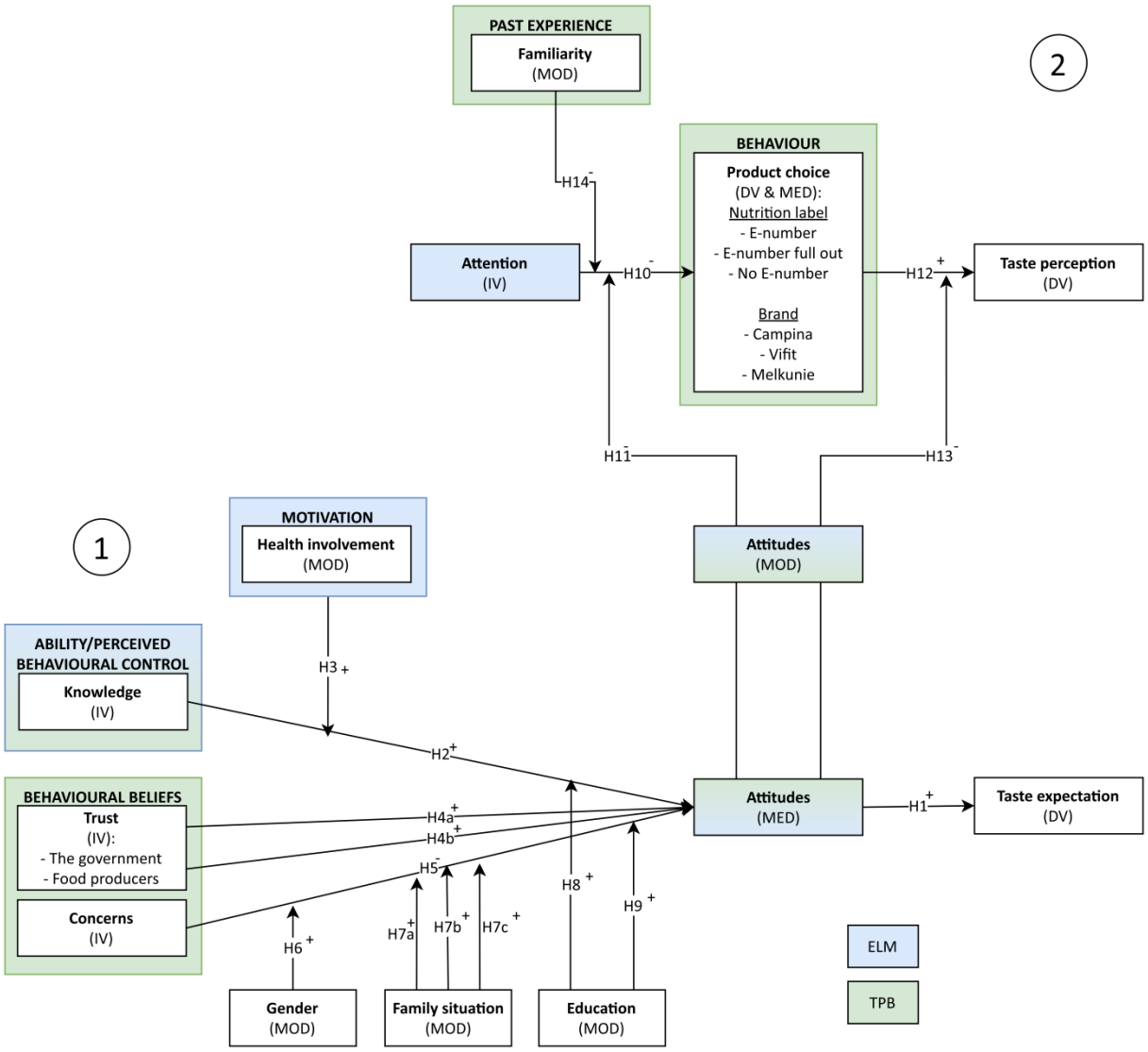

Figure 2. Conceptual model for (1) the survey and (2) the eye tracking study

3. STUDY 1: SURVEY

In this chapter the survey will be discussed, starting with the media analysis performed as input for the survey. Next, the method and data analyses of the survey will be described. Finally, the conclusions that can be drawn from the survey will be discussed.

3.1. Method

3.1.1. Media analysis

Prior to the survey, a media analysis was performed to make sure statements for both the 'Knowledge' and 'Concerns' variable were realistic, and reflected what is frequently stated regarding E-numbers in online blogs and news articles. The purpose of this media analysis was to find out more about what knowledge and misunderstandings, and concerns are communicated regarding E-numbers. In total, 138 statements about knowledge and concerns regarding E-numbers were derived from 18 different articles and blogs. The twelve most frequently mentioned statements were included as statements for the 'Knowledge' and 'Concerns' variable in the survey. A more extensive review of the media analysis can be found in Appendix 9.1.

3.1.2. Research design

For further investigating consumers' attitudes regarding E-numbers, an online survey was held. Respondents were asked for their participation through social media (initiated by the researcher), in order to reach a wide audience. After clicking on the survey link respondents were asked for their consent to participate in the study. After giving their consent, they were informed about the purpose of the study: investigating consumers' perceptions regarding E-numbers in food. Respondents received questions regarding attitudes towards E-numbers, knowledge regarding E-numbers, health involvement, trust in the government and food producers, concerns regarding E-numbers, gender, family situation, and education. After filling in the survey, respondents were thanked for their participation and they received the e-mail address of the researcher in case they would like to receive more information regarding the outcomes of the study. Finally, the gathered data was analysed using SPSS.

3.1.3. Participants

Participants for the survey were consumers of eighteen years and older (N = 193). This age category was chosen to make sure consumers who regularly shop for groceries were included. Only Dutch consumers were allowed to participate, because this research is about E-numbers in The Netherlands. The aim was to include at least 180 participants in the survey. In total, 195 consumers completed the survey in the course of one week. Two cases were excluded from the data analysis due to not meeting the requirements of the target group for the survey. In one case, the respondent

was a minor and in another case the age question had not been filled in. Out of 193 respondents, 135 were female (69.9%), 57 were men (29.5%), and one person identified otherwise (0.5%). Most respondents fell into the 18-24 years category (54.4%). Within the total of seven age categories, the second and third largest categories were 24-34 years (17.1%) and 55-64 years (10.4%). Most respondents had a HBO/WO education level (73.6%). Besides, it is unlikely that respondents had prior knowledge regarding E-numbers because of their allergies, as 74.6% of the respondents did not have an allergy (*n* = 144).

3.1.4. Measures

Below, all measures for the variables used in the survey will be discussed. In the actual survey, all statements were translated to Dutch. A full overview of the survey can be found in Appendix 9.2.

In this study, 'Attitudes' was about consumers' general attitudes towards E-numbers in food. Eight items were used to measure 'Attitudes', based on previous studies (Batra & Ahtola, 1990; Spears & Singh, 2004). Respondents used a seven point Likert scale to fill in the statements, for instance ranging from 'bad' to 'good', 'useful' to 'not useful' or 'negative' to 'positive'. Reliability analysis for the eight items showed a Cronbach's alpha of α = .905. As this is above the set threshold of α = .600, the items were combined. Overall, respondents have slightly negative attitudes towards E-numbers (*M* = 3.63, *SD* = 1.146).

To measure 'Taste expectation' three statements were used using a seven point Likert scale. The scale ranged from 'not at all' to 'very much so' and included the following three statements: 'products with E-numbers taste artificially', 'products with E-numbers taste naturally' and 'products with E-numbers taste well'. Consumers did expect products with E-number to taste artificially (*M* = 4.46, *SD* = 1.507), and not naturally (*M* = 3.51, *SD* = 1.267). The first item had to be recoded prior to analysis. Then, the performed reliability analysis showed a Cronbach's alpha of α = .519. After deleting the first item, the Cronbach's alpha became α = .746, and analysis showed respondents' taste expectation for products with E-numbers was slightly negative (*M* = 3.94, *SD* = 1.189).

For 'Knowledge' a set of 12 statements was used with the options true, false, or 'I do not know' (Paans, 2013). The extra option 'I do not know' was chosen to make sure respondents would not simply guess (Paans, 2013; Tobler, Visschers, & Siegrist, 2012). The statements were based on the media analysis and earlier research (Bearth, Cousin, & Siegrist, 2014; Grujić et al., 2013), and edited to fit the context of E-numbers. Examples are: 'E-numbers are regulated by the EU (EFSA)' and 'E-numbers are codes given to food additives'. All statements should have been answered with 'correct'. Prior to analysis, the items were therefore recoded into correct = 1, incorrect = 0, and 'I do not know' = 0. Reliability analysis showed a Cronbach's alpha of α = .609. Afterwards, the sum of

correct answers was calculated for each participant and recoded into a new variable. On average, respondents answered six items correctly (*M* = 6.03, *SD* = 2.210), which is just half of the statements. Before recoding, the data does not only show how 50% of the participants answered the statements correctly, but also that 17% of the participants answered incorrectly, and 33% of the participants did not know the answer to the statements. An overview of the answers regarding each statement can be found in Table 1 below.

Table 1.

Overview of answers for the knowledge statements

Statement	Correct (in %)	Incorrect (in %)	I do not know (in %)
1. E-numbers are used to improve the quality of food.	53.4	22.8	23.8
2. E-numbers are regulated by the European Union.	78.8	2.6	18.7
3. E-numbers are codes for food additives.	89.1	4.7	6.2
4. E-numbers are frequently tested before their approval.	62.7	5.2	32.1
5. E-numbers ensured that certain food poisonings cannot occur anymore.	19.7	22.3	58.0
6. Without E-numbers food expires more quickly.	66.8	15.5	17.6
7. E-numbers can cause allergies.	56.5	9.3	34.2
8. There are several kinds of E-number such as sweeteners, colourants, anti-oxidants and preservatives.	87.0	2.1	10.9
9. Most E-numbers are not vegetarian.	9.3	30.1	60.6
10. E-numbers can exist naturally in a product, without being added to the product.	30.6	29.5	39.9
11. The letter E of E-number represents Europe.	30.6	19.2	50.3
12. Vegetables and fruit naturally contain E-numbers.	18.7	38.9	42.5
Total (in %)	**50.0**	**17.0**	**33.0**

For measuring 'Health involvement' respondents were asked to what extent they were involved with their health. Respondents received answering options on a seven point Likert scale ranging from 'totally disagree' to 'totally agree', along with six statements in total such as 'health means a lot to me' and 'healthy food is important to me' which were based on prior research (Altintzoglou et al., 2011). Reliability analysis resulted in a Cronbach's alpha of α = .898 for the six items, therefore all six items were combined. Respondents were generally highly involved with their health (*M* = 5.60, *SD* = .959).

The variable 'Trust' was divided into two different categories, namely trust in the Dutch government and in food producers. Respondents were able to answer using a seven point Likert scale ranging from 'totally disagree' to 'totally agree'. For measuring 'Trust in the government', four statements were used, for example: 'I trust the government to make sure food in the supermarkets is safe to consume'. To measure 'Trust in food producers', another four statements were used such as 'I am confident that food producers make sure food is safe'. The statements were based on prior research (Berg et al., 2005; Poortinga & Pidgeon, 2003), and edited to fit the context of E-numbers. Reliability analyses showed a Cronbach's alpha of $\alpha = .908$ for trust in the government, and a Cronbach's alpha of $\alpha = .838$ for trust in food producers. Results showed that respondents have a high level of trust in food producers ($M = 5.18$, $SD = 1.293$), and an even higher level of trust in the government ($M = 6.14$, $SD = 1.258$).

For measuring 'Concerns', respondents were asked to what extent they are concerned or not regarding E-numbers using a seven point Likert scale, which ranged from 'not at all concerned' to 'very much concerned' (Liu & Niyongira, 2017; Zhang, 2005). The concerns used as statements were based on multiple studies and the media analysis (see Appendix 9.1., 9.3.). In total, 12 different statements were used, such as 'I am worried that E-numbers are toxic' and 'I am worried that there is a lack of adequate information available about E-numbers'. All 12 items were combined, because reliability analysis showed a Cronbach's alpha of $\alpha = .930$. Results showed that respondents were not necessarily concerned regarding E-numbers ($M = 3.99$, $SD = 1.239$).

For 'Gender' the options were either male ($n = 57$), female ($n = 135$), or 'other, namely…' ($n = 1$). 'Family situation' was grouped into three items: family size, elderly, and children. 'Family size' was measured via a question asking how many people the respondent lives with (Liu & Niyongira, 2017). The question for both the 'elderly' and 'children' item was whether or not the respondent lives with children (below age 20) or elderly in one household (above age 65) (Liu & Niyongira, 2017). Most respondents usually go grocery shopping for two persons (34.7%), followed by doing groceries for one person (27.5%), four persons (15.0%), and three persons (13.5%). Moreover, most respondents did not live with elderly (95.9%) or children (72.0%) in their home. To measure 'Education' respondents selected their highest level of education (Ergönül, 2013; Liu & Niyongira, 2017; Zhang, 2005). These categories were labelled as follows (see Table 2 below): elementary/secondary school (3.1%), high school (23.3%), or college/university (73.6%), and correspond with the categories of CBS (2017). Most respondents were thus highly educated at college/university level.

Table 2.

Explanation of education variable – categories

Nr.	Category label	Education	Included educations (Dutch system) based on the CBS (2017)
1	Elementary/secondary school (*n* = 6)	Less than 9 years	Elementary school (group 1-8)/HAVO class 1-3/VWO class 1-3/MBO level 1
2	High school (*n* = 45)	Between 9-14 years	HAVO class 4-5/VWO 4-6/MBO level 2-4
3	College/university (*n* = 142)	More than 15 years	HBO/WO

3.2. Results

3.2.1. Hierarchical multiple regression analysis regarding 'Attitudes'

To test the hypotheses, a hierarchical multiple regression analysis was performed. All interaction variables: the combination of the independent variable and the accompanying moderator, were centralised prior to analysis. The first model included 'Attitudes' as the outcome variable, and the following independent variables: 'Knowledge', 'Trust in the government', 'Trust in food producers', and 'Concerns'. In this model, the influence of these independent variables on attitudes towards E-numbers was tested. As shown in Table 3, the first model shows that knowledge regarding E-numbers, trust in the government, trust in food producers, and concerns regarding E-numbers explain 16.6% of the variance in attitudes towards E-numbers (adj. R^2 = .166, F (4, 188) = 10.54, p < .001). Further analysis showed that attitudes towards E-numbers are influenced by trust in food producers (β = .309, p < .001), which confirms H4b. The second model also included 'Attitudes' as the outcome variable, and the independent variables: 'Knowledge', 'Trust in the government', 'Trust in food producers', and 'Concerns'. Moreover, the following interaction variables were added: 'Health involvement' and 'Knowledge', 'Concerns' and 'Family situation', 'Knowledge' and 'Education', and 'Concerns' and 'Education'. With these added variables, the second model accounted for an additional 4.1% of the variance in attitudes regarding E-numbers as shown in Table 3 (adj. R^2 = .207, F (7, 181) = 5.56, p < .001). This R^2 change proved to be significant (F (7, 181) = 5.56, p = .000). Further analysis showed that trust in food producers influences attitudes towards E-numbers (β = .257, p < .01), which again confirms H4b. Moreover, analysis showed that the interaction variable of concerns regarding E-numbers and family situation with regard to family size significantly influences attitudes towards E-numbers (β = .220, p < .01), which confirms H7a.

Table 3.

Hierarchical multiple regression results for 'Attitudes'

	β	*t*	*p*	*df* (reg, res)	*F*	Adj. R^2	$\triangle R^2$
Model 1			**.000*** **	(4, 188)	10.54	.166	.183
Knowledge	.105	1.550	.123				
Trust in the government	.038	.391	.696				
Trust in food producers	.309	3.438	**.001*** **				
Concerns	.121	1.563	.120				
Model 2			**.000*** **	(7, 181)	5.56	.207	.069
Knowledge	.106	1.547	.124				
Trust in the government	.082	.838	.403				
Trust in food producers	.257	2.870	**.005** **				
Concerns	.073	.945	.346				
Health involvement * Knowledge	.104	1.575	.117				
Concerns * Gender	-.100	-1.394	.165				
Concerns * Family situation family size	.220	3.062	**.003** **				
Concerns * Family situation elderly	.065	.946	.346				
Concerns * Family situation children	.049	.616	.539				
Knowledge * Education	.008	.117	.907				
Concerns * Education	.121	1.580	.116				

Note. Outcome variable = Attitudes.

* $p < .050$. ** $p < .010$. *** $p < .001$.

reg: regression score; res: residual score.

3.2.2. Hierarchical multiple regression analysis regarding 'Taste expectation'

Another hierarchical multiple regression analysis was performed with 'Taste expectation' as the outcome variable. The first model included the independent variables 'Attitudes', 'Knowledge', 'Trust in the government', 'Trust in food producers', and 'Concerns'. In this model, the influence of these independent variables on attitudes towards E-numbers was tested. Table 4 shows that the first model including attitudes towards E-numbers, knowledge regarding E-numbers, trust in the government, trust in food producers, and concerns regarding E-numbers accounted for 18.4% of the variance in taste expectation (adj. $R^2 = .184$, $F(5, 187) = 9.68$, $p < .001$). Further analysis showed that taste expectation is influenced by attitudes towards E-numbers ($\beta = .234$, $p < .001$), which confirms H1. Besides, knowledge regarding E-numbers negatively influences taste expectation ($\beta = -1.34$, $p < .05$). In the second model, which also included 'Taste expectation' as the outcome variable, and the independent variables: 'Attitudes', 'Knowledge', 'Trust in the government', 'Trust in food

producers', and 'Concerns', the interaction variables were added: 'Health involvement' and 'Knowledge', 'Concerns' and 'Family situation', 'Knowledge' and 'Education', and 'Concerns' and 'Education'. As shown in Table 4, the second model accounted for an additional 0.5% of the variance in taste expectation (adj. R^2 = .189, F (7, 180) = 4.74, p < .001). This R^2 change also proved to be significant (F (7, 180) = 4.74, p = .000). Additional analysis showed that attitudes towards E-numbers influences taste expectation (β = .237, p < .01), which again confirms H1. Furthermore, the interaction variable of knowledge regarding E-numbers and education directly influences taste expectation (β = .161, p < .05).

Table 4.

Hierarchical multiple regression results for 'Taste expectation'

	β	*t*	*p*	*df* (reg, res)	*F*	Adj. R^2	△R^2
Model 1			**.000*** **	(5, 187)	9.68	.184	.206
Attitudes	.234	3.240	**.001*** **				
Knowledge	-.134	-1.981	**.049***				
Trust in the government	.165	1.728	.086				
Trust in food producers	.090	.982	.327				
Concerns	.126	1.642	.102				
Model 2			**.000*** **	(7, 180)	4.74	.189	.034
Attitudes	.237	3.149	**.002** **				
Knowledge	-.109	-1.570	.118				
Trust in the government	.142	1.438	.152				
Trust in food producers	.118	1.270	.206				
Concerns	.111	1.413	.160				
Health involvement * Knowledge	-.027	-.407	.684				
Concerns * Gender	.051	.699	.485				
Concerns * Family situation family size	-.023	-.312	.755				
Concerns * Family situation elderly	.029	.419	.676				
Concerns * Family situation children	-.105	-1.305	.193				
Knowledge * Education	.161	2.398	**.018***				
Concerns * Education	-.022	-.285	.776				

Note. Outcome variable = Taste expectation.

* p < .050. ** p < .010. *** p < .001.

reg: regression score; res: residual score.

3.3. Conclusions

In conclusion, significant effects were found for the influence of attitudes towards E-numbers on taste expectation (H1), trust in food producers on attitudes towards E-numbers (H4b), and a moderating effect of family situation with regard to family size on the influence of concerns regarding E-numbers on attitudes towards E-numbers (H7a) (see Figure 3). Other results showed that knowledge regarding E-numbers negatively influences taste expectation, and a moderating effect of education on the influence of knowledge regarding E-numbers on taste expectation was found. Half of the consumers have correct knowledge regarding E-numbers. Another finding is that the first tested models with attitudes towards E-numbers as the outcome variable had a higher level of explanation in variance than the models with taste expectation as the outcome variable. The remaining hypotheses (H2, H3, H4a, H5, H6, H7bc, H8, H9) were non-significant.

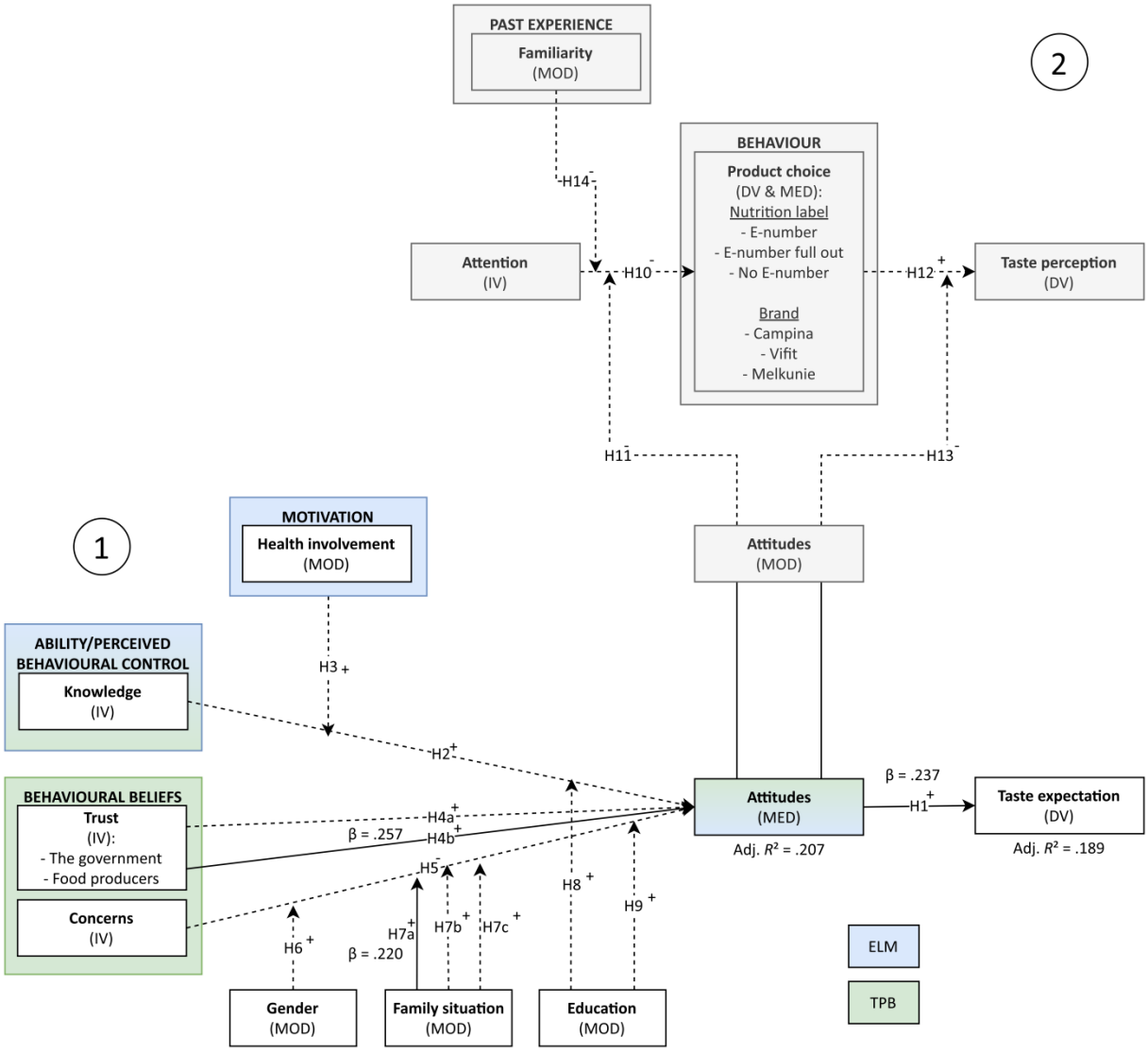

Figure 3. Results for (1) the survey

4. STUDY 2: EYE TRACKING

4.1. Method

4.1.1. Research design

The focus of the eye tracking study was to map how consumers pay attention to E-number labels displayed on food products, to what extent they base their product choices on attention to nutrition labels, and how this influences their taste perception. The eye tracking study consisted of three different parts for participants: making a product choice while wearing the Tobii eye tracking glasses, tasting the product of their choice, and filling in a small digital questionnaire. In this study, drink yogurt was used as a food product as it was expected to be a more neutral product that people do not feel strongly negative or positive about. Another reason was that drink yogurt was easy to taste for participants. Within the first part, participants were asked to choose one out of nine drink yogurt packages, meaning that every participant saw all nine packages. These drink yogurt packages differed in brand (Campina vs. Vifit vs. Melkunie) and nutrition label (E-number full out label vs. E-number label vs. no E-number label), and for each label category all three product brands were used. All nine packages were displayed to participants on a table (see Figure 4). To make sure participants did not base their choice on where the food packages were placed, the location of the packages on the table changed several times during the study. For the second part, participants were asked to taste the drink yogurt product they chose in the first part of this study. Although participants thought they tasted the product of their choice, all taste samples were from the same drink yogurt. Otherwise, results of the taste perception of participants could not be compared. For the third part, participants received the link of a digital exit questionnaire by scanning a QR code on a flyer (see Appendix 9.4.2, 9.4.3.), including questions regarding their taste perception, familiarity with the brand of their product choice, and their attitudes towards E-numbers. Ultimately, the gathered data was analysed using the Tobii eye tracking software and SPSS.

Figure 4. Setting for the eye tracking study

4.1.2. Procedure

Prior to participation, participants were told about the purpose of this research, which was initially explained as investigating food packages. Due to possible bias influences, participants were asked to look at the nutrition labels but the purpose of the study was not revealed in detail regarding E-numbers. However, after their participation participants were informed about the actual purpose of the study. In advance, participants were informed about wearing the eye tracking glasses and tasting the drink yogurt product of their choice. Besides, participants were asked for their informed consent by explaining anonymity is guaranteed, participation is voluntarily, and that one could stop at any time without giving an explanation. The informed consent form can be found in Appendix 9.4.1. After participants gave their consent, they were asked to put the eye tracking glasses on, which needed to be calibrated first. This was done using a tablet, where participants had to look at a dot in the middle of the tablet. Afterwards, participants could start with making their product choice, followed by the tasting, and filling in the digital exit questionnaire.

4.1.3. Participants

To make sure results of the survey and eye tracking study could be easily compared, participants for the eye tracking study also consisted of consumers aged eighteen or older (*N* = 20). Note that for this study as well, only Dutch consumers were allowed to participate. The aim was to include a minimum of 15 participants in the eye tracking study which took place on the campus of the University of Twente. Participants were recruited by asking them to participate when they were passing by the stand. Besides, the SONA system of the University of Twente, social media, and word-of-mouth was used to recruit new participants. The goal was to reach a wide audience that does not solely include students of the University of Twente. In total, 22 participants took part in the eye tracking study over the course of two days. However, two cases had to be removed from the data as their recordings were unsuccessful. Out of 20 recordings, 11 participants were male (55%) and 9 participants were female (45%). The mean age was 24 years and most participants were in the 18-24 age group (65%). The other age groups were 25-34 years (20%), 35-44 years (10%), and 45-54 years (5%). Most participants had a HBO/WO level of education (90%), along with HAVO class 4-5, VWO class 4-6, and MBO level 2-4 (10%).

4.1.4. Stimulus materials

The used stimulus materials consisted of nine different yogurt packages, which differed in brand (Campina vs. Vifit vs. Melkunie) and nutrition label (E-number full out label vs. E-number label vs. no E-number label). For each brand (see Figure 5, Appendix 9.4.4.), the strawberry variant was chosen, to make sure participants could not base their product choice on flavour preference. However, the Melkunie package did not solely include strawberry, it also had a hint of cherry flavour. This was

nevertheless not displayed on the nutrition labels (see Figure 6). The nutrition labels included nutrition information derived from a combination of several drink yogurt products (Albert Heijn, n.d.-b, n.d.-a; Jumbo, n.d.). The no E-number label solely displayed the basic ingredients of the drink yogurt: yogurt and strawberry juice. The stimulus materials were pretested by asking two other researchers for their input, and a more detailed overview of the stimulus materials can be found in Appendix 9.4.4.

Figure 5. Packages organised by brand

Figure 6. Packages organised by label

4.1.5. Measures

All measures for the variables used in the eye tracking study will be discussed below. Note that for the actual study, all statements were translated to Dutch. The questions used in the exit questionnaire can be found in Appendix 9.4.2.

For measuring 'Attention', the Tobii eye tracking glasses were used (Nicolaas, 2017). Participants wore the eye tracking glasses, with which their level of attention to the nutrition labels was measured. The eye tracking software provided details on how long and how often participants

fixated on each food package prior to making a product choice. This way, participants did not have to recall the actions of their eyes regarding processing the food packages, it could be measured instead. This method is very useful, as "consumers have limited capacity to process all the information they face when deciding their food choices" (Ares et al., 2014, p. 28). Thus, where the participants' eyes focus on, is where their attention goes (Theeuwes, Kramer, Hahn, & Irwin, 1998). To measure 'Attention', participants' mean total fixation duration in the area of interest (AOI) was used. The AOIs were the different nutrition labels on the food packages with regard to nutrition label type (see Figure 7, 8, 9). The mean total fixation duration in an AOI pionted out how long a participant paid attention to the E-number full out label (*M* = 3.94, *SD* = 2.96), E-number label (*M* = 2.94, *SD* = 2.78), and no E-number label (*M* = 2.95, *SD* = 2.34). Participants' attention thus lasted longest to the E-number full out labels. The mean total number of fixations in an AOI indicated how many times participants fixated on the E-number full out label (*M* = 13.88, *SD* = 9.77), E-number label (*M* = 10.82, *SD* = 8.29), and no E-number label (*M* = 11.53, *SD* = 7.06). The heat maps below show that most attention was paid to the E-number full out labels (see Figure 7, 8, 9).

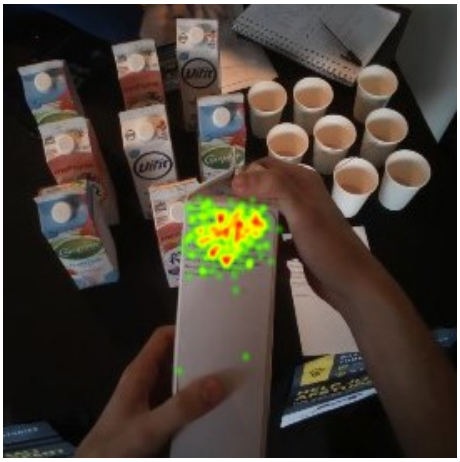

Figure 7. Heat map E-number full out label

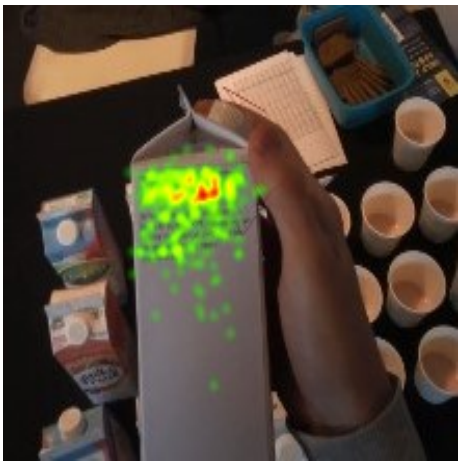

Figure 8. Heat map E-number label

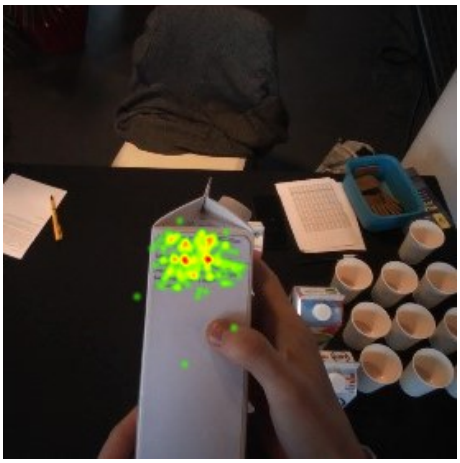

Figure 9. Heat map no E-number label

To measure 'Product choice', participants were asked to choose one out of nine different drink yogurt packages. Their choice was written down based on the combination of the brand and nutrition label. Table 5 provides an overview of which combinations of nutrition labels and brands were chosen by participants. In total, both the E-number full out labels and the no E-number labels were chosen 10 times. Note that the E-number labels were not chosen at all by participants. The most chosen brand was Vifit (*n* = 11), followed by Campina (*n* = 6), and Melkunie (*n* = 3). For the Campina brand only the E-number full out labels were selected, for the Vifit brand both the E-number full out and the no E-number labels were chosen, and for the Melkunie brand solely the no E-number labels were chosen (see Table 5).

Table 5.

Overview of product choices made by participants

Brand and label type	*n*
Campina total	6
- E-number full out	6
- E-number	0
- No E-number	0
Vifit total	11
- E-number full out	4
- E-number	0
- No E-number	7
Melkunie total	3
- E-number full out	0
- E-number	0
- No E-number	3
Labels	-
- E-number full out	10
- E-number	0
- No E-number	10

Within this study, 'Attitudes' regarded consumers' general attitudes towards E-numbers in food. The moderator 'Attitudes' was measured using eight items based on prior research (Batra & Ahtola, 1990; Spears & Singh, 2004), and edited to fit the context of E-numbers. Participants could fill in their answers using a seven point Likert scale, for instance ranging from 'bad' to 'good', or from 'negative'

to 'positive'. Reliability analysis showed a Cronbach's alpha of α = .710. The results indicated that participants had slightly negative attitudes towards E-numbers (*M* = 3.84, *SD* = .827).

'Taste perception' was measured by the following question: 'what did you think about the taste of the drink yogurt?', and included eight different statements regarding the taste of the drink yogurt chosen by the participant. For example, 'the drink yogurt tasted sweet' and 'the drink yogurt was creamy' (Steggink, 2018). To answer the statements, a seven point Likert scale was used ranging from 'not at all' to 'very much so'. The main statement was 'the drink yogurt tasted good', and regardless of E-numbers, participants did not find the drink yogurt very tasteful (*M* = 3.60, *SD* = 1.273). Because E-number labels were not chosen at all, the taste between E-number labels and no E-number labels could not be compared.

For measuring 'Familiarity', the following three statements were used based on prior research (Nicolaas, 2017): 'I buy drink yogurt regularly', 'I am familiar with the product I have chosen', and 'I am familiar with the brand of this product'. Participants gave their answers using a seven point Likert scale ranging from 'totally disagree' to 'totally agree'. Reliability analysis showed a Cronbach's alpha of α = .564, which is below the set threshold of α = .600. Therefore, the second item was deleted resulting in a Cronbach's alpha of α = .630. Overall, participants were quite familiar with the drink yogurt brand of their choice (*M* = 4.68, *SD* = 1.641).

4.2. Results

For further analysis of consumers' attention to the nutrition labels a one-way repeated measures ANOVA was performed for the mean total fixation duration (see Table 6). The analysis showed that the assumption of sphericity was violated by using Mauchly's test (X^2 (2) = 7.49, *p* = .024). For that reason, the degrees of freedom were corrected using the Huynh-Feldt estimates of sphericity (ε = .80). A significant effect was found for the mean total fixation duration per nutrition label (*F* (1.60, 30.21) = 5.43, *p* = .014). The results suggest that the mean total fixation duration (thus, the attention) was significantly higher for the E-number full out label than for the E-number label (*p* = .032). An additional one-way repeated measures ANOVA was done for the mean total number of fixations for the nutrition labels (see Table 6), showing that using Mauchly's test, the assumption of sphericity was met (X^2 (2) = 4.40, *p* = .111). Therefore, the results were non-significant for the effect of the mean total number of fixations per label type. This means that none of the labels received a significantly higher number of fixations than the others. In short, the average duration of the attention was significantly higher for the E-number full out label than the E-number label but there were no differences in the amount of fixations for the nutrition labels (see Table 6).

Another one-way repeated measures ANOVA was done for the different brands, and showed

that the assumption of sphericity was met using Mauchly's test for both the mean total fixation duration (X^2 (2) = 3.39, p = .184) and the mean total number of fixations (X^2 (2) = 3.98, p = .137). The results were thus non-significant for the effect of the mean total fixation durations and the mean total number of fixations per brand, meaning that none of the brands received a significantly higher level of attention or amount of fixations than another.

Performing binary logistic regression analyses showed no significant results for the effect of attention to the nutrition labels on product choice. For the effect of attention to nutrition labels on taste perception, mediated by product choice no supporting evidence was found either. Therefore, H10, H11, H12, H13, and H14 were not confirmed by this research.

Table 6.

Mean fixation count and total fixation duration on the nutrition labels and brands

		Mean total fixation duration (in seconds)	Mean total number of fixations
Label type	E-number full out label	**3.94 (± 2.96)***	13.88 (± 9.77)
	E-number label	**2.94 (± 2.78)***	10.82 (± 8.29)
	No E-number label	2.95 (± 2.34)	11.53 (± 7.06)
Brand	Campina	3.21 (± 2.94)	11.97 (± 9.41)
	Vifit	3.59 (± 2.76)	12.90 (± 9.25)
	Melkunie	3.03 (± 3.26)	11.37 (± 9.01)

Note. * p < .050. ** p < .010. *** p < .001.

reg: regression score; res: residual score.

4.3. Conclusions

To conclude, no significant effects were found for the hypotheses of the eye tracking study (see Figure 10). A possible explanation for this lack of significant results is the small sample size. One remarkable finding was that all participants avoided the packages with E-number labels. Therefore, any differences in taste perception between the E-number and no E-numbers labels could not be studied. Half of the participants chose the E-number full out labelled packages and the other half chose the no E-number labelled packages. Results showed that most attention was paid to the E-number full out labels. A possible explanation is that the E-number full out labels required more reading time, as these labels were simply longer than the E-number and no E-number labels. No differences were found for the amount of fixations to the labels, for which the reason possibly is that participants assessed each package for roughly the same number of times. An explanation for the

lack of differences in attention and number of fixations between brands is that most participants evaluated all packages and were asked to look at the nutrition labels, not specifically the brands.

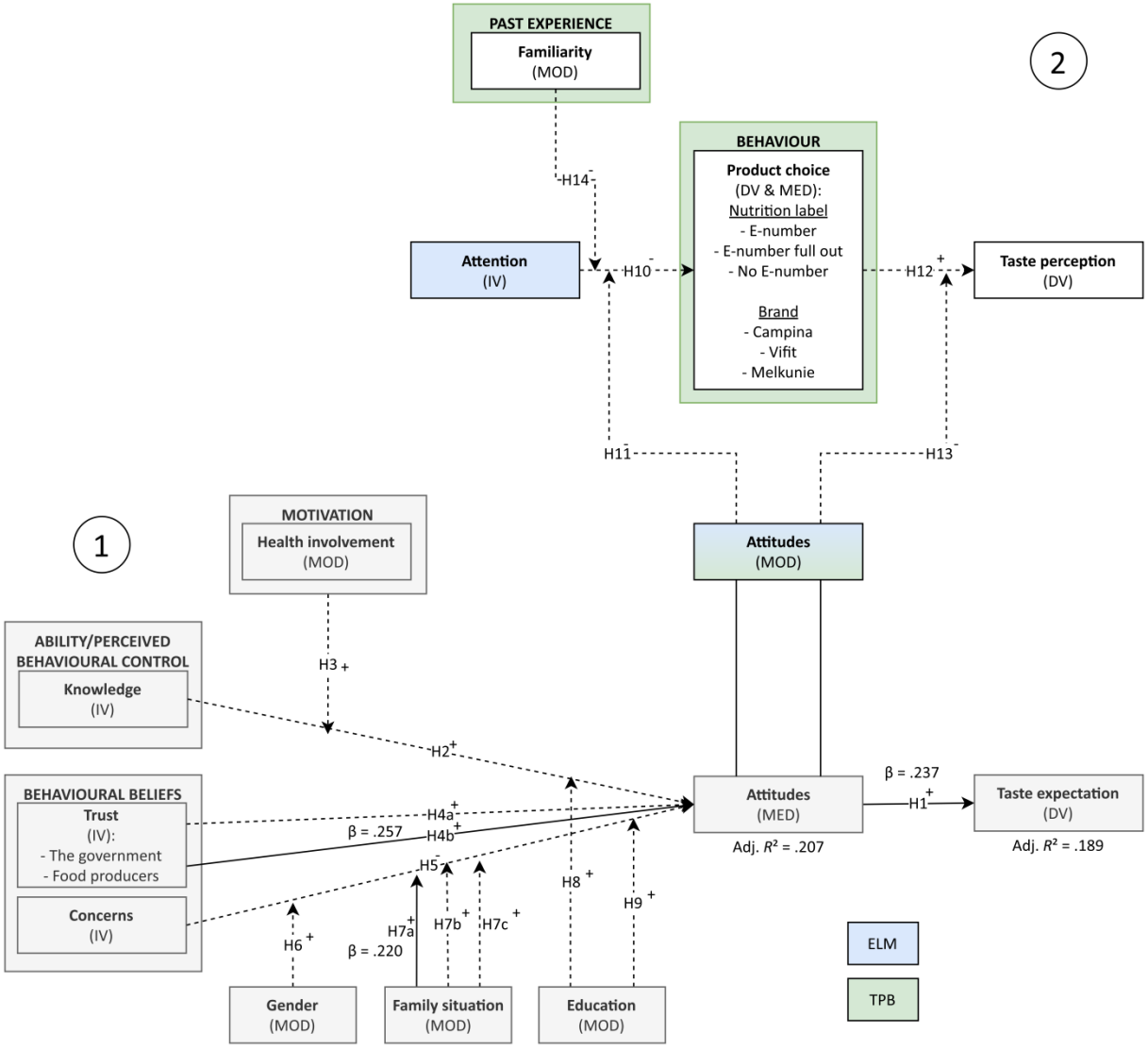

Figure 10. Results for (2) the eye tracking study

5. CONCLUSIONS AND DISCUSSION

First, the aim of this research will be explained along with the main basic findings. Next, the discussion, implications, limitations and directions for future research will be discussed.

5.1. Hypotheses and main findings

The aim of this study is to investigate what factors influence consumers' attitudes and behaviour in the context of E-numbers in food. Ultimately, the goal is to present useful suggestions to the government and food producers for communicating E-numbers on nutrition labels, and help consumers make informed food choices. Table 7 provides an overview of the hypotheses and the main findings of this research.

Table 7.
Overview of the hypotheses and main findings

Hypotheses	Main findings
Survey	
H1: Attitudes towards E-numbers positively influence taste expectation of a product with E-numbers.	Consumers' attitudes towards E-numbers do positively influence their taste expectations of a product with E-numbers. Both consumers' attitudes and taste expectations towards products containing E-numbers are slightly negative.
H2: Knowledge regarding E-numbers positively influences attitudes towards E-numbers.	No supporting evidence is found for the influence of knowledge on attitudes towards E-numbers. However, knowledge regarding E-numbers does seem to influence taste expectation directly. Half of the consumers had correct knowledge regarding E-numbers.
H3: The effect of knowledge regarding E-numbers on attitudes towards E-numbers will be more positive when health involvement is high.	No supporting evidence is found for the moderating effect of health involvement on the influence of knowledge regarding E-numbers on attitudes towards E-numbers. Consumers were highly involved with their health.
H4a: High levels of trust in the government positively influence attitudes towards E-numbers.	No supporting evidence is found for the influence of trust in the government on attitudes towards E-numbers. Consumers highly trust the government.
H4b: High levels of trust in food producers positively influence attitudes towards E-numbers.	Trust in food producers does positively influence consumers' attitudes towards E-numbers and consumers highly trust food producers.
H5: Concerns regarding E-numbers negatively influence	No supporting evidence is found for the influence of concerns regarding E-numbers on attitudes towards

attitudes towards E-numbers.	E-numbers. Dutch consumers are not necessarily concerned regarding E-numbers.
H6: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be more negative for women than for men.	No supporting evidence is found for the moderating effect of gender on the influence of concerns regarding E-numbers on attitudes towards E-numbers.
H7a: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when family size is larger.	Family size moderates the influence of concerns regarding E-numbers on attitudes towards E-numbers.
H7b: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when elderly are involved in one household.	No supporting evidence is found for the moderating effect of having elderly in one's household on the influence of concerns regarding E-numbers on attitudes towards E-numbers.
H7c: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be stronger when children are involved in one household.	No supporting evidence is found for the moderating effect of having children in one's household on the influence of concerns regarding E-numbers on attitudes towards E-numbers.
H8: The effect of knowledge regarding E-numbers on attitudes towards E-numbers will be more positive when education is high.	No supporting evidence is found for the moderating effect of education on the influence of knowledge regarding E-numbers on attitudes towards E-numbers. However, there seems to be a moderating effect of education on the influence of knowledge regarding E-numbers on taste expectation.
H9: The effect of concerns regarding E-numbers on attitudes towards E-numbers will be more positive when education is high.	No supporting evidence is found for the moderating effect of education on the influence of knowledge regarding E-numbers on attitudes towards E-numbers.
<u>Eye tracking study</u>	
H10: Consumers with a higher level of attention to nutrition labels will choose the no E-number label rather than the E-number or E-number full out label.	Consumers pay more attention to the E-number full out label than the E-number label and do not choose the E-number labelled packages. However, this hypothesis cannot be confirmed because both the E-number full out and no E-number labels are equally chosen by consumers.
H11: Consumers with a higher level of attention to nutrition labels will choose the no E-number label especially when their attitudes towards E-numbers are negative.	This hypothesis cannot be confirmed, because consumers also chose E-number full out labels. Consumers' attitudes towards E-numbers are slightly negative. No moderating effects for attitudes towards E-numbers are found.

H12: Only consumers' high level of attention to nutrition labels, which results in choosing the no E-number label, will positively influence taste perception.	No supporting evidence is found for the influence of attention on taste perception, mediated by product choice.
H13: Consumers find products with E-number and E-number full out labels less tasteful than products with a no E-number label, especially when their attitudes towards E-numbers are negative.	Differences in taste perception could not be tested, because consumers avoid E-number labelled packages.
H14: Consumers with a high level of familiarity with one of the brands will pay less attention to reading the nutrition labels of this brand, but do choose this brand.	No differences in attention are found for the brands, therefore this hypothesis cannot be confirmed. Overall, consumers were quite familiar with the brand of their product choice. No moderating effect of familiarity is found.

5.2. Discussion

Although E-numbers are regulated by the EU and repeatedly tested by scientists, consumers' attitudes towards E-numbers remain negative and they avoid E-numbers as confirmed by the current and prior research (Paans, 2013; Tarnavölgyi, 2003). This shows that the boomerang effect regarding E-numbers is still relevant today. Current research confirms that consumers' negative attitudes towards E-numbers influence their taste expectations (see 3.2.1.). These results suggest that consumers expect E-numbers to be less tasteful than products without E-numbers, which contradicts with one of the main reasons why E-numbers are added to food: to enhance taste (World Health Organization, 2018).

Consumers' attitudes and behaviour regarding E-numbers are complex, which this research confirms. The model for attitudes towards E-numbers namely explained more of the variance than the model for taste expectation (see Table 3, 4). Although the proposed models are significant, much variance remains unexplained. It suggests that there are many other factors that influence consumers' attitudes and product choice in this context. A possible explanation is that consumers increasingly prefer healthy food (Nathalia et al., 2017), and incorrectly think that E-numbers do not fit in a healthy lifestyle because they perceive them as a risk for their health (Paans, 2013). This research does show that consumers are highly involved with their health. It is likely that consumers' attitudes and product choices depend on the evaluation they make regarding the risks and benefits of consuming the product (LaMorte, 2019; Pieniak et al., 2008). Consumers do seem to be aware of the risks of food, and know that governments and food producers cannot fully take away the risks of certain food consumption (Brom, 2000). They can only minimise the risks by implementing and maintaining rules and regulations.

Although the direct influence of knowledge regarding E-numbers on attitudes towards E-numbers is not found, knowledge does seem to influence consumers' taste expectation of a

product (see 3.2.2.). This highlights the importance of consumers' knowledge regarding E-numbers, because taste is one of the main factors where consumers base their food choices on (Velema et al., 2019). Moreover, education moderates the effect of knowledge regarding E-numbers on taste expectation (see 3.2.2.). A possible explanation is that the higher educated value knowledge more, which results in them having a stronger opinion on taste expectation for products containing E-numbers. This research shows consumers answered only 50% of the statements about knowledge regarding E-numbers correctly, which seems insufficient and is in agreement with prior findings (Ismail et al., 2017; Lee et al., 2014; Shim et al., 2011). Insufficient product labelling and consumers' lack of knowledge do seem to have played a role in this study, as expected based on earlier research (Davies & Wright, 1994, as cited in Grujić et al., 2013). Half of the participants namely chose the E-number full out labels (see Table 5), which means that although the name of the E-number is written down instead of the E-number itself, the product still contains E-numbers. Besides, this research shows that consumers avoid E-numbers. Therefore, it seems necessary to provide more information to consumers regarding E-numbers but earlier research shows that this does not necessarily change consumers' attitudes and purchase intentions towards E-numbers (Paans, 2013). Based on the current media analysis (see 3.1.1.), results show that there are still many misconceptions about E-numbers which are frequently communicated online. This could explain why consumers do not change their attitudes and behaviour towards E-numbers. Therefore, it is necessary that communication about E-numbers is based on scientific facts, and not on misconceptions. It is also possible that social pressure plays a role when consumers decide to buy or not buy a product containing E-numbers. Subjective norm, based on the TPB (Ajzen, 1991), can influence consumers' behaviour. For example, if most consumers intend to avoid E-numbers, it is possible that they tell other consumers to avoid E-numbers as well.

Consumers are not necessarily concerned regarding E-numbers (see 3.1.3.), as opposed to prior research about food additives (Rimal et al., 2001; Shim et al., 2011; Tarnavölgyi, 2003). This could be due to the fact that consumers have less concerns regarding food hazards that they do not know well (Rosati & Saba, 2004). Moreover, in line with the findings by Liu and Niyongira (2017) in China, as family size increases the influence of concerns regarding E-numbers on consumers' attitudes towards E-numbers also increases (see 3.2.1.). Unexpectedly, consumers have high levels of trust in the government and food producers (see 3.1.3.). This contradicts prior research by Haen (2014), who stated that consumers lack trust in the government and food producers. It is however not unlikely that consumers nowadays have more trust in the government and food producers than six years ago. A possible explanation is that although consumers' attitudes towards E-numbers are negative, at least the dialogue between the government, food producers, and consumers is more open now than it was in 2014. As trust in food producers does influence consumers' attitudes

towards E-numbers (see 3.2.1.), it could explain why consumers' attitudes are only slightly and not extremely negative nowadays.

Contrary to earlier findings regarding food additives (Rimal et al., 2001), this research does not demonstrate a gap between consumers' perceived and actual behaviour. Consumers' attitudes remain negative and consumers avoid E-numbers which does not contradict each other and is in agreement with prior research (Paans, 2013). Based on the TPB (Ajzen, 1991), consumers' attitudes towards E-numbers directly influence their product choices, which seems to be the case in this research as well.

Consumers' attention is necessary for making informed food decisions based on nutrition labels, because it helps them understand the nutrition labels (Walters & Long, 2012). Consumers paid most attention to the E-number full out nutrition labels instead of the E-number labels (see 4.2.), which adds to prior research (Hoogma, 2015). A possible clarification is that the E-number full out labels took more time to read than the E-number labels, because they included more text (see 4.1.4.). Contrary to Hoogma (2015), who states that consumption intention is not necessarily higher for E-number full out labels than for E-numbers, this research shows that consumers do prefer E-number full out labels instead of E-number labels (see Table 5). Half of the consumers namely chose the E-number full out labels and the other half chose the no E-number labels. Therefore, any differences in taste perception between E-number and no E-number labels could not be studied. Moreover, these results suggest that consumers do not fully understand nutrition labels, as E-number full out labels still include E-numbers. It is therefore necessary that consumers learn more about additives and E-numbers, in line with their increasing interest for healthy food (Nathalia et al., 2017). Possibly due to the small sample size in the eye tracking study, no influence of attention to nutrition labels on product choice could be established.

5.3. Implications

This research adds to existing literature by involving both perceived and actual behaviour of consumers. Although consumers' health involvement is high (motivation), their knowledge seems to be insufficient (ability) which in this research seems to result in consumers' avoidance of E-numbers. Therefore, a theoretical implication of this research is that it is likely that consumers usually follow the peripheral route of information processing when making food choices. This was expected because prior research shows that consumers usually make their product choices habitually (Ares et al., 2014). It means that consumers do not mainly follow the central route of information processing which results in avoidance of E-number labelled packages, but no avoidance for the E-number full out labelled packages. Consumers would need to follow the central route in order to induce a change in their consumer behaviour, which possibly explains why consumers' attitudes towards E-numbers

remain negative based on this research. An important practical implication is that this research provides evidence for the effectiveness of leaving out E-numbers on food packages. In the eye tracking study, consumers avoided the E-number labelled packages, but not the E-number full out labelled packages. In fact, consumers paid most attention to the E-number full out labels. This suggests that having a 'clean label' policy by writing down the full name of an additive is useful for food producers, which coincides with prior research (Saltmarsh, 2015). This research thus provides new insights in consumers' attention to nutrition labels, their perceptions, and their actual behaviour in the context of E-numbers in food. However, there are some limitations to this research which should be noted.

5.4. Limitations and future research

A limitation for both the survey and the eye tracking study was that the target group consisted mainly of consumers with an average age between 18 and 24 years old, with a high level of education. Hence, they were not representative of the lower educated consumers. It is therefore suggested that future research includes a broader age group and the lower educated to further investigate differences between these groups. Besides, future research should test whether consumers' attitudes differ between E-number categories, such as preservatives and sweeteners. Although the survey helped to identify determinants which influence consumers' attitudes and taste expectation, the results suggest that there are many other variables which should be studied in future research because the models did not explain much of the variance in attitudes and taste expectation. It is therefore recommended that future research looks into the possible influences of risks and benefits and subjective norm within the context of E-numbers on attitudes and taste expectation. Qualitative research is required to further investigate consumers' perceptions regarding E-numbers, for instance by doing in-depth interviews.

One limitation of the eye tracking study is that the setting was not very realistic, as the study took place on the campus of the University of Twente and not in a supermarket. Nevertheless, the stimulus materials were as realistic as possible, by solely changing the nutrition label on the packages. The rather small number of participants is another limitation of the eye tracking study, which was due to lack of time because the location could only be used for three days. Future research should focus on a large scale eye tracking study and include different product categories. For example, consumers' attitudes towards E-numbers could differ between chips and yogurt. Moreover, future research should focus on whether consumers still avoid E-numbers in a large scale study. Another suggestion is to study consumers' behaviour in different situations, to see to what extent a consumers' environment influences their food choices. For instance, consumers at festivals who order fries compared to consumers who are grocery shopping and want a healthy meal for their

family. Another limitation is that it is possible that because the drink yogurt could not be cooled like it would have been in a supermarket, this influenced consumers' taste perception. However, this setting was chosen because participants could be more easily reached. A final limitation of the eye tracking study is that participants did not choose the E-number labels. Therefore, differences in taste perception between E-number labels and no E-number labels could not be studied. This should be included in future research. However, because there were no set conditions for the participants, the results of this research show that consumers still avoid E-numbers. Setting conditions on forehand would mean that consumers could not make an actual product choice, as it would have been made for them already. The way this research is held now is more realistic. The main suggestion for future research is to distinguish and evaluate possible interventions on how to make not just E-numbers, but food additives in general more attractive and understandable to consumers.

5.5. Conclusions

Within this research, two different studies have been performed. Therefore, the following two research questions have been examined:

'What factors influence consumers' attitudes and taste expectation, and what knowledge do they have in the context of E-numbers in food in The Netherlands? (survey)'

'To what extent do consumers base their product choices on attention to nutrition labels, how does this influence their taste perception, and how do consumers pay attention to nutrition labels in the context of E-numbers in food in The Netherlands? (eye tracking)'

The boomerang effect appeared in this research. Although E-numbers are regulated by the EU and frequently tested by scientists, consumers' attitudes towards E-numbers remain negative and consumers still avoid E-numbers. Therefore, no gap between perceived and actual behaviour is found regarding E-numbers and any differences in taste perception could not be studied. Attitudes towards E-numbers do influence consumers' taste expectation of products containing E-numbers, and only half of the consumers have correct knowledge regarding E-numbers. It seems likely that much of consumers' knowledge regarding E-numbers is based on misconceptions. Besides, consumers do not seem to fully understand nutrition labels regarding E-numbers, because despite their avoidance of E-number labels consumers did choose E-number full out labels. It seems that consumers need more information about nutrition labels regarding E-numbers. Moreover, more attention was paid to the E-number full out labels than to the E-number labels. However, attention did not seem to predict consumers' food choices. This research contributed to gaining insights in consumers' perceived and actual behaviour with regard to E-numbers. Future research should further examine what factors influence consumers' attitudes towards E-numbers, and their related food choices.

6. RECOMMENDATIONS

This chapter will discuss recommendations based on this research. Current research provides useful suggestions to the government and food producers for communication regarding E-numbers on nutrition labels, and help consumers to make informed food choices.

Based on this research, the following suggestions can be given:

- Food producers should use the full out names of E-numbers (e.g. citric acid) on nutrition labels instead of E-numbers (e.g. E330);
- food producers and the government should continue to enable an open discussion between them and consumers regarding E-numbers;
- as trust in food producers is an important determinant for consumers' attitudes, food producers should make sure to communicate transparently when it comes to nutrition labels;
- consumers should learn more factual knowledge regarding E-numbers and additives instead of believing (online) misconceptions regarding E-numbers;
- consumers should realise that E-numbers are safe in the amounts used in food and extensively tested by scientists.

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9. APPENDICES

9.1. Media analysis

The media analysis reviewed statements derived from online blogs and articles to find the most frequently used statements about knowledge and concerns regarding E-numbers. Inclusion criteria for the blogs and articles were: (1) must be written in the last decade (2010+), (2) must contain the name of an author or food institution, (3) and must be in English or Dutch. Used search terms included 'E-numbers', 'E-numbers news', and 'E-nummers nieuws'. Of the 138 statements, 71 were categorised for 'knowledge', and 67 were categorised for 'concerns'.

The media analysis proved to be very useful, as frequently mentioned concerns in the blogs and articles were not always covered by scientific literature. For example, the concern that E-numbers cause hyperactivity in children and concerns regarding E-number E951 (aspartame). Furthermore, reading the blogs and articles showed that the association between E-numbers and unhealthy food is continuously made. For instance, E-numbers are often mentioned in relation to obesity and the articles regarding E-numbers repeatedly included candy pictures. Besides, there are many different terms used when it comes to E-numbers, which can be confusing for consumers. For example, terms such as 'natural', 'processed food', and 'clean labels'. Although used interchangeably, these terms have different meanings and associations. Therefore, it is relevant to realise that information regarding E-numbers available to consumers is likely very confusing for them. Table 8 and 9 below provide a full overview of the used articles and blogs, along with the statements derived from them.

Table 8.

Media analysis – overview used articles and blogs

Nr.	Date	Title	Source	Link
1	13-2-2014	The dreaded E number	Rob Ramaker	https://resource.wur.nl/en/show/The-dreaded-E-number.htm
2	23-8-2010	Are E numbers really bad for you?	Stefan Gates	https://www.bbc.co.uk/blogs/food/2010/08/are-e-numbers-really-bad-for-y.shtml
3	24-1-2014	Food E numbers explained	Tiia Monto	https://www.healthplanspain.com/blog/health-tips/266-food-e-numbers-

				explained.html
4	24-5-2017	Should all E-numbers be prohibited?	Truefoods	https://www.truefoodsblog.com/articles/should-all-e-numbers-be-prohibited-truefoods_748/
5	25-8-2010	The day I ate as many E numbers as possible	Stefan Gates	https://www.bbc.com/news/magazine-10773893
6	30-6-2018	Top E numbers to avoid	Rachel Newcombe	http://www.exploreenumbers.co.uk/top-10-e-numbers-try-avoid.html
7	19-9-2018	Ingredients with confusing names or food full of E numbers? What does it all mean?	Melissa Hawkins	https://www.ashfords.co.uk/news-and-media/general/ingredients-with-confusing-names-or-food-full-of-e-numbers-what-does-it-all-mean
8	21-2-2017	What future for E numbers after Brexit?	Sarah Glatte & Joseph D'Urso	https://www.bbc.com/news/uk-politics-39028071
9	3-3-2015	Why does the media have a blindspot on food science?	Robin Bisson	https://www.theguardian.com/science/head-quarters/2015/mar/03/why-does-the-media-have-a-blindspot-on-food-science
10	27-5-2019	Zijn E-nummers schadelijk voor de gezondheid?	Rosa Rolvink	https://www.consumentenbond.nl/gezond-eten/e-nummers-schadelijk-gezondheid
11	13-7-2010	De zin en onzin van E-nummers: Experts aan het woord	Madeleine van de Wouw	https://www.gezondheidsnet.nl/voeding/de-zin-en-onzin-van-e-nummers
12	7-3-2019	Snijbietsap en bamboevezels zijn de nieuwe E-nummers	Ellen den Hollander	https://www.ad.nl/koken-en-eten/snijbietsap-en-bamboevezels-zijn-de-nieuwe-e-nummers~ad7c6098/?referrer=https://www.google.nl/
13	9-12-2018	Het veilige E-nummer zorgt voor onbehagen	Geertje Tuenter	https://www.nrc.nl/nieuws/2018/12/09/het-veilige-e-nummer-zorgt-voor-onbehagen-a3060010
14	15-3-2019	Wat is bewerkt voedsel en is het echt zo slecht?	Anouk Broersma	https://www.volkskrant.nl/wetenschap/wat-is-bewerkt-voedsel-en-is-het-echt-zo-slecht~b53decb3/

15	22-7-2015	Hoe zit het nu écht met e-nummers?	Redactie Vrouw: Astrid Postma-Smeets	https://www.telegraaf.nl/nieuws/670916/hoe-zit-het-nu-echt-met-e-nummers
16	15-7-2015	Zijn we doorgeslagen in onze angst voor E-nummers?	Gabriella Codonesu	https://www.trouw.nl/nieuws/zijn-we-doorgeslagen-in-onze-angst-voor-e-nummers~b86b8d5d/
17	23-9-2017	Hoe gevaarlijk of ongevaarlijk zijn E-nummers nu echt?	Avrotros > Loethe Olthuis	https://www.nporadio1.nl/consument/5923-hoe-gevaarlijk-of-ongevaarlijk-zijn-e-nummers-nu-echt
18	1-2-2011	Eerlijk over e-nummers	Bo Blanckenburg	https://www.nemokennislink.nl/publicaties/eerlijk-over-e-nummers/

Table 9.

Media analysis – overview statements derived from articles and blogs

Article /blog nr.	Statements 'knowledge'	Statements 'concerns'
1	- E-numbers are used to increase the quality of food - It depends on the amount of an E-number to be poisonous or not (Ramaker, 2014).	- E-numbers are poison (Ramaker, 2014).
2	- E-numbers are regulated by the EU (EFSA) - E-numbers have been extensively tested and analysed to ascertain safe levels (Gates, 2010a).	- Some E-numbers cause hyperactivity in children - E-numbers are good for you (Gates, 2010a).
3	- E-numbers are codes given to food additives - E-numbers are approved to use as additives by the EU - The EFSA is responsible for approving and assessing additives - E-numbers means that the additives have passed safety tests and are approved	- Some colours used frequently in sweets and drinks for children can have a detrimental effect on children's behaviour - Certain additives can cause allergies - Children with ADHD should avoid certain E-numbers (Monto, 2014).

	- There are different categories for additives: antioxidants/preservatives/emulsifiers, stabilisers, gelling agents and thickeners/flavour enhancers/sweeteners/colours (Monto, 2014).	
4	- Nearly every person in the Western world consumes E-numbers every day - E-numbers are codes for food additives whereas the "E" stands for Europe - Most E-numbers are not vegetarian - Most E-numbers come from a natural origin - Some E-numbers such as emulsifiers, stabilisers, thickeners, and preservatives are indispensable for the haptic, shelf life and integrity of nearly all products to be found in a conventional supermarket (Truefoods, 2017).	- E-numbers cause health issues - Some food colours (E-numbers) can increase hyperactivity in children - Aspartame, E951, is an artificial sweetener which can cause headaches and trigger several allergies - Long-term effects of E-numbers are unsure, especially for children (Truefoods, 2017).
5	- A lot of fine and expensive foods are made using E-numbers as preservatives, including the best wines (E220) and the finest hams (E252) (Gates, 2010b).	- Removing E-numbers from food would actually make food more dangerous to eat in some cases - It is nearly impossible to eat so much of one E-number to get you poisoned, because of the used safety levels - E-numbers are good for us (Gates, 2010b).
6	- The letter E (for Europe) together with its number, simply means it's been tested by the powers-that-be in the EU - Natural substances like vitamin C (E300), paprika (E160c) and even oxygen (E948) each have an E-number assigned to them (Newcombe, 2018).	- E-numbers actually helped to remove the threat of serious food poisoning such as that caused by botulism - E-numbers can have negative side effects on certain consumer groups - A few E-numbers link to hyperactivity in children - E-numbers you should avoid are aspartame, sodium benzoate, black PN/brilliant black BN, brilliant blue FCF, and calcium benzoate (Newcombe, 2018).
7	- Without additives food would not stay good for long	

	- Before additives are used in food they must be assessed for safety - Only approved additives can be used in food and limits and conditions are set on their use - When selling an additive directly to a consumer as an additive there are detailed labelling requirements (Hawkins, 2018).	- Food businesses use food additives to ensure their products are stable and uniform and also to preserve flavour or enhance its taste, appearance, or other qualities - There is a link between food colours and hyperactivity in children for the following food colours: sunset yellow, quinoline yellow, carmoisine, allura red, tartrazine, and ponceau - For food with such food colours (as mentioned above), a warning must be present on the package (Hawkins, 2018).
8	- For a substance to be permitted for use as a food additive in the EU, it must be given an E-number - Most E-numbers are perfectly benign and lots are good for us, like E300, otherwise known as Vitamin C - Every new additive (E-number) needs authorization from an expert panel at the EFSA - The EFSA are experts in chemistry, toxicology and other relevant fields and meet regularly to assess which additives are safe (Glatte & D'Urso, 2017).	- E-numbers are often associated with processed food - Some E-numbers can cause hyperactivity in children (Glatte & D'Urso, 2017).
9	- Food toxicologists work out the lowest amount of a substance that can be eaten at which there is any negative biological effect, and then set thresholds around 100-fold lower for acceptable levels in food (Bisson, 2015).	- Many people equate "chemical" with "bad" and "natural" with "good", but as chemists are at pains to point out, natural things are made up of chemicals too and not all of them are good for you - Previous generations were exposed to dangerous chemicals (think lead paint, asbestos) that have been removed from everyday life thanks to toxicology - Several large-scale studies have found a correlation between artificial sweetener consumption and weight gain

		- Accumulating evidence suggests that artificial sweeteners may also increase our risk of type 2 diabetes - Current epidemiological data in humans do not support a meaningful link between diet drinks and risk for diabetes - It is fat, salt and sugar that we should worry about (Bisson, 2015).
10	- Alle E-nummers zijn onderzocht op schadelijke bijwerkingen - Alleen als uit wetenschappelijk onderzoek blijkt dat een stof veilig is mag het in Europa worden gebruikt - E-nummers verbeteren bijvoorbeeld de kleur, smaak of houdbarheidsdatum van producten - Voedingsmiddelen mogen maar een maximale hoeveelheid E-nummers bevatten (ADI) - De ADI (aanvaardbare dagelijkse inname) is meestal een honderdste van de hoeveelheid waarvan wetenschappelijk is onderzocht dat dit geen effect heeft op ratten of muizen - Bij het opstellen van de normen is een flinke marge ingebouwd (Rolvink, 2019).	- Veel verhalen over E-nummers zijn overdreven - De combinatie van bepaalde E-nummers zou een ongewenst effect kunnen hebben, daardoor worden bepaalde E-nummers steeds beperkter gebruikt - De kans is erg klein dat kinderen hyperactief worden van kleurstoffen, of dat kleurstoffen concentratieproblemen veroorzaken - Fabrikanten moeten echter wel verplicht een waarschuwing op de verpakking zetten als zij bepaalde kleurstoffen gebruiken - Aspartaam is veilig, net als alle andere zoetstoffen met een E-nummer - Aspartaam is niet veilig voor mensen met de erfelijke stofwisselingsziekte fenylketonurie (Rolvink, 2019).
11	- Er zijn, naast synthetische, ook veel natuurlijke E-nummers - Het is niet voor niets bij wet bepaald dat deze stoffen (bepaalde E-nummers) alleen toegevoegd mogen worden als het noodzakelijk is - E-nummers zijn niets meer of minder dan een lijst met goedgekeurde additieven, zowel natuurlijke als synthetische - Geur- en smaakstoffen hebben géén E-nummer, kleurstoffen wel - Als er al beperkingen zijn met E-nummers, dan is de kans bijna nihil dat je als gewone consument over de toegelaten marges gaat	- Mensen krijgen van bepaalde E-nummers allergische reacties, zoals netelroos en astmatische aanvallen - Aspartaam wordt in lightproducten gebruikt als vervanging voor suiker, maar je wordt er juist alleen maar dikker van. - Bovendien staat aspartaam bekend om bijwerkingen en overgevoeligheden die je ervan kunt krijgen

	- In een tomaat, biologisch of niet, zitten al tien tot vijftien E-nummers - Mensen die absoluut geen E-nummers willen eten, zijn veroordeeld tot het drinken van water en het eten van zout en suiker (Van de Wouw, 2010)	- Een andere bekende stof waar mensen overgevoelig op reageren is E621: Ve-Tsin, die vooral gebruikt wordt als smaakversterker en vele reacties (zoals hoofdpijn) geeft - Om zo min mogelijk kunstmatige geur-, kleur- en smaakstoffen binnen te krijgen, moet je niet-biologische kant-en-klare producten laten staan - In niet-biologische kant-en-klare producten zitten allerlei stoffen en toevoegingen die we beter kunnen vermijden om het risico op overgevoeligheden uit te sluiten - Wetenschappelijk medisch gezien is er niets aan de hand met E-nummers, sociaal maatschappelijk wel - Je kunt allergisch zijn voor één, of hooguit een paar E-nummers, maar niet voor alle (Van de Wouw, 2010)
12	- Bamboevezels en snijbietextract vervangen de term nitriet, wat nodig is om te voorkomen dat vlees bederft - Fabrikanten zoeken alternatieven voor E-nummers en willen een clean label voor consumenten - Toch worden de alternatieven ook vaak niet gebruikt, want E-nummer E250 (nitriet) is veel zuiverder (Den Hollander, 2019).	- Fabrikanten gebruiken exotisch klinkende stoffen niet voor een betere smaak, maar om geen E-nummer te hoeven vermelden (Den Hollander, 2019).
13	- Eten is nog nooit zo veilig geweest, maar de consument wantrouwt kunstmatige toevoegingen en de fabrikant buigt mee - E-nummers kunnen ontzettend veel dingen: ze geven niet alleen smaak, maar ook kleur, zorgen voor binding, langere houdbaarheid of gaan klontering tegen – en dit is nog maar een deel van de toepassingen	- MSG en aspartaam behoren tot de beruchtste E-nummers, maar ook de rest raakt uit de gratie - Veel E-nummers betekent meestal ook veel suiker, vet of zout - Wantrouwen voor E-nummers is vaak gebaseerd op verkeerde conclusies en onzorgvuldige onderzoeken

	- Fabrikanten benadrukken dat E-nummers door de EU goedgekeurd hulpstoffen zijn, waarvan na zeer uitgebreide toetsing is gebleken dat ze niet schadelijk zijn - Er zijn geen regels voor wat clean label is - 'Natuurlijk' betekent niet dat een product vrij is van E-nummers, want helemaal zonder is soms lastig: hulpstoffen hebben een functie, maar ze zijn dan idealiter wel van natuurlijke oorsprong (Tuenter, 2018).	- Niet alle E-nummers zijn onschuldig: een klein deel van de astmapatiënten is bijvoorbeeld overgevoelig voor sulfiet (E220 t/m E228) - EFSA doet opnieuw onderzoek naar (poly)fosfaten die in bewerkt vlees te vinden zijn en mogelijk bijdragen aan hart- en vaatziekten (Tuenter, 2018).
14	- Bewerken is alles wat we doen om grondstoffen om te zetten in iets wat we eetbaar vinden, bijna alles wat we eten is dus bewerkt - E-nummers zijn stoffen die voedsel bijvoorbeeld meer kleur geven of langer houdbaar maken - Je zou zonder E-nummers kunnen, maar dan lever je in op aspecten als veiligheid, houdbaarheid en gebruiksgemak - Het Voedingscentrum adviseert toch ook om 'minder bewerkt' te eten, het doelt dan op producten waar tijdens het bewerkingsproces de vezels, vitamines en mineralen verloren gaan (Broersma, 2019).	- E-nummers hebben echter geen zorgwekkende gezondheidseffecten, blijkt uit talloze studies - Schadelijk zijn E-nummers dus niet, al hebben ze ook geen voedingswaarde (Broersma, 2019).
15	- E-nummers worden niet altijd handmatig toegevoegd aan onze voeding, veel producten zoals groenten en fruit bevatten van nature al verschillende E-nummers zoals vitamine C - Er zijn verschillende soorten E-nummers, bijvoorbeeld E-nummers die ervoor zorgen dat we onze voeding langer kunnen bewaren of die bijv. onze voeding aantrekkelijker moet maken, ook wel kleurstoffen genoemd - Er zijn producten die E-nummers bevatten, maar die je wel degelijk nodig hebt: zo bevatten brood, zuivel, vlees en vis ook E-nummers en toch passen ze binnen een gezond eetpatroon (Redactie Vrouw, 2015).	- Gevaarlijke E-nummers bestaan niet, hulpstoffen krijgen namelijk een E-nummer als de EFSA ze heeft gecontroleerd - E-nummers worden inderdaad toegevoegd aan frisdrank en snoep, maar het is natuurlijk niet zo dat E-nummers de grote boosdoeners zijn: zo zijn suikers en zuren niet goed voor de gezondheid van kinderen - Wel kunnen we ons afvragen of we – in een maatschappij waar in veel kinderen kampen met overgewicht – ongezonde producten als snoep nóg aantrekkelijker moeten maken

		- Kies zoveel mogelijk producten die niet of nauwelijks bewerkt zijn, laat zakjes, pakjes en koekjes staan en ga voor verse en onbewerkte producten zoals groente en fruit (Redactie Vrouw, 2015).
16	- Stoffen krijgen namelijk pas een E-nummer als de EFSA heeft aangesteld dat ze verantwoord kunnen worden gebruikt - Bovendien zijn veel E-nummers gewoon natuurlijke stoffen die ook gewoon in groenten en fruit zitten - Fabrikanten komen ineens op de proppen met producten die 'E-nummer vrij' zouden zijn, maar in werkelijkheid zitten de E-nummers nog steeds in het product, verstopt onder hun chemische naam (Codonesu, 2015).	- Die angst voor E-nummers is helemaal nergens voor nodig - Als een stof schadelijk was, zou het geen E-nummer mogen heten - Gevaarlijke E-stoffen bestaan niet - Aspartaam en mononatriumglutamaat hebben een slechte naam gekregen in de afgelopen jaren - Het gaat hierbij vaak om achterhaalde informatie, gebaseerd op slecht onderzoek (Codonesu, 2015).
17	- E-nummers worden toegevoegd aan ons eten om de eigenschappen ervan te verbeteren - E-nummers zorgen ervoor dat voedingsproducten langer houdbaar blijven, dat voorkomt voedselverspilling - E-nummers zijn de meest onderzochte stoffen in onze voeding en daardoor ook de veiligste - Een stof mag bij de gebruikte hoeveelheden niet schadelijk zijn voor de gezondheid en krijgt pas een E-nummer als dat ook zo blijft als je er wat meer dan bij een normaal voedingspatroon van binnenkrijgt - Consumenten schatten de risico's van E-nummers hoger in dan wetenschappers	- E-nummers leveren vooral veel geld op - E-nummers zijn absoluut niet gevaarlijk - Mensen kunnen allergisch reageren op sulfiet - Nitriet kan in ons lichaam worden omgezet in kankerverwekkende nitrosaminen (gebruikt in vlees om het mooi rood te houden), we krijgen er echter zo weinig van binnen dat het risico klein is - Zonder natriumnitriet is het bijna onmogelijk om vleeswaren zoals worst te maken, we worden er niet ziek van (Avrotros, 2017).

	- Synthetische kleurstoffen worden steeds vaker vervangen door natuurlijke kleurstoffen, zoals bietenrood of wortelextract (Avrotros, 2017).	
18	- De helft van de Nederlanders maakt zich weleens zorgen over E-nummers - De eisen waar voedingsadditieven aan moeten voldoen in Europa zijn best zwaar, en staan beschreven in de Warenwetbesluiten - Als een fabrikant een stof aan zijn product wil toevoegen, moet hij op alle mogelijke manieren bewijzen dat het veilig is - De aanbevolen dagelijkse hoeveelheid is dus honderd keer minder dan de concentratie waar proefdieren nog net géén last van kregen - Dingen die 'de gemiddelde mens' vaak eet mogen dus minder (E-nummers) bevatten dan dingen die we heel zelden eten - 80% van de E-nummers zijn gewoon natuurlijke stoffen - Als je helemaal geen E-nummers wilt eten, kan je alleen nog water, suiker en zout eten (Blanckenburg, 2011).	- Aspartaam is waarschijnlijk het best onderzochte voedseladditief dat er is - Bij al die testen (aspartaam) zijn geen negatieve effecten gevonden bij de hoeveelheden die in consumentenproducten zitten - Natuurlijk zijn er wel mensen die extra gevoelig zijn voor bepaalde ingrediënten - De Southampton six zijn bepaalde kleurstoffen met benzoaat die een verhoogde kans geven op AHDH, maar de EFSA kon dit resultaat niet vinden (Blanckenburg, 2011).

9.2. Study 1: Survey

Introduction

Beste consument,

Allereerst bedankt voor uw deelname aan dit onderzoek. Mijn naam is Mariska Bloeming en ter afronding van mijn master Communication Studies voer ik dit onderzoek uit. Het onderzoek gaat over E-nummers in voedsel. Het invullen van deze vragenlijst zal ongeveer 5-10 minuten duren. Met uw gegevens wordt betrouwbaar omgegaan en de resultaten worden anoniem verwerkt. Denk eraan dat er geen goede of foute antwoorden zijn. Mocht u meer informatie willen over het onderzoek, dan kunt u contact opnemen met: m.bloeming@student.utwente.nl.

Door verder te gaan met de vragenlijst gaat u akkoord met uw deelname aan dit onderzoek.

Met vriendelijke groet,

Mariska Bloeming

Q1 Taste expectation

Geef hieronder aan in hoeverre u het eens bent met de volgende statements. 1 = helemaal mee oneens en 7 = helemaal mee eens. Er zijn geen goede of foute antwoorden.

Producten met E-nummers smaken kunstmatig.	1	2	3	4	5	6	7
Producten met E-nummers smaken natuurlijk.	1	2	3	4	5	6	7

Producten met E-nummers smaken lekker.	1 2 3 4 5 6 7

Q2 Attitudes

Dit onderzoek gaat over E-nummers in voedsel. Geef bij onderstaande statements aan in hoeverre ze voor u gelden betreffende wat u vindt van E-nummers in voedsel. Er zijn geen goede of foute antwoorden. Het gebruik van E-nummers in voedingsproducten is...

	1 2 3 4 5 6 7	
Onaantrekkelijk		Aantrekkelijk
Slecht		Goed
Ongunstig		Gunstig
Vies		Lekker
Negatief		Positief
Ongezond		Gezond
Niet nuttig		Nuttig
Schadelijk		Onschadelijk

Q3 Knowledge

Geef voor de volgende statements aan of ze volgens u juist of onjuist zijn, of dat u het antwoord niet weet.

	Juist	Onjuist	Weet ik niet
E-nummers worden gebruikt om de kwaliteit van voedsel te verhogen.			
E-nummers worden gereguleerd door de Europese Unie.			
E-nummers zijn codes voor toevoegingen aan voedsel.			
E-nummers worden veelvuldig getest voordat ze worden goedgekeurd.			
E-nummers hebben ervoor gezorgd dat bepaalde voedselvergiftigingen niet meer kunnen gebeuren.			
Zonder E-nummers is voedsel minder lang houdbaar.			
E-nummers kunnen allergische reacties veroorzaken.			
Er zijn verschillende soorten E-nummers zoals zoet- en kleurstoffen, antioxidanten en conserveringsmiddelen.			
De meeste E-nummers zijn niet vegetarisch.			
E-nummers kunnen ook van oorsprong in een product zitten, zonder dat ze eraan toegevoegd zijn.			
De letter E van E-nummer staat voor Europa.			
In groenten en fruit zitten van nature E-nummers.			

Q4 Trust

Geef bij onderstaande statements aan in hoeverre ze voor u gelden betreffende wat u vindt van E-nummers. Er zijn geen goede of foute antwoorden.

	Helemaal mee oneens	Mee oneens	Een beetje mee oneens	Noch mee eens noch mee oneens	Een beetje mee eens	Mee eens	Helemaal mee eens
Je kunt erop vertrouwen dat voedselveiligheidsinstanties ervoor zorgen dat voedsel veilig is om te consumeren.							
Ik heb er vertrouwen in dat de overheid ervoor zorgt dat het voedsel in de supermarkten veilig is.							
De huidige wet- en regelgeving zorgt ervoor dat het voedsel dat ik consumeer veilig is.							
Doordat de overheid nauw samenwerkt met voedselveiligheidsinstanties zorgt dit ervoor dat de kwaliteit van voedsel goed en veilig is.							
Ik heb er vertrouwen in dat de voedselfabrikanten ervoor zorgen dat voedsel veilig is.							
De marktwerking tussen voedselfabrikanten zorgt ervoor dat de kwaliteit van voedsel goed en veilig genoeg is.							
Ik vertrouw erop dat voedselfabrikanten alleen de nodige E-nummers toevoegen aan hun producten.							

Ik heb er vertrouwen in dat voedselfabrikanten zich aan de voorgeschreven regels houden, waardoor voedsel veilig te consumeren is.	

Q5 Concerns

Geef voor de volgende stellingen aan in hoeverre u er bezorgd over bent. Er zijn geen goede of foute antwoorden. Ik ben er bezorgd over dat...

	Zeer bezorgd	Bezorgd	Een beetje bezorgd	Noch bezorgd noch onbezorgd	Een beetje onbezorgd	Onbezorgd	Zeer onbezorgd
...E-nummers hyperactiviteit veroorzaken bij kinderen.							
...E-nummers giftig zijn.							
...E-nummers kanker veroorzaken.							
...E-nummers allergieën veroorzaken.							
...de periodes voor het testen van E-nummers te kort zijn.							
...E-nummers worden gebruikt om schadelijke ingrediënten te verbergen van de ingrediëntenlijst.							
...E-nummers worden gebruikt om een product langer houdbaar te maken.							
...E-nummers worden gebruikt om kleur aan het eten toe te voegen.							

...er te weinig geld is om E-nummers goed te kunnen controleren.	
...er onvoldoende informatie beschikbaar is over E-nummers.	
...E-nummers vaak slecht in het nieuws zijn.	
...bepaalde E-nummers, zoals aspartaam, nadelige bijwerkingen hebben.	

Q6 Health involvement

Geef aan in hoeverre de volgende statements voor u gelden. Er zijn geen goede of foute antwoorden.

	Helemaal mee oneens	Mee oneens	Een beetje mee oneens	Noch mee eens noch mee oneens	Een beetje mee eens	Mee eens	Helemaal mee eens
Gezondheid betekent veel voor mij.							
Ik geef veel om mijn gezondheid.							
Ik doe er alles aan om gezond te blijven.							
Gezond eten is belangrijk voor mij.							
Ik ben erg begaan met gezondheidskwesties.							

Het is belangrijk voor mij om gevarieerd te eten.

Tot slot nog enkele aanvullende vragen:

Q7 Age

Wat is uw leeftijd (in jaren)?

_____

Q8 Gender

Wat is uw geslacht?

- Man
- Vrouw
- Anders, namelijk _____

Q9 Education

Wat is uw huidige of hoogst genoten opleiding?

- Basisschool / HAVO klas 1, 2, 3 / VWO klas 1, 2, 3 / MBO klas 1
- HAVO klas 4, 5 / VWO klas 4, 5, 6 / MBO klas 2, 3, 4
- HBO / WO

Q10a Family situation – family size

Voor hoeveel personen doet u meestal boodschappen? Vul de volgende stelling aan. Ik doe meestal boodschappen voor ... (aantal) personen.

_____

Q10b Family situation – elderly

Wonen er ouderen (ouder dan 65 jaar) bij u in huis?

- Ja
- Nee

Q10c Family situation – children

Wonen er kinderen (jonger dan 20 jaar) bij u in huis?

- Ja
- Nee

Q11 Allergies

Heeft u of heeft iemand in uw gezin een allergie?

- Ja, ik heb zelf een allergie, namelijk: _____
- Ja, iemand in mijn gezin heeft een allergie, namelijk: _____
- Nee

9.3. Overview of general consumer concerns

Table 10.

Overview of general consumer concerns regarding food additives based on scientific literature

Concern	Source(s)
Ineffective regulations	(Tarnavölgyi, 2003)
Toxicology	(Anilakumar et al., 2017; Kayışoğlu & Coşkun, 2016; Shim et al., 2011)
Causes cancer	(Kayışoğlu & Coşkun, 2016; Shim et al., 2011; Tarnavölgyi, 2003)
Causes allergies	(Shim et al., 2011)
Test periods of food safety are too short	(Tarnavölgyi, 2003)
E-numbers are used to conceal harmful ingredients	(Tarnavölgyi, 2003)
Preservatives	(Shim et al., 2011)
Colourants	(Shim et al., 2011)
Lack of money causes lack of continuous control by food safety authorities	(Tarnavölgyi, 2003)
Insufficient information	(Ismail et al., 2017; Shim et al., 2011)
Negative media attention	(Shim et al., 2011)

9.4. Study 2: Eye tracking

9.4.1. Informed consent form

Beste participant,

Bedankt voor uw deelname aan dit onderzoek. Dit onderzoek zal ongeveer 10 minuten duren en gaat over verpakkingen van voedsel. Het onderzoek bestaat uit drie korte onderdelen: (1) het kiezen van een product m.b.v. de eye tracker bril, (2) het proeven van het door u gekozen product en (3) het invullen van de vragenlijst. U zult zo beginnen met het eerste deel van dit onderzoek, waarbij u gevraagd wordt de eye tracker bril te dragen. Deze wordt allereerst gekalibreerd en meet waar uw ogen op focussen. Nadat u een product gekozen heeft, begint het tweede gedeelte van het onderzoek. Hierbij mag u het door u gekozen product proeven, welke u door de onderzoeker wordt aangeboden. Daarna kunt u de QR code van de korte vragenlijst scannen en mag u deze invullen.

Met uw gegevens wordt betrouwbaar omgegaan en de resultaten worden anoniem verwerkt. Denk eraan dat er geen goede of foute antwoorden zijn tijdens het onderzoek. Voor meer informatie kunt u contact opnemen met: m.bloeming@student.utwente.nl.

Door het zetten van uw handtekening hieronder, gaat u akkoord met uw deelname aan het onderzoek. Nogmaals hartelijk dank voor uw deelname!

Handtekening:

9.4.2. Exit questionnaire

Q1 Taste perception

Wat vond u van de smaak van de drinkyoghurt? Geef hieronder aan in hoeverre u het eens bent met de volgende stellingen. 1 = helemaal mee oneens en 7 = helemaal mee eens. Er zijn geen goede of foute antwoorden.

De drinkyoghurt smaakte zoet.	1	2	3	4	5	6	7
De drinkyoghurt smaakte bitter.	1	2	3	4	5	6	7
De drinkyoghurt smaakte zout.	1	2	3	4	5	6	7
De drinkyoghurt smaakte zuur.	1	2	3	4	5	6	7
De drinkyoghurt was romig.	1	2	3	4	5	6	7
De drinkyoghurt was kunstmatig.	1	2	3	4	5	6	7
De drinkyoghurt was natuurlijk.	1	2	3	4	5	6	7
De drinkyoghurt was lekker.	1	2	3	4	5	6	7

Q2 Familiarity

Onderstaande stellingen gaan over het door u gekozen product. Geef bij onderstaande stellingen aan in hoeverre ze voor u gelden. 1 = helemaal mee oneens en 7 = helemaal mee eens. Er zijn geen goede of foute antwoorden.

Ik koop vaker drinkyoghurt.	1	2	3	4	5	6	7
Ik ben bekend met het door mij gekozen product.	1	2	3	4	5	6	7
Ik ben bekend met het merk van dit product.	1	2	3	4	5	6	7

Q3 Attitudes

Dit onderzoek gaat over E-nummers in voedsel. Geef bij onderstaande statements aan in hoeverre ze voor u gelden betreffende wat u vindt van E-nummers in voedsel. 1 = helemaal mee oneens en 7 = helemaal mee eens. Er zijn geen goede of foute antwoorden. E-nummers zijn...

	1	2	3	4	5	6	7	
Onaantrekkelijk								Aantrekkelijk
Slecht								Goed
Ongunstig								Gunstig
Vies								Lekker
Negatief								Positief

Ongezond		Gezond
Niet nuttig		Nuttig
Schadelijk		Onschadelijk

Tot slot nog enkele aanvullende vragen:

Q4 Age

Wat is uw leeftijd (in jaren)?

_____

Q5 Gender

Wat is uw geslacht?

- Man
- Vrouw
- Anders, namelijk _____

Q6 Education

Wat is uw huidige of hoogst genoten opleiding?

- Basisschool / HAVO klas 1, 2, 3 / VWO klas 1, 2, 3 / MBO klas 1
- HAVO klas 4, 5 / VWO klas 4, 5, 6 / MBO klas 2, 3, 4
- HBO / WO

9.4.3. Marketing materials

Figure 11. Melkunie package

9.4.4. Stimulus materials

Table 11.

Stimulus materials – overview of E-numbers and E-number full out names used on the nutrition labels

E-number full out name in English	E-number full out name in Dutch	E-number (based on (Voedingscentrum, n.d.; Voedingswaardetabel.nl, n.d.)	E-number category (based on Merck, n.d.)
Riboflavin / Vitamin B2	Riboflavinen/Vitamine B2	E101	Colour additives
Lactic acid	Melkzuur	E270	Preservatives
Calcium lactate	Calciumlactaat	E327	Antioxidants, acidity regulators
Citric acid	Citroenzuur	E330	Antioxidants, acidity regulators
Calcium	Calcium	E385	Antioxidants, acidity regulators
Guar gum	Guarpitmeel	E412	Thickeners, stabilizers, emulsifiers
Sucralose	Sucralose	E955	Miscellaneous

Figure 12. Campina package

Figure 13. Vifit package

Figure 14. Melkunie package