Older adults, mealtime-related emotions, and functionalities

Tailoring protein-enriched meals

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Thesis

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Chapter 1

General Introduction

Worldwide, the number of older adults is increasing tremendously (RIVM, 2013; United Nations, 2013). The number of persons aged 60 years or over is expected to more than double from 841 million people in 2013 to more than 2 billion in 2050. In developed countries there is a trend that these persons also live independently for a longer period of time than the previous generations (United Nations, 2013).

Dietary proteins are of special interest for this growing group of older adults (Bauer et al., 2013; Deutz et al., 2014; Paddon-Jones et al., 2015), as these people do not always have an adequate protein intake (Tieland, Borgonjen- van den Berg, van Loon, & de Groot, 2012). The latter is troublesome given the risk for negative outcomes linked to inadequate protein intakes, such as loss of muscle mass (Deer & Volpi, 2015; Houston et al., 2008). In addition, this older group is highly heterogeneous (Morgan, 2003; Sudbury & Simcock, 2009), due to long and divergent ageing processes and life experiences/memories. It would therefore be relevant to tailor protein-rich foods to subgroups of older persons, as a first step in empowering them to better meet their food requirements (van der Zanden, van Kleef, de Wijk, & van Trijp, 2014).

Previous attempts to customise foods to older adults paid little attention to the heterogenic nature of this group and focused on e.g. served meals, nutritional counselling, and targeted nutritional supplementation (Best & Appleton, 2011; Krondl, Lau, Coleman, & Stocker, 2003; Trabal, Hervas, Forga, Leyes, & Farran-Cordina, 2014; Ziylan, Kremer, Eerens, Haveman-Nies, & de Groot, 2016). However, such strategies seem to be less suitable when developing protein-enriched meals for the diverse group of vital community-dwelling seniors, who in general aim at maintaining their independence (e.g. preparing their meals themselves) for as long as possible (Harrefors, Sävenstedt, & Axelsson, 2009). In the current thesis, we therefore explored two segmentation approaches for tailoring protein-enriched (PE) meals to subgroups of vital community-dwelling older adults.

This general introduction will further elaborate on the protein needs and heterogeneity of the older consumer group. Subsequently, the two segmentation approaches as explored in this thesis will be introduced; emotion-based and functionality-based. Finally, the objective and outline of this thesis will be given.

Protein intake and healthy ageing

When people age, they often encounter a gradual loss of muscle mass and muscle strength. This condition is referred to as sarcopenia (Morley, Baumgartner, Roubenoff, Mayer, & Nair, 2001). An adequate protein intake, combined with physical activity, may postpone the onset of sarcopenia, slow down its progression, and attenuate its functional consequences (Bauer et al., 2013; Deutz et al., 2014; Paddon-Jones et al., 2015). In the Netherlands, about 10% of the community-dwelling and 35% of the institutionalised seniors has a dietary protein intake below the estimated average requirement of 0.66 g/kg/day (Tieland, Borgonjen- van den Berg, van Loon, & de Groot, 2012). The latter is alarming taking into account the negative consequences of sarcopenia; such as frailty, disability, physical dependence, and even mortality (Deer & Volpi, 2015). Therefore, strategies to tailor protein-rich foods to seniors' needs and wants are necessary to optimise dietary protein intake of this large consumer group.

The onset of sarcopenia is multifactorial (Fielding et al., 2011), and is – amongst other factors – linked to both lower protein intakes and higher protein needs, as shown in Figure 1.1. On the one hand, dietary protein intake has been described to decrease over time. Deutz et al. (2014) relate this lower intake to several factors, such as medical conditions and physiological changes that lead to anorexia. Besides, physical and mental disorders may limit access to (and preparation of) food. Also, socio-economic status (e.g. poverty) and genetic predisposition of low appetite may interfere with an adequate protein intake. On the other hand, seniors might have higher protein requirements for muscle maintenance and muscle accretion, due to anabolic resistance, decreased muscle perfusion, and low postprandial availability of amino acids compared to their younger counterparts. Moreover, inflammatory conditions, such as heart failure and chronic obstructive pulmonary disease (COPD), may increase protein catabolism, resulting in even higher protein needs.

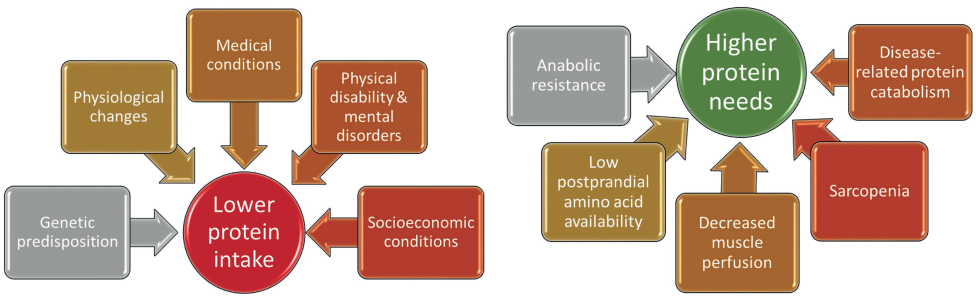

Figure 1.1 Factors associated with lower protein intake and higher protein needs (Deutz et al., 2014, p. 3).

Recently the PROT-AGE Study Group (Bauer et al., 2013) and the ESPEN Expert Group (Deutz et al., 2014) published targets for optimising older adults' (65+ years) dietary protein intake. They advise a protein intake of 1 – 1.2 g/kg/d for healthy older adults and 1.2 – 1.5 g/kg/day for older adults who are malnourished or at risk of malnutrition because they have an acute or chronic disease. An even higher protein intake is advised for individuals with severe illness or injury. These targets take into account the various age-related physiological changes and they focus on health promotion rather than prevention of protein deficiency (Deer & Volpi, 2015).

At the same time, the debate also continues about whether older adults' protein synthesis is best stimulated by a per-meal threshold amount of protein (i.e. 25-30 gram per meal; Paddon-Jones & Leidy, 2014; Paddon-Jones et al., 2015), or whether it is linearly related to daily protein intake (Deutz & Wolfe, 2013). Either way, evidence suggests that older adults who consume more protein are better able to maintain muscle mass and muscle strength for a longer time (Gaillard, Alix, Boirie, Berrut, & Ritz, 2008; Gray-Donald , Arnaud-McKenzie, Gaudreau, Morais, Shatenstein, & Payette, 2014; Houston et al., 2008; Scott, Blizzard, Fell, Giles, & Jones, 2010).

Heterogeneity of ageing

Given the above described important role of dietary protein for older adults, strategies for tailoring protein-rich foods to older adults are necessary to optimise their protein intake. When developing such strategies, it is essential to take the heterogeneous nature of the older group into account (Morgan, 1993; Moschis, 2003; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014); i.e. focussing on older consumer segments (smaller, more homogeneous subgroups; Wedel & Kamakura, 2000), rather than on the older population as such. This heterogeneity results – amongst other factors – from the broad range of life experiences and the large variety in biological ageing (such as declines in cognitive/ sensory/ physical functioning: Craik & Salthouse, 2011; Daly et al., 2013; Doets & Kremer, 2015). Older adults most likely vary in their food-related experiences and memories as well, which might influence their current views on food and mealtimes.

So far, the attempts to cluster older adults were mainly based on demographics (e.g. chronological age), psychographics (e.g. values/attitudes), and gerontographics (e.g. life changing events) (McCann, 1974; Morgan, 1993; Moschis, 2003; Reisenwitz & Iyer, 2007). One food-related example is the segmentation of Morgan (1993), where seniors were divided in the three clusters ('Nutrition concerned', 'Fast & healthy', and 'Traditional couponers'), based on attitude statements regarding food and eating, such as 'I'm willing to pay more for easy-to-prepare foods,' 'I am trying to cut down on the amount of salt I consume,' and 'Eating at restaurants is too expensive.' However, the consumer segments

obtained from such approaches seem to be too general to provide actionable insights for tailoring actual food products or meals to older consumer subgroups, let alone for tailoring protein-enriched foods and meals.

Benefit-segmentation might be an actionable alternative to the above approaches (Ahmad, 2003; Haley, 1968; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014). Such a strategy takes into account the desired benefits that people seek in their mealtimes. Ahmad (2003) described that these benefits, when present as product attribute or service, trigger consumers to choose and buy products. In addition, van der Zanden and colleagues (2014) reviewed bases for segmenting the older consumer group. The authors conclude that a segmentation based on the sought benefits (referred to as a preference-based segmentation) is most suitable for describing older consumer subgroups, as it provides concrete input for product development and marketing efforts (Finley, Rogers, Napier & Wyatt, 2011; Greengrove, 2002; Greenberg & McDonald, 1989). Therefore, in the current thesis we explore two benefit-segmentation approaches; emotion-based and functionality-based (further introduced in the sections "Mealtime-related emotions and food-evoked emotions" and "Mealtime functionality"). Following the model of Grunert & van Trijp (2014; Figure 1.2), congruency between emotional and functional mealtime expectations (i.e. 'desired product benefits') and actual emotional and functional meal associations (i.e. 'inferred product benefits'), is thought to positively impact on product experience.

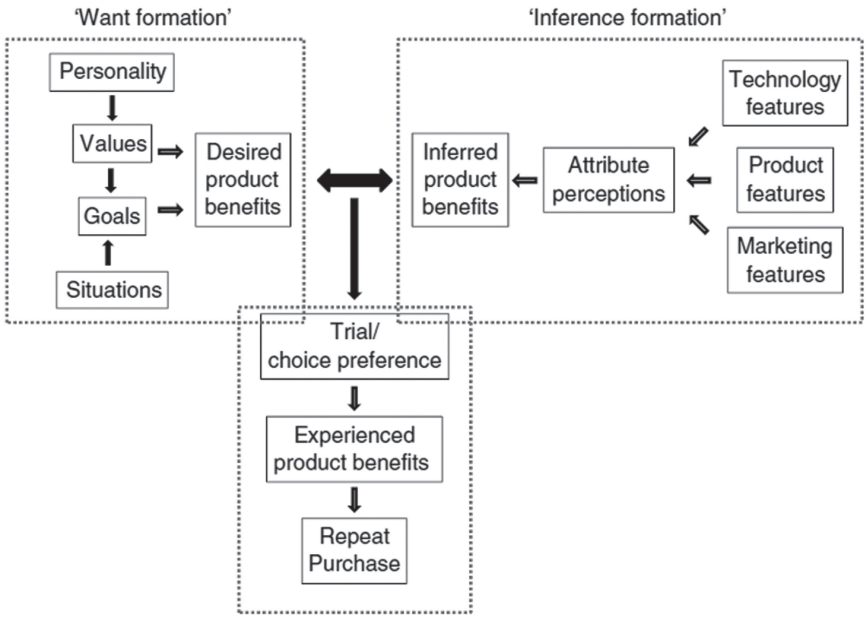

Figure 1.2 A frame work of how consumers decide on new products (Grunert & van Trijp, 2014, p. 379).

Emotional ageing

The first benefit-segmentation approach that we explored is 'emotion-based', focussing on the mealtime-related emotional expectations of older adults. In contrast to a number of cognitive functions, the emotion system seems to be relatively well preserved across the life course (Craik & Salthouse, 2011), which makes emotions an interesting starting point for older consumer segmentation.

Over the years, different theories on emotional ageing have been put forward. For example, Baltes, Baltes, and Baltes (1990), Carstensen (1992), Labouvie-Vief (2003), and Charles and Piazza (2009) proposed theories related to the mainly positive affective orientation of older adults. In the social selectivity theory (SST), Carstensen (1992) explained seniors' focus on emotionally gratifying goals by 'the time that is left in life'. Later, Charles and Piazza (2009) reported in their strength and vulnerability integration theory (SAVI) that seniors' expanding knowledge about emotion regulation and their social lives could underlie their avoidance of negative experiences. Labouvie-Vief (2003) explained in her dynamic integration theory that seniors' preference for positive over negative information may be related to the greater cognitive demands required to process the latter. Other theories focussed on the emotional processing, rather than on senior's positivity bias. For example, in their cognitive-affective developmental theory, Labouvie-Vief, DeVoe, & Bulka (1989) argued that emotional expression and functioning become more sophisticated (e.g. more complex and flexible) in later life.

Interestingly, each of the above theories on emotional ageing addresses some central issue of emotion and ageing, but none of them seem to fully cover the all the aspects related to the phenomenon (Ebner & Fischer, 2014). It is important to be aware of the latter, since not all aspects seem to be affected in the same way. For example, emotional experiences seem to become more complex/sophisticated (Carstensen, Mayr, Pasupathi, & Nesselroade, 2000) and seem to be biased towards to positive (known as a 'positivity bias'; Carstensen, Mikels, & Mather, 2006; Mather & Carstensen, 2005). The latter phenomenon has been described for emotional memory as well (Leigland, Schulz, & Janowsky, 2004; Mather, Knight, & McCaffrey, 2005; Truong & Yang, 2014). In contrast, emotion recognition seems to decrease in older adults, as they experience more difficulty with recognizing certain (negative-) facial, bodily, and vocal expressions than the younger persons (Isaacowitz et al., 2007; Isaacowitz & Stanley, 2011; Orgeta & Phillips, 2008; Riediger, Studtmann, Westphal, Rauers, and Weber, 2014; Ruffman, Halberstadt, & Murray, 2009).

Mealtime-related emotions and food-evoked emotions

Given the above described preservation of emotional experience and emotional memory in older adults, emotional responses and expectations towards food and mealtimes could be an actionable basis for tailoring PE meals. In this thesis we focus on mealtime expectations rather than on food-specific expectations, as this allows a broader application of our approach.

Interestingly, in younger adults 'food-evoked emotions' have shown to provide additional consumer insights, beyond liking alone (Gutjar et al., 2014; Gutjar et al., 2015; Ng, Chaya, & Hort, 2013), whereas our current knowledge on the measurement and application of such emotions in older adults is limited. During the past decade of sensory and consumer science, the number of studies focussing on food-evoked emotions has expanded tremendously (Meiselman, 2015). Despite this expansion, there is still no commonly agreed-upon definition of 'emotion' (Coppin & Sander, 2016), let alone of 'food-evoked emotion'. Nonetheless, in the well-known emotion theories (e.g. basic emotion theory, dimensional theory, appraisal theory) there is some common ground regarding emotion characteristics; such as 'event focus', 'relevance to the person', 'short lasting', 'quick onset', and 'multifactorial nature' (including e.g. action tendency, automatic reaction, expression, feeling etc.; Coppin & Sander, 2016). Ferrarini et al. (2010) and Meiselman (2015) translated these characteristics to the food context as follows: "affective responses to a specific food referent that are rapid, intense, and short lasting".

According to these definitions, (food-evoked) emotions consist of cognitive and physical elements, which can both be target in emotion measurement. So far little is known about measurement of the physical component of food-evoked emotion in older adults (Kremer & den Uijl, 2016), whereas some self-reporting studies are available. For example, Dubé, LeBel, and Lu (2005) developed an emotion list, balanced for valence and arousal. They observed that, compared to their younger counterparts, older adults reported more positive emotions prior to comfort food consumption. However, post-consumption the moderating effect of age was no longer visible. A few years later, Narchi, Walrand, Boirie, and Rousset (2008) composed an emotion lexicon from existing lists of Juillard (2003) and Rousset, Deiss, Juillard, Schlich, and Droit-Volet (2005) to measure seniors' emotional associations towards food pictures. Seniors with a low food intake appeared to report more negative emotions, such as 'frustration' and 'indifference', than seniors with a high food intake. However, it is currently unknown whether subgroups of older adults differ in their mealtime-related emotions, and whether these emotion profiles can be applied to tailor PE meals to older consumer clusters.

Mealtime functionality

The second benefit-segmentation approach that we explored is 'functionality-based', focussing on mealtime functionality (i.e. functional mealtime expectations, such as 'combating hunger', 'energising', and 'having a cosy moment'). Köster (2009) stressed the importance of such situation-oriented research, since depending on one's intention, a similar situation or food product can have different meanings. Mealtime may be such a situation; persons from different consumer clusters might link different meanings/ expectations to e.g. their dinner or breakfast, which subsequently could impact on their product experience during these eating occasions. In addition, Thomson and colleagues reported on the relevance of cognitive associations for product development and referred to these terms as 'conceptualisations' (Thomson, Crocker, & Marketo, 2010). The authors divided conceptualisations in three categories; namely emotional (e.g. this product will make me feel happy), abstract (e.g. this product is feminine), and functional (e.g. this product will refresh me) conceptualisations. They report that during product evaluation the actual product experiences are integrated with the product expectations (based on the cognitive associations). When congruent, such experiences are even hypothesised to increase product success and brand strength.

Translating the latter line of thought to the current mealtime context, mealtime functionality may provide inspiration for the development of tailored PE meals. One could align the functional meal associations with the functional mealtime expectations of specific older consumer segments in order to positively impact on meal experience (see also Figure 1.2). Interestingly, to date little is known about the functional mealtime expectations of (subgroups of) older adults and the application of such expectations when tailoring PE meals to older consumer clusters.

Aims and thesis outline

The overall objective of this PhD thesis is to find an actionable (i.e. practically achievable) and effective (i.e. resulting in a better 'product–cluster fit') basis to tailor PE meals to vital community-dwelling older consumers. To that end we studied the emotional and functional mealtime expectations of older consumer subgroups, and we explored the extent to which these two benefit-segmentation approaches can be applied to tailor PE meals to these groups (Table 1.1).

In chapters 2, 3, and 4 we focussed on the emotion-based approach. In chapter 2 we described segments of vital-community dwelling older adults on the basis of their mealtime-related emotions. Following the model of Grunert & van Trijp (2014, Figure 1.2), we hypothesised that meals appeal to these clusters when they evoke emotions congruent to the cluster-specific emotional mealtime expectations. However, to identify the meals

evoking such emotions, food-evoked emotions need to be measured. In chapter 3 and 4 we therefore explored older adults' food-evoked emotion profiles, and we compared them to the profiles of younger adults. To this end, we selected three well-known self-reporting emotion measurement tools; EsSense25 (chapter 3), PrEmo tool (chapter 4), and Affect Grid (chapter 4).

In chapter 5 and 6 we explored the functionality-based approach. In chapter 5 we described segments of vital-community dwelling older adults on the basis of their self-reported mealtime functionality. We additionally conducted in-depth interviews in order to obtain further details about these segments' functional mealtime expectations and their attitudes towards proteins and protein enrichment. Building on the latter insights, we tailored PE meal concepts to the mealtime expectations of two functionality-based clusters (chapter 6). During a home-use test the participants prepared and consumed these tailored meal concepts (congruent and incongruent to their own functional mealtime expectations). We compared the seniors' self-reported experiences regarding these meal concepts to get an idea of the actionability and effectivity of mealtime functionality for tailoring PE meals to older consumer segments.

Finally, in the general discussion of this thesis we reflect on the main findings, methodological considerations, practical implications, and directions for future research (chapter 7).

Table 1.1 Overview of the studies described in this thesis.

Chapter	Aim	Method
The emotion-based approach:		
2	Describing subgroups of older adults based on their mealtime-related emotions	Consumer segmentation
3	Exploring older adults' food-evoked emotions and compare them to the profiles of younger adults	CLT*: EsSense25 Products: chocolates & gingerbreads
4	Exploring older adults' food-evoked emotions and compare them to the profiles of younger adults	CLT*: PrEmo tool & Affect Grid Products: chocolates & gingerbreads
The functionality-based approach:		
5	Describing subgroups of older adults based on their mealtime functionality	Consumer segmentation & In-depth interviews
6	Exploring mealtime functionality for tailoring protein-enriched (PE) meals to older consumer subgroups	Home-use test Products: tailored PE meal concepts

*CLT: Central location test.

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Chapter 2

It is not just a meal, it is an emotional experience

A segmentation of older persons based on the emotions that they associate with mealtimes

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Abstract

Worldwide, the group of older persons is growing fast. To aid this important group in their food and meal requirements, a deeper insight into the expectations and experiences of these persons regarding their mealtimes and snack times is needed. In the current study, we aim to identify consumer segments within the group of vital community-dwelling older persons on the basis of the emotions they associate with their mealtimes and snack times (from now on referred to as mealtimes). Participants (n=392, mean age 65.8 (y) ± 5.9 (SD)) completed an online survey. The survey consisted of three questionnaires: emotions associated with mealtimes, functionality of mealtimes, and psychographic characteristics (health and taste attitudes, food fussiness, and food neophobia). Consumer segments were identified and characterised based on the emotions that the respondents reported experiencing at mealtimes, using a hierarchical cluster analysis. Clusters were described using variables previously not included in the cluster analysis, such as functionality of mealtimes and psychographic characteristics. Four consumer segments were identified: *pleasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*. These segments differed significantly in their emotional associations with mealtimes both in valence and level of arousal. The present study provides actionable insights for the development of products and communication strategies tailored to the needs of vital community-dwelling older persons.

Introduction

Older persons are the consumers of the future as they are an increasingly growing and heterogeneous part of the world's population (RIVM, 2013; United Nations, 2002). Currently available commercial food products do not always meet the needs and wants of these persons (Moschis, 2003; Reisenwitz & Iyer, 2007). When products are better aligned with the requirements of older persons, an adequate nutrient intake is more likely. The latter can prolong the independence of older persons in the long term. Surprisingly, older persons have often been neglected in the past few decades of product development and marketing. Also, segments within the elderly food market have received little attention, despite the diversity in meanings of food and eating for these subgroups (Morgan, 1993; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014). These diverse meanings result from long and divergent experiences and memories regarding food and eating occasions. Consequently, products targeted at a generic older population, neglecting subgroups, have a high chance of failing on the market (Hawkins & Mothersbaugh, 2010). Hence, it is essential to tailor healthy and tasty foods to subgroups of older persons in order to better meet their food requirements (van der Zanden et al., 2014).

In previous segmentations of older persons, various approaches were applied. McCann's (1974) early attempts to segment older persons were based on chronological age: young old (age(y) 55–64), mature old (age(y) 65–74) and old old (age(y) >75). However, age alone did not sufficiently explain differences in behaviour, and segmentation models based on socio-demographic factors were introduced (Leventhal, 1991; Lumpkin, 1985; Moschis & Mathur, 1993). Later studies showed that psychographics (e.g. values, attitudes, and personality traits) and gerontographics (e.g. life changing events and experiences) gave a more actionable basis for segmentation (Morgan, 1993; Moschis, 2003; Reisenwitz & Iyer, 2007; Tynan & Drayton, 1985a, 1985b). For example, Morgan (1993) segmented older persons based on general attitude statements towards food and eating, such as 'I'm willing to pay more for easy-to-prepare foods,' 'I am trying to cut down on the amount of salt I consume,' and 'Eating at restaurants is too expensive.' Three segments were described: 'Nutrition concerned', 'Fast & healthy' and 'Traditional couponers'. Later, comprehensive segmentation models, using gerontographics of older Americans, were used by Moschis (2003) and Sudbury and Simcock (2009). Moschis divided the group of older persons into four segments that differed in level of financial independence, healthiness, isolation, socially withdrawnness, solitariness, activity, and acceptance of being 'old.' Sudbury and Simcock (2009) segmented 650 older persons (age 50–79y) based on variables reflecting the major dimensions of ageing and behavioural variables relevant for older adults. Five segments emerged that differed in, for example, general consumer behaviour and behaviour towards marketing campaigns.

Segmentation based on mealtime and snack time (from now on referred to as mealtimes) experiences could give additional insights into the needs and wants of older subgroups

(Hawkins & Mothersbaugh, 2010). This approach has been suggested as most suitable for the nutrient-enriched food market targeted at older persons, and is referred to as a 'preference-based approach' (van der Zanden et al., 2014). We believe that psychographics and gerontographics are too general to provide such specific insights. Various factors may influence the experience of mealtimes, such as emotions related to mealtimes, functionality of mealtimes (e.g. energising, calming), attitudes towards health and taste, food neophobia, and food fussiness. So far, little is known about the influence of these factors on the mealtime experiences of older persons.

Older persons may vary in the emotions that they associate with their mealtimes, due to long and divergent experiences with and memories of these occasions. Segmenting older persons based on these emotions can give valuable insights into the meal experience of subgroups. King and Meiselman (2010) suggest that the emotions that foods elicit after consumption may help to elucidate product choice and consumer behaviour, beyond liking alone. Besides, it is known that, as people grow older, they more often seek emotionally meaningful goals, and they tend to rely more on emotions and heuristics than their younger counterparts (Fung & Carstensen, 2003; Perry & Wolburg, 2011). Consequently, older persons might also rely more on their emotions when it comes to food consumption and meal experience.

Meal functionality – the functions that persons ascribe to specific mealtimes, e.g. energising or relaxing – seems to be another concept that provides a deeper understanding of food consumption motives. Thomson, Crocker, and Marketo (2010) recently discussed this topic and emphasised the use of conceptualisations, such as 'will refresh me,' 'will make me happy,' and 'will annoy me,' to understand consumer behaviour. These conceptualisations seem to be inevitably connected to food experience, since we react not only to the product itself but also to the associations that we assign to that product.

Psychographic characteristics, such as health and taste attitudes (Roininen, Lahteenmaki, & Tuorila, 1999), food neophobia (Pliner & Hobden, 1992), and food fussiness (Wardle, Sanderson, & Rapoport, 2001), may provide insight into the meal experience as well. The health and taste attitude scales measure the impact of health and taste in the food choice process. When the relative importance of these two aspects is understood, a deeper insight into the meal experience of older persons is gained (Roininen et al., 2001). Food neophobia scores and food fussiness scores indicate the willingness of a person to accept both known and unknown foods. This acceptance is important for new product development, as low product acceptance can occur when food neophobia and food fussiness are high. Early studies showed that people become less neophobic as they grow older (Pliner & Hobden, 1992). However, in more recent studies, the opposite was observed (Dovey, Staples, Gibson, & Halford, 2008; Henriques, King, & Meiselman, 2009; Meiselman, King, & Gillette, 2010). This age dependency, either positive or negative, underlines the importance of including a food neophobia questionnaire when mealtime experiences are being assessed.

In the current study, we aim to identify consumer segments of vital community-dwelling older persons on the basis of the emotions that they associate with their mealtimes. We describe these segments using the functionality of mealtimes, health and taste attitudes, food neophobia, and food fussiness.

Materials and Methods

Participants

Table 2.1 provides the participants' characteristics. Three hundred ninety-two vital independently living older persons (158 males and 234 females, mean age 65.8 (y) ± 5.9 (SD)) completed an online survey. The participants were all member of the SenTo panel (Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future). The SenTo panel is a panel initiated by Wageningen UR of 769 healthy community-dwelling Dutch older persons. The criteria for membership of the SenTo panel are: being at least 55 years old, being capable of working online with a computer, being able to go out for, e.g., grocery shopping independently, and being fluent in Dutch.

Table 2.1 Demographic characteristics of the vital community-dwelling older persons (n=392).

Factor	Level	% of sample
Gender	Male	40
	Female	60
Age	55–65 y	46
	66–75 y	47
	76–85 y	7
Marital status	Single	9
	Married/ living together	81
	Divorced	5
	Widowed	5
Living arrangements	Living independently alone	24
	Living independently together	74
	Assisted living	2
Educational level	Low	23
	Middle	20
	High	38
	Unknown	19
Consumption of a meal/snack	Breakfast	98
	Lunch	96
	Dinner	99
	Snack morning	52
	Snack afternoon	55
	Snack evening	52
	Dessert	55

Procedure and Questionnaires

Participants filled out an online survey consisting of three questionnaires emailed to them with at least a week in between (Table 2.2). The questionnaires included a total of 243 questions, all scored on 9-point Likert scales. The social ethical committee of Wageningen University approved the current study.

The first questionnaire contained emotions relating to mealtimes. Participants rated 15 EsSense Profile® emotions (King & Meiselman, 2010) for three traditional mealtimes (breakfast, lunch, and dinner) and four additional eating occasions (snack morning, snack afternoon, snack evening and dessert) (Table 2.2). Before the participants rated their emotions for each mealtime, they were provided with a short description to evoke the situation. The 15 emotions were selected during a pre-study that consisted of a free sorting task (EyeQuestion software version 3.9.4). Participants (all SenTo members, n=148, 67 men and 81 women, mean age 65.2 (y) ± 5.8 (SD)) sorted overlapping EsSense Profile® emotion terms and selected the most applicable term in relation to mealtimes of each self-made group. Thus, redundant and inappropriate emotion terms were removed from the original list. A description of the free sorting pre-study is included in the Supplementary material.

The second questionnaire focused on the functionality of mealtimes. Participants rated 13 functionality constructs for seven mealtimes (as above). In this questionnaire also, participants were provided with a short evocative description of the mealtimes prior to the functionality ratings. The 13 constructs of the functionality questionnaire were developed during two focus groups (n=14, 7 men and 7 women, mean age 65.4 (y) ± 6.4 (SD)). During the focus groups, participants discussed the terms of the food choice questionnaire (Steptoe, Pollard, & Wardle, 1995). Items that were deemed appropriate for mealtimes were included in the functionality questionnaire, as shown in Table 2.2. A detailed description of the focus groups is provided in the Supplementary material.

The third questionnaire was split into two parts (a and b). Both parts focused on the participants' psychographic characteristics. Questionnaire 3a focused on health and taste attitudes (Roininen et al., 1999). Questionnaire 3b focused on food neophobia (Pliner & Hobden, 1992) and food fussiness (Wardle et al., 2001). Dutch translations of the validated questionnaires were used (Hoek et al., 2013; Roininen et al., 1999; Sleddens, Kremers, & Thijs, 2008). The food fussiness scale was originally developed for children and directed at their parents. In the present study, the questions on the food fussiness scale were reformulated so that the older persons were addressed directly.

Table 2.2 Overview of questionnaires, questions included, and terms used for analysis (if different from 'questions included') of the online survey.

Questionnaire	Questions included	Term used for analysis (if different from 'Questions included')
1: Emotions related to mealtimes	• guilty, warm, happy, enthusiastic, adventurous, whole, eager, nostalgic, interested, good, pleased, disgusted, satisfied, daring, pleasant	
2: Functionality of mealtimes*	• I have breakfast to combat hunger/thirst	• Hunger
	• I have breakfast out of habit	• Habit
	• I have breakfast because I like it	• Liking
	• I have breakfast because it is cosy	• Cosiness
	• I have breakfast because I enjoy it	• Pleasure
	• I have breakfast to get energy	• Energising
	• I have breakfast because it is rewarding	• Rewarding
	• I have breakfast because it is healthy	• Healthiness
	• I have breakfast because I feel more pleasant afterwards	• Pleasing
	• I have breakfast because it calms me down	
	• I have breakfast because my body needs it	• Calming
	• I have breakfast unconsciously and I eat whatever is available at that moment	• Physical needs • Thoughtless eating
	• I have breakfast to be conscious about the environment (i.e. by eating vegetarian, etc.)	• Environmental awareness
3: Psychographic characteristics	• Health and taste attitude scale (Roininen et al.,1999)	
	• Food neophobia (Pliner & Hobden, 1992)	
	• Food fussiness (Wardle et al., 2001)	
	- I enjoy tasting new foods	
	- I enjoy a wide variety of foods	
	- I am interested in tasting food I haven't tasted before	
	- I refuse new foods at first	
	- I decide that I don't like food, even without tasting it	
	- I am difficult to please with meals	

*For functionality of mealtimes, the 'Questions included' column uses 'breakfast' as an example. In the online survey, this term was adapted to the mealtime of interest (e.g. lunch, dinner).

Data analysis

The data were analysed using IBM SPSS Statistics 19 and Biosystemes Fizz Calculations. Clusters were explored using Architect, a statistical programme designed by Open Analytics that facilitates R statistics analyses. The results were significant at a level of 0.05, unless otherwise stated.

Emotions and functionalities associated with mealtimes were examined using spider plots and BiPlots. Four spider plots were made to visualise and compare the means of the emotions and functionalities. Two plots (one for emotions and one for functionalities) contained the main meals, and the other plots contained the snack times and dessert. In addition, two BiPlots were made, one on the emotions relating to mealtimes and the other on the functionalities relating thereto. From these BiPlots, the predominant emotions and functionalities per mealtime were described.

Means and standard deviations of the health and taste attitudes, food neophobia, and food fussiness were calculated. Means of the health and taste attitudes were analysed using paired comparisons. Furthermore, sum scores and standard deviations were calculated for the health and taste attitudes, food neophobia, and food fussiness. A sum score represents the sum of item ratings. For instance, the health and taste attitude 'general health interest' consists of eight questions; the sum score of that category is the sum of those eight questions.

The data were processed prior to cluster characterisation and profiling. Average meal and snack emotion scores were calculated. An average meal emotion score represented the mean of the breakfast, lunch, and dinner emotion scores. An average snack emotion score represented the mean of the morning snack, afternoon snack, evening snack, and dessert emotion scores. Reverse-type questions on the food neophobia and food fussiness scales were transformed so that they were comparable to direct-type questions. A factor analysis of the functionality scores reduced multicollinearity between questionnaire items. An explorative factor analysis with principal components extraction and varimax rotation identified a five, seven, and nine factor solution with an eigenvalue exceeding 1.0. After that, a confirmative factor analysis was performed with five, seven, and nine factors, using maximum likelihood extraction and direct oblimin rotation. We decided to use the five factor solution, as the factors obtained from this solution were the most interpretable, and most items loaded strongly on one of the five factors. However, six items had a factor loading of 0.4 or less, and three items cross loaded. After excluding these items, the five factors explained 52.1% of the variance. The reliability of the factors was acceptable, as assessed using Cronbach's alpha (α's $\geq$ 0.05). Items 'dinner liking' and 'snack calming' were excluded to improve scale reliability. The following names were assigned to the factors: (1) 'physical function meals' (e.g. 'I have a meal to get energy,' 'I have a meal to combat hunger'), (2) 'physical function snacks' (e.g. 'I have a snack to get energy,' 'I have a snack to combat hunger'), (3) 'environmental awareness' (e.g. 'I have a meal/snack to be conscious about the environment'), (4) 'pleasure' (e.g. 'I have a meal/snack because it is cosy,' 'I have a meal/snack because it is a pleasure'), and (5) 'thoughtless eating/habit' (e.g. 'I have this meal/snack out of habit,' 'I have this meal/snack unconsciously and I eat whatever is available').

Cluster analysis

Segments of the older persons were analysed as described by Hair, Anderson, Tatham, and Black (1998), including the scores of the 15 emotions for seven mealtimes. The numeric data were double-scaled: by variable and by subject. Principal components were analysed using scaled data and the NIPALS method from the pcaMethods R package. The NIPALS method properly handles missing values in the dataset. The PCA was used to project the data into four components, so that each component was a linear combination of variables from the original dataset. The projection was defined in such a way that each subsequent component accounted for less variability in the data than the component before it. The use of PCA projections ensured that the cluster analysis was driven by underlying differences between the participants. The PCA projections were used to create an *nxn* Euclidian distance matrix, where n is the number of participants in the study. The distance matrix was used to create a hierarchical complete linkage clustering via the hclust() function. This hierarchical cluster structure was visualised in a dendrogram. The dendrogram was visually inspected to decide upon the number of clusters to use. This way, clusters of approximately 50 to 100 participants were obtained (Dolnicar, 2003). Clusters were characterised by ANOVA and Tukey Post Hoc tests (α 0.05), including the average meal emotion scores and the average snack emotion scores. After that, clusters were profiled using ANOVA, Tukey Post Hoc tests, chi-square tests, Fisher's exact tests, and standardised residuals analysis (using a cut-off point of ±1.96). Variables that had not been entered in the initial cluster analysis were included (e.g. functionality of mealtimes, health and taste attitudes, food neophobia, demographic variables, and risk of malnutrition).

Results

Descriptive statistics online survey

Emotions relating to mealtimes (n=392)

Figure 2.1 presents the means of the 15 emotions for the seven mealtimes. The spider plots showed comparable emotion patterns for all mealtimes. In particular, ratings of the emotions 'pleasant,' 'nostalgic,' and 'disgusted' were alike. Participants strongly related mealtimes to 'pleasantness,' whereas 'disgusted' was least associated with these times. However, the BiPlot (Figure 2.2) showed differences in the intensity of emotions associated with specific mealtimes. Participants linked emotions such as 'pleased,' 'good,' 'interested,' 'satisfied,' and 'whole' more strongly to breakfast, lunch, dinner, and dessert. In addition, the emotions 'warm,' 'daring,' 'eager,' 'enthusiastic,' 'happy,' and 'adventurous' were experienced more predominantly during lunch and dinner than during the other mealtimes. 'Guilt' was reported particularly for snack times.

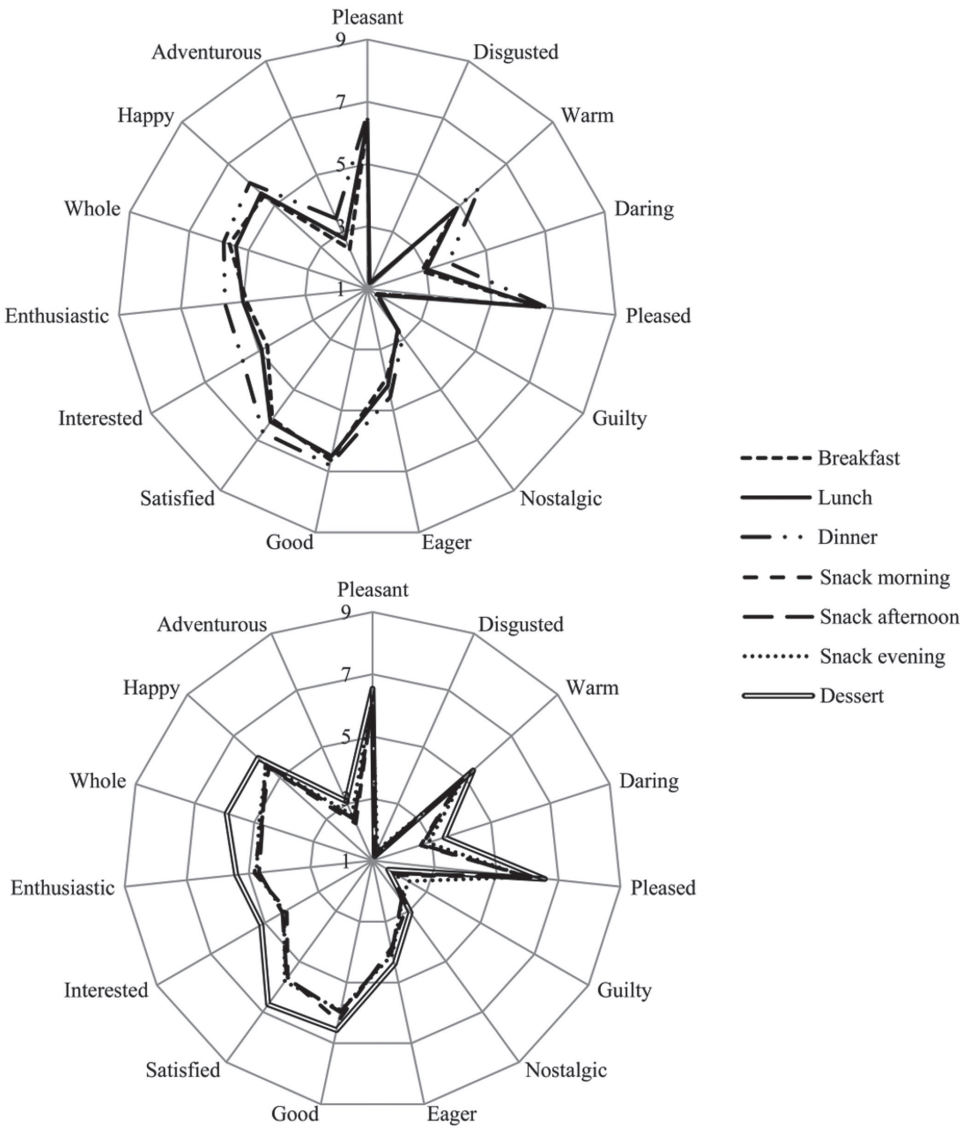

Figure 2.1 Spider plots representing the means of 15 emotions for main meals and snacks separately (n=392).

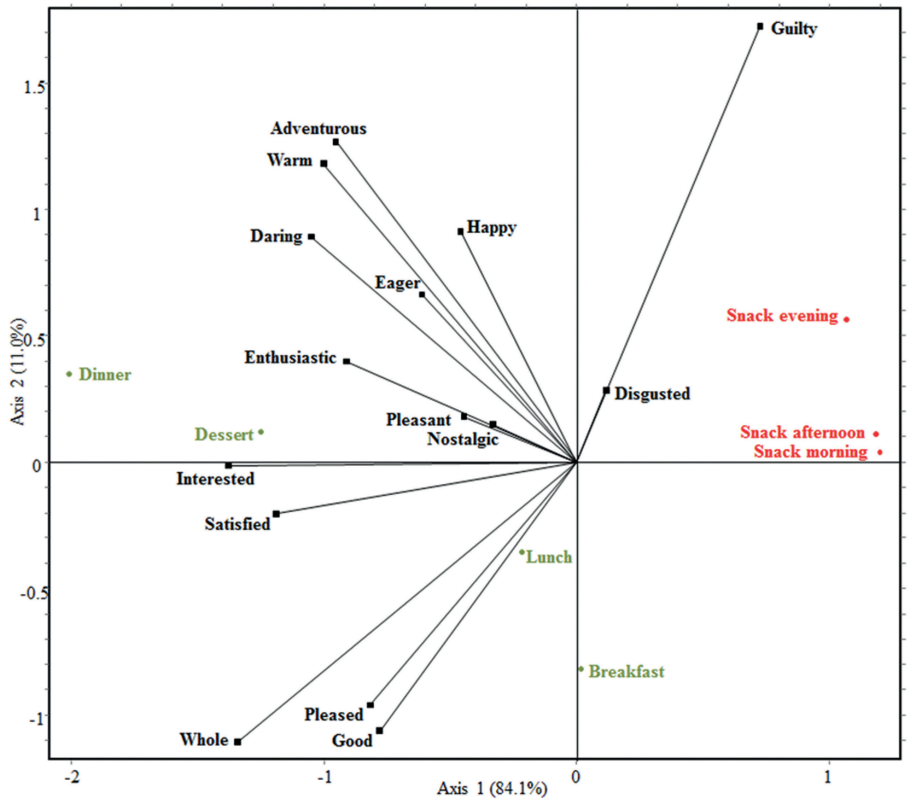

Figure 2.2 BiPlot of 15 emotions for seven eating times (n=392).

Functionality of mealtimes (n=392)

Figure 2.3 visualises the means of 13 functionalities for the seven mealtimes. The functionality patterns of main meals differed from the patterns of snack times and dessert. The functionalities 'liking' and 'pleasure' scored highest for all seven mealtimes; other functionalities differed between mealtimes. The BiPlot (Figure 2.4) shows that participants consumed their main meals mainly to be 'energised,' 'eat healthily,' and 'fulfil their physical needs.' In addition, lunch and dinner were related to the functionalities 'hunger' and 'calming.' 'Reward' was predominantly reported for snack times and dessert and least for breakfast. For older persons, breakfast seemed to be the time to 'eat out of habit' and to 'eat thoughtlessly.' They reported dinner as a time to 'eat because they like it' and to 'eat for pleasure.' Furthermore, dinner was related to 'cosiness' and 'environmental awareness.'

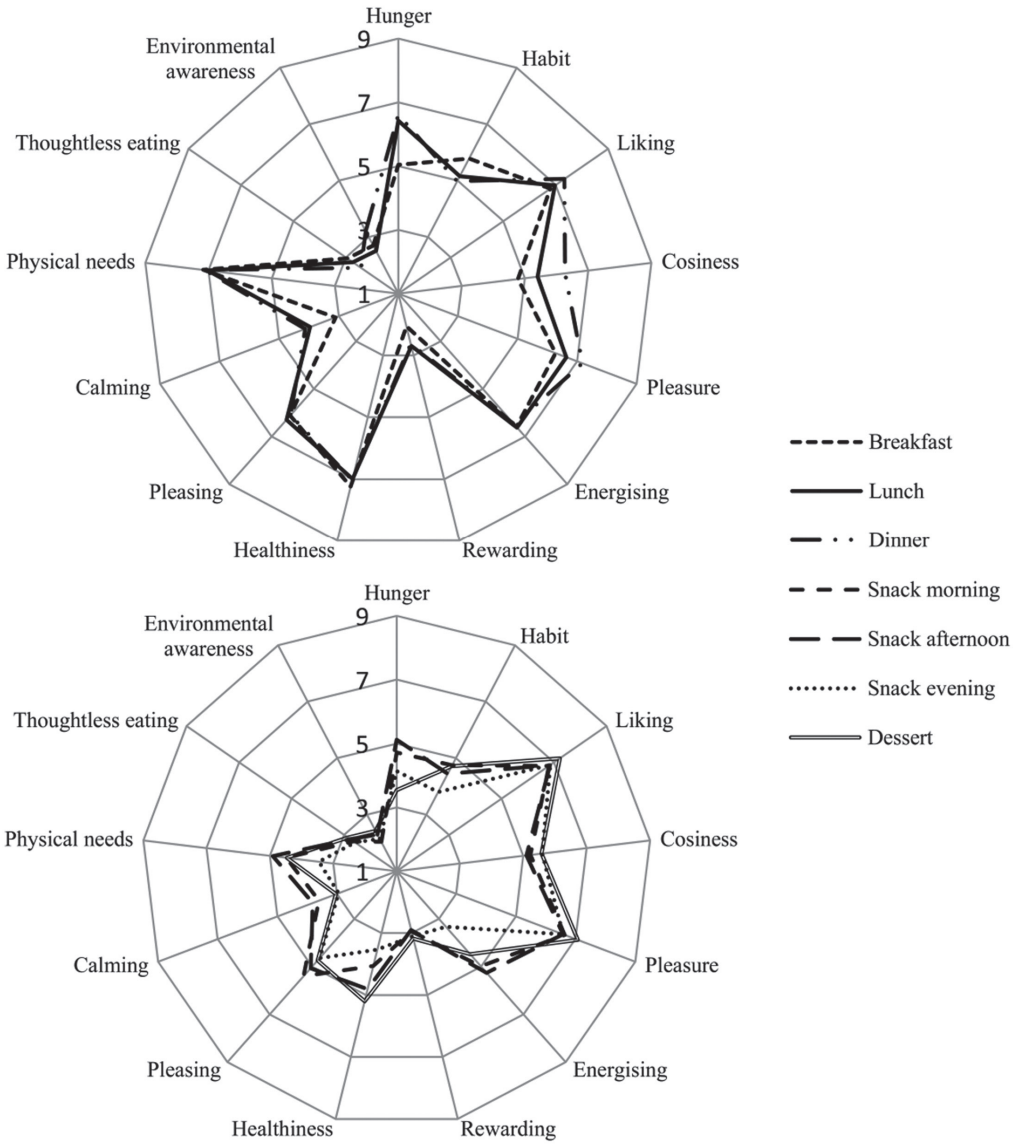

Figure 2.3 Spider plots representing the means of 13 meal functionalities for main meals and snacks separately (n=392).

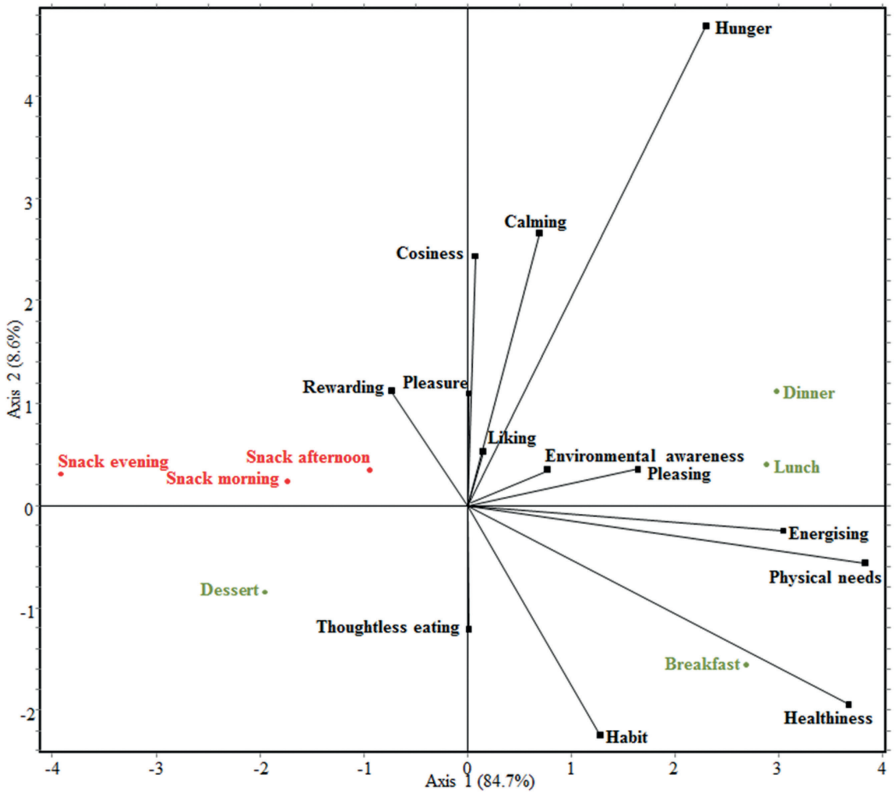

Figure 2.4 BiPlot of 13 meal functionalities for seven eating times (n=392).

Psychographic characteristics: Health and taste attitudes, food neophobia, and food fussiness (n=392)

Table 2.3 gives an overview of the means and SD for the health and taste attitudes, food neophobia, and food fussiness. The older persons considered 'general health interest' and 'pleasure' important, as they scored highest on these health and taste attitudes (mean ± SD 6.6 ± 1.9, p <0.001 and mean ± SD 6.5 ± 2.2, p <0.001, respectively). They expressed less 'interest in light products' and did not tend to see 'food as reward' (mean ± SD 4.0 ± 2.3, p < 0.001 and mean ± SD 4.0 ± 2.6, p <0.001, respectively).

Table 2.3 Means, standard deviations (SD) for health and taste attitudes, food neophobia, and food fussiness (n=392).

	Mean	SD	Mean sum score	SD sum score
General health interest	6.6[a]	1.9	52.8	9.2
Pleasure	6.5[b]	2.2	38.7	7.0
Interest in natural products	5.5[c]	2.3	32.9	8.9
Craving for sweet foods	4.4[d]	2.6	26.6	9.5
Interest in light products	4.0[e]	2.3	24.0	9.8
Using food as a reward	4.0[e]	2.6	23.8	8.5
Food neophobia	3.7	2.3	36.9	14.3
Food fussiness	3.0	1.9	17.8	8.0

Note: The sum score reflects the sum of the individual items of each category of the questionnaire. Similar letters refer to statistically similar terms (α=0.05).

Cluster analysis

The cluster analysis resulted in four segments. Tables 2.4 and 2.5 give an overview of the segment characteristics and profiling variables, respectively. Figure 2.5 gives a schematic overview of the four segments, based on the dimensions of valence and arousal level of emotions and functionalities relating to mealtimes. Note that this plot is schematic and no values can be obtained from it. In the next sections, the features of each segment are described using 'imaginary' persons from the segments.

Segment 1: pleasurable averages (n=200)

Mrs Smith is a *pleasurable average*. She does not score highest or lowest for any of the emotions. Her scores are comparable to the scores of *adventurous arousals* for a number of positive emotions (e.g. 'pleasant,' 'good'), but lower for the high arousal emotion scores (e.g. 'daring,' 'eager'). Her average – though positive scores – explain her title, *pleasurable average*. Food neophobia, food fussiness, health and taste attitudes, and functionalities of mealtimes do not distinguish her from the others. Mean age of her group is 66.6 years old (± 5.9 SD) and, within her segment, 38% of the persons are male and 62% are female. This gender distribution is similar to that in the other clusters (p >0.05).

Segment 2: adventurous arousals (n=99)

Mr Hunter is an *adventurous arousal*. As an *adventurous arousal*, he typically experiences high arousal emotions, such as 'adventurous' and 'daring,' during mealtimes. He considers these occasions to be 'nostalgic' as well. For other positive emotions, such as 'pleasant' and 'satisfied,' he scores comparably to *pleasurable averages*. He rates the functionality 'pleasure' more highly than *pleasurable averages*. In addition, food neophobia, food fussiness, and health and taste attitudes do not distinguish him from the others. *Adventurous arousals* have an average age of 65.8 years old (± 5.9 SD) and, within this segment, 41% of the persons are male and 59% female.

Table 2.4 Mean emotion scores for main meals and snack times of *pleasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*.

		Pleasurable averages **(n=200)**	***Adventurous arousals*** **(n=99)**	***Convivial indulgers*** **(n=52)**	***Indifferent restrictives*** **(n=41)**
	Emotion	**Mean**	**Mean**	**Mean**	**Mean**
Meal	Pleasant	6.4^{b}	6.4^{b}	8.0^{a}	4.7^{c}
	Disgusted	1.1^{b}	1.2^{b}	1.0^{b}	1.8^{a}
	Warm	4.9^{c}	5.6^{b}	6.5^{a}	4.0^{d}
	Daring	2.8^{b}	4.4^{a}	2.6^{b}	3.3^{b}
	Pleased	6.7^{b}	6.5^{b}	8.2^{a}	4.8^{c}
	Guilty	1.3^{b}	1.3^{b}	1.0^{b}	2.3^{a}
	Nostalgic	2.0^{c}	4.2^{a}	2.6^{bc}	3.0^{b}
	Eager	4.2^{ab}	4.7^{a}	4.3^{ab}	3.4^{b}
	Good	6.7^{b}	6.4^{b}	8.2^{a}	4.9^{c}
	Satisfied	6.4^{b}	6.3^{b}	8.0^{a}	4.7^{c}
	Interested	4.8^{b}	5.6^{a}	6.0^{a}	4.0^{b}
	Enthusiastic	4.9^{c}	5.6^{b}	6.5^{a}	3.9^{d}
	Whole	5.4^{b}	5.9^{b}	7.0^{a}	4.2^{c}
	Happy	5.5^{b}	5.9^{b}	7.4^{a}	4.2^{c}
	Adventurous	2.4^{c}	4.1^{a}	2.2^{c}	3.2^{b}
Snack	Pleasant	5.5^{b}	5.5^{b}	7.5^{a}	4.1^{c}
	Disgusted	1.0^{b}	1.1^{b}	0.9^{b}	1.8^{a}
	Warm	4.0^{bc}	4.7^{ab}	5.6^{a}	3.3^{c}
	Daring	2.3^{bc}	3.7^{a}	2.0^{c}	2.8^{ab}
	Pleased	5.4^{b}	5.5^{b}	7.5^{a}	4.0^{c}
	Guilty	1.8^{b}	1.7^{b}	1.2^{b}	2.5^{a}
	Nostalgic	1.9^{b}	3.6^{a}	2.4^{b}	2.8^{ab}
	Eager	3.6^{a}	3.8^{a}	3.9^{a}	3.4^{a}
	Good	5.4^{b}	5.3^{b}	7.5^{a}	4.4^{b}
	Satisfied	5.2^{b}	5.3^{b}	7.4^{a}	3.8^{c}
	Interested	3.6^{b}	4.6^{a}	4.6^{a}	3.5^{b}
	Enthusiastic	4.1^{bc}	4.8^{ab}	5.7^{a}	3.4^{c}
	Whole	4.2^{bc}	4.8^{ab}	5.8^{a}	3.5^{c}
	Happy	4.7^{bc}	5.2^{b}	7.0^{a}	3.9^{c}
	Adventurous	1.9^{bc}	3.5^{a}	1.8^{c}	2.6^{b}

Note: The meal scores reflect the average scores for breakfast, lunch, and dinner. The snack scores reflect the average scores for snack times and dessert. Similar letters refer to statistically similar terms (α=0.05).

Segment 3: convivial indulgers (n=52)

Mrs Rose is a *convivial indulger*. She associates low arousal positive emotions, such as 'pleasant,' 'good,' and 'satisfied,' with her mealtimes. She relates the functionalities 'physical needs' and 'pleasure' to meals. However, her scores for these functionalities are comparable to those of *adventurous arousals*. She scores higher on the health and taste attitude 'general health interest' than *indifferent restrictives*. Further, she rates the health and taste attitude 'pleasure' more highly than *indifferent restrictives* and *adventurous*

arousals. Members of her segment have a mean age of 64.1 years old (± 6.0 SD) and 40% of them are male and 60% female. They give their quality of life most often a 10 out of 10 (standardised residual 2.1). In addition, they seem to be slightly more integrated in social networks (family, friends, and so forth) than *indifferent restrictives* (sig = 0.07).

Segment 4: indifferent restrictives (n=41)

Mr Sadler is an *indifferent restrictive*. He owes his name to his higher ratings on negative emotions (e.g. 'guilty,' 'disgusted') compared to the other clusters. He also scores lowest on a number of positive emotions, such as 'pleasant' and 'satisfied'. Thereby Mr Sadler seems a bit indifferent regarding his mealtimes, which explains his name, *indifferent restrictive*. As an *indifferent restrictive*, he least associates the functionalities 'physical needs' and 'pleasure' with meals. On the health and taste attitudes 'general health interest' and 'pleasure,' he scores lower than *convivial indulgers*. Members of his segment display slightly higher food fussiness scores; however, not significantly higher than the others. They have an average age of 65.0 years old (± 6.4 SD) and, within this segment, 49% are male and 51% female. They are involved more often than the others in personal conflicts and are at higher risk of malnutrition (standardised residual 2.0 and 3.0, respectively).

Table 2.5 Means for health and taste attitudes, food neophobia, food fussiness, and functionality of eating times of *pleasurable averages, adventurous arousals, convivial indulgers,* and *indifferent restrictives.*

Questionnaire	Item	*Pleasurable averages* (n=200)	*Adventurous arousals* (n=99)	*Convivial indulgers* (n=52)	*Indifferent restrictives* (n=41)
Person characteristics	SUM General health interest	52.9^{ab}	53.0^{ab}	55.0^{a}	49.3^{b}
	SUM Pleasure	39.0^{ab}	37.7^{b}	41.0^{a}	37.0^{b}
	SUM Interest in natural products	33.3^{a}	33.1^{a}	32.2^{a}	31.4^{a}
	SUM Interest in light products	23.3^{a}	25.4^{a}	23.4^{a}	24.6^{a}
	SUM Food as a reward	24.7^{a}	22.4^{a}	22.4^{a}	23.9^{a}
	SUM Craving for sweet foods	26.3^{a}	26.6^{a}	26.6^{a}	27.8^{a}
	SUM Food neophobia	36.1^{a}	38.9^{a}	36.1^{a}	37.3^{a}
	SUM Food fussiness	17.4^{a}	18.7^{a}	16.1^{a}	19.5^{a}
Functionality of meals/snacks	Factor physical needs meal	6.8^{b}	6.8^{ab}	7.3^{a}	6.1^{c}
	Factor physical needs snack	4.1^{b}	4.6^{ab}	5.0^{a}	4.2^{ab}
	Factor environmental awareness	2.7^{a}	2.9^{a}	2.5^{a}	2.5^{a}
	Factor pleasure	4.8^{b}	5.2^{ac}	5.7^{a}	4.6^{bc}
	Factor thoughtless eating/habit	3.8^{a}	4.2^{a}	3.7^{a}	4.3^{a}

Note: The sum score reflects the sum of the individual items of each category of the questionnaire. Similar letters refer to statistically similar terms (α=0.05).

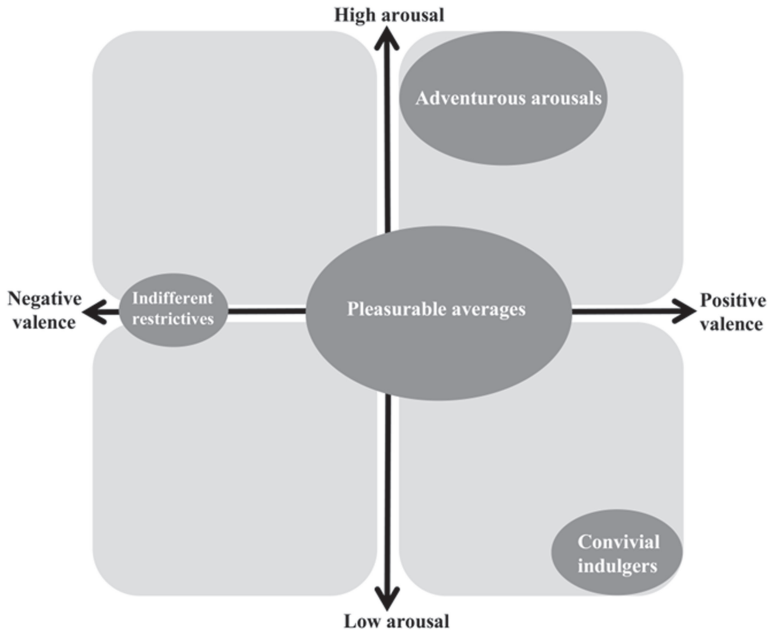

Figure 2.5 Schematic overview of the four clusters (p*leasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*) in the dimensions valence and arousal. The size of the clusters schematically reflects the cluster size; i.e. the larger the cluster in the scheme, the more participants belong to that cluster. Note that this figure illustrates the dimensions of the clusters schematically, hence no absolute numbers can be obtained from it.

Discussion

Four consumer segments were identified on the basis of the emotions associated with mealtimes in a group of vital community-dwelling older persons: *indifferent restrictives*, *adventurous arousals, pleasurable averages*, and *convivial indulgers*. Each segment associated different emotions with mealtimes, varying in the dimensions, valence and arousal. *Indifferent restrictives* scored lowest on positive emotions, such as 'pleasant' and 'satisfied,' and they scored highest on negative emotions, such as 'guilty' and 'disgusted.' *Adventurous arousals* reported high arousal emotions, such as 'adventurous' and 'daring' when mealtimes were examined. *Pleasurable averages* had an average score on all variables. However, the ratings for positive emotions of this average group were comparable to *adventurous arousals*. *Convivial indulgers* associated low arousal positive emotions, such as 'pleasant,' 'pleased,' and 'satisfied,' with mealtimes.

Surprisingly, the four clusters differed mainly in their emotional associations with mealtimes, although the psychographic characteristics of the clusters were roughly comparable. The

older persons differed only slightly in their health and taste attitudes. The health and taste attitudes 'general health interest' and 'pleasure' were indicated as most important attitudes, especially by *convivial indulgers*, whereas 'reward,' 'craving,' 'interest in light products,' and 'interest in natural products' were found less important for the current older population. This pattern is comparable to those of younger persons (mean age 42 (y) ± 16 (SD)) as described by Roininen et al. in 1999 and 2001. The level of food fussiness and food neophobia of the present population was also comparable to those of other populations (Meiselman et al., 2010; Wardle et al., 2001). Henriques et al. (2009), Meiselman et al. (2010), and Tuorila, Lahteenmaki, Pohjalainen, and Loti (2001) observed that, as age increased, food neophobia increased as well. The current older population's level of food neophobia was indeed higher than that of the younger consumers described by Meiselman et al. (2010). However, in Tuorila et al.'s (2001) study, adults reported higher neophobia scores than the older persons in the current study. Several explanations come to mind, such as cultural differences or generational differences between the populations. A direct comparison of the current study participants' food neophobia levels with those of a younger Dutch subgroup would give a deeper insight into the effect of age on this parameter.

Interestingly, three of the four segments in the present study linked predominantly positive emotions to mealtimes. *Pleasurable averages, adventurous arousals*, and *convivial indulgers* associated, although not all to the same extent, positive emotions (e.g. 'pleasant,' 'pleased') with mealtimes. This phenomenon has been repeatedly described in the literature as hedonic asymmetry or positive bias (Desmet & Schifferstein, 2008; Ferrarini et al., 2010; King & Meiselman, 2010; Pineau et al., 2010), i.e. consumers respond to commercial food products with mainly positive emotions. It seems that this positive bias holds true not only for food products and beverages, but also for consumers' associations with mealtimes.

The current study's segments differed in valence and arousal level of emotions, as previously described by Feldman Barrett and Russell (1998). In previous segmentation studies, these dimensions have also been observed, for example in segmentations based on gerontographics (Moschis, 2003), senior consumer behaviour (Sudbury & Simcock, 2009), and senior travelling attitudes (Horneman, Carter, Wei, & Ruys, 2002). However, in other segmentation studies, they were not well reflected, for example in studies on domestic safety of older persons or motivation to participate in social tourism programmes (Carneiro, Eusébio, Kastenholz, & Alvelos, 2013; Kendall, Kuznesof, Seal, Dobson, & Brennan, 2013). Therefore, the presence or absence of valence/arousal dimensions in a segmentation seems to depend on how emotionally involved the participants are with the chosen segmentation variables. Food products are well known for their strong emotional associations (Gibson, 2006; King & Meiselman, 2010), and this is supported by the results of the current study.

Adventurous arousals, pleasurable averages, and *convivial indulgers* seem the most potent segments for product development and communication, as the characteristics of these

segments can be translated into actual products or packaging. For instance, *convivial indulgers* and *pleasurable averages* seem to prefer mildly positive, family-directed, social hints in products, as they associate low arousal positive emotions with their mealtimes. In contrast, *adventurous arousals* might prefer high arousal elements in products, such as adventurous or daring cues. In practice, for *pleasurable averages* and *convivial indulgers* one can think about – for example – tailored advertising (show e.g. a family scene) or introducing positive, low arousal characteristics in products (e.g. creaminess or softness). In contrast, for *adventurous arousals* the use of spices or the use of compounds that trigger the trigeminal system (capsaicin, menthol, and so on) might be appealing. Also, adventurous packaging or commercials starring outgoing older persons in adventurous surroundings might appeal to older people in this segment. However, the effectiveness of these segmentation-based design rules should be studied thoroughly before their actual application in food products.

The results of the current study apply mainly to the vital community-dwelling older population, and the implications should therefore focus mainly on this target group. The implication of the four segments for frail older persons and other older populations may also be relevant. However, conclusions should be drawn with caution, since the clusters should first be verified within such populations. We considered the vital community-dwelling older persons an important part of the Dutch senior population, as approximately 70% of the total Dutch 65+ population live independently and receive no form of professional care (CBS Statline, 2011). In the current study we chose for an emotion-driven segmentation as emotions are important in food perception of older persons, the more so once olfactory function declines (Murphy et al., 2002; Narchi, Walrand, Boirie, & Rousset, 2008). Of course also other segmentation approaches are possible, depending on the objective of the study (van der Zanden et al., 2014).

Surprisingly, emotion patterns for main meals and snacks were relatively comparable. The older persons reported overlapping emotions for both occasions, such as high ratings for 'pleasant' and low ratings for 'disgusted.' Previous studies reported clear differentiations in emotion patterns between main meals and snacks (Desmet & Schifferstein, 2008; Rousset, Deiss, Julliard, Schlich, & Droit-Volet, 2005). However, those studies were performed on adults, and – to our best knowledge – no other studies on this topic include older persons. It may be that older persons are less diverse in their emotional associations towards mealtimes, especially snacks. In the current study, snacks were consumed by only half of the participants, whereas main meals were consumed by almost all of them. Kremer, Holthuysen, and Boesveldt (2014) and Summerbell, Moody, Shanks, Stock, and Geissler (1995) found low consumption rates of snack foods in older persons as well. Therefore, snack times seem less relevant to the current older generation than main meals; which could explain the lower diversity of emotional associations for snack times.

'Guilt' was the only emotion specifically related to snack times. In previous studies also, some snack foods (e.g. chocolate) were related to feelings of guilt, whereas others (e.g. apples) were not (Macht & Dettmer, 2006; Rodgers, Stritzke, Bui, Franko, & Chabrol, 2011; Steenhuis, 2009). It seems that feelings of guilt depend on the type of snack food. SenTo panellists regularly consume chocolate, gingerbread, nuts, fruits, and biscuits at snack times (Kremer et al., 2014). Possibly our participants imagined the consumption of an unhealthy snack (chocolate, biscuits, and so on) when assessing their emotions relating to snack times, as snack foods are often seen as unhealthy by this group (Price, McMurdo, & Anderson, 2006).

Members of the segments linked different functionalities to mealtimes. *Convivial indulgers* most strongly associated 'pleasure' (cosiness, reward, and so on) and 'physical function' (eat to combat hunger, eat to get energy, and so on) with mealtimes, as previously observed by Morgan et al. (1993) and Costa, Schoolmeester, Dekker, and Jongen (2007). Morgan described the 'nutrition concerned' persons when segmenting the mature market. Costa and colleagues stated that older persons experienced mood functionalities, such as 'eat for pleasure' and 'enjoy food,' when preparing and consuming home-made meals. In contrast, *indifferent restrictives* often considered these meal functionalities less important. In the current study, *convivial indulgers* associated both the hedonic (pleasure) and functional (physical function) drivers of food consumption with mealtimes. At first sight, this finding seems to contradict a concept introduced by Rick, Cryder, and Loewestein (2008). They divided consumers into spendthrifts and tightwads. Spendthrifts consume for immediate pleasure and hedonic reward, whereas tightwads act more functionally and try to prevent the 'pain of paying' during consumption. However, to date, this concept has mostly been applied in financial contexts, such as fiscal behaviour, willingness to pay, and credit card debts (Fredrick, 2012; Gill & Thurber, 1999; Rick et al., 2008; Rick, Small, & Finkel, 2011; Wilcox, Block, & Eisenstein, 2011). Perhaps the strict division between the functionalities does not hold true for food consumption contexts.

General conclusion

In conclusion, vital community-dwelling older persons can be subdivided into four segments that express different emotional associations regarding mealtimes. Valence and level of arousal were the main drivers of the segmentation. The segments can be used to develop products and communication strategies tailored to the needs of older persons.

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Supplementary material

The online questionnaire for the current study was developed during an extensive pre-study. The pre-study consisted of two parts: focus group discussions and a free sorting task. Focus group discussions were conducted to fine-tune the functionality questionnaire. The free sorting task was performed to customise the EsSense Profile® (King and Meiselman, 2010) to older persons. Members of the SenTo panel were included (SenTo= Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future, a panel initiated by Wageningen UR of 769 healthy, independently living elderly).

Focus group discussions

Two focus groups were organised, including 14 SenTo members (7 male, 7 female, mean ± SD age 65.4 years ± 6.4 years). The functionalities discussed during the focus groups were inspired by the food choice questionnaire (Steptoe et al., 1995). All items of the food choice questionnaire that were deemed appropriate for eating occasions were included. Thereby, an impression of the completeness and clarity of the functionality questionnaire was gained. Functionalities mentioned during the focus groups and not yet in the questionnaire were added to this list. Functionalities included in the online survey were: hunger, habit, liking, cosiness, pleasure, energising, rewarding, healthiness, pleasing, calming, physical needs, thoughtless eating, and environmental awareness.

Free sorting task

The current study's emotion questionnaire was developed from the EsSense Profile® (King and Meiselman, 2010). Tailoring this existing questionnaire seemed to be necessary, as some emotion terms have been considered inappropriate in the context of foods (Jaeger, 2012). Furthermore, emotion patterns can be less reliable when participants have to rate 273 emotions (39 emotions for seven eating occasions) in a single questionnaire, due to response fatigue or boredom (Jaeger, 2012; Jaeger et al., 2013).

A free sorting task was performed to reduce the number of overlapping and food irrelevant emotion terms of the EsSense Profile®. One hundred and forty-eight SenTo panellists (67 male, 81 female, mean age 65.2 y (± 5.8 SD) completed an online free sorting task, using EyeQuestion software version 3.9.4. Participants were instructed to make groups of the EsSense Profile® terms that they considered to be synonyms. The starting screen contained two boxes. One box contained the 39 EsSense Profile® terms, the other box was empty. Participants were asked to drag the emotions terms and drop them in the empty box to make groups. By dropping terms on top of one another, a group was constructed. The first term was dragged and dropped at a random location in the empty box. The next was dropped either on top when it was a synonym, or at a different random location

when it was not. This way, new groups were made. This procedure was repeated until all emotion terms were assigned to a group. After the participants had grouped all the terms, they were asked to choose from each group one term that was most representative and most applicable in the context of eating occasions; this term was denoted as the group name. Participants were allowed to make as many groups as they wanted and could place as many emotion terms in each group as they chose. The results of the free sorting task were analysed using the software EyeOpeneR version 3.9.4. A contingency table was constructed, representing the frequencies of group names. In addition, a list representing the total frequency of use of each EsSense term was constructed. The total frequency of use list represents the frequency with which an emotion term was used as group name; this implicated that that term was considered most applicable to eating occasions by the participants. The reduced list with emotion terms was constructed by hand by analysis of the contingency table and total frequencies of use.

An EsSense Profile® term was included in our newly developed list if at least one of the following conditions was fulfilled:

- The corresponding EsSense Profile® term was used as a group name 148 times or more. The cut-off point of 148 was chosen because this was the upper 25% of the maximal frequency of use (maximal total frequency of use: 590).
- The group name corresponded to the EsSense Profile® term and the other group names had a frequency below 10 in the contingency table.

The EsSense Profile® that was adapted to older persons consisted of 15 emotions terms. Emotions included in the adapted list were: guilty, warm, happy, enthusiastic, adventurous, whole, eager, nostalgic, interested, good, pleased, disgusted, satisfied, daring, and pleasant. Our adapted emotion questionnaire gives opportunities for further research on food- and meal-related emotions in older persons, as this is one of the first questionnaires in this field that to have been specifically developed for the older population.

Chapter 3

Emotion, olfaction, and age

A comparison of self-reported food-evoked emotion profiles of younger adults, older normosmic adults, and older hyposmic adults

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Abstract

This study compared the self-reported food-evoked emotion profiles of younger adults (n=80, mean age 29.4 (years) ± 9.5 (SD)), older normosmic adults (n=84, mean age 68.9 (years) ± 4.2 (SD)), and older hyposmic adults (n=70, mean age 69.4 (years) ± 6.1 (SD)). The three groups evaluated gingerbreads and chocolates using the EsSense25 questionnaire. Our results demonstrated several differences in the self-reported emotion profiles of the participant groups, especially between those of the older groups and younger adults (*Rv*-coefficients of 0.39 and 0.42 for older normosmic/hyposmic adults and younger adults, versus 0.77 for older normosmic adults and older hyposmic adults). Firstly, the emotions as reported by the younger adults varied along the two dimensions valence and arousal, whereas the emotions of the older groups mainly varied along the valence dimension. Secondly, both older groups scored generally lower on a number of negative emotions, such as 'disgusted', and 'bored' (p <0.05). Finally, compared to their younger counterparts, the two older groups were generally less extreme in their emotion scores (i.e. they reported lower scores for a number of emotions, p <0.05). The influence of olfactory function was product dependent, as the emotion profiles of older normosmic and hyposmic adults differed only for specific products. In conclusion, participants' age and – to a lesser extent – olfactory function seem to impact on self-reported food-evoked emotions. Therefore, both factors should be taken into account when products are being tailored to the needs of older persons.

Introduction

Life expectancy is increasing, and older adults are becoming the fastest growing segment of the world's population (RIVM, 2013; World Health Organization, 2014). It is well known that aging comes with various physiological and psychological changes. One frequently encountered phenomenon is an age-related decrease in olfactory function (Doty & Kamath, 2014). In addition, as people age, their emotions seem to become more important during psychological processes, such as memory and problem solving (Ebner & Fischer, 2014; Fung & Carstensen, 2003). Since emotions are closely connected to odours (Herz & Cupchik, 1992), aging and the subsequent change in olfactory function may influence the perception of food-evoked emotions. To serve the senior population with foods that better meet their needs and expectations (Moschis, 2003; Reisenwitz & Iyer, 2007), it might be important to understand the interplay between age-related decline in olfactory function and perceptions of food-evoked emotions.

The close link between olfactory function and emotion perception has been described before, and smell has even been denoted as 'a sensory emotion' (Stevenson, 2009; Yeshurun & Sobel, 2010). For example Herz and Cupchik (1992) showed that odour-evoked emotional memories are highly vivid, specific, and relatively old. Another example is the strong evocation of nostalgic feelings on exposure to specific scents, such as apple pie or baby powder (Reid, Green, Wildschut, & Sedikidens, 2014). These phenomena could be explained by the close anatomical location in the brain of the olfactory system and the systems for learning, memory, emotion, and language (Shepherd, 2006). The scientific and practical relevance of the relation between odours and emotions is underlined by the introduction of several tools to measure odour-elicited emotions by the research teams at Firmenich and the University of Geneva, such as the GEOS, ScentMoveTM, and UniGEOS (Chrea et al. 2009; Ferdenzi et al., 2013; Porcherot et al., 2010).

When persons age, olfactory function can decrease. A study performed in the US indicates that around 24.5% of the older population is olfactory impaired. The prevalence of olfactory impairment increases with increasing age, and the impairment is highest among men (Murphy et al., 2002). A recent Dutch study showed even higher prevalence rates of olfactory dysfunction, as in this study 35% of the vital older population and 93% of the geriatric older population had an impaired olfactory function (Toussaint, de Roon, van Campen, Kremer, & Boesveldt, 2015). Although earlier research suggests that food liking in healthy independently living older persons is not affected by age-associated changes in sensory perception (Kremer, Bult, Mojet, & Kroeze, 2007), impaired olfaction may still influence consumer behaviour via unconscious emotional responses to a food product (Soudry, Lemogne, Malinvaud, Consoli, & Bonfils, 2011). Little has been reported about possible differences in food-evoked emotion profiles between persons with a good and an impaired sense of smell.

Alongside the decrease in olfactory function, aging itself might result in different emotion responses. For example, as people grow older, emotionally meaningful goals (e.g. balancing emotional states or sensing that one is needed by others) become more important, and they tend to invest greater resources in emotionally meaningful activities (Fung & Carstensen, 2003; Perry & Wolburg, 2011). Taking into account the important role of emotions in food choice (Gibson, 2006; Macht, 2008), it seems plausible that older persons therefore also rely more on their emotions when it comes to their food choice and meal experience. Additionally, building on the dimensional work of Russell, Weiss, and Mendelsohn (1989), the food-evoked emotion responses of younger adults can often be differentiated into the orthogonal dimensions valence (i.e. pleasure-displeasure) and arousal (i.e. sleepiness-activation) (Dalenberg et al., 2014; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014), whereas for seniors few food-related results have been reported. Although seniors tend to rely more on their emotions and heuristics during various psychological processes, Svärd, Fischer, and Lundqvist (2014) have shown that older persons tend to report emotions with a lower level of valence and emotional arousal than their younger counterparts. However, Svärd et al. (2014) did not study food-evoked emotion responses. Several explanations come to mind for these expected differences in reported emotional associations between the age groups. For example, emotions are formed upon experience and memory (Hamann, 2001). Older adults most likely have a longer history with food products and might therefore differ from younger adults in the intensity of their food-evoked emotions. Furthermore, May, Rahhal, Berry, and Leighton (2005) reported that for older individuals emotional associations (e.g. safety, happiness, and satisfaction) may be more important than cognitive associations (e.g. location of an item). That is, in their study the recall of emotional information did not decline when source memory (i.e. memory of recent events; Glisky, Rubin, & Davidson, 2001) declined.

Taken together, it seems plausible to expect differences in food-evoked emotion profiles between older and younger adults, and it could even be that persons with an impaired sense of smell (hyposmic persons) experience different food-evoked emotions than their unimpaired counterparts (normosmic persons). So far, little attention has been paid to the impact of aging itself and olfactory decline on food-evoked emotions. Therefore, in the current study, we investigate whether (and if so how) younger adults, older normosmic adults, and older hyposmic adults differ in their self-reported food-evoked emotion profiles.

Materials and methods

Participants

Two hundred and thirty-four Dutch participants enrolled in the current study: 80 younger adults (aged between 18 and 45 years old), 84 older normosmic adults (TDI-score >30.3, age >65 years old), and 70 older hyposmic adults (TDI-score <30.3, age >65 years old). Table 3.1 provides the participants' characteristics.

The younger adults were all members of Panelnet, a database initiated by Wageningen UR containing potential study participants. Since the prevalence of olfactory impairment in younger adults is reported to be low (approximately 2-5%, Brämerson, Johansson, Ek, Nordin & Bende, 2004; Landis, Konnerth, & Hummel, 2004), it was not deemed necessary by the authors of the current study to assess the actual olfactory status of this group. Consequently, since their olfactory status is assumed rather than measured, we will refer to this group as 'younger adults' throughout the current paper.

The older participants were all members of the SenTo panel (Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future). The SenTo panel is a panel, initiated by Wageningen UR, of around 800 healthy community-dwelling Dutch older persons. The criteria for membership of the SenTo panel are: being at least 55 years old, being capable of working online with a computer, being able to go out independently (for example, to do their grocery shopping), and being fluent in Dutch. We consider vital community-dwelling older adults an important part of the Dutch senior population, as approximately 70% of the total Dutch 65+ population live independently and receive no form of professional care (CBS Statline, 2011). The older participants were recruited based on their TDI score, as measured using Sniffin'sticks (Burghart, Wedel, Germany). A TDI-score is a measure of nasal chemosensory function (Kobal et al., 1996) and is composed of an odour threshold measure, an odour discrimination measure, and an odour identification measure. The TDI score reflects the summed scores of these measures, each ranging between 0 and 16. A TDI-score of 30.3 or lower indicates impaired olfactory functioning; i.e. hyposmia (Hummel, Kobal, Gudziol, & Mackay-Sim, 2007). The TDI scores of the SenTo panellists are measured on a regular basis in the sensory lab of Wageningen UR, the Netherlands.

All participants were consumers of gingerbread and chocolate, and were included only if they had no allergies or intolerances for milk, gluten, or lactose. The social ethical committee of Wageningen University approved the current study.

Table 3.1: Participants' demographic characteristics and TDI-scores.

		Younger adults (n=80)	Older normosmic adults (n=84)	Older hyposmic adults (n=70)
Age (years)	Mean ± SD	29.4 ± 9.5	68.9 ± 4.2	69.4 ± 6.1
Gender [%(n)]	Male	22.5 (18)	40 (34)	54.3 (38)
	Female	77.5 (62)	60 (50)	45.7 (32)
TDI-score*		n.a.	36.1	27.2

*A TDI-score is a measure of nasal chemosensory function and is composed of an odour threshold, discrimination measure, and identification measure. A TDI-score of 30.3 or lower indicates impaired olfactory functioning.

Products

Six products were evaluated: three types of chocolate from the Lindt Excellence brand (milk chocolate, dark chocolate 70% cacao, dark chocolate mint flavour), and three types of gingerbread from the Peijnenburg brand, (regular gingerbread, wholegrain gingerbread, and gingerbread ginger flavour). Figure 3.1 shows the sensory consumer profiles of the products (n=30 Dutch adults, 14 females, mean age 41 years ± 12 SD, age range: 23-63 years). Gingerbread regular is described as a sweet product. The wholegrain version is reported to be less sweet than the other gingerbread variants. The ginger flavour variant is described as a product with an intense overall taste and strong ginger flavour taste. Milk chocolate is described as a sweet and creamy product. Dark chocolate is reported to be a bitter, hard, and dry product with a high overall taste intensity. Mint chocolate is referred to as a product with a strong mint flavour and a strong overall taste.

The products (20g/sample) were presented – blind – in small transparent cups. All these products are commercially available in the Netherlands. We selected the products because in the Netherlands both younger adults and elderly consumers alike are regular consumers of these types of products (Kremer, Holthuysen, & Boesveldt, 2014; RIVM, 2011), and these products are well known for their strong emotional associations.

Study design

We collected our data using the EsSense25 method (Nestrud, Meiselman, King, Lesher, & Cardello, 2013), a shortened version of the EsSense Profile® (King & Meiselman, 2010). The EsSense Profile® is a food-specific questionnaire to measure self-reported food-evoked emotions. The questionnaire seems to be best validated and influential in the field of sensory science (Gutjar et al., 2014; King, Meiselman, & Carr, 2013; Ng, Chaya, & Hort, 2013). As the length of the questionnaire might be a challenge in some testing situations, we used the shortened version of this emotion measuring questionnaire.

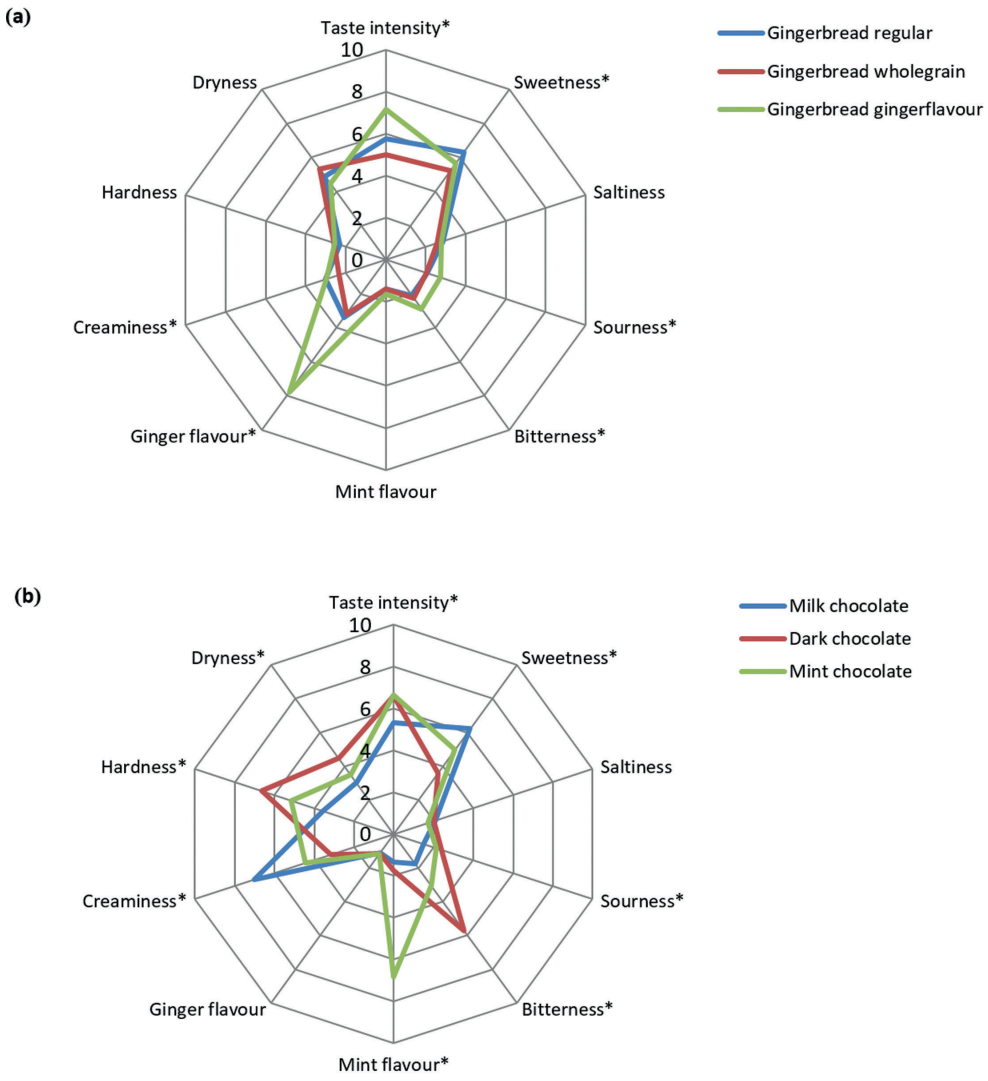

Figure 3.1 Sensory consumer profiles of the three gingerbreads (a) and three chocolates (b). Significant differences between the three products from one category are indicated per attribute (p <0.05).

The participants took part in a one-hour test session. This session started with a warm-up sample (Peijnenburg gingerbread regular) to familiarize the participants with the procedure. Then, the participants rated their liking for one of the test products on a 9-point hedonic scale. After that, they rated that product on 25 emotion terms: 'active', 'adventurous', 'aggressive', 'bored', 'calm', 'disgusted', 'enthusiastic', 'free', 'good', 'good-natured', 'guilty', 'happy', 'interested', 'joyful', 'loving', 'mild', 'nostalgic', 'pleasant', 'satisfied', 'secure', 'tame', 'understanding', 'warm', 'wild', and 'worried'. The participants rated the intensity of each emotion on a 5-point scale with anchors ranging from *not at all* (score = 1) to *very strong*

(score = 5). At four-minute intervals, this procedure of rating liking and emotions was repeated until the participants had evaluated all products. The participants first evaluated the three gingerbreads in randomized order, followed by the three chocolates in randomized order. This way, the fatty chocolate mouth film could not influence the evaluation of the gingerbread products (Lawless & Heymann, 2010). The participants were instructed to rinse their palate and neutralize their taste with water and unsalted crackers between samples. The test sessions, conducted between 13:00 and 17:00 hours to ensure that the eating time would be salient, were organized in the sensory booths of the Restaurant of the Future in Wageningen, The Netherlands.

Data analysis

SPSS 22.0 (IBM, New York, USA) and R-studio (R version 3.1.0, R Development Core Team, 2010) were used for statistical analyses. The results of this study were considered significant at a level of 0.05, unless stated otherwise.

First, we compared emotional responses to the samples across serving positions (i.e. three gingerbreads and three chocolates for which serving order was randomized across participants), as described before by Gutjar et al. (2014) and King et al. (2013). The means per emotion term per positional response were compared using a mixed model ANOVA. This procedure (data not reported) revealed no indications of systematic sample order effect on the evaluation of the emotions. Therefore, presentation order was not taken into account in further analyses.

Liking of the products

We calculated the mean liking scores and standard deviations of the products per participant group. For each product separately, the liking scores were compared by a mixed model ANOVA, including liking as the dependent variable and participant group as the fixed factor. Participants' individual data were indicated as random factors. Bonferroni's multiple comparisons tested for differences in liking between the groups.

Self-reported food-evoked emotion profiles of younger adults, older normosmic adults, and older hyposmic adults

To test whether the three participant groups differed with regard to their food-evoked emotion profiles we conducted a MANCOVA including the 25 emotions as dependent variables. Product and participant group (and their interaction) were entered in the model as fixed factors. As liking of some products differed between the participant groups we entered it as a covariate. Additionally, a multiple factor analysis (MFA, FactoMineR package; Lê, Josse, & Husson, 2008; Pages, 2004) was performed to globally compare the configurations between the three groups for each food product. As a measure of correlation between the product configurations, *Rv*-coefficients were calculated across the three groups.

To visualise how the groups differed with regard to their food-evoked emotions, an individual factor map was composed. A correlation cycle was composed for each participant group. In combination with the individual factor maps, these correlation circles indicate which emotions were coupled to which product by which group. These differences between the participant groups were statistically substantiated using mixed model ANOVA's, separately for each of the products. Each emotion was separately entered as dependent variable and participant group was entered as fixed factor. Participants' individual data were indicated as random factors. Bonferroni's multiple comparisons tested for differences in emotion scores between the participant groups. The comparison of the younger adults and the older normosmic adults showed whether there was an effect of age on food-evoked emotions. The comparison of older normosmic adults and older hyposmic seniors showed whether there was an effect of olfactory function on food-evoked emotions. These results were visualised in line plots, each showing the mean emotion scores and significances for the three groups for one of the products.

Results

Liking of the products

The mean liking scores of the products were compared between the participant groups (Table 3.2). Regarding the gingerbread products, the three participant groups equally liked the regular and the wholegrain variant. The two older groups liked the ginger flavour variant better than the younger adults. Regarding the chocolates, the three groups equally liked the milk variant. Compared to the two other groups, older hyposmic adults liked the dark chocolate better. In addition, the two older groups better liked the mint chocolate than the younger adults.

Table 3.2 Mean liking scores (± SD) of the six products, presented per product category for the younger adults, older normosmic adults, and older hyposmic adults.

		Younger adults (n=80)	Older normosmic adults (n=84)	Older hyposmic adults (n=70)
Gingerbread	Regular	6.4 ± 1.4	6.4 ±1.5	6.1 ±1.6
	Wholegrain	5.5 ± 1.7	5.5 ± 1.8	5.5 ± 1.7
	Ginger flavour	4.7 ± 2.7[b]	7.0 ± 1.9[a]	6.3 ± 2.3[a]
Chocolate	Milk	7.3 ± 1.7	6.9 ± 1.9	7.0 ± 1.7
	Dark	5.1 ± 2.5[b]	5.0 ± 2.5[b]	6.1 ± 2.1[a]
	Mint	5.4 ± 2.8[b]	6.5 ± 2.0[a]	6.9 ± 1.7[a]

[a,b] Similar letters within one row refer to statistically comparable liking scores of the participant groups for a specific product ($p < 0.05$).

Self-reported food-evoked emotion profiles of younger adults, older normosmic adults, and older hyposmic adults

A MANCOVA was used to test whether the emotion profiles of the three groups differed. These multivariate results were significant for participant group, indicating that the three participant groups differed in their food-evoked emotions (Pillai's trace = 0.22, F = 6.9, df = (50, 2736), $p < 0.05$). These results were confirmed by the MFA. The *Rv*- coefficients indicated that the younger adults differed most from the older normosmic adults and older hyposmic adults. The *Rv*-coefficients of younger adults vs. older normosmic adults and younger adults vs. older hyposmic adults were 0.39 and 0.42, respectively, both much lower than 1, meaning that the participant groups had different emotion configurations. The older normosmic and hyposmic adults were more alike, having an *Rv*- coefficient of 0.77.

To understand how the three participant groups differed with regard to their self-reported food-evoked emotions the MFA partial individuals plot (Figure 3.2a) and MFA correlation cycles per participant group (Figures 3.2b, c, and d) were constructed. The first two dimensions represent valence (dimension 1, emotions contributing to the factor are e.g. 'happy' and 'free') and arousal (dimension 2, emotions contributing to the factor are e.g. 'wild' and 'adventurous'), and together they account for 87.8% of the variance (50.4% and 37.4%, respectively). In Figure 3.2a, the six products are shown as mean points and the emotion configurations of the three groups are shown as partial individuals.

The individual factor map (Figure 3.2a) indicates that the three groups differ in the extent to which their food-evoked emotions vary along the dimensions valence and arousal. When we draw an imaginary line between the six products for each of the three groups, we observe that the emotion profiles of the younger adults vary along both the valence and the arousal dimension, whereas those of the two older groups vary less along the arousal dimension.

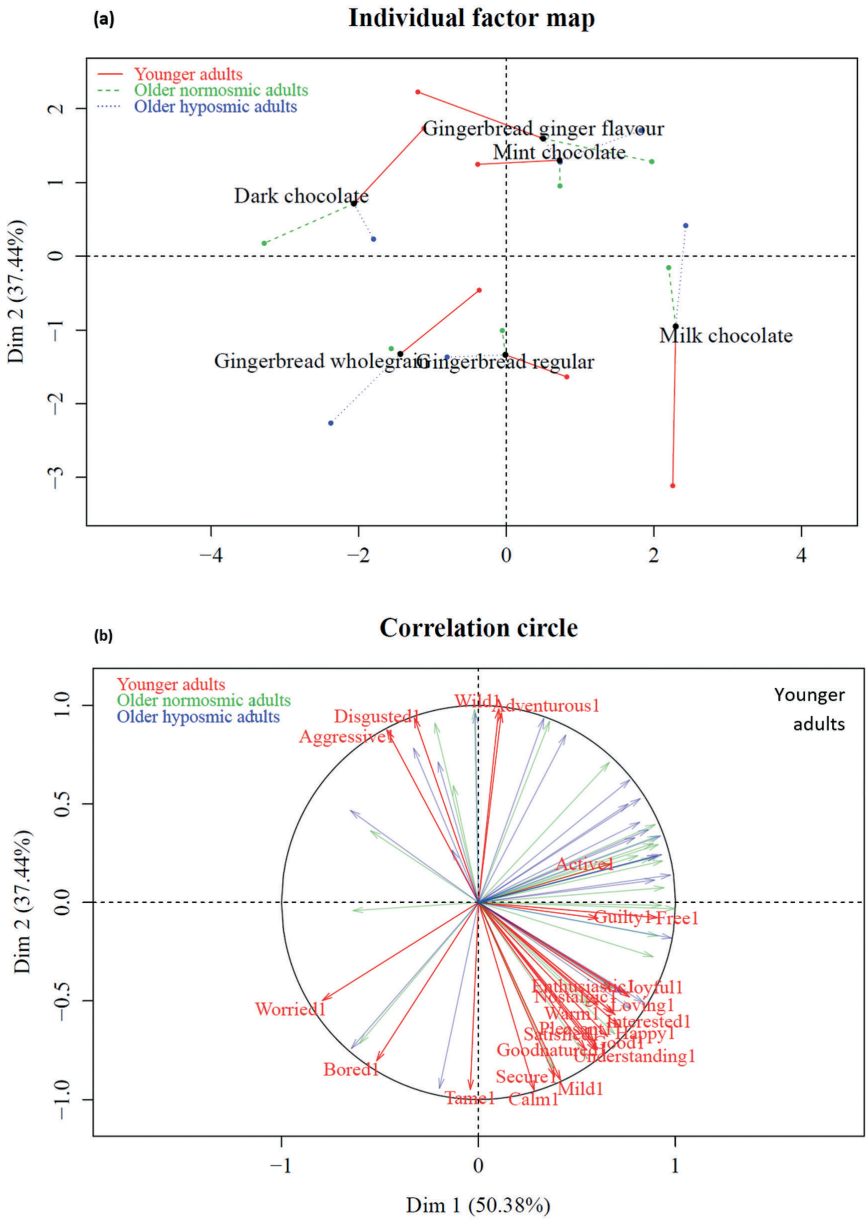

Figure 3.2 Representation of the first two dimensions of the MFA space showing (a) the six products as mean points, the partial individuals representing the emotion configurations of the products of the three participant groups, and representations of the emotion terms in the two-dimensional space for (b) the younger adults, (c) the older normosmic adults, and (d) the older hyposmic adults.

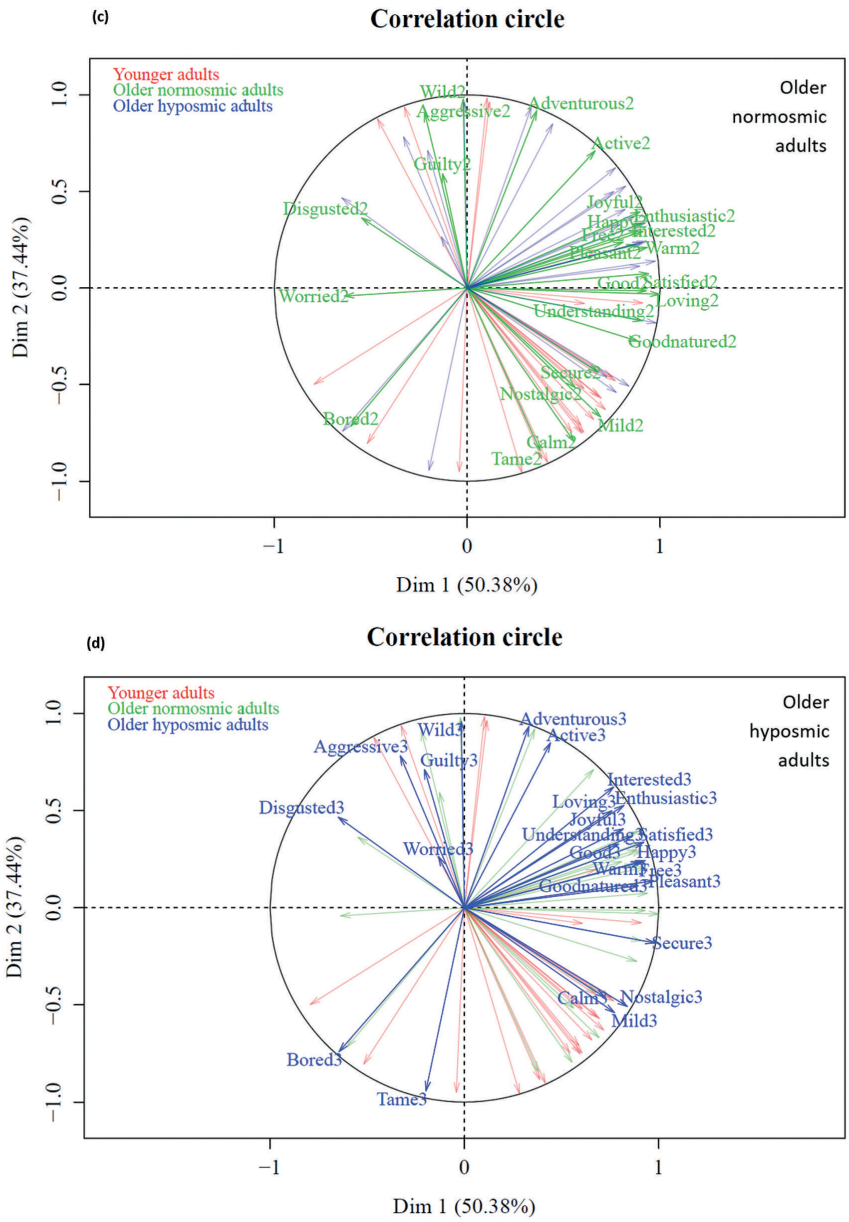

Figure 3.2 Continued

Additionally, visual inspection of the MFA correlation circles (Figures 3.2b-d) showed that the type of emotions associated with the six products differed between the participant groups, especially between the younger adults and the two older groups. We used a mixed model ANOVA to statistically substantiate the differences between the three participant groups (Figures 3.3 and 3.4). Both the MFA results and mixed model ANOVA results show that the three groups associated mainly positive emotions (e.g. 'good', 'loving') with gingerbread regular, with the younger adults scoring significantly higher on a number of these emotions. The three groups associated the wholegrain variant with mainly positive emotions (e.g. 'happy', 'loving') as well, and also here the younger adults scored significantly higher on a number of these emotions. Younger adults differed from the two older groups with regard to their emotional associations towards gingerbread ginger flavour. The younger adults associated this product significantly stronger with the emotion 'disgusted', whereas the seniors stronger linked this product to positive emotions, such as 'pleasant', 'happy', and 'enthusiastic'.

With regard to the chocolates, the MFA and mixed model results indicated differences between the three participant groups as well, and again most poignant between the younger adults and the two older groups. The three groups associated mainly positive emotions (e.g. 'secure' and good') with milk chocolate, with the younger adults scoring significantly higher on most of these emotions. Compared to the two older groups, younger adults associated the dark variant significantly stronger to the emotion 'disgusted'. For the mint chocolate the younger adults had different emotional associations as well. The younger adults associated the mint variant to the emotions 'disgust' and 'wild', whereas the seniors linked this variant to a number of positive emotions, such as 'pleasant' and 'satisfied'. Additionally, for dark and mint chocolate some differences in food-evoked emotions were observed between the older normosmic and hyposmic adults. For example, older hyposmic adults linked the mint variant stronger to the emotions 'mild' and 'satisfied' compared to older normosmic adults.

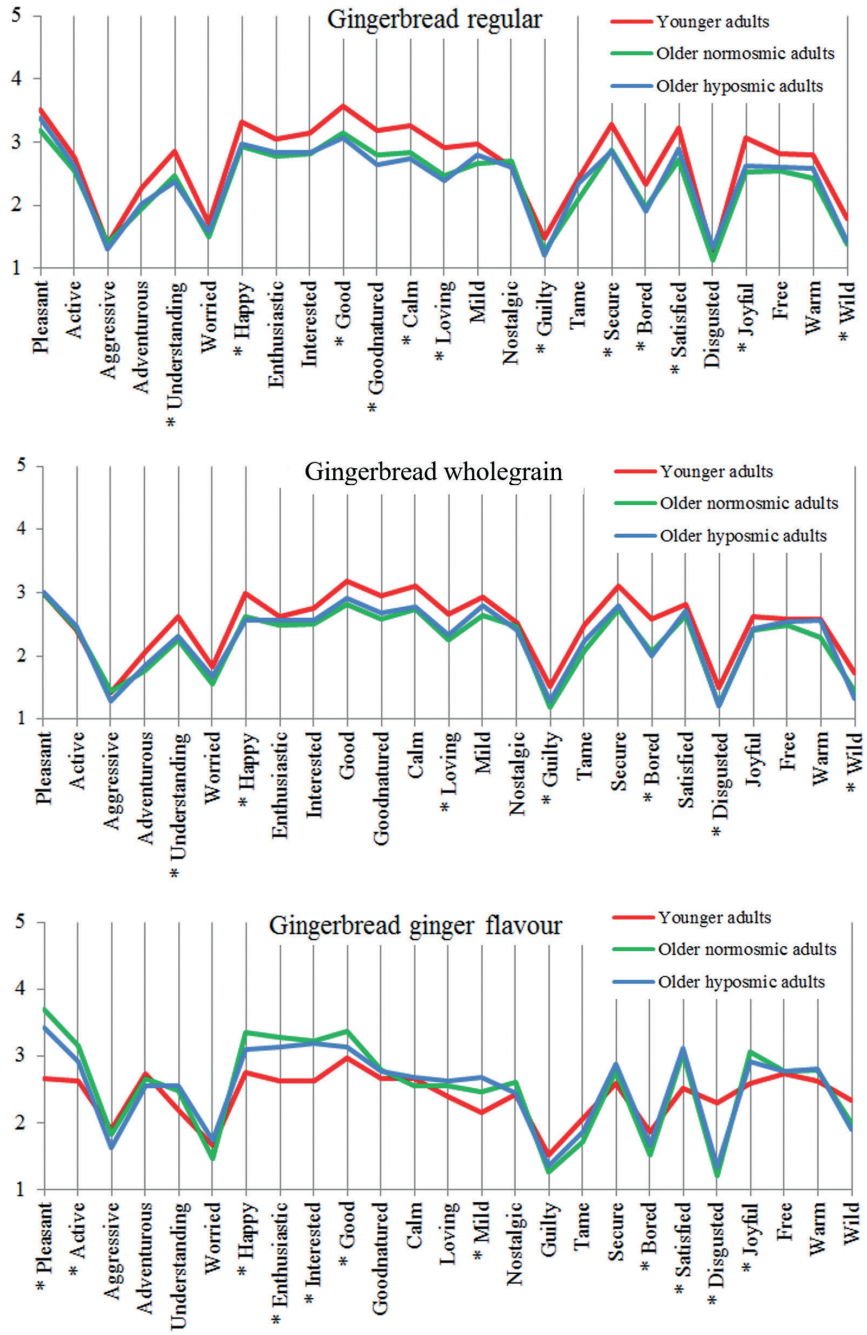

Figure 3.3 Line graphs presenting the mean emotion scores and significant differences between the three participant groups: younger adults, older normosmic adults, and older hyposmic adults. Results are presented separately for the gingerbread regular, gingerbread wholegrain, and gingerbread ginger flavour. Note: * indicates the emotions for which the groups significantly differ at $p < 0.05$, ** indicate the emotions for which the groups significantly differ at $p < 0.002$.

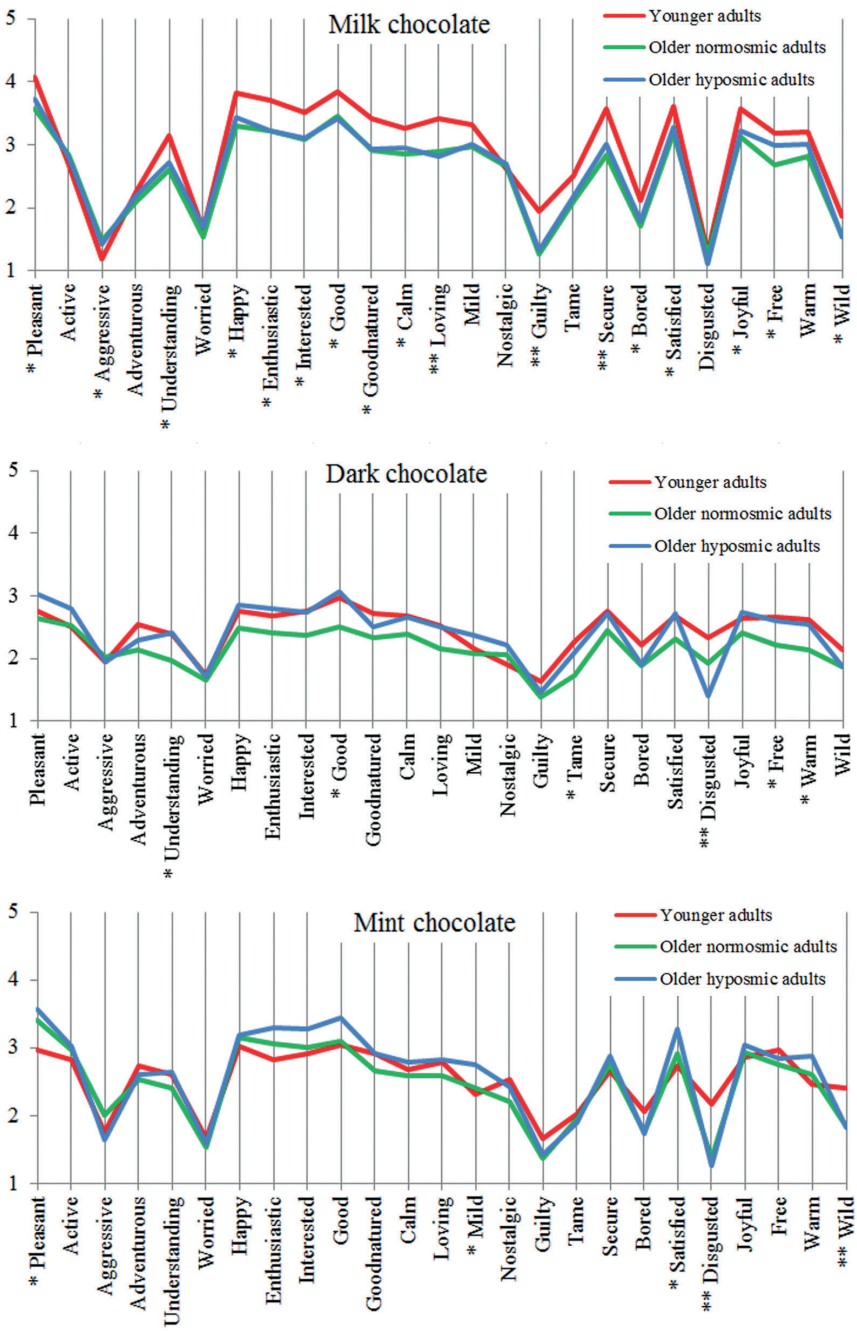

Figure 3.4 Line graphs presenting the mean emotion scores and significant differences between the three participant groups: younger adults, older normosmic adults, and older hyposmic adults. Results are presented separately for the milk chocolate, dark chocolate, and mint chocolate. Note: * indicates the emotions for which the groups significantly differ at $p < 0.05$, ** indicate the emotions for which the groups significantly differ at $p < 0.002$.

Discussion

The current study explored self-reported food-evoked emotion profiles of older normosmic adults, older hyposmic adults, and younger adults. Age seemed to be an important factor when measuring self-reported food-evoked emotions, since the emotional profiles of the younger adults and older normosmic adults differed with regard to the type and intensity of the rated emotions. The influence of olfactory function on food-evoked emotions was less pronounced and demonstrated product dependency, as the emotion profiles of older normosmic and older hyposmic adults differed only for specific products.

We observed that the type of emotions differed between the age groups, since their food-evoked emotions did not vary along the dimensions valence and arousal (Feldman-Barrett & Russell, 1998) to the same extent. The emotions as reported by the younger adults varied along the two dimensions valence and arousal, whereas the emotions of the older groups mainly varied along the valence dimension. This observation seems to have some parallel with previous observations. For example, Montepare and Dobish (2014) reported that compared to younger adults, older persons more often report low arousal emotions than high arousal negative emotions. Moreover, Kunzmann, Kupperbusch, and Levenson (2005), Smith Hilman, and Duley (2005), and Tsai, Levenson, and Carstensen (2000) showed that seniors can have lower physiological responses (e.g. cardiovascular responses) towards arousing stimuli, regardless of the stimuli's valence. Therefore, it could be that seniors are less able to distinguish between valence and arousal. Future longitudinal studies are needed – measuring the emotion responses of seniors towards a wide range of food products over time – to be able to disentangle whether in the current study observed differences between the age groups come forth from aging itself or whether they are the reflection of a certain cohort effect.

The conscious emotional product differentiation of seniors appeared to be not only valence-based, but also biased towards positive emotions. That is, the seniors scored generally lower on a number of negative emotions, such as 'disgusted', and 'bored'. This so called 'positivity bias' has been described before for psychological processes, such as emotional expression, perception, and memory (Carstensen et al., 2011; Chipperfield, Perry & Weiner, 2003; English & Carstensen, 2014; Montepare & Dobish, 2014; Mroczek & Kolarz, 1998). Hence, it seems plausible that this general positive orientation with increasing age holds true not only for general psychological processes, but also extends to emotional food experience, or – at least – the rating of food-evoked emotions.

Compared to the younger adults, the two older groups were generally less extreme in their emotion scores (i.e. the older adults rated a number of emotions with lower intensities). These rating differences are in line with earlier findings. For example, Edwards, Hartwell, and Brown (2013) observed that, in general, younger adults (13–45 years old) have a more critical view of food than older adults (45–65 and 65+ years old). Seo and Hummel

(2009) reported that younger adults rated pleasantness of an increasing coffee or green tea odour concentration with more extreme values than their normosmic and hyposmic counterparts. Kremer et al. (2014) reported the occurrence of lower fluctuation of product liking scores among older hyposmic adults. Additionally, Svärd et al., 2014 reported that when persons grow older, they tend to report less extreme ratings for arousal, potency, and valence. Consequently, they may also either experience, or at least report, less extreme ratings for other attributes, like emotions.

The effect of olfactory function on emotion profiles seemed product specific, as the two older groups associated some products with different emotions, while for other products they reported comparable emotion profiles. Several explanations for this observation come to mind. It is possible that differences in product liking between the two older groups influenced the reported emotion profiles (e.g. for dark chocolate). However, the two older groups also differentiated some equally liked products (e.g. mint chocolate) on an emotion-profile basis. For these products the sensory characteristics (for details see Figure 3.1) may have influenced the food-evoked emotion profiles, since sensory attributes are important drivers of food-evoked emotions (Desmet & Schifferstein, 2008; Gibson, 2006). Compared to their older normosmic counterparts, older hyposmic adults may perceive the sensory product characteristics differently (e.g. perceive the bitter taste or trigeminal stimulation of mint chocolate as less intense (Doets & Kremer, 2016; Frasnelli & Hummel, 2007; Hummel et al., 1996), and hence report different food-evoked emotion profiles. Future studies that examine the influence of taste intensity and character – including a product set balanced for both aspects – are necessary to further the understanding of the interplay between olfactory status and emotional product perception.

The current results can provide R&D guidance beyond the traditional liking and sensory characteristics (Dalenberg et al., 2014; King & Meiselman, 2010; Ng et al., 2013). This guidance seems to be important with an eye on the increasing need for tailored and emotionally meaningful products for seniors (den Uijl, Jager, de Graaf, Waddell, & Kremer, 2014). For example, whereas younger adults associated mint chocolate with the high arousal emotions such as 'disgusted' and 'wild', older adults associated this product more with the low arousal emotions 'pleasant', 'mild', and 'satisfied'. Incorporating these low arousal associations into a chocolate marketing campaign (e.g. through music (Groenland & Schoormans, 1994; Västfjäll, 2002) or colours (Oberascher & Gallmetzer, 2003) may result in increased product appeal and satisfaction among senior consumers. Moreover, when applied to – for seniors – nutritionally beneficial food products (e.g. protein-rich products), these marketing strategies may aid to better meet the nutritional requirements of senior consumers (van der Zanden, van Kleef, de Wijk, & van Trijp, 2014).

Interestingly, Dubé, LeBel, and Lu (2005) and Edwards et al. (2013) reported a potential influence of gender on food-evoked emotion ratings, with men scoring generally higher than woman. In the current study, gender proportions within and between the three

groups differed. The younger adult group and – to a lesser extent – the older normosmic group consisted mainly of women, and men were overrepresented in the older hyposmic group. On the one hand, this gender imbalance can be regarded as a practical limitation of the current study. On the other hand, this distribution reflects the higher prevalence of olfactory impairment in men and the fact that women will outperform men in sensory functioning at all ages (Doty & Kamath, 2014; Murphy et al., 2002). Since in the current study gender did not influence the product or group effect, we did not take these interaction effects into further consideration.

The results of the current study apply mainly to the vital community-dwelling older population. The implications should therefore also focus mainly on this target group. It may also be relevant to measure food-evoked emotions in other older populations, such as frail older persons, care home residents, or specific consumer segments within these groups such as 'faithful patients' (Morgan, 1993), or 'heavy-users' (King & Meiselman, 2010). For the frailer groups, the shortened length of the questionnaire and the possibility of applying the method as a pencil-and-paper task in natural settings could be of particular importance (Köster, 2009; Nestrud et al., 2013). However, as the currently applied method requires cognitive deliberation and verbalisation of thoughts, a verification of the method in these frailer populations is required first. Furthermore, as the current study focuses on gingerbreads and chocolates, its results may not apply to other foods, such as staple foods or complete dishes. King and Meiselman (2010) suggest that the emotions associated with these foods can differ from those for snack-type foods. It would be interesting to replicate the current study, using different products, the more so since the influence of olfactory function seems to be product dependent. Finally, it seems interesting to explore senior's emotions as evoked by memorised meals, and compare them to those as reported directly after actual consumption. Piqueras-Fiszman and Jaeger (2014a, b) reported that the remembered satisfaction and enjoyment of meals may influence future meal choice decisions. Hence, this approach of – additionally – taking 'memory-evoked' emotions into account might be effective when developing emotionally-meaningful products for seniors. However, to our knowledge this concept has not yet been explored in the senior population, or population with varying olfactory functions.

In conclusion, the current results show that the age groups differed in their self-reported food-evoked emotion profiles, both regarding the type and intensity of the emotion scores. The influence of olfactory function on food-evoked emotions was product-specific, as only for some products the emotions profiles differed between the normosmic and hyposmic group. Therefore, age – and to a slightly lesser extent olfactory function – seem to be important factors to take into consideration when emotionally meaningful products targeted at specific consumer groups are being developed.

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Chapter 4

Self-reported food-evoked emotions of younger adults, older normosmic adults, and older hyposmic adults as measured using the PrEmo2 tool and the Affect Grid

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Abstract

Food-evoked emotions may provide relevant consumer insights, beyond liking alone. Previous research, using the EsSense25 method, showed that the food-evoked emotion profiles of adults vary along the two dimensions valence and arousal, whereas those as reported by seniors vary mainly in valence. However, it is unknown to what extent these findings can be replicated using other self-reported emotion measuring tools. This study therefore compared food-evoked emotion profiles of 71 younger adults (mean age 30.8 (years) ± 9.3 (SD)), 86 older normosmic adults (i.e. normal sense of smell, mean age 67.5 (years) ± 5.4 (SD)), and 70 older hyposmic adults (i.e. impaired sense of smell, mean age 68.2 (years) ± 5.9 (SD)). These groups evaluated three types of gingerbread and three types of chocolate using the self-reporting emotion measurement tools Premo2 tool and the Affect Grid. In line with previous observations, the self-reported emotion profiles differed between the age groups. The emotion profiles of younger adults varied for both methods along the dimensions valence and arousal, whereas, for the older groups, this valence/arousal differentiation was less clear. The effect of olfactory function was less pronounced, as the older adults with normal and impaired olfactory function had similar emotion profiles. For the PrEmo2 tool specifically, the older adults had generally lower scores for negative emotions compared to the younger adults. Hence, age should be considered an important factor when self-reported food-evoked emotions are being measured in order to develop food products targeted at specific consumer groups.

Introduction

In contrast to a number of cognitive functions, emotion experience and regulation seem to be relatively well preserved with increasing age (Craik & Salthouse, 2011). Sometimes these emotional processes may even be better than they were in younger years (Carstensen, Mikels, & Mather, 2006). For example, seniors more often seek emotionally meaningful goals, and they tend to rely more on their emotions during psychological processes than their younger counterparts (Fung & Carstensen, 2003; Perry & Wolburg, 2011). It seems plausible that this emotional dominance even extends to food choice and product perception, given the importance of emotions in food choice and product experience (Gibson, 2006; Gutjar et al., 2014; Gutjar et al., 2015; Macht, 2008). With an eye on the need for tailored and emotionally meaningful products for seniors (den Uijl, Jager, de Graaf, Waddell, & Kremer, 2014; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014), it seems essential to fully understand the features of seniors' food-evoked emotions.

Several explicit tools to measure food-evoked emotions are available, such as EsSense® Profile (King & Meiselman, 2010), UniGeos (Ferdenzi et al., 2013), ScentMove™ (Porcherot et al., 2010), EmoSemio (Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014), Emotion lexicon (Rousset, Deiss, Juillard, Schlich, & Droit-Volet, 2005), and PANAS (Watson, Clarke, & Tellegen, 1988). Nevertheless, studies reporting on the application of these tools in the senior population are scarce, and this makes it difficult to understand the impact of age on food-evoked emotion profiles. For example, Dubé, LeBel, and Lu (2005) explored emotional associations pre- and post-consumption of comfort foods through an online survey. Prior to consumption, seniors reported more positive emotions than their younger counterparts, whereas post-consumption age no longer had a moderating effect. Later, Narchi, Walrand, Boirie, and Rousset (2008) combined existing lists of Juillard (2003) and Rousset et al. (2005), and measured seniors' emotional associations with food pictures. They observed that seniors with a low food intake reported more negative emotions than seniors with a high intake.

Olfactory decline is another factor that may impact on seniors' food-evoked emotion profiles. Odours and emotions are anatomically closely connected to each other, and odours clearly evoke an emotional response (Kalogjera & Dzepina, 2012). When people grow older, their sense of smell can decrease (Doty & Kamath, 2014; Toussaint, de Roon, van Campen, Kremer, & Boesveldt 2015). Although research suggests that food liking is not per se affected by age-associated changes in food perception (Kremer, Bult, Mojet, & Kroeze, 2007; Seo & Hummel, 2009), an impaired olfaction may still impact on consumer behaviour via modulations of the emotional response to a food product (den Uijl, Jager, de Graaf, Meiselman, & Kremer, 2016; Soudry, Lemogne, Malinvaud, Consoli, & Bonfils, 2011). Yet, olfactory decline is often not taken into account when food-evoked emotions are being measured.

We recently explored food-evoked emotions of seniors with a normal olfactory function (i.e. normosmic seniors), seniors with an impaired olfactory function (i.e. hyposmic seniors), and younger adults (den Uijl et al., 2016). The three groups tasted gingerbreads and chocolates, and evaluated them using the 25-item self-reporting emotion measurement tool EsSense-25 (Nestrud, Meiselman, King, Lesher, & Cardello, 2016). The results showed that the older adults had a so-called positivity bias, as their scores for emotions with a negative valence (e.g. boredom) were lower than those of the younger adults. Moreover, building on Russell's dimensional model (1980), the EsSense25 emotions can be classified not only by their valence (i.e. being positive or negative), but also by their level of emotional arousal (having a low or high level of activity/energy, such as calm or wild). In the above described study, the emotions reported by the older adults varied less clearly along the valence/arousal dimensions than those of the younger adults (den Uijl et al., 2016). A better understanding of this age-specific variation in valence and arousal of self-reported food-evoked emotions may be relevant for R&D and communication strategies. The more so, as in a previous study the mealtime expectations of specific older consumer segments varied along the two dimensions valence and arousal (den Uijl et al., 2014). For example, whereas some segments regarded mealtimes as 'satisfying' and 'calm' (i.e. low arousal, high valence), others regarded these moments as 'daring' and 'adventurous' (i.e. high arousal). To serve these specific segments with the products that match their expectations, it is essential to reliably measure product-evoked valence and arousal (Lindstrom, 2005; Thomson, Crocker, & Marketo, 2010).

To date, the question remains as to what extent the differences in food-evoked emotion profiles (e.g. with regard to valence/arousal) between younger adults, older normosmic adults, and older hyposmic adults can be replicated. Therefore, the aim of the current study was to explore self-reported food-evoked emotions of younger adults, older normosmic adults, and older hyposmic adults, using two other frequently applied tools: the PrEmo2 tool and the Affect Grid. The results of the current work were compared with those of den Uijl et al. (2016). From our previous observations, we hypothesized that the emotions of the younger adults would vary in valence and arousal, whereas those of the older adults would vary mainly in valence. Moreover, we expected that the older persons would report fewer negative emotions than the younger adults.

Materials and Methods

Participants

Table 4.1 shows the participants' demographic characteristics. Two hundred and twenty-seven persons enrolled in the current study: 71 younger adults (mean age 30.8 (years) ± 9.3 (SD)), 86 older normosmic adults (mean age 67.5 (years) ± 5.4 (SD)), and 70 older hyposmic adults (mean age 68.2 (years) ± 5.9 (SD)).

The older adults were all members of the SenTo panel (Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future). The SenTo panel is a panel, initiated by Wageningen UR, of around 800 healthy community-dwelling Dutch older persons. The criteria for membership of the SenTo panel are: being at least 55 years old, being able to go out independently (for example, to do their grocery shopping), being capable of working online with a computer, and being fluent in Dutch. We consider the group of vital community-dwelling older adults to be an important part of the Dutch senior population, as approximately 70% of the total Dutch 65+ population lives independently and without any form of professional care (CBS Statline, 2011).

The older adults were labelled 'normosmic' or 'hyposmic' on the basis of their TDI scores, as measured using Sniffin'sticks (Burghart, Wedel, Germany). A TDI-score is a measure of nasal chemosensory function (Kobal et al., 1996). The TDI score reflects the summed scores of an odour threshold measure, an odour discrimination measure, and an odour identification measure, these measures each ranging between 0 and 16. The participants with a TDI score lower than the group average (i.e. a TDI score <32.8) were labelled as 'hyposmic'. The participants with a TDI score higher than the group average (i.e. TDI score ≥ 32.8) were labelled as 'normosmic'.

The younger adults were recruited from Panelnet, a Wageningen UR database of potential (non-trained) participants. Because of the low prevalence of olfactory impairment in younger adults (approximately 2–5%, Brämerson, Johansson, Ek, Nordin, & Bende, 2004; Landis, Konnerth, & Hummel, 2004), their olfactory status was presumed to be normal. Consequently, as their olfactory status was assumed rather than measured, we refer to this group as 'younger adults' throughout this paper.

All participants were consumers of gingerbread and chocolate, and were only included if they had no allergies or intolerances for milk, gluten, or lactose. The current study was approved by the social ethical committee of Wageningen University.

Table 4.1 Demographic characteristics.

		Younger adults (n=71)	Older normosmic adults (n=86)	Older hyposmic adults (n=70)
Age (years)	Mean ± SD	30.8 ± 9.3	67.5 ± 5.4	68.2 ± 5.9
Gender	% Male	18	30	57
TDI-score[a]	Mean	n.a.	36.2	27.7

[a] A TDI-score is a measure of nasal chemosensory function and is composed of an odour threshold, a discrimination measure, and an identification measure.

Products

The participants evaluated three types of gingerbread from the brand Peijnenburg (i.e. regular, wholegrain, and ginger flavour), and three types of chocolate from the brand Lindt Excellence (milk, dark 70% cacao, dark with mint flavour). The products (ca 20g/sample) were presented – blind coded – in small transparent cups similar to those used by den Uijl et al. (2016). Details on the sensory characteristics of these products can be obtained from the latter study.

We selected chocolates since in the Netherlands both younger and older adults are regular consumers of this type of product (RIVM, 2011). Moreover, Jager et al. (2014) reported that younger adults associated different food-evoked emotions with differently flavoured Lindt Excellence chocolates (e.g. dark 70% cocoa, mint, and blueberry). For example, for the dark chocolate 70% cocoa, the emotions 'calm' and 'bored' were most dominant, whereas for the mint flavoured chocolate the emotions 'energetic', 'nostalgic', and 'whole' were more dominant. The milk variant was included as the 'regular' variant.

Gingerbread was selected because – like chocolate – this product is frequently consumed by both younger and older Dutch adults (Kremer, Holthuysen, & Boesveldt, 2014). Furthermore, on the Dutch market, this product is available in various flavour varieties, so a similar product selection strategy as for the chocolates could be applied: a 'regular' variant and two flavour variants (i.e. wholegrain and ginger flavour).

Tasks and Procedure

The participants completed two sessions. In the first session, the participants scored a product on a 9-point hedonic scale (anchoring 1= 'dislike extremely' to 9= 'like extremely'), and subsequently evaluated the product using the PrEmo2 tool (Laurans & Desmet, 2012). This procedure was repeated for the six products. In the second session organized at least two weeks later, the participants evaluated the products using the Affect Grid (Russell, Weiss, & Mendelsohn, 1989). Details on the procedures followed are provided in the sections '*Procedure for the PrEmo2 Tool*' and '*Procedure for the Affect Grid*'.

The participants started each session with an instruction and warm-up sample (wheat bread, Albert Heijn brand), to become familiar with the task. After the warm-up sample, the participants evaluated the three gingerbreads in randomised order, followed by the three chocolates in randomised order. This way, we minimised the influence of the fatty – chocolate – mouth film on the evaluation of the gingerbread products. After each sample, the participants were instructed to rinse their palate with water and to neutralise their taste with unsalted crackers. The test sessions were conducted in sensory booths of the Restaurant of the Future in Wageningen between 1 and 5pm to ensure a salient eating time.

Procedure for the PrEmo2 Tool

The PrEmo2 tool (Laurans & Desmet, 2012) is a non-verbal web-based tool to measure self-reported product-evoked emotions. The PrEmo2 tool is an updated version of the PrEmo tool (Desmet, 2002, 2005), including restyled characters to maximise expressivity. The PrEmo2 tool consists of 12 animations of a cartoon character that each express an emotion in approximately one second, both with facial/bodily movement and vocal sound, 'desire', 'satisfaction', 'pride', 'hope', 'joy', 'fascination', 'disgust', 'dissatisfaction', 'shame', 'fear', 'sadness', and 'boredom'. Expressing an emotion by means of animations rather than written words is thought to make the task more intuitive, as participants are not asked to articulate their emotion associations. In addition, the tool's non-verbal character facilitates application of the method across different languages and cultures (Laurans & Desmet, 2012). During the test session, the participants tasted a product and were subsequently asked to what extent they experienced the emotions as expressed by the animated cartoons on a 5-point scale (anchoring 0 = 'I do not feel this' to 4 = 'I feel this strongly'). These animated cartoons were randomised across participants and food stimuli. The above described procedure was repeated for each product.

Procedure for the Affect Grid

The Affect Grid (Russell et al., 1989) is a tool that allows for fast and repeated assessment of affect (Einöther, Baas, Rowson, & Giesbrecht, 2015). It directly measures valence and arousal, using a grid of 9*9 – empty – boxes, in which each box represents a combination of valence (1 = 'strong negative valence' and 9 = 'strong positive valence') and emotional arousal (1 = 'very low arousal' and 9 = 'very high arousal'). The participant is instructed to tick the box that best corresponds to his/her affect state after tasting a product. In the current study, an adapted version of the Affect Grid was used, consisting of 361 (19*19) boxes, enabling the measurement of subtle effects (Figure 4.1; Einöther et al., 2015). During the test, each participant tasted a product and subsequently ticked whichever one of the 361 boxes of the Affect Grid that corresponded to his/her current affective state.

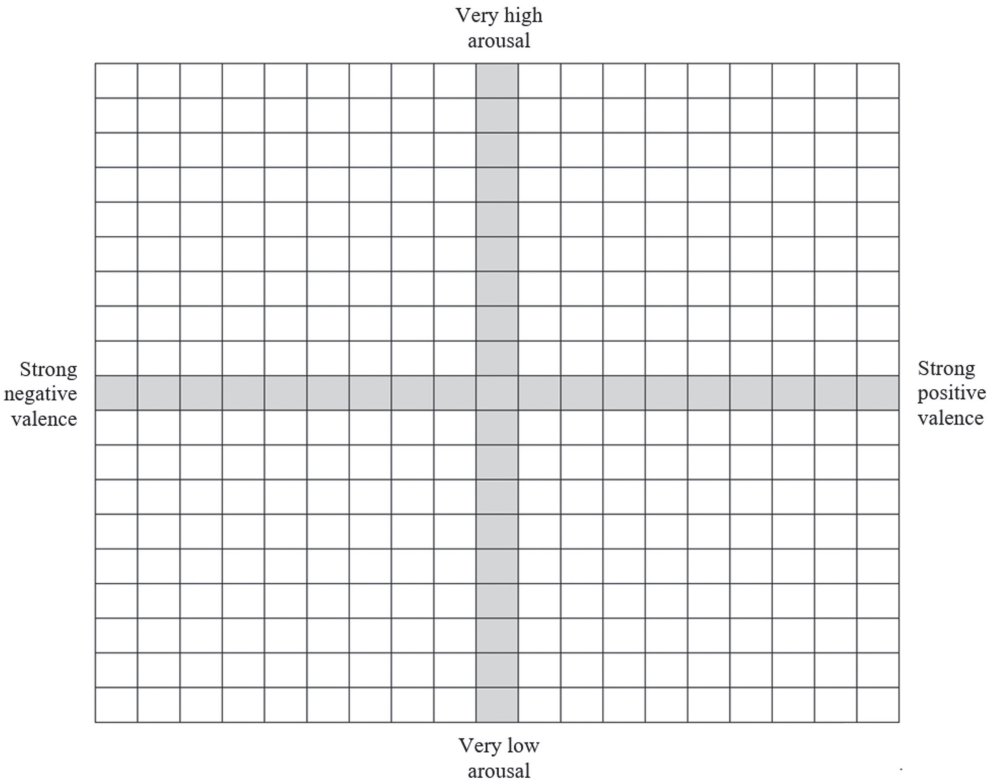

Figure 4.1 Adapted version of the Affect Grid as used in the current study.

Data analysis

SPSS 22.0 (IBM, New York, USA) and R-studio (R version 3.1.0, R Development Core Team, 2010) were used for statistical analyses. The results of this study were considered significant at a level of 0.05, unless stated otherwise.

Product characteristics: liking

For each product and participant group, the mean (±SD) liking scores were calculated. Using a mixed model ANOVA procedure, we checked for each product separately whether the three groups differed in their liking scores. During this procedure, liking was entered as dependent variable and participant group was entered as a fixed factor. The participants' individual data were entered as a random factor. Bonferroni's multiple comparisons indicated the differences in liking scores for a specific product between the three participant groups.

Self-reported food-evoked emotion profiles: the PrEmo2 tool and the Affect Grid

For each method separately, we used a MANCOVA to test whether the participant groups differed with regard to their food-evoked emotion profiles. The PrEmo2 tool emotions and the Affect Grid scores were entered as dependent variables. Product and participant group were entered as fixed variables. As the liking of some products differed between the participant groups, this was entered into the model as a covariate. Furthermore, a multiple factor analysis (MFA, FactoMineR package; Lê, Josse, & Husson, 2008; Pages, 2004) was performed to globally compare the configurations between the three groups for each food product. As a measure of correlation between the product configurations, *Rv*-coefficients were calculated across the three groups.

In addition, we created an MFA individual factor map and an MFA correlation circle for each method separately, to visualise how the groups differed with regard to their food-evoked emotion profiles. These differences were statistically substantiated using mixed model ANOVA procedures, separately for each product. For each product and method separately, the PrEmo tool emotions and the Affect Grid scores were entered as dependent variables. Participant group was entered as a fixed factor. Participants' individual data were entered as random factors. We applied Bonferroni's multiple comparisons to test for differences in emotion scores between the participant groups. The PrEmo2 tool results were visualised in line plots, each showing the mean emotion scores and significant differences between the three groups for one of the products. The Affect Grid results were visualised using bar graphs, each showing the mean valence and arousal scores and significances between the three groups for one of the products.

To assess the effect of age on self-reported food-evoked emotion profiles, the emotion profiles of the younger adults were compared with those of the older normosmic adults. To assess the effect of olfactory function on food-evoked emotion profiles, the emotion profiles of the older normosmic adults were compared with those of the older hyposmic adults.

Results

Product characteristics: liking

The mean liking scores of the products were compared amongst the three participant groups, separately for each product (Table 4.2). Gingerbread regular and wholegrain were similarly liked by the three groups ($F = 2.02$, $df = (2, 203)$, $p > 0.05$ and $F = 0.12$, $df = (2, 203)$, $p > 0.05$, respectively), whereas the ginger flavour variant was better liked by the two older groups than by the younger adults ($F = 31.09$, $df = (2, 203)$, $p < 0.05$). In addition, milk chocolate was better liked by the younger adults than by the two older adult groups (F

= 13.29, df = (2, 203), p <0.05). Dark chocolate was similarly liked by the three groups (F = 1.53, df = (2, 203), p >0.05). Mint chocolate was better liked by the older adults than by the younger adults (F = 5.64, df = (2, 203), p <0.05).

Table 4.2 Mean liking scores (± SD) of the six products, presented per product category for the younger adults, older normosmic adults, and older hyposmic adults.

		Younger adults (n=71)	Older normosmic adults (n=86)	Older hyposmic adults (n=70)
Gingerbread	Regular	6.1 ± 1.7	5.7 ± 1.7	5.6 ± 1.4
	Wholegrain	5.3 ± 1.9	5.4 ± 1.9	5.2 ± 1.5
	Ginger flavour	4.3 ± 2.8[b]	7.4 ± 2.0[a]	6.8 ± 2.1[a]
Chocolate	Milk	7.8 ± 1.3[a]	6.1 ± 2.3[b]	6.7 ± 1.9[b]
	Dark	5.1 ± 2.5	5.2 ± 2.5	5.6 ± 2.3
	Mint	5.6 ± 2.9[b]	6.6 ± 2.2[a]	6.7 ± 1.6[a]

[a,b] Similar letters within one row refer to statistically comparable liking scores of the participant groups for a specific product (p <0.05).

Food-evoked emotion profiles measured using the PrEmo2 tool

The difference in emotion profiles between groups was assessed using a MANCOVA procedure. The multivariate results were significant for the group effect, indicating that the three participant groups differed with regard to their PrEmo2 emotion profiles (Pillai's trace = 0.16, F = 8.48, df = (24, 2414), p <0.05). Also the multivariate results for product, product*group, and the covariate liking were significant (p <0.05). The differences between the groups were further specified by the MFA results. The *Rv*-coefficients showed that the emotion profiles of the younger adults differed most from those of the older groups (*Rv*-coefficient of young adults and older normosmic adults = 0.17; *Rv*-coefficient of young adults and older hyposmic adults = 0.27; *Rv*-coefficient of older normosmic adults and older hyposmic adults = 0.90). The *Rv*-coefficients of the younger adults and the older normosmic/hyposmic adults were both much lower than 1, indicating that the participant groups differed with regard to their emotion configurations.

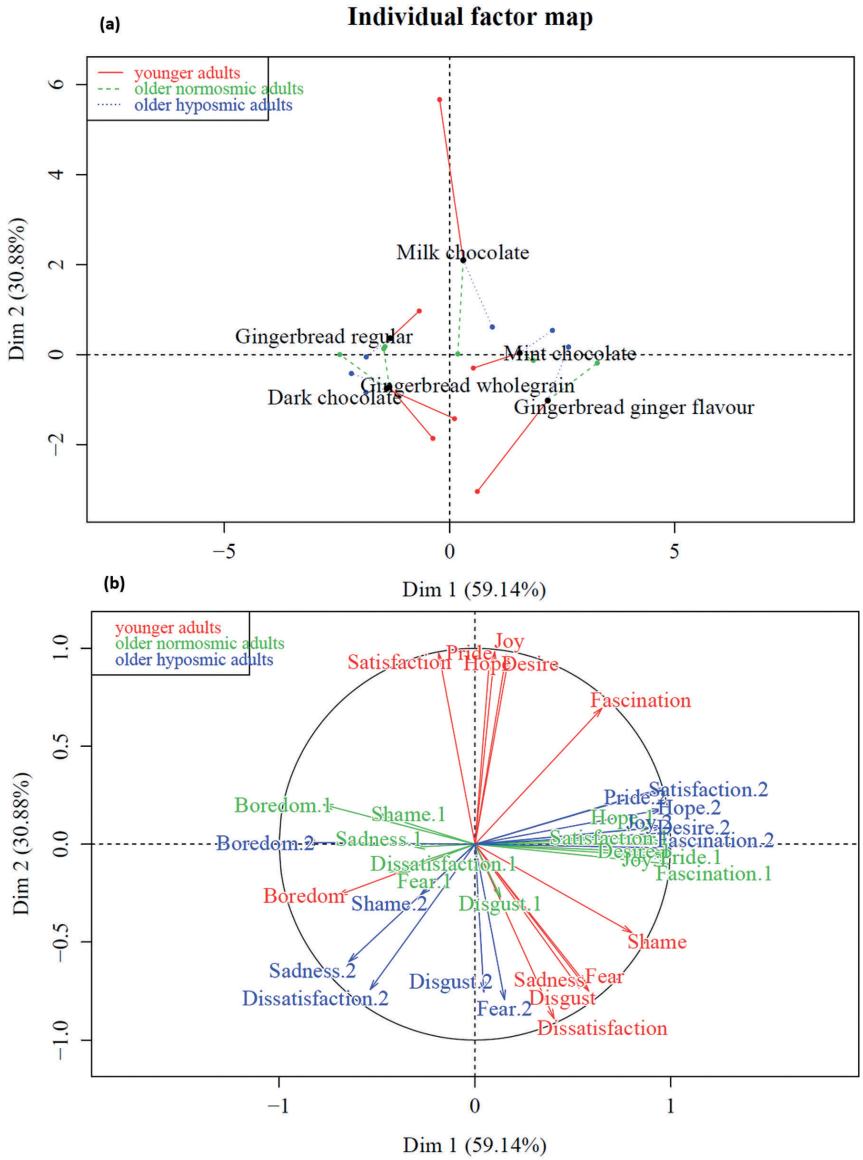

Figure 4.2 Representation of the first two dimensions of the MFA space showing (a) the six products as mean points, the partial individuals representing the emotion configurations of the products of the three participant groups, and representations of the PrEmo2 tool emotion terms in the two-dimensional space (b) for the younger adults, the older normosmic adults, and the older hyposmic adults.

The MFA individual factor map (Figure 4.2a) and correlation circle (Figure 4.2b) of the PrEmo2 tool results indicated how the groups differed in their emotional associations with the products. In Figure 4.2a, the six products are shown in black as mean points and the emotion configurations of the three participant groups are shown in colour (i.e. 'the

partial individuals'). The first two dimensions of the maps account for 90% of the variance (59.1% and 30.9%, respectively). For the younger adults, the two dimensions reflect valence (dimension 2; contributing emotions are for example 'satisfaction' and 'desire') and arousal (dimension 1; contributing emotions are for example 'fascination' and 'boredom'). An imaginary line drawn between the six products revealed that the emotion profiles of the younger adults varied along both the valence and the arousal dimension. Contrastingly, for the older groups, valence and arousal were both reflected by the same dimension; this limits the differentiation of the products along the two dimensions.

Additionally, visual inspection of the MFA correlation circle (Figure 4.2b) indicated specific differences between the participant groups with regard to the type of emotions associated with the six products. Mixed model ANOVA procedures were used to statistically substantiate the differences between the groups (Figures 4.3 and 4.4).

Visual inspection showed that all groups associated mainly positive emotions with gingerbread regular. The older adults linked the emotion 'pride' to gingerbread regular more strongly than the younger adults. The three groups scored the negative emotions with low ratings; i.e. ratings lower than 1. Despite these low scores, there were some differences between the groups. The younger adults scored the regular variant lower on 'shame' than the older normosmic adults. The younger adults scored the regular version lower on 'sadness' and higher on 'boredom' than the older hyposmic adults. Gingerbread wholegrain was associated with mainly positive emotions (e.g. 'desire', 'pride', and 'hope') by the two older groups. The younger adults scored the wholegrain version lower on these positive emotions, but higher on 'dissatisfaction' and 'boredom'. Also, the ginger flavour variant was associated with mainly positive emotions (e.g. 'desire', 'satisfaction' and 'hope') by the older adults. The younger adults more strongly linked this version to negative emotions, such as 'disgust' and 'dissatisfaction'.

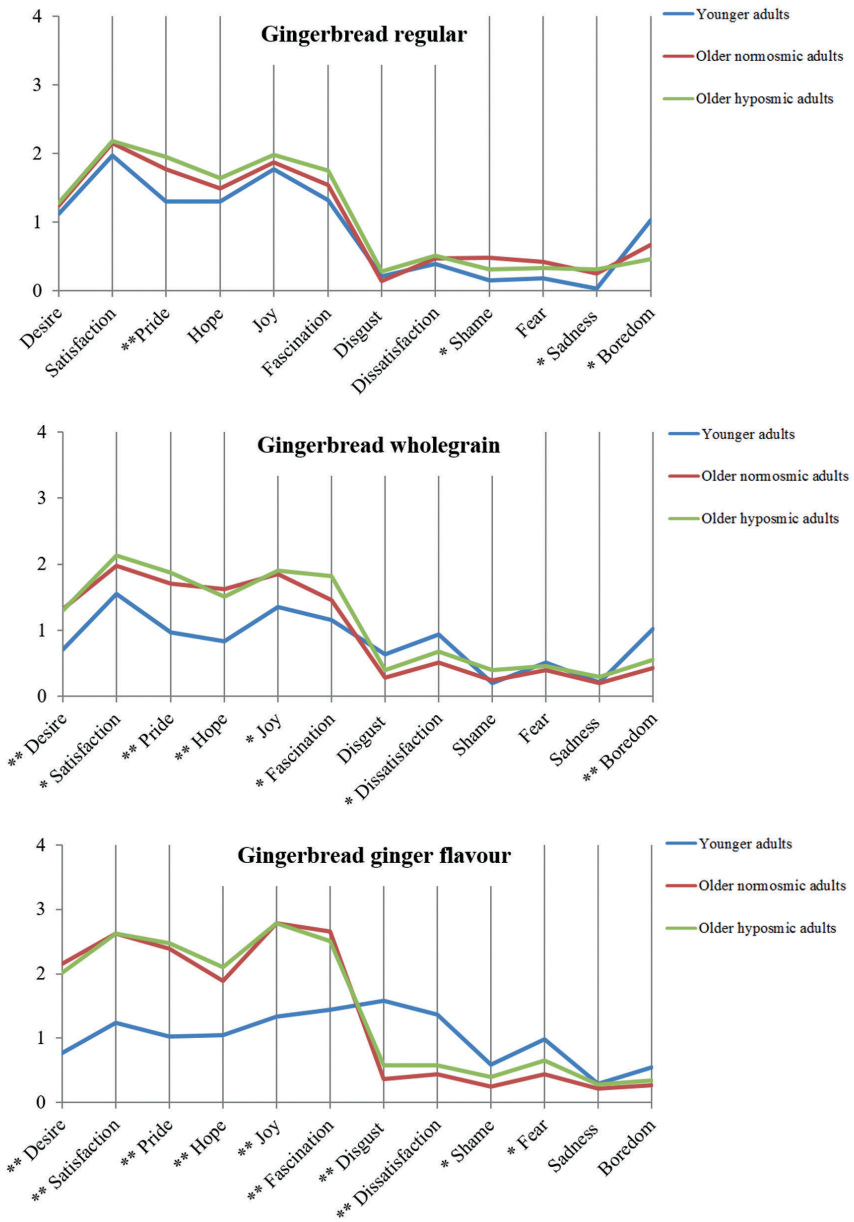

Figure 4.3 Line graphs presenting the mean PrEmo2 tool emotion scores and significant differences between the three participant groups: younger adults, older normosmic adults, and older hyposmic adults. Results are presented separately for the gingerbread regular, gingerbread wholegrain, and gingerbread ginger flavour. Note: * indicates the emotions for which the groups significantly differ at $p < 0.05$, ** indicate the emotions for which the groups significantly differ at $p < 0.004$.

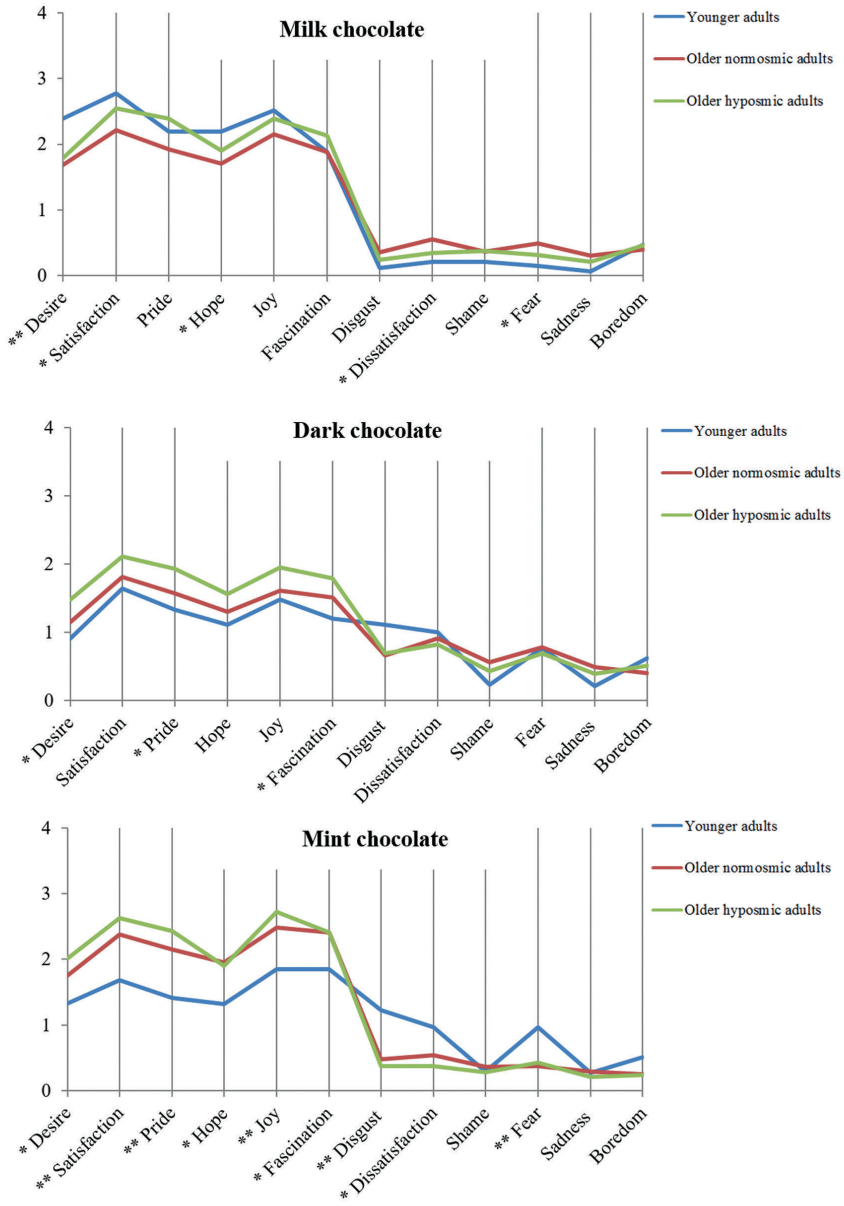

Figure 4.4 Line graphs presenting the mean PrEmo2 tool emotion scores and significant differences between the three participant groups: younger adults, older normosmic adults, and older hyposmic adults. Results are presented separately for the milk chocolate, dark chocolate, and mint chocolate. Note: * indicates the emotions for which the groups significantly differ at $p < 0.05$, ** indicate the emotions for which the groups significantly differ at $p < 0.004$.

With regard to the chocolates, the MFA and the mixed model results indicated differences between the three groups as well. Visual inspection showed that the three groups associated mainly positive emotions with milk chocolate. The younger adults linked the milk variant to the emotion 'desire' more strongly than the two older groups. Compared to the older normosmic adults, the younger adults linked the milk chocolate more strongly to 'satisfaction' and 'hope'. For this product, the three groups scored the negative emotions with low ratings; i.e. ratings lower than 1. Despite these low scores, the older normosmic adults associated this product with 'dissatisfaction' and 'fear' more strongly than their younger counterparts. The dark version was associated most strongly with 'desire', 'pride', and 'fascination' by the older hyposmic adults. Mint chocolate was linked to positive emotions (e.g. 'desire', 'satisfaction', and 'pride') by the older groups, whereas it was linked more strongly to negative emotions by the younger group (e.g. 'fear' and 'disgust').

Food-evoked emotion profiles measured using the Affect Grid

For the Affect Grid data also, a MANCOVA procedure tested whether the three groups differed with regard to their emotion profiles. The multivariate outcomes showed that the participant groups differed significantly (Pillai's trace = 0.015, F = 4.92, df = (4, 2642), $p < 0.05$). Also the multivariate results for product, product*group, and the covariate liking were significant ($p < 0.05$).The MFA results indicated that the emotion configurations of the younger adults differed most from those of the two older groups (*Rv*-coefficient younger adults and older normosmic adults = 0.11, *Rv*-coefficient younger adults and older hyposmic adults = 0.16). The profiles of the older normosmic and hyposmic adults were more alike, having an *Rv*-coefficient of 0.74.

The MFA individual factor map (Figure 4.5a) and correlation circle (Figure 4.5b) of the Affect Grid results indicated how the valence and arousal scores differed between the participant groups. In Figure 4.5a, the six products are shown as mean points, and the emotion configurations of the three groups are shown as partial individuals. The first two dimensions account together for 86% of the variance in the data. The first dimension (54.9%) reflects both valence and arousal for the two older adult groups and arousal for the younger adult group. The second dimension (31.1%) reflects valence for the younger adults group. An imaginary line drawn between the products for the younger adults revealed that their emotion profile varied along the two dimensions valence and arousal. Contrastingly, for the two older groups, valence and arousal were reflected by the same dimension; this limits the differentiation of the products along the two dimensions.

Additionally, visual inspection of the MFA correlation circles (Figure 4.5b) indicated specific differences in emotion associations between the participant groups. Mixed model ANOVA procedures were used to statistically substantiate the differences between the three groups (Figures 4.6 and 4.7). With regard to the gingerbread regular and wholegrain

variant, the groups did not differ in their emotion associations (for either valence or arousal). However, the younger adults scored the ginger flavour variant significantly lower on valence than the two older adult groups. Compared to the older normosmic adults, the younger adults also scored this variant lower on arousal.

In relation to the chocolates, the younger adults scored the milk variant higher on valence than the older normosmic adults. The three groups did not differ in their arousal scores for this product. The three groups also comparably rated dark chocolate on valence, although the dark variant was more arousing for the younger adults than for the older normosmic adults. Mint chocolate was scored higher on valence by the older adult groups, whereas the groups did not differ with regard to their arousal scores for this product.

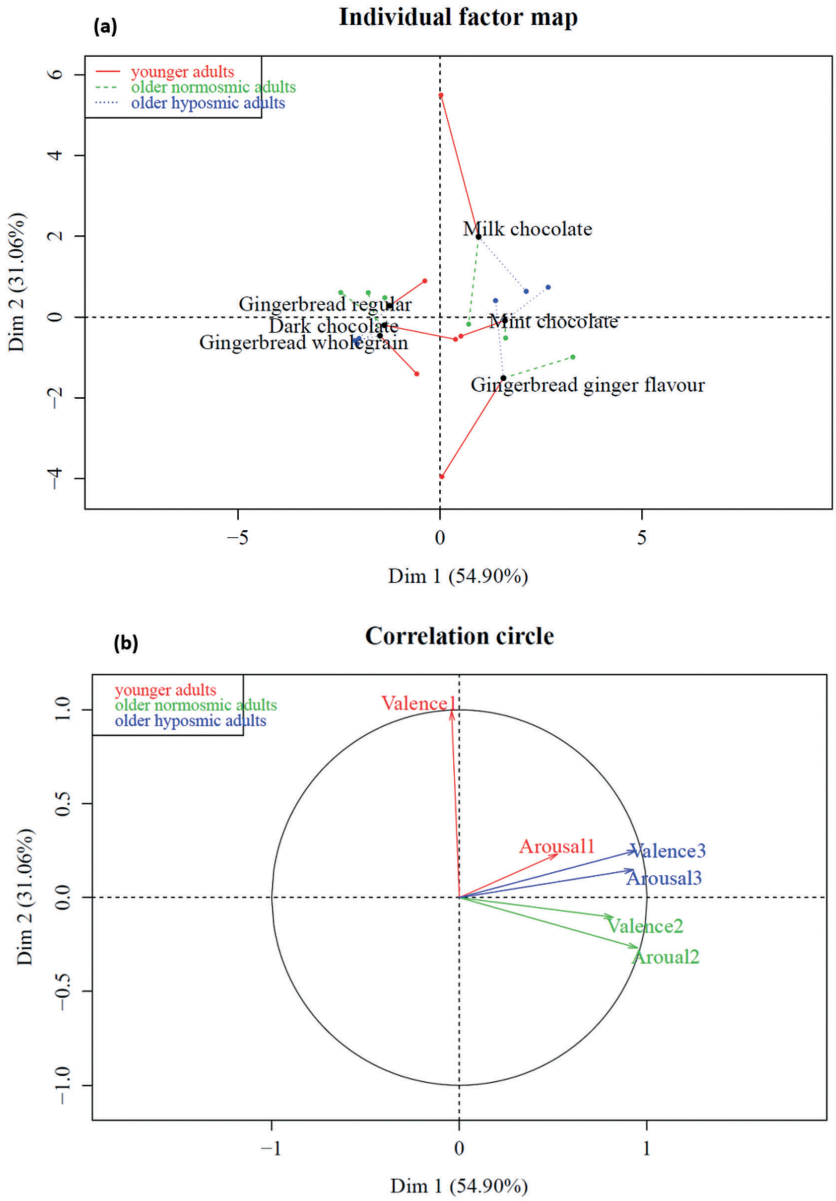

Figure 4.5 Representation of the first two dimensions of the MFA space showing (a) the six products as mean points, the partial individuals representing the emotion configurations of the products of the three participant groups, and representations of the Affect Grid terms in the two-dimensional space (b) for the younger adults, the older normosmic adults, and the older hyposmic adults. Note: Similar letters refer to statistically similar groups (p <0.05).

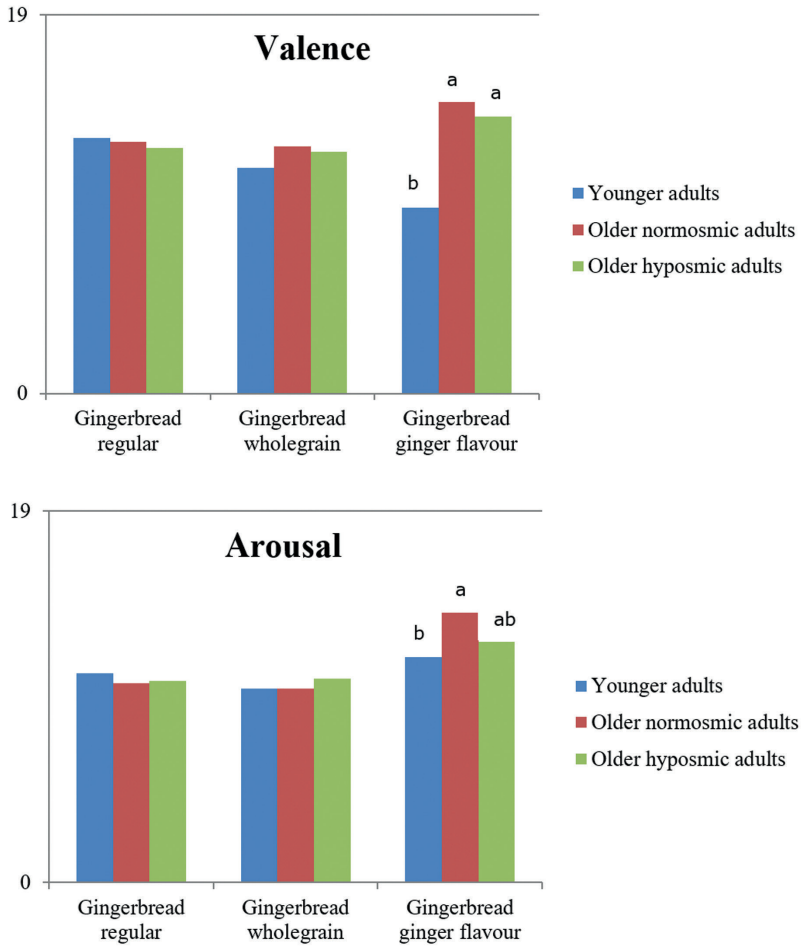

Figure 4.6 Mean valence and arousal scores of the three gingerbreads for younger adults, older normosmic adults, and older hyposmic adults, as measured using the Affect Grid. Significant differences between the groups are indicated per product. Note: Similar letters refer to statistically similar groups (p <0.05).

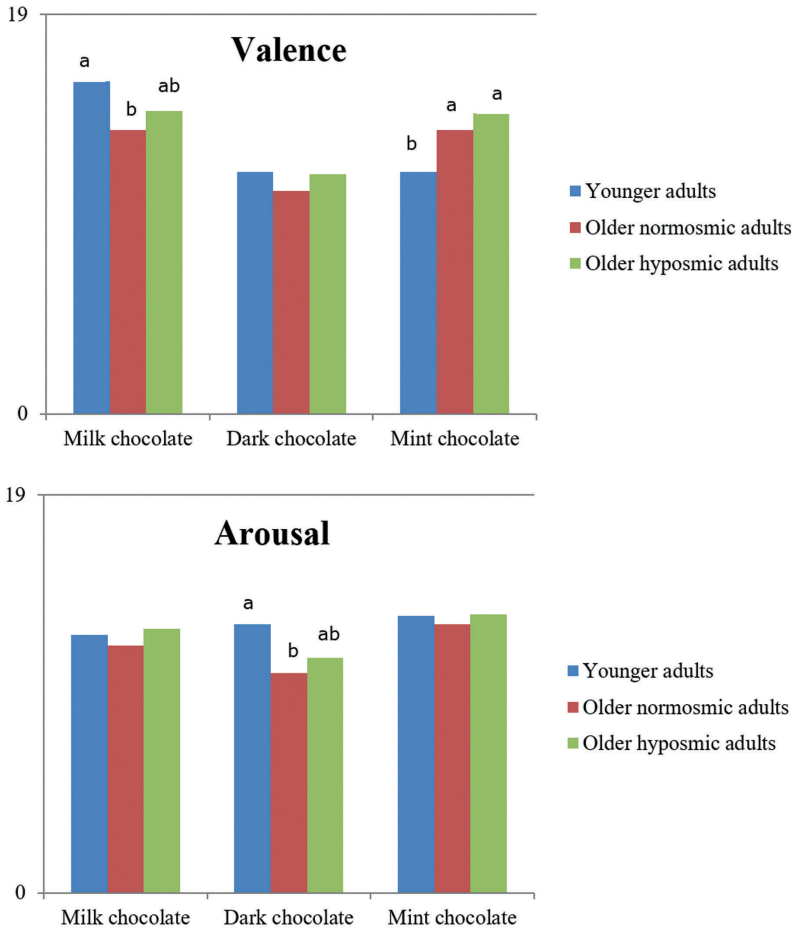

Figure 4.7 Mean valence and arousal scores of the three chocolates for younger adults, older normosmic adults, and older hyposmic adults, as measured using the Affect Grid. Significant differences between the groups are indicated per product. Note: Similar letters refer to statistically similar groups (p <0.05).

Discussion

In line with previous observations, this study shows that younger and older adults report different emotion profiles directly after the consumption of a food. Regardless of the method (i.e. the PrEmo2 tool or the Affect Grid), the self-reported food-evoked emotions of the younger adults varied along the two dimensions valence and arousal, whereas for the older adults this valence/arousal differentiation was less clear. Moreover, the older persons reported generally lower scores on negative emotions than the younger adults. The influence of olfactory function on food-evoked emotions was less pronounced, as the emotion profiles of older normosmic and older hyposmic adults were rather similar. Therefore, age seems an important factor to take into consideration when self-reported food-evoked emotions of specific consumer groups are being measured.

In line with our hypothesis, the emotion profiles of the older adults showed little variation along the orthogonal dimensions valence and arousal. This weaker differentiation on the latter dimensions has been reported before in the food domain, using the EsSense25 tool (den Uijl et al., 2016). In the non-food domain also, comparable results have been reported. Recently, Pearce and Halpern (2015) explored the emotional responses of younger and older adults towards music. They observed that older individuals reported generally lower levels of arousal than their younger counterparts when they were listening to fearful, happy, and tender music. Kuijsters, Redi, de Ruyter, and Heynderickx (2015) showed that an activating ambiance (i.e. a room with blue lighting) was physically more arousing for seniors, whereas no effect could be detected using the self-assessment manikin (SAM) (Bradley & Lang, 1994). Several explanations for this difference in self-reporting of emotional arousal between the age groups come to mind. One could for example speculate that, as people grow older, they maybe value foods and mealtimes differently than they did in younger years. The central role that is often encountered for food can diminish in older adults' lives, whereas other themes, such as independence and self-control, might become more dominant in seniors' perception (Harrefors, Sävenstedt, & Axelsson, 2009). Hence, these other themes might be more likely to evoke emotional arousal in the older population. Furthermore, it could be that the current observations are a result of a certain cohort effect (Windsor, Burns, & Byles, 2012). Some of our participants grew up during and/or directly after World War II, and this may have influenced their current view on food (e.g. no 'fussing' about food). The question remains as to whether our findings apply mainly to the current participants, or whether they can also be observed in younger participants as they age. Such a longitudinal approach – although challenging to execute in terms of for example compliance – might further our understanding of age and its impact on self-reported food-evoked emotions.

In contrast, the emotions of younger adults could be additionally differentiated on the valence and arousal dimensions, with both the PrEmo2 tool and the Affect Grid. These results seem to have some parallel with existing literature. For example, Reimann, Castaño,

Zaichkowsky, and Bechara (2012) reported that younger adults differentiated names of consumer brands on the valence/arousal dimension when using the Affect Grid. In addition, Ng, Chaya, and Hort (2013) measured self-reported food-evoked emotion responses in younger adults, using a consumer-defined lexicon. They reported that their participants' emotions varied along the two dimensions pleasantness and activation. Later, Einöther et al. (2015) showed that younger adults successfully applied the Affect Grid to differentiate beverages. Their valence ratings increased when they were consuming a tea and an arousing control drink. Their arousal ratings remained stable after consuming the tea, but they increased after consuming the arousing control drink. As this dimensional differentiation has been reported for various settings and product categories, it seems to be a feature of self-reported food-evoked emotion profiles of younger adults.

The older adults' self-reported emotions were not only mainly valence-driven, but also biased towards the positive side of the valence dimension; i.e. the older adults scored particularly low on negative emotions, such as 'disgust' and 'fear'. These results are in line with our previous observations (den Uijl et al., 2016). Earlier studies also extensively described this so-called positivity bias for other psychological processes, such as emotional perception, expression, and memory (Carstensen et al., 2011; Chipperfield, Perry, & Weiner, 2003; English & Carstensen, 2014; Montepare & Dobish, 2013; Mroczek & Kolarz, 1998). It could therefore be that this age-related positive orientation not only exists for general psychological processes, but also extends to the rating of food-evoked emotions, or even to the emotional experience of food products.

Surprisingly, the older participants' olfactory function did not clearly impact on their food-evoked emotion profiles. That is, the emotions as reported by the older normosmic adults did not differ from those of the older hyposmic adults. These results are in contrast to our previous findings that normosmic and hyposmic seniors differ in their food-evoked emotion profiles for specific products, as assessed using the EsSense25 (den Uijl et al., 2016). This absent olfactory effect could be related to the method selection. In den Uijl et al.'s (2016) study, the EsSense25 was applied, consisting of 25 emotion terms. The currently applied methods included fewer terms (i.e. 12 for the PrEmo2 tool and 2 for the Affect grid), and therefore might not have been sensitive enough to pick up slight product-specific differences, if any. Alternatively, it is possible that the (hyposmic) seniors evaluated the products using their recalled emotional experiences/emotional conceptual associations with the products, rather than their actual food-evoked emotional consequences (Köster & Mojet, 2015; Thomson et al., 2010). These recalled emotions may be independent of their current olfactory status and are therefore potentially comparable to those of their normosmic counterparts. Future research, focusing on the relative importance of actual and recalled food-evoked emotions in normosmic and hyposmic persons seems warranted to better understand the interplay between olfactory function and self-reported food-evoked emotion responses.

Next to the differences in food-evoked emotional associations between the three participant groups, we observed some differences in the hedonic appraisal of test products. For example, the older adults liked mint chocolate and gingerbread ginger flavour, whereas the younger adults reported lower liking scores for these products. These differences in liking can potentially confound the reported food-evoked emotions; i.e. better liked products are most likely associated with more positive emotions (Gutjar et al., 2014). In the current study we therefore included liking as a covariate. Along the same lines, consumption frequency of the tested flavour variants could be regarded as a potential confounder as well. We recruited regular consumers of the product categories chocolate and gingerbread, rather than consumers of the tested flavour variants (e.g. mint chocolate). A higher consumption frequency of a specific product could either (1) result in more positive associations due to a mere exposure effect (Bornstein, 1989; Zajonc, 1968), or (2) in itself be the result of positive associations connected to the product (de Graaf et al., 2005). Although it seems relevant to consider this confounding factor for future research, it may also be a practical challenge to distinguish consumption frequency between age groups, due to – for example – recall bias or product variation over time.

From a methodological point of view, both the PrEmo2 tool and the Affect Grid have their strengths and limitations that are worth discussing. The PrEmo2 tool has the advantage of being a non-verbal tool that can be easily applied cross-culturally (Laurans & Desmet, 2012), whereas the short length of the Affect Grid may be advantageous in other circumstances. Despite the fact that these characteristics make the two methods more intuitive, participants are still expected to be consciously aware of their emotional experience (Köster & Mojet, 2015). Köster & Mojet would advocate the use of implicit emotion measuring methods, such as physiological measurements (skin conductance response, skin temperature, heart rate, and so on) or reaction time measurements (e.g. implicit association tasks, lexical decision tasks) (de Wijk, Kooijman, Verhoeven, Holthuysen, & de Graaf, 2012; Greenwald, McGhee, & Schwartz, 1998; Liao, Corsi, Chrysochou, & Lockshin, 2015; Meyer & Schvaneveldt, 1971). However, it seems that age-related factors (e.g. physiological changes and medication) make it difficult to measure for example seniors' autonomic nervous system responses or reaction times (Debey, de Schryver, Logan, Suchotzki, & Verschuere, 2015; Kunzmann, Kuperbusch, & Levenson, 2005; Levenson, Carstensen, Friesen, & Ekman, 1991; Neiss, Leigland, Carlson, & Janowsky, 2009; Tsai, Levenson, & Carstensen, 2000). Therefore, it seems too preliminary to label an implicit emotion measuring method as suitable or unsuitable for measuring food-evoked emotions in older consumers.

In conclusion, the current results show that – regardless of the method – younger and older adults differ in various ways in their self-reported food-evoked emotion responses. These differences seem to relate mainly to the age of the participant and, to a far lesser extent, to their olfactory status. These insights add to our current understanding of

seniors' product-specific emotional experiences and hence can support the development of tailored food products for this expanding consumer group.

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Chapter 5

Cosy or nutritious proteins?

Exploring mealtime functionality of vital community-dwelling older adults through consumer segmentation and a means-end chain approach

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Abstract

Senior consumers are a rapidly growing and highly heterogeneous part of the world's population. This group does not always meet its recommended protein intake, which can negatively impact on their physical functioning and quality of life. To date, little is known about their motivations to consume protein-rich meals. In the current study, we therefore aim to identify consumer segments within the group of vital community-dwelling older adults on the basis of mealtime functionality (for example 'I eat because I'm hungry', or 'I eat because it is cosy'). To this end, we first conducted an online survey to identify these functional mealtime expectations of older consumers (study I, n=398, 158 males, mean age 65.8 (y) ± 5.9 (SD)). To obtain further insights regarding mealtime functionality and proteins/protein enrichment, laddering interviews were conducted with a subgroup of the segmentation study participants (study II, n=40, 20 males, mean age 66.9 (y) ± 4.8 (SD)). The results of the online survey showed three consumer clusters: *cosy socialisers, physical nutritioners,* and *thoughtless averages*. *Thoughtless averages* do not distinguish themselves clearly from the other clusters and they report having no explicit associations with their mealtimes. Both the segmentation and the in-depth interviews showed that, for the *cosy socialisers*, the cosiness and social function of a meal are important motivators, whereas for the *physical nutritioners* the focus is more on the health and nutrient aspects of a meal. For *cosy socialisers*, protein enrichment can best be achieved through addition of protein-rich ingredients, whereas, for *physical nutritioners*, addition of protein powder is preferred. These results provide practical guidelines for the development of protein-rich meals and communication strategies tailored to the needs of specific vital community-dwelling older subgroups.

Introduction

The older generation is a rapidly growing and highly heterogeneous part of the world's population (RIVM, 2013; United Nations, 2002). Interestingly, this heterogenetic nature of the senior consumer group has so far received little attention from product development and marketing (Moschis, 2003; Reisenwitz & Iyer, 2007), and consequently the currently available food products do not always match the needs and wants of these older adults (Moschis, 2003; Reisenwitz & Iyer, 2007). Long and divergent experiences and memories of eating occasions can result in various age-related shifts in the meaning and expectations of mealtimes (Niemelä-Nyrhinen, 2007; Simcock & Sudbury, 2006). Hence, it is essential to tailor healthy and tasty meals to subgroups of senior consumers to better meet their requirements (van der Zanden, van Kleef, de Wijk, & van Trijp, 2014).

So far, various approaches to segmenting older consumers have been adopted. Early segmentation attempts focused on chronological age (i.e. young old, mature old, and old old; McCann, 1974) but insufficiently explained differences in consumer behaviour. Later, socio-demographic factors, psychographics (e.g. values, attitudes, personality traits), and gerontographics (e.g. life changing events/experiences) were introduced (Leventhal, 1991; Morgan, 1993; Moschis, 2003; Reisenwitz & Iyer, 2007). Recently, we proposed a segmentation model based on mealtime experiences (den Uijl, Jager, de Graaf, Waddell, & Kremer, 2014), thereby assuming that psychographics and gerontographics are not specific enough to provide mealtime-related consumer insights. We took into account the increased importance of emotions and heuristics during psychological processes in older persons (Fung & Carstensen, 2003; Perry & Wolburg, 2011) and clustered the older persons on the basis of the emotions that they associate with mealtimes. We identified four senior consumer clusters, *pleasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*. Building on Russell, Weiss, and Mendelsohn's (1989) dimensional framework, we found that the valence (positive-negative appraisal) and level of arousal (low-high activation) of the mealtime-associated emotions differed between the four clusters.

At first sight, these emotion-based senior consumer segments could serve as a starting point for meal tailoring. For example, one could develop an evening meal that appeals to *adventurous arousals* by incorporating elements (e.g. spices, colours) that evoke feelings of emotional arousal (Lindstrom, 2005; Thomson, Crocker, & Marketo, 2010). However, in contrast to mealtime-evoked emotions, the emotions reported after actual consumption (i.e. food-evoked emotions) did not vary clearly along the two dimensions, valence and arousal (den Uijl, Jager, de Graaf, Meiselman, & Kremer, 2016; den Uijl, Jager, Zandstra, de Graaf, & Kremer, 2016). Food-evoked emotions varied mainly along the valence dimension, and less clearly along the arousal dimension. Therefore, it seems challenging, if not impossible, to tailor food products to the expectations of the previously described valence/arousal-based emotion segments.

Alternatively, mealtime functionality (i.e. functional mealtime expectations, such as: 'I eat to combat hunger', 'I eat because it is cosy') might serve as an actionable basis for older consumer segmentation. Thomson et al. (2010) emphasised the relevance of such cognitive associations (e.g. 'will make me happy', 'will refresh me', and 'will annoy me') to better understand consumer behaviour. They proposed that consumers react not only to the product itself, but also to the associations connected to it. Köster (2003) stressed that eating situation and eating context strongly impact on food perception, and that therefore situation-oriented research might aid in elucidating food choice behaviour. Recently, Sorensen, Holm, Frøst, and Kondrup (2012) described a frail senior population based on their mealtime functionality in a model of 'food sensory quality to promote intake in patients at nutritional risk' (Figure 5.1). Seniors' motivation to eat, or lack thereof, was described in terms of 'pleasure', 'comfort', or 'survival'. According to the model, seniors who are motivated by 'pleasure' have fewest eating symptoms and focus mainly on the intrinsic characteristics of a meal, such as appearance, taste, and variety. 'Comfort'-oriented seniors focus more on the practical aspects of food, such as level of familiarity, thirst-quenching properties, and satiating properties. In contrast, seniors with a 'survival' eating motivation are confronted with most eating problems, and hence seek for ease and convenience in their meals. Interestingly, to date such mealtime functionalities have not yet been explored in subgroups of vital-community dwelling seniors, although they might provide hands-on insights for product development and marketing of meals.

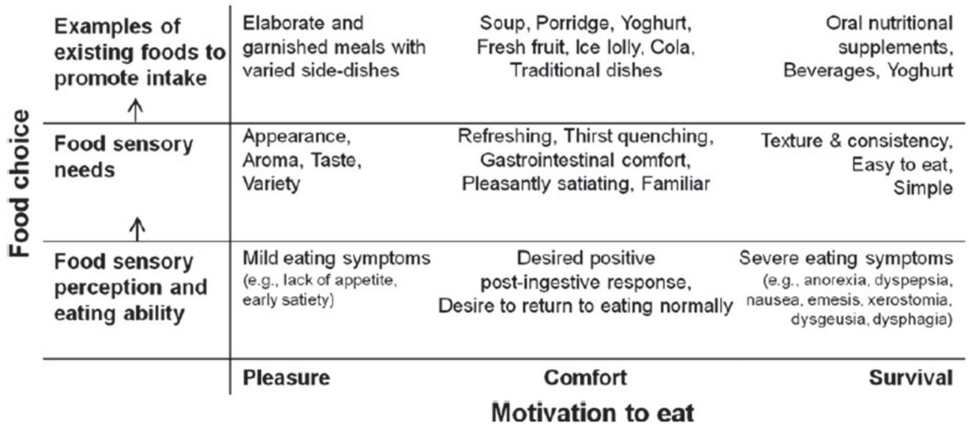

Figure 5.1 "Model of food sensory quality to promote intake in patients at nutritional risk. The process of choosing foods (y-axis) within the context of motivation to eat (x-axis) is shown. Food sensory perception and eating ability profiles correspond to specific food sensory needs (i.e., appearance, aroma, taste, texture, temperature and variety of the food), which coincides with examples of existing foods with sensory qualities to promote intake." (Sorensen et al., 2012, p. 644).

Furthermore, proteins require special attention when tailored meals are being developed for seniors, as this group does not always meet its protein requirement (Bauer et al., 2013; Bauer & Diekmann, 2015; Tieland, Borgonjen-van den Berg, van Loon, & de Groot, 2012). Inadequate protein intake can lead to loss of lean body mass (e.g. muscle mass) and therefore can impact on physical functioning and quality of life (Bauer et al., 2013; Wolfe, Miller, & Miller, 2008). Given the heterogenic nature of the older population, it seems relevant to better understand specific senior subgroups' attitudes towards protein-rich products and meals.

In the current study, we therefore conducted two studies to explore mealtime functionality in vital community-dwelling older consumers. First, we identified consumer segments on the basis of the functionality that they assign to their mealtimes (study I). Subsequently, we interviewed a subgroup of the participants to zoom in on the personally relevant evening meal functionalities and attitudes towards proteins/protein enrichment (study II). We compared the functional segment's characteristics with the in-depth insights from the interviews to better understand seniors' explicit motivations to consume a protein-rich meal.

Materials and Methods

Study I: Segments based on mealtime functionality

Participants

Three hundred and ninety-two older participants (158 males, mean age 65.8 (y) ± 5.9 (SD)) completed an online survey. Some data for these participants, focusing on mealtime-evoked emotions, have been published before (den Uijl et al., 2014). Table 5.1 provides the participants' characteristics. The participants were all member of the SenTo panel (Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future). The SenTo panel is a consumer panel, initiated by Wageningen UR, of around 800 healthy community-dwelling Dutch older persons. The membership criteria for the SenTo panel are: being at least 55 years old, being able to go out independently (for example for grocery shopping), being capable of working online with a computer, and being fluent in Dutch. The social ethical committee of Wageningen UR approved study I.

Table 5.1 Demographic characteristics of study I and study II participants.

Factor	Level	% of sample Segmentation study (study I)	% of sample Means-end chain study (study II)
Sex	Male	50	40
	Female	50	60
Age	55–65 y	42	46
	66–75 y	52	47
	76–85 y	5	7
Marital status	Single	10	9
	Married/living together	85	81
	Divorced	3	5
	Widowed	3	5
Living arrangements	Living independently alone	15	24
	Living independently together	85	74
	Assisted living	0	2

Procedure and questionnaire

For the current segmentation study, we re-analysed the mealtime functionality data from our previous online survey (den Uijl et al., 2014). The latter study consisted of three questionnaires, of which one focused on mealtime functionality. These questionnaires included a total of 243 questions; all scored on 9-point Likert scales. The first questionnaire explored 15 EsSense Profile® emotions (King & Meiselman, 2010) for seven mealtimes: breakfast, morning snack, lunch, afternoon snack, dinner, dessert, and evening snack. The second questionnaire focused on mealtime functionality. The participants rated 13 functionality constructs (hunger, habit, liking, cosiness, pleasure, energising, rewarding, healthiness, pleasing, calming, physical needs, thoughtless eating, and environmental awareness) on 9-point Likert scales for the seven mealtimes. The third questionnaire covered the personal characteristics of the participants, including their health and taste attitudes (Roininen, Lahteenmaki, & Tuorila, 1999; Roininen et al., 2001), level of food neophobia (Pliner & Hobden, 1992), and level of food fussiness (Wardle, Guthrie, Sanderson, & Rapoport, 2001).

Data analysis

The data were analysed using IBM SPSS Statistics 19 and Architect (R version 3.1.0, R Development Core Team, 2010).

The data from the functionality questionnaires were analysed following the procedures as described by den Uijl et al. (2014). The data were double scaled: by variable and by subject, and principle components were constructed using the NIPALS method from the pcaMethods R package. The segments of the older persons were described on the basis of the scores of 13 functionalities for seven mealtimes. To this end, we used the

PCA projections to create an *nxn* Euclidian distance matrix, where n is the number of participants in the study. Subsequently, we used the distance matrix and the hclust() function to create a hierarchical complete linkage clustering. This hierarchical cluster structure was visualised in a dendrogram. The number of clusters to use was decided on the basis of visual inspection of the dendrogram, thereby obtaining clusters of at least 100 participants (Dolnicar, 2003).

For the cluster characterisation, the average mealtime and snack time functionality scores were calculated. An average mealtime functionality score represents the mean of the breakfast, lunch, and dinner functionality scores. An average snack time functionality score represents the mean of the morning snack, afternoon snack, evening snack, and dessert functionality scores. Using ANOVA and Tukey Post Hoc tests ($\alpha = 0.05$), these average mealtime and snack time functionality scores were used to characterise the clusters. After that, the clusters were profiled using ANOVA, Tukey Post Hoc tests, chi-square tests, Fisher's exact tests, and standardised residual analysis (using a cut-off point of ± 1.96). Variables that had not been entered in the initial cluster analysis were included (e.g. mealtime-evoked emotions, emotion segments as in den Uijl et al. (2014), health and taste attitudes, food neophobia, and demographic variables).

Study II: Zooming in on the personally relevant factors regarding evening meals and proteins

Participants

We selected a subgroup of forty persons (20 males, mean age 66.9 (y) ± 4.8 (SD)) from the segmentation study participants (study I): 20 *cosy socialisers* and 20 *physical nutritioners*. Table 5.1 provides the participants' characteristics. The participants were selected only when they reported cooking at least two to three times per week and eating their warm meal in the evening. We decided not to include the *thoughtless averages* in study II, since in study I this group did not differentiate themselves clearly from the other clusters by their average mealtime functionality scores. Moreover, this group reported eating without explicit thoughts or associations, making it challenging to obtain further insights regarding their mealtime functionality through laddering interviews. The social ethical committee of Wageningen UR approved study II.

Method background: MEC method and laddering interview technique

To zoom in on the personally relevant factors regarding evening meals, proteins, and protein enrichment, we applied the means-end chain method (MEC: Gutman, 1982). This method helps to elucidate the link between consumer knowledge and consumer behaviour (Barrena & Sánchez, 2009; Flight, Russell, Blossfeld, & Cox, 2003; Ha & Jang, 2013; Reynolds & Olson, 2001). One assumes that the products (or in the current study:

meals) evaluated by this method are not consumed for the products' sake (the product factors, or in MEC terms: attributes), but rather for the personal benefits associated with them (the person factors, or in MEC terms: consequences and values). When MEC is being applied, the following constructs are often encountered: (1) concrete attributes, e.g. taste, brand, appearance; (2) abstract attributes, e.g. tasty, easy to prepare; (3) functional consequences, e.g. more energy, weight management; (4) psychosocial consequences, e.g. satisfaction; and (5) values, e.g. independence. The relationships between the attributes, consequences, and values can be obtained using laddering interviews. The attributes of interest are defined prior to each laddering interview and serve as a starting point for a number of 'why-probes'. The participants are thereby encouraged to elaborate on the personally relevant consequences and values. The results as obtained by the MEC method are presented in a schematic overview map, called a hierarchical value map (HVM). This HVM shows on group level how the product factors are connected to the person factors, thereby providing actionable consumer insights.

Procedure for laddering interviews

A trained researcher interviewed the participants for approximately 45 minutes, using a structured soft-laddering interview guide (Costa, Dekker, & Jongen, 2004; Saaka, Sidon, & Blake, 2004). The interviews were conducted double blind (i.e. both the interviewer and interviewee were unaware of the participants' cluster membership). At the start of the interview, the interviewer and participant introduced themselves, and the interviewer introduced the topic, thereby creating a pleasant interview atmosphere. Subsequently, the participants were visually exposed to a self-taken picture of a regular evening meal. Taking the picture as a starting point, the interviewer probed soft-laddering questions on their regular evening meals. The following topics were covered: (1) important associations with evening meals, (2) regularly consumed dishes, (3) location, (4) social company, (5) regularly consumed drinks, (6) table setting, (7) success factors, (8) evening meal satisfaction, (9) convenience products, and (10) drivers for consuming an evening meal. Directly after these questions, the interview continued with laddering questions about proteins and protein enrichment, focusing on: (1) associations with proteins, (2) attitudes towards eating more proteins, (3) preferences for protein enrichment, i.e. adding protein powder or consuming more products that are naturally rich in protein. The interviews were recorded using a voice recorder, and topic-related issues were transcribed afterwards.

Data analysis

The soft-laddering data were analysed using LadderUX software™ (Vanden Abeele, Hauters, & Zaman, 2012), following the procedures described by den Uijl et al. (2015). Each interview was translated into ladders that represented attributes, consequences, and values. Overlapping constructs were summarised, and a content code was assigned

to each summary term. Two summary content code tables were made, one for the *cosy socialisers* and one for the *physical nutritioners*. After that, an implication matrix was composed for each group. An implication matrix quantifies on group level the links between the attributes, consequences, and values, and serves as a blueprint for the HVM. In the current study, two HVMs were constructed: one for *cosy socialisers* and one for *physical nutritioners*.

The HVMs were constructed using different cut-off values (i.e. the minimum frequency with which a construct needs to be mentioned in order to be included in the HVM) for each level of abstraction. As recommended by Costa et al. (2004), Saaka et al. (2004), and Vanden Abeele et al. (2012), the following cut-off values were applied: 5 for attributes, 4 for consequences, and 3 for values.

In addition, we scored the self-taken pictures of the regular evening meals on presence of the following eight predefined characteristics: a table cloth, candles, table mats, pots, serving dishes, a glass of wine/beer, a glass of water, and flowers as decoration. We computed a contingency table and compared the two clusters on each of the characteristics using chi-square tests.

Results

Study I: Segments based on mealtime functionality

The vital community-dwelling seniors were divided in three clusters based on mealtime functionality: *cosy socialisers, physical nutritioners,* and *thoughtless averages*. In the following sections, the features of these segments are described. Tables 5.2 and 5.3 give an overview of the segment characteristics.

Segment 1: Cosy socialisers (n=110)

Cosy socialisers consume their meals because they consider it to be a cosy/sociable occasion. They also report that they eat because they like it and because they consider it to be a pleasure.

These persons associate mainly positive emotions with their meals ('pleasant', 'pleased', 'good', 'satisfied', 'whole', and 'happy'). The vast majority of this group (91%) also belong to den Uijl et al.'s (2014) positive emotion segments: pleasurable averages (53% of the *cosy socialisers*), adventurous arousals (23% of the *cosy socialisers*), and convivial indulgers (15% of the *cosy socialisers*). Only a few *cosy socialisers* (9%) belong to den Uijl et al.'s (2014) negative emotion segment: indifferent restrictives.

Cosy socialisers report food neophobia and food fussiness scores similar to those of *physical nutritioners. Cosy socialisers* are less neophobic and less fussy regarding food than *thoughtless averages*. Their health and taste attitudes did not distinguish them clearly from the two other clusters.

Cosy socialisers are on average 66.4 years old ± 5.4 (SD), and 43% of this group are male. Compared to the other clusters, the number of persons living alone is lower (standardised residual -2.2). They report an excellent quality of life more frequently than the other clusters (standardised residual +2.2). Also, persons from this group have fewer dental problems compared to the others (standardised residual -2.0).

Segment 2: Physical nutritioners (n=153)

For *physical nutritioners*, a meal is an occasion to combat hunger and to get energy. They eat because it is healthy, because it is pleasing, and because they experience a physical need to eat. In addition, they eat because they like it and because it is a pleasure.

Just like *cosy socialisers*, *physical nutritioners* associate mainly positive emotions with their mealtimes (e.g. 'pleasant', 'good', and 'satisfied'). Most of them (96%) belong to den Uijl et al.'s (2014) positive emotion segments: pleasurable averages (56% of the *physical nutritioners*), adventurous arousals (21% of the *physical nutritioners*), and convivial indulgers (19% of the *physical nutritioners,* standardised residual 1.9). Only a few *physical nutritioners* (4%) belong to den Uijl et al.'s (2014) negative emotion segment: indifferent restrictives (standardised residual -2.3).

Physical nutritioners report comparable food neophobia scores as *cosy socialisers* and *thoughtless averages*. Their food fussiness scores are comparable to those of the *cosy socialisers*. Their health and taste attitudes did not distinguish them clearly from the two other clusters.

Physical nutritioners are on average 64.9 years old ± 5.9 (SD), and 33% of this group's participants are male. The number of *physical nutritioners* who do not consider 'health' important is low (standardised residual -1.9). In addition, they often need the help of someone else to do domestic work (standardised residual +2.3) and often report an average quality of life (standardised residual +2.7).

Segment 3: Thoughtless averages (n=129)

Thoughtless averages score averagely on most mealtime functionalities (such as hunger, energising, cosiness, and so forth). Although the average scores of the functionalities 'thoughtless eating' and 'rewarding' are generally low, this cluster reports higher scores than the others. These seniors seem to eat without having explicit thoughts about it. Compared to *cosy socialisers*, they report higher scores for environmental awareness.

Table 5.2 Mean functionality scores for main meals and snack times of *cosy socialisers, physical nutritioners,* and *thoughtless averages.*

	Functionality	*Cosy socialisers* (n=110)	*Physical nutritioners* (n=153)	*Thoughtless averages* (n=129)
Main meals	Hunger	5.5[b]	6.9[a]	5.5[b]
	Habit	5.0	5.4	5.4
	Liking	7.5[a]	7.5[a]	6.1[b]
	Cosiness	6.6[a]	5.1[b]	5.0[b]
	Pleasure	7.3[a]	7.1[a]	5.7[b]
	Energising	5.8[b]	7.7[a]	5.8[b]
	Rewarding	2.3[b]	1.9[b]	3.2[a]
	Healthiness	7.1[b]	8.0[a]	6.1[c]
	Pleasing	5.9[b]	6.9[a]	5.5[b]
	Calming	3.8	3.4	4.2
	Physical needs	6.8[b]	8.1[a]	6.2[c]
	Thoughtless eating	2.3[b]	2.2[b]	3.7[a]
	Environmental awareness	2.3[b]	3.0[ab]	3.2[a]
Snack times	Hunger	3.3[b]	5.0[a]	4.5[a]
	Habit	3.3	4.2	4.9
	Liking	7.4[a]	7.4[a]	6.1[b]
	Cosiness	6.1[a]	4.7[b]	5.1[ab]
	Pleasure	7.1[a]	7.2[a]	5.9[b]
	Energising	3.4[b]	5.2[a]	4.5[a]
	Rewarding	2.8[ab]	2.5[b]	3.2[a]
	Healthiness	3.6[b]	5.2[a]	4.3[b]
	Pleasing	4.3[b]	5.4[a]	4.9[ab]
	Calming	3.0	3.0	3.8
	Physical needs	3.0[b]	5.1[a]	4.3[a]
	Thoughtless eating	2.5[b]	2.1[b]	3.7[a]
	Environmental awareness	1.6[b]	2.4[a]	2.7[a]

Note: The main meal scores reflect the average scores for breakfast, lunch, and dinner. The snack time scores reflect the average scores for snack times and dessert. Similar letters refer to statistically similar terms (α=0.05).

Table 5.3 Means for emotion scores, health and taste attitudes, food neophobia, and food fussiness of *cosy socialisers, physical nutritioners,* and *thoughtless averages.*

Questionnaire	Item	*Cosy socialisers* (n=110)	*Physical nutritioners* (n=153)	*Thoughtless averages* (n=129)
Person characteristics	Mean general health interest	6.6^{ab}	6.8^{a}	6.3^{b}
	Mean pleasure	6.5^{a}	6.7^{a}	6.0^{b}
	Mean interest in natural products	5.6	5.4	5.4
	Mean interest in light products	3.6^{b}	4.1^{a}	4.3^{a}
	Mean food as a reward	3.8	3.8	4.2
	Mean craving for sweet foods	4.5	4.3	4.6
	SUM Food neophobia	34.8^{b}	36.4^{ab}	39.3^{a}
	SUM Food fussiness	16.8^{b}	16.7^{b}	20.0^{a}
Emotions (main meals)	Pleasant	6.7^{a}	6.8^{a}	5.8^{b}
	Disgusted	1.1	1.1	1.3
	Warm	5.5	5.2	4.9
	Daring	3.3	3.1	3.3
	Pleased	6.8^{a}	7.1^{a}	6.0^{b}
	Guilty	1.3^{ab}	1.2^{b}	1.6^{a}
	Nostalgic	2.8	2.7	2.9
	Eager	4.4	4.1	4.3
	Good	6.8^{a}	7.0^{a}	6.1^{b}
	Satisfied	6.5^{ab}	6.7^{a}	5.9^{b}
	Interested	5.3	5.2	4.8
	Enthusiastic	5.3	5.3	4.9
	Whole	5.8^{ab}	6.0^{a}	5.1^{b}
	Happy	6.1^{a}	5.8^{ab}	5.3^{b}
	Adventurous	3.0	2.7	3.1
Emotions (snack times)	Pleasant	5.9	5.9	5.0
	Disgusted	1.2^{ab}	0.9^{b}	1.3^{a}
	Warm	4.7	4.3	4.1
	Daring	2.7	2.5	2.8
	Pleased	5.9	5.7	5.0
	Guilty	1.8	1.4	2.0
	Nostalgic	2.6	2.4	2.5
	Eager	4.0	3.6	3.6
	Good	5.9	5.7	5.1
	Satisfied	5.5	5.6	4.9
	Interested	4.2	3.8	3.9
	Enthusiastic	4.6	4.5	4.2
	Whole	4.9	4.5	4.2
	Happy	5.5	5.1	4.6
	Adventurous	2.4	2.1	2.6

Note: The SUM score reflects the sum of the individual items of each category of the questionnaire. Similar letters refer to statistically similar terms (α=0.05).

Thoughtless averages least associated their meals with the positive emotions 'pleasant', 'pleased', 'good, satisfied', 'whole', and 'happy'. They linked these occasions more strongly to the negative emotions 'guilty' and 'disgusted'. Compared to the other functional clusters, the *thoughtless averages* more often belong to den Uijl et al.'s (2014) negative emotion segment: indifferent restrictives (19% of the *thoughtless averages*, standardised residual 2.9) and less often to the positive emotion segment: convivial indulgers (4% of the *thoughtless averages*, standardised residual -2.7).

In addition, these persons are more food neophobic than *cosy socialisers* and fussier regarding their meals compared to *cosy socialisers* and *physical nutritioners.* Their health and taste attitudes did not distinguish them clearly from the two other clusters.

Persons from this cluster are on average 66.4 years old ± 6.3 (SD), and 47% of this cluster are male. Furthermore*, thoughtless averages* are more often at risk of malnutrition compared to persons from the other clusters (standardised residual +2.2). They are not concerned about health (standardised residual +1.9) and more often have problems with their teeth (standardised residual +2.2).

Study II: Zooming in on the personally relevant factors regarding evening meals and proteins

MEC structures of the cosy socialisers

The HVM in Figure 5.2 shows *cosy socialisers'* evening mealtime experiences and attitudes towards proteins and increasing protein intake. The thickness of the lines in the diagram represents the hierarchy of influencing factors: the thicker the line, the more often the participants made this connection.

For *cosy socialisers,* the evening meal is an occasion to experience cosiness/social interaction (95%), to relax (70%), and to feel good (65%), giving them a feeling of social bonding (65%). This social connectedness is also achieved by eating together (55%), serving a glass of wine with the meal (65%), and setting the table properly (85%). For some members of this group, a proper table setting also reflects taking care with the meal (15%). Around one third of the *cosy socialisers* like the challenge (30%) of exploring new meals and products (35%), as this provides them satisfaction (65%). Some members even indicate cooking (50%) as their hobby (60%). Cooking too much, so that it results in food waste, is not appreciated by approximately one third of the group. For *cosy socialisers*, it is important to sit at the table while eating (85%), so that attention can be paid to the food (55%), and the food is better appreciated (40%). Tasty meals provide this group with enjoyment (85%) and satisfaction (65%), which is supported by drinking a glass of wine (65%) and

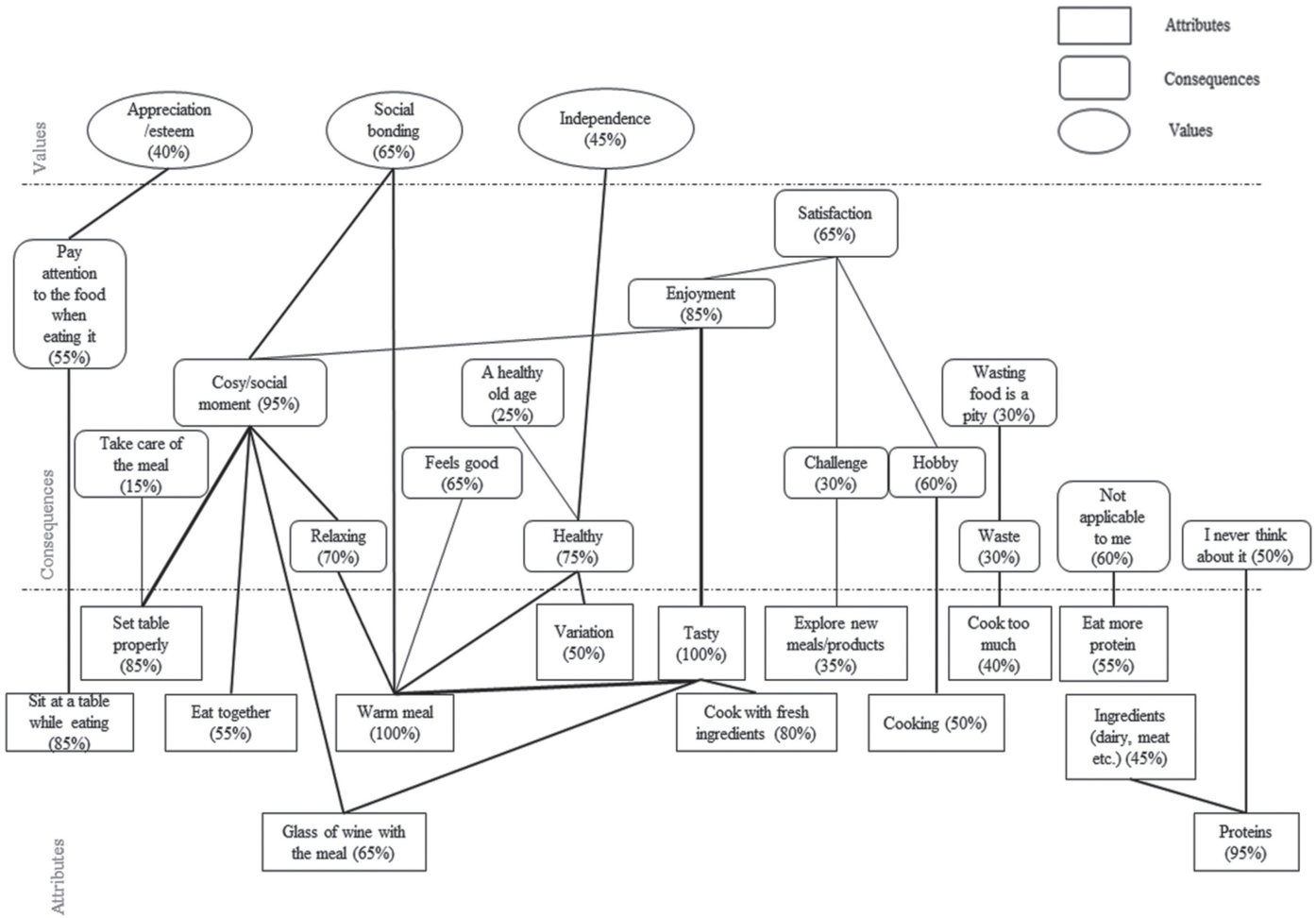

Figure 5.2 Hierarchical value map (HVM) representing the personally relevant associations with mealtimes of *cosy socialisers* (n=20). Note: This HVM represents 60% of all direct links mentioned during the laddering interviews. Thicker lines reflect stronger relationships between the HVM items.

cooking with fresh products (80%). *Cosy socialisers* associate the evening meal with healthiness (75%), which for them prolongs independence (45%) and ensures a healthy old age (25%). Variation is a factor that contributes to health according to half of the *cosy socialisers*.

Half of the *cosy socialisers* hardly ever explicitly think about proteins in relation to their daily diet (50%) or consider it to be non-applicable to them (60%). If for any reason they needed to increase their protein intake, they would prefer to increase their daily protein intake by eating more products that are naturally rich in protein (45%).

MEC structures of the physical nutritioners

The HVM in Figure 5.3 shows the evening mealtime experiences and attitudes towards protein and increasing protein intake of the *physical nutritioners*. Again, the thickness of the lines in the diagram represents the hierarchy of influencing factors.

The members of this cluster consume their evening meal to combat hunger and thirst (40%) and to feel satisfied (35%). They eat a lot of vegetables (70%) because these contain important nutrients (90%). Consumption of these nutrients fulfils their physical requirements (80%) and makes them feel good (70%) and thereby stay fit (55%) and healthy (80%). With a proper health and energy status, the *physical nutritioners* achieve a desired level of wellbeing (30%), stay independent (45%), and have a healthy old age (50%). They use ready-products (55%) for convenience (60%), whereas they consume fresh ingredients (55%) for health reasons (80%). Approximately half of the members of this cluster consider cooking as their hobby (45%). As in the other cluster, food waste is not appreciated (25%). *Physical nutritioners* consume their meals preferably at the table (85%), so that they can relax (45%) and pay attention to the food (45%). They consider this to be a habit (80%). For this group, evening meals need to be tasty as well (95%), so that they can enjoy them (55%) and feel good (70%).

As observed for the *cosy socialisers, physical nutritioners* have a low awareness of proteins in relation to their daily diet (40%), and some even consider this to be non-applicable to them (35%). Nonetheless, if for any reason they needed to increase their protein intake, persons of this cluster intend to adhere to it (50%). They link this increase in protein intake to weight management (75%) and healthiness (80%). *Physical nutritioners*' first associations with proteins are protein rich foods (like dairy and meat, 55%) and eggs (30%). A majority of the *physical nutritioners* would prefer to increase their protein intake by adding protein powder to their diet (65%). Some members of this cluster would prefer to increase protein intake by consuming more products naturally rich in protein (35%), as this is more natural to them (60%).

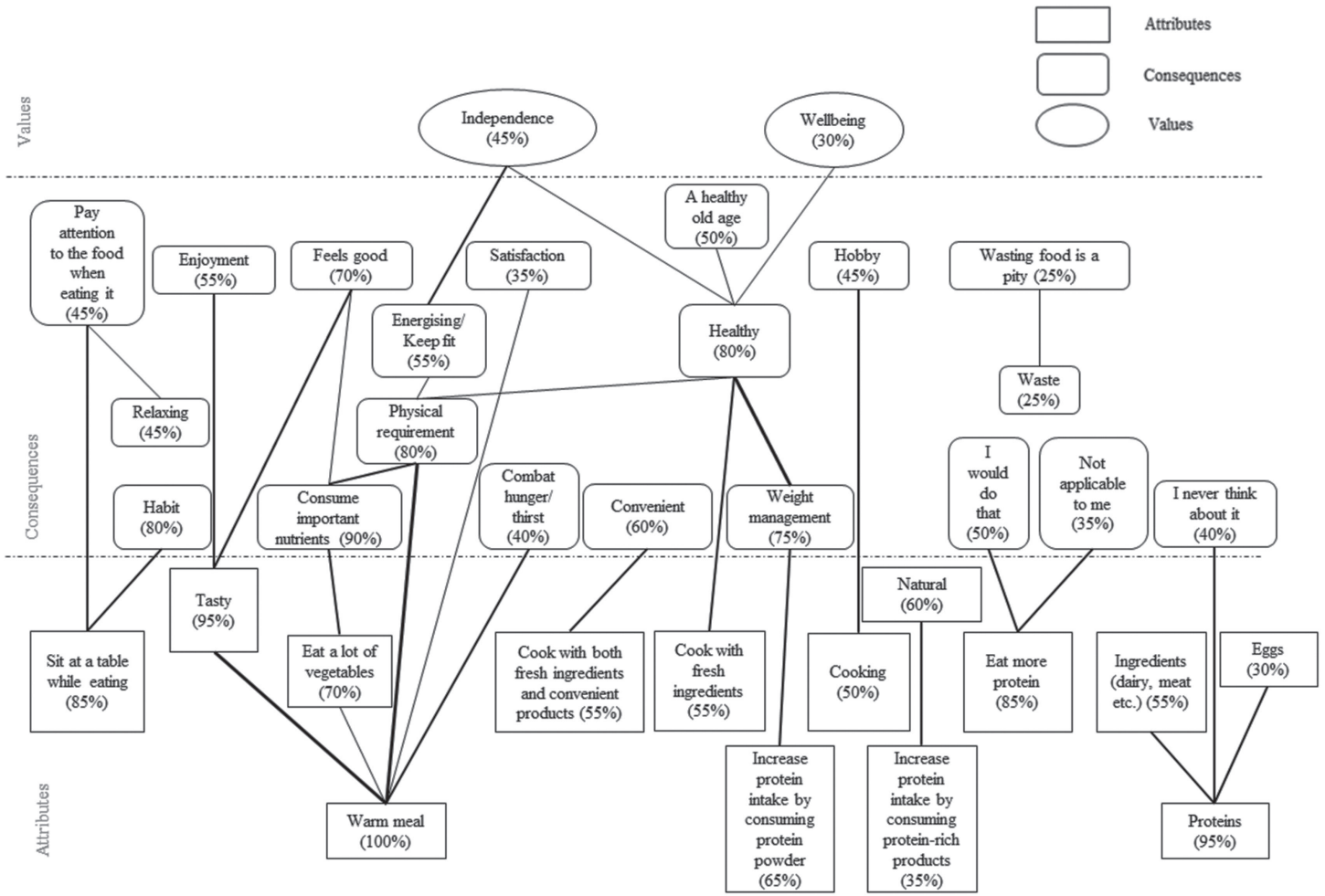

Figure 5.3 Hierarchical value map (HVM) representing the personally relevant associations with mealtimes of *physical nutritioners* (n=20). Note: This HVM represents 60% of all direct links mentioned during the laddering interviews. Thicker lines reflect stronger relationships between the HVM items.

Characteristics of the self-taken pictures of evening meals

The participants' self-taken evening meal pictures were rated on eight characteristics. Table 5.4 shows for each cluster the percentage of pictures in which a characteristic was present. In the *cosy socialisers*' pictures, a table cloth was present more often than in those of the *physical nutritioners* (p <0.05). Moreover, in the *cosy socialisers*' pictures, a glass of wine or beer was present more often (p <0.05). The *physical nutritioners*' pictures showed table mats more frequently (p <0.05). About equally often, both groups' pictures showed candles, pots, serving dishes, glasses of water, and flowers. Figure 5.4 shows a picture of a stereotype *cosy socialiser,* incorporating the significant characteristics for this cluster. Figure 5.5 shows a representative picture of a *physical nutritioner*.

Table 5.4 Percentage of pictures from *cosy socialisers* and *physical nutritioners* showing a specific characteristic.

Present on table	% *Cosy socialisers*	% *Physical nutritioners*
Table cloth	80	50*
Candles	25	5
Table mats	10	50*
Pots	55	40
Serving dishes	50	25
Glass wine/beer	40	10*
Glass water	50	45
Flowers as decoration	5	15

***** Indicates a significant difference between *cosy socialisers* and *physical nutritioners* (α=0.05).

Figure 5.4 Representative picture of a *cosy socialisers'* evening meal.

Figure 5.5 Representative picture of a *physical nutritioners'* evening meal.

Discussion

Three clusters of vital community-dwelling seniors were described on the basis of mealtime functionality: *cosy socialisers, physical nutritioners,* and *thoughtless averages*. *Cosy socialisers* consider their mealtimes to be cosy and social occasions, whereas the *physical nutritioners* focus more on the physical needs, health, and nutrient aspects of a meal. *Thoughtless averages* do not distinguish themselves clearly from the other clusters and report eating without having explicit thoughts. We zoomed in on the personally relevant mealtime functionalities and attitudes towards proteins/protein enrichment of *cosy socialisers* and *physical nutritioners* to obtain an in-depth understanding of their motivations for consuming a protein-rich meal.

Both social and nutrient/physical functionalities are important motives in the current segmentation. In other consumer populations, both older and younger, such eating motivations have been reported before. For example, Morgan (1993) clustered 55+ seniors in *nutritious concerned, fast and healthy*, and *traditional couponers*. The *nutrition concerned* seniors believe that 'how you feel is influenced by what you eat'; this overlaps with the functional mealtime associations of the current *physical nutritioners*. Mahadevan, Hartwell, Feldman, Ruzsilla, and Raines (2014) also reported both social and physical mealtime motivations in a frailer senior population. Assisted-living seniors mentioned during focus group discussions that the ability to make healthy food choices, socialise, interact with staff, friends, and family, and enjoy a tasty meal increased their dignity and wellbeing. Focusing on the adult population, Geeroms, Verbeke, and van Kenhove (2008) described five consumer clusters based on their motives for pursuing health: *energetic experimenters, harmonious enjoyers, normative carers, conscious experts,* and *rationalists*. The social and physical orientations are to some extent represented in these clusters as well. For example, *energetic experimenters* perceive health mainly in terms of vitality and energy, whereas *harmonious enjoyers* and *normative carers* stress the social aspects of health and interpret health in terms of enjoying life and emotional well-being. Apparently, the abovementioned segmentation themes (e.g. energy/health, social function) not only exist for a wide age-range of consumers, but also can be used to further cluster senior consumers specifically.

Besides the differences in mealtime associations, the *cosy socialisers* and *physical nutritioners* also reported some overlap. Both clusters reported that they were in favour of tasty meals and cooking (with fresh ingredients). They associate their evening meal with relaxation and positive emotions, and consider it important to sit at the table on these occasions, so that they can pay attention to the food. In addition, they disapprove highly of food waste, and they associate their meals with health and independence. Some of these mealtime functionalities have been described before. For example, a qualitative study by Brombach (2002) showed that independently living seniors generally prefer

fresh homemade meals over ready meals. Heinio, Pentikainen, Rusko, and Peura-Kapanen (2014) even state that ready meals are generally not appreciated by seniors as they do not fulfil their requirements for a 'good meal', due to a lack of taste, high saltiness, and scrappy texture. Renner, Sproesser, Strohbach, and Schupp (2012) applied a 15-item scale to compare younger and older adults' eating motivations (TEMS; including for example hunger/need, health, habit, pleasure, and sociability). Their study showed that older participants were more concerned about naturalness and more focused on health (both 'long-term' focused), whereas younger adults were more focused on immediate/short-term factors such as affect regulation, pleasure, visual appeal, and need/hunger. Some mealtime functionalities might therefore be more generation-specific – or maybe even more population-specific – than others. Future research should include not only vital community-dwelling seniors, but also other populations, such as younger adults or frail older adults, to further our understanding of mealtime experiences and expectations at different life stages.

Interestingly, the *thoughtless averages* did not differentiate themselves clearly from the other clusters by their mealtime functionalities, as their scores for most functional associations were about average. Moreover, this group reported eating without explicit thoughts or associations. Hence, as it seems challenging to obtain further insights regarding their mealtime functionality through explicit (laddering) interviews, we decided not to include the *thoughtless averages* in study II of our research. However, given this cluster's relatively high risk of malnutrition and low health concern, this group might, from a public health perspective, certainly be interesting for future studies. We speculate that a product focus rather than a mealtime focus could in this case provide tangible insights into product-specific needs. Future studies are needed to establish whether such a product-based strategy can be used to tailor nutrient-rich products to seniors without clear functional mealtime associations.

Both the *cosy socialisers* and *physical nutritioners* are expected to be actionable segments for the development and marketing of evening meals, as their characteristics can be translated practically into tailored protein-rich meals or communication strategies. For example, marketers may want to focus more on the social and connective aspects of a meal in their communication strategies for *cosy socialisers* and less on the physical/nutrient aspects. Also for this group, protein-rich meals may be more appealing if they are prepared in a more traditional way, for example, by increasing the amount of a product that is naturally rich in protein. For the *physical nutritioners*, the meal tailoring may focus more on the nutritional aspects of a meal and the subsequent fulfilment of physical requirements. For this group, protein-rich meals might better be realised in a non-traditional way, by the addition of protein powder. Although these results show potentially actionable ways of tailoring protein-rich meals to senior subgroups, little is known about the predictive validity of means-end chain constructs for real-life eating behaviour and

food choice (Grunert, 2010; Grunert & Bech-Larsen, 2005; Grunert, Beckmann, & Sørensen, 2001). Hence, future real-life studies are recommended to explore whether the currently observed segment characteristics can be applied to tailor protein-rich meals and products to specific senior consumer segments.

Moreover, for successful implementation of such tailored protein-rich meals, it is a prerequisite that people are convinced and motivated to increase their protein intake. Interestingly, during the in-depth interviews, both *cosy socialisers* and *physical nutritioners* mentioned that they barely think about proteins in relation to their diet. Some even believe that eating more protein is not applicable to them. This reflects a low awareness of proteins and their nutritional value, as reported before by, for example, Chatard-Pannetier, Rousset, Bonin, Guillaume, and Droit-Volet, (2004), Maaskant, Doets, and Kremer (submitted), and van der Zanden, van Kleef, de Wijk, and van Trijp (2015). Chatard-Pannetier and colleagues interviewed French older adults on their meat consumption and reported a low awareness of the risks associated with protein deficiency and muscle loss. Maaskant et al. (submitted) explored interest in nutritional health among vital community-dwelling seniors. They reported that the number of vital community-dwelling seniors who pay attention to nutritive values of foods is low (32%) and that the number of seniors with an interest in protein-enriched foods is even lower (23%). Therefore, when healthy protein-rich meals are being tailored to senior consumer clusters, it seems essential not only to focus on the meal-related aspects, but also to put effort into increasing protein awareness and motivation to actually consume them.

General conclusion

In conclusion, older consumers can be divided into three segments differing with regard to mealtime functionality. These clusters are expected to provide actionable insights for the development of protein-rich products/meals and communication strategies tailored to the nutritional and functional needs of vital community-dwelling older consumers.

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Chapter 6

Applying mealtime functionality to tailor protein-enriched meals to older consumer segments

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Abstract

The older adults group is highly heterogeneous, and its members do not always meet their recommended protein intake. We explored mealtime functionality as a basis for tailoring protein-enriched (PE) meal concepts to two senior consumer segments: 1) *cosy socialisers,* who eat mainly for cosiness and social interaction, and 2) *physical nutritioners,* who eat mainly for nutrients and physical needs. We hypothesised an increased 'product–cluster fit' when the functional meal associations are congruent to the clusters' functional mealtime expectations. In a home-use test, participants (n=91, mean age 68.1 (y) ± 5.3 (SD), 42 *cosy socialisers*) prepared and consumed three kale mash meal concepts once over three weeks: (1) a basic meal concept (without PE/tailoring), (2) a cosy meal concept (PE/tailored to mealtime expectations of *cosy socialisers*), and (3) a physical meal concept (PE/tailored to mealtime expectations of *physical nutritioners*). The participants reported their expectations and experiences with the recipes and dishes (e.g. expected liking; attractiveness recipe; actual liking; taste; smell; satisfaction). The results showed that the cosy meal concept was experienced as 'traditional' (p <0.05), whereas the physical meal concept was perceived as 'healthy' (p <0.05), 'trendy' (p <0.05), and 'energising' (p <0.09). Nonetheless, the cluster*meal concept effect did not reach statistical significance for any of the outcome variables, indicating a similar actual experience of the congruent and incongruent meal concepts. This study highlights for the first time both the potency and challenges of tailoring PE dishes to specific older consumers and underlines that an increased 'product–cluster fit' is not straightforwardly achieved.

Introduction

As people grow older, they become highly experienced consumers. Because of their varying experiences, the diverse ageing process, and the memories that build up over the years, this group is highly heterogeneous (Giacalone et al., 2014; Moschis, 2003). In addition, the consumption of protein is of special interest for older adults, as people in this group do not always meet their daily protein requirements (Bauer et al., 2013; Tieland, Borgonjen-van den Berg, van Loon, & de Groot, 2012). This is alarming, as a suboptimal protein intake can negatively impact on lean body mass (e.g. muscle mass) and physical functioning as people age (Bauer et al., 2013; Wolfe, 2012). So far, this older consumer group has received little attention from marketing and product development, although the currently available – protein-enriched (PE) – products do not always seem to meet their needs and wants (Moschis, 2003; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014). Hence, tailoring PE dishes to subgroups of senior consumers will be a first step to better meet their requirements.

Mealtime functionality (i.e. the functional mealtime expectations, such as 'getting nutrients', 'having a cosy moment', and so on) might provide a good starting point for tailoring PE meals to senior subgroups. Köster (2003, 2009) and Blake, Bisogni, Sobal, Devine, and Jastran (2007) stressed the relevance of situation-oriented research for better understanding consumer behaviour, because – depending on intention – food can mean different things to people in different situations. Mealtime (e.g. breakfast, dinner) may be such a situation where different people can have different motivations for consumption. In addition, Thomson, Crocker, and Marketo (2010) emphasised the relevance of conceptualisations (e.g. functional associations such as 'will refresh me', and 'is energising') to better understand consumer behaviour. They proposed that consumers evaluate products by integrating product expectations and actual product experiences. Congruency between the two is proposed to impact positively on product and brand perception. The latter can be translated to mealtimes as well, when the focus is on mealtime expectations and actual meal experiences.

Following up on the relevance of mealtime functionality and the heterogenic nature of the senior population, we recently defined subgroups of older consumers on the basis of their functional expectations regarding breakfast, lunch, dinner, desert, and snack times (den Uijl, Jager, de Graaf, & Kremer, submitted). We observed three subgroups of senior consumers; *cosy sociables, physical nutritioners,* and *thoughtless averages*. The *cosy sociables* reported associating their mealtimes with cosiness and social interactions, whereas the *physical nutritioners* were more focused on the nutrient and energy/hunger aspects of their mealtimes. The *thoughtless averages* linked their mealtimes more strongly to thoughtless eating.

These older consumer segments may serve as an actionable basis for functionality-focused tailoring of PE meals. We hypothesised that such tailoring can be successful when the inferred functional meal associations are congruent with the consumers' functional mealtime expectations. This strategy builds on Grunert and van Trijp's (2014) theoretical framework, which describes how consumers decide on new products (Figure 6.1). This model is based on the idea that products are not consumed for the products' sake, but for the benefits that they communicate to the consumer (Gutman, 1982; Reynolds & Olson, 2001). The authors suggest that congruency between the inferred product benefits (i.e. actual perception of the product) and desired product benefits (i.e. product expectations) can positively impact on product experience, product preference, and even – repeated – product choice. According to the model, the desired product benefits are influenced by personal values and situations, whereas the inferred product benefits result from the product characteristics (e.g. ingredients, sensory characteristics), the marketing features (e.g. product information, brand image), and the technology features (e.g. processing techniques). Interestingly, so far, little is known on whether this theoretical framework can be applied to seniors' mealtimes and tailored PE meals.

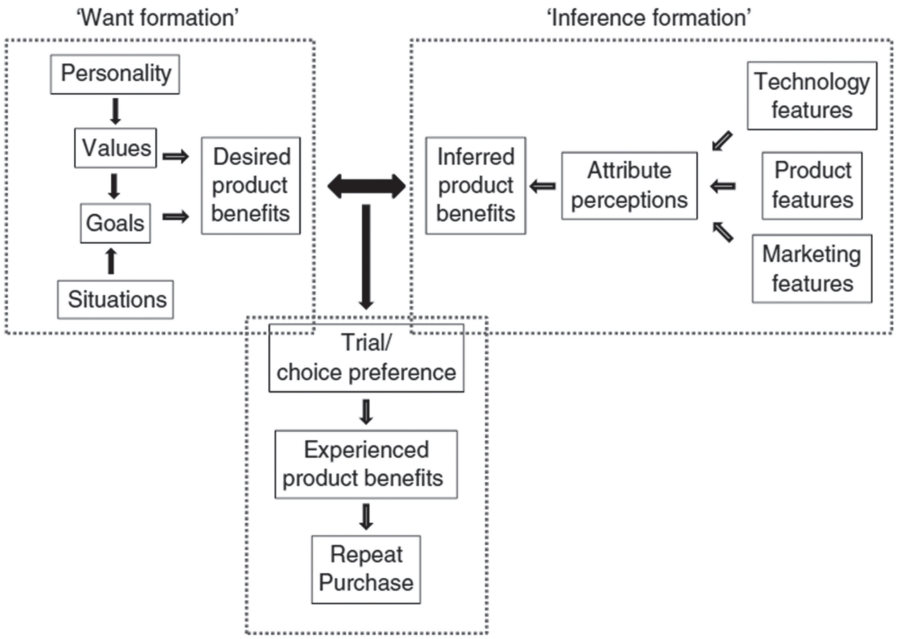

Figure 6.1 A framework of how consumers decide on new products (Grunert & van Trijp, 2014, p. 379).

In the current study, we therefore explored the extent to which we can apply mealtime functionality to tailor PE dishes to subgroups of older adults: in this case *cosy sociables* and *physical nutritioners*. To this end, we developed two PE meal concepts, one tailored to the functional mealtime expectations of *cosy sociables* and one tailored to those of *physical nutritioners*. Subsequently, we compared the actual PE meal concept experiences between the two senior clusters. Following Grunert and van Trijp's (2014) model, we hypothesised an increased 'product–cluster fit' (i.e. a more positive meal experience and more satisfied consumers) when the inferred functional meal associations are congruent with the clusters' functional mealtime expectations.

Materials and Methods

Participants

Ninety-one older participants (35 males, mean age 68.1 (y) ± 5.3 (SD)) participated in a home-use test. Among these participants, 42 seniors belonged to the *cosy socialisers* cluster and 49 seniors belonged to the *physical nutritioners* cluster (for cluster details see the next section and den Uijl et al., submitted). All participants were regular consumers (≥ once per month) of kale mash, i.e. a traditional Dutch dish of potato mashed with kale (in Dutch: *boerenkoolstamppot*). They scored kale mash with at least a 7 on a 9-point hedonic scale. Table 6.1 provides the participants' characteristics for each of the clusters. The participants were all member of Wageningen UR's SenTo panel (Dutch abbreviation of *Senioren van de Toekomst*: Seniors of the Future). This consumer panel consists of around 800 healthy community-dwelling Dutch seniors. Seniors can become a member of the SenTo panel if they are at least 55 years of age, are able to go out independently (for example for grocery shopping), are capable of working online with a computer, and are fluent in Dutch. The participants received a financial compensation for participation and completed a consent form. The current study was approved by the social ethical committee of Wageningen UR.

Table 6.1 Participants' characteristics.

	Cosy socialisers **(n=42)**	***Physical nutritioners*** **(n=49)**
Age (y ± SD)	68.6 ± 4.8	67.5 ± 5.8
Sex (% male)	48	29
Cooking 4–6 times a week (%)	73	82
Liking kale mash	8	8
Eating kale mash 1–3 times per month (%)	86	88

Cosy socialisers and physical nutritioners

Our previous study showed that *cosy socialisers* and *physical nutritioners* differ clearly in their functional mealtime expectations (den Uijl et al., submitted). We observed that c*osy socialisers* associate their mealtimes with cosiness and that they value the social connectedness of these occasions. They regularly consume a glass of beer or wine with their meals and link this directly to cosiness and social bonding. In an additional task during den Uijl et al.'s study (data not reported), the participants were asked to select the most applicable dinner functionalities from a set of 20 cards with written dinner functionalities and subsequently rank them from least to most applicable. From this task, the following mealtime functionalities were most frequently chosen by *cosy socialisers*: 'because it is cosy', 'because it is calming', 'because it has a full taste', and 'because it is a delight'. *Cosy socialisers* associate proteins mainly with protein-rich products (e.g. dairy, meat). If they had to increase their protein intake, they would prefer to do so by eating more products that are naturally rich in protein (X^2 (1, $N = 20$) = 4.91; $p < 0.05$).

In contrast, the *physical nutritioners* associated their mealtimes more strongly with physical needs and nutrients. They combat hunger and get energy at these times. The following mealtime functionality cards were selected most frequently by *physical nutritioners*: 'because it gives me nutrients', 'because my body needs it', 'because I'm hungry', and 'because it gives me energy'. When asked about their first associations with proteins, this group mentioned 'eggs' as well as protein-rich products (e.g. dairy, meat). If they had to increase their protein intake, they would prefer to do so by adding protein powder to their diet (X^2 (1, $N = 20$) = 6.47; $p < 0.05$).

Meal concepts

The participants prepared and consumed three different meal concepts (Figure 6.2):

(1) a basic meal concept: a non-tailored kale mash without PE (527 kcal/portion, 20 g protein);
(2) a cosy meal concept: a PE kale mash tailored to the *cosy socialisers* (597 kcal/portion, 32 g protein);
(3) a physical meal concept: a PE kale mash tailored to the *physical nutritioners* (603 kcal/portion, 32 g protein).

We chose kale mash because this is a frequently consumed and well-accepted dish among Dutch seniors. Moreover, the dish allows for various methods of protein enrichment (e.g. milk powder versus milk, addition of different protein-rich ingredients).

Figure 6.2 Front and back of the physical meal concept.

Figure 6.2 Continued Front and back of the cosy meal concept.

The tailoring of the PE meal concepts was achieved by co-variation of two factors described in Figure 6.1: product characteristics (protein-rich ingredients) and marketing features (communication through the recipe, e.g. text fragments and pictures). By incorporating the insights as described in section 'Participants', we aimed to trigger dish associations congruent with the functional mealtime expectations of the *cosy socialisers* and *physical nutritioners*. The next sections provide the details on how the meal concepts were enriched with protein and how they were tailored to the clusters' functional mealtime expectations.

Figure 6.2 Continued Front and back of the basic meal concept.

The cosy meal concept

The cosy meal concept was protein-enriched by cubes of cooked ham, as this group preferred to increase protein intake by consuming products naturally rich in protein. In addition, the semi-skimmed milk as used in the basic meal concept was replaced with whole milk, which was communicated as having a full taste. The recipe communication was further tailored to the expectations of the *cosy socialisers* by the following text fragments: 'cosy', 'calming', 'full taste', and 'delight'. A picture of two seniors drinking a glass of wine over dinner was shown on the recipe, triggering the direct association with cosiness.

The physical meal concept

The physical meal concept was protein-enriched by pieces of boiled egg, because of the direct egg–protein link that *physical nutritioners* reported during the in-depth interviews. The energy and protein content of the egg (physical meal concept) and ham cubes (cosy meal concept) were matched to minimise nutrient and energy differences between the tailored meal concepts. Furthermore, whole milk powder and water were added. We communicated this whole milk powder as 'protein powder' to the participants, as this matched their preferred way to increase protein intake. Moreover, when whole milk powder is dissolved in water it becomes whole milk, and this minimises sensory and nutritional differences between the cosy and physical meal concepts. The layout of the recipe was adapted to the expectations of the *physical nutritioners* by the following text fragments: 'essential nutrients', 'body needs it', 'combat hunger', and 'energising'. In addition, the picture of this meal concept showed two healthy and energetic seniors, reflecting important mealtime associations of *physical nutritioners*.

Procedure and questionnaire

The home-use test was conducted in three successive weeks in winter, the traditional season for kale mash. In the first week, all participants, irrespective of cluster, prepared and consumed the warm-up basic meal concept, in order to get used to the test procedures. In the subsequent two weeks, the participants prepared – in randomised order – the cosy meal concept and the physical meal concept.

The following procedure was adhered to during each week of the home-use test: the participants came to our research facilities to pick up the ingredients and the recipe to prepare and consume at home. Once at home, they were instructed to first read the recipe and subsequently rate their expectations regarding the meal concept on 100 mm VAS scales, anchored by 'not at all' and 'very much' (i.e. attractiveness recipe; clarity recipe; attractiveness photos recipe; applicability functional recipe associations: healthy, energetic, cosy, social, traditional, trendy, natural, artificial; expected liking; feelings of pleasantness and energy, suitability dish; suitability protein-rich ingredients, hunger, fullness, and desire to eat). Subsequently, they prepared the dish, took a picture of their plate before they started eating, and consumed the dish. After they finished their meal, they rated their actual dish experiences on 100 mm VAS scales, anchored by 'not at all' and 'very much' (i.e. actual liking; pleasantness of appearance/taste/smell/texture; satisfaction; extent to which expectations are met; feelings of pleasantness and energy; applicability functional meal associations: healthy, energetic, cosy, social, traditional, trendy, natural, artificial; desire to make again in the future; user friendliness recipe; hunger; fullness; and desire to eat). They also photographed their meal leftovers and emailed us their picture.

Two days later, they filled out an online questionnaire with questions on remembered liking and willingness to prepare the meal again (both rated on 100 mm VAS, using Eye Question software).

In the third week, the online questionnaire was extended with a 3-alternative forced choice between the meal concepts (cosy meal concept, physical meal concept, no preference) to be prepared and consumed again in the future. Besides that, they rated 13 functional mealtime associations (hunger, habit, liking, cosiness, pleasure, energising, rewarding, healthiness, pleasing, calming, physical needs, thoughtless eating, and environmental awareness) on 9-point Likert scales. This mealtime functionality questionnaire was similar to the one used by den Uijl, Jager, de Graaf, Waddell, and Kremer (2014) and was included to double-check the clusters' functional mealtime expectations.

Data analysis

The data were analysed using IBM SPSS Statistics 22. Results were considered statistically significant at a level of 0.05, unless stated otherwise.

Clusters' functional mealtime expectations

For both clusters separately, we calculated the mean mealtime functionality scores as measured in the third week's online questionnaire (hunger, habit, liking, cosiness, pleasure, energising, rewarding, healthiness, pleasing, calming, physical needs, thoughtless eating, and environmental awareness). Taking into account the tailored evening meals developed during this study, we focused on the functional dinner expectations. These functional dinner expectations were visualised in a spider plot. The scores were compared between the clusters by using a mixed model ANOVA, including each of the dinner functionality constructs as the dependent variables and cluster as the fixed factor. Participants' individual data were indicated as random factors.

Inferred functional meal associations

Separately for the two tailored meal concepts and the two clusters, we calculated the mean scores for the inferred functional meal associations: 'healthy', 'energetic', 'social', 'cosy', 'traditional', 'trendy', 'natural', and 'artificial'. These functional meal concept associations were compared using a mixed model ANOVA procedure, including the functional associations as dependent variables and cluster as fixed factor. Participants' individual data were indicated as random factors.

Clusters' actual experiences with tailored meal concepts

We calculated the mean scores for each of the outcome variables for both clusters and tailored meal concepts separately. The differences between the clusters' experiences

were statistically substantiated using mixed model ANOVAs, including each of the outcome variables as dependent variable and both cluster and meal concept as fixed factors. Participants' individual data were indicated as random factors. The interaction term cluster*meal concept was included to test whether the congruent meal concept (i.e. the cosy meal concept for the *cosy socialisers* and the physical meal concept for the *physical nutritioners*) was perceived as significantly different from the incongruent meal concept (i.e. the physical meal concept for the *cosy socialisers* and the cosy meal concept for the *physical nutritioners*).

In addition, rather than taking a group-level approach, we analysed the data at individual level. To this end, we composed a separate SPSS data file including the Δ-scores of the congruent meal concept and the incongruent meal concept for each of the participants' scores. For each variable and cluster separately, we counted the number of participants that scored the congruent meal concept higher ($\Delta \geq 10$) than the incongruent meal concept. Also, the frequency of participants that scored the incongruent meal concept higher ($\Delta \leq -10$) was calculated, as well as the number of participants that scored both meal concepts about similar ($-10 < \Delta < 10$). We decided to apply a threshold of 10 mm on a 100 mm VAS, so that only the most meaningful effects – if any – would be considered.

Furthermore, we calculated the mean scores for hunger, fullness, and desire to eat for both senior consumer clusters and meal concepts separately. The differences between the participating groups were statistically substantiated using mixed model ANOVAs, including each of the outcome variables as dependent variable. Cluster and meal concept were entered as fixed factors. Participants' individual data were indicated as random factors. The interaction term cluster*meal concept was included to test whether the appetite ratings in the congruent meal concept differed from those in the incongruent meal concept.

At the end of the study, in an online questionnaire, we assessed the choice to prepare and consume one of the tailored meal concepts again. Choice frequency was calculated and compared between clusters using a chi-square analysis.

Results

Clusters' functional mealtime expectations

We compared the functional expectations of *cosy socialisers* and *physical nutritioners* regarding their evening meals (Figure 6.3). The *cosy socialisers* associated their dinner more strongly with 'cosiness' than the *physical nutritioners* cluster ($p < 0.05$). In contrast, the *physical nutritioners* associated their dinner more strongly with 'hunger', 'energising', 'healthiness', and 'physical needs' than the *cosy socialisers* ($p < 0.05$). For the other dinner

functionalities, we did not observe significant differences between the clusters. Overall, the scores for 'liking', 'pleasure', and 'pleasing' were relatively higher (ranging from 6.9 to 7.9 on a 9-point Likert scale) than those for 'habit', 'rewarding', 'calming', 'thoughtless eating', and 'environmental awareness' (ranging from 2 to 4.6 on a 9-point Likert scale), irrespective of cluster membership.

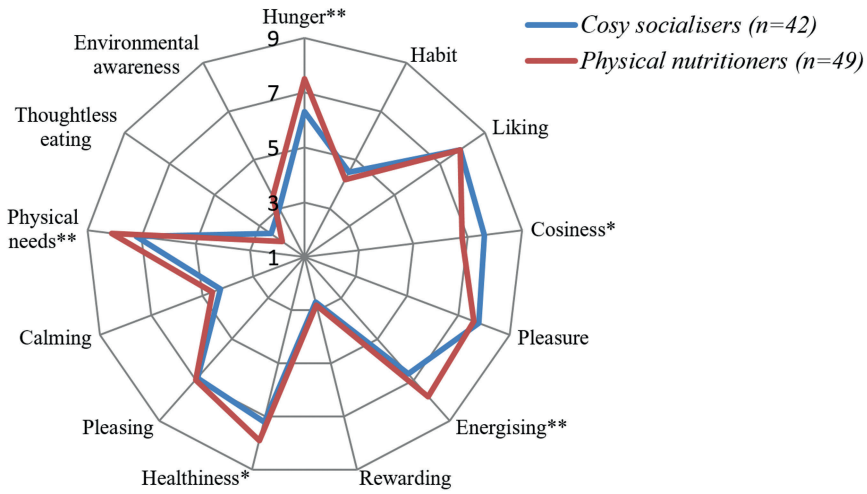

Figure 6.3 Functional dinner expectations of cosy socialisers and physical nutritioners.
Note: * indicates the functionality constructs for which the two clusters significantly differ at *p* <0.05, ** indicate the associations for which the clusters significantly differ at *p* <0.004.

Inferred functional meal associations

Table 6.2 shows the inferred functional meal associations. We observed significant differences in functional associations between the cosy and the physical meal concept. Both clusters considered the cosy meal concept (both recipe and meal) to be more 'traditional' than the physical meal concept. Moreover, the *physical nutritioners* reported the cosy recipe to be more 'artificial' than the physical recipe.

Both groups considered the physical meal concept to be more 'trendy' and 'healthy' than the cosy meal concept. The *physical nutritioners* additionally reported the physical meal concept to be more 'energetic' than the cosy meal concept, whereas for the *cosy socialisers* the physical recipe was perceived as more 'artificial' than the cosy recipe.

Table 6.2 Mean inferred functional meal associations of *cosy socialisers* and *physical nutritioners* with the cosy meal concept and the physical meal concept.

		***Cosy socialisers* (n=42)**			***Physical nutritioners* (n=49)**		
		Cosy concept	**Physical concept**	**Sig**	**Cosy concept**	**Physical concept**	**Sig**
Recipe	Healthy	75	79	0.02*	72	77	0.00**
	Energetic	77	80	0.12	75	80	0.00*
	Cosy	74	74	0.91	70	69	0.90
	Social	71	70	0.78	59	59	0.81
	Traditional	82	68	0.00**	76	64	0.01*
	Trendy	42	56	0.00**	42	52	0.01*
	Natural	76	74	0.41	67	68	0.87
	Artificial	28	38	0.02*	43	28	0.00**
Meal	Healthy	75	78	0.23	74	76	0.29
	Energetic	75	77	0.40	76	79	0.07†
	Cosy	73	74	0.53	67	68	0.71
	Social	70	73	0.16	60	63	0.20
	Traditional	80	71	0.00*	75	68	0.07†
	Trendy	43	53	0.01*	41	51	0.000*
	Natural	72	74	0.30	68	69	0.730
	Artificial	25	33	0.01	33	36	0.400

Note: * indicates the mealtime associations for which the two clusters significantly differ at p <0.05, ** indicate the associations for which the clusters significantly differ at p <0.003, and † indicates the associations for which the difference between the clusters is a trend p <0.09.

Clusters' actual experiences with tailored meal concepts

Table 6.3 shows the *cosy socialisers'* and *physical nutritioners'* experiences just before preparation (after reading the recipe) and directly after actual consumption of the meal. The mixed model ANOVA procedure showed that, for all participants, the cosy recipe was scored as more suitable for the occasion (p <0.05), whereas the physical meal met expectations better (p <0.05). There was a trend for (all) the participants to consider the cosy recipe as more attractive than the physical recipe. The cluster effect and the cluster*meal concept effect did not reach statistical significance, indicating no clear differences between the clusters' actual experience of the congruent and the incongruent meal concept.

Table 6.3 Mean scores of actual experiences with the cosy and the physical meal concepts, separately for *cosy socialisers*, *physical nutritioners*, and all participants.

		Cosy socialisers (n=42)		*Physical nutritioners* (n=49)		All (n=91)		Sig Cluster	Sig Meal concept	Sig Cluster* Meal concept
		Cosy concept	Physical concept	Cosy concept	Physical concept	Cosy concept	Physical concept			
Recipe	Attractiveness	72	69	70	66	71	68	0.63	0.06†	0.94
	Clarity	89	89	92	92	91	91	0.10	0.87	0.78
	Attractiveness photos	81	80	79	80	80	80	0.86	0.79	0.73
	Expected liking	73	71	71	70	72	71	0.76	0.48	0.97
	Pleasantness	80	81	81	84	81	82	0.51	0.13	0.26
	Energetic	77	78	78	79	78	78	0.76	0.78	0.94
	Suitability	82	79	82	78	82	79	0.87	0.02*	0.70
	Hunger	66	68	72	71	69	70	0.19	0.82	0.38
	Fullness	32	31	33	35	33	33	0.53	0.77	0.54
	Desire to eat	67	70	72	74	69	72	0.27	0.27	0.77
Meal	Actual liking	72	72	69	72	70	72	0.62	0.43	0.57
	Appearance	77	77	77	77	77	77	0.93	0.77	0.98
	Taste	73	71	68	72	71	71	0.57	0.75	0.25
	Smell	69	71	68	66	68	68	0.40	0.92	0.36
	Texture	76	72	73	73	74	72	0.69	0.37	0.35
	Satisfaction	79	77	75	80	77	79	0.93	0.40	0.13
	Expectations	67	71	66	74	67	72	0.66	0.03*	0.52
	Pleasantness	79	79	79	82	79	81	0.50	0.30	0.24
	Energetic	73	77	78	78	75	77	0.39	0.13	0.15
	User friendliness	88	88	90	88	89	88	0.66	0.19	0.21
	Desire to make again	65	58	61	62	63	60	0.98	0.15	0.94
	Remembered liking	6.6	6.3	6.3	6.2	6.5	6.3	0.60	0.55	0.74
	Hunger	13	11	12	10	12	11	0.75	0.56	0.93
	Fullness	69	73	73	72	71	72	0.67	0.73	0.40
	Desire to eat	13	15	12	14	12	15	0.72	0.15	0.94
	% eaten (from photo)	96	95	97	97	96	96	0.52	0.77	0.64

Note: Significances are indicated for the cluster, meal concept, and cluster*meal concept effect. * indicates the outcome measures for which the two clusters significantly differ at $p < 0.05$, and † indicates the outcome measures for which the difference between the clusters is a trend $p < 0.09$.

In addition to the mixed model ANOVA – group level – approach, we took a more individual approach (Table 6.4). These results show that, for most variables, the majority of the participants scored the congruent meal concept about the same as the incongruent meal concept ($-10<\Delta<10$), irrespective of cluster membership. For some variables (e.g. actual liking, expectations met, desire to make again in the future, and taste), some of the participants scored the congruent meal concept higher. However, in those cases, a substantial number of participants also scored the incongruent meal concept higher. Therefore, these results further confirm the above findings that the clusters had no clear preference for the congruent or the incongruent meal concept.

We did not observe significant differences in appetite ratings (hunger, fullness, and desire to eat), neither between the clusters nor the meal concepts (Table 6.3). Interestingly, from the photographs we observed that the participants consumed almost the complete meal (≥95%), irrespective of meal concept or cluster membership.

Finally, at the end of the study, the participants chose one of the meal concepts to prepare and consume again in the near future. The physical meal concept was chosen most often, by both the *cosy socialisers* and the *physical nutritioners*. The clusters did not differ in their choice patterns (X^2 (2, N = 91) = 1.61, p >0.05).

Table 6.4 Frequencies of participants in terms of the Δ-scores for the congruent meal concept and the incongruent meal concept.

		n *Cosy socialisers*			n *Physical nutritioners*		
		Preference congruent concept (Δ>10)	**Preference incongruent concept (Δ<-10)**	**No preference (10<Δ<10)**	**Preference congruent concept (Δ>10)**	**Preference incongruent concept (Δ<-10)**	**No preference (10<Δ<10)**
Recipe	Attractiveness	12	6	24	9	15	23
	Clarity	4	4	34	3	3	41
	Attractiveness photos	6	8	28	11	10	26
	Expected liking	7	9	26	9	14	24
	Pleasantness	5	7	30	11	4	32
	Energetic	9	7	26	8	8	31
	Suitability	11	3	25	4	12	31
	Hunger	7	10	23	11	13	23
	Fullness	12	12	16	14	13	18
	Desire to eat	10	12	18	11	10	26
Meal	Actual liking	12	14	16	16	10	22
	Appearance	9	9	24	10	7	31
	Taste	12	12	18	17	12	19
	Smell	11	13	18	12	11	25
	Texture	13	10	19	11	7	29
	Satisfaction	11	11	20	9	8	31
	Expectations met	11	16	15	17	11	20
	Pleasantness	8	6	28	7	5	35
	Energetic	6	15	21	6	7	33
	User friendliness	4	2	36	2	7	37
	Desire to make again	15	10	17	14	15	16
	Hunger	9	2	31	4	6	35
	Fullness	10	12	19	10	15	21
	Desire to eat	4	5	33	10	6	30
	% eaten (from photo)	8	5	29	7	7	32

Note: For *cosy socialisers*, the Δ congruent–incongruent meal concept reflects the scores for the cosy meal concept minus the scores for the physical meal concept. For *physical nutritioners*, the Δ congruent–incongruent concept reflects the scores for the physical meal concept minus the scores for the cosy meal concept.

Discussion

In this study, we applied mealtime functionality to tailor PE meal concepts to two senior consumer clusters: *cosy socialisers* and *physical nutritioners*. We compared the clusters' experiences with a congruent meal concept (in terms of mealtime functionality) with their experiences with an incongruent meal concept. These meal concepts were well-accepted by our participants, and they finished almost the whole dish (irrespective of the PE/tailoring). However, congruency between the inferred functional meal associations and clusters' functional mealtime expectations did not result in an increased 'product–cluster fit', i.e. the senior consumer clusters did not perceive the congruent meal concept as more positive (e.g. more appealing or satisfying) than the incongruent concept.

Several explanations for this unexpected finding come to mind. One possibility is that the type of meal, i.e. kale mash, may have interfered with our manipulation. In the Netherlands, kale mash is a frequently consumed and iconic dish anchored in the culture. It could therefore be that strong (positive) pre-existing associations 'overruled' those of our intervention, resulting in equally positive evaluations of both tailored meal concepts. King and Meiselman (2010) reported on the impact of consumption frequency in relation to food-evoked emotions and compared responses to never, rarely, occasionally, and frequently consumed emotionally laden foods. They showed that consumption frequency impacted on intensity of emotional associations; frequently consumed foods elicited the most intense food-evoked emotions, especially for the positive emotions. Future research could therefore explore whether a better 'product–cluster fit' can be achieved by tailoring novel meal concepts, as these carriers are less likely to have such pre-existing associations.

Alternatively, it is possible that our 'cosy dish' intervention did not appeal specifically enough to the *cosy socialisers*. The cosy meal concept was considered to be 'traditional', which is one of the characteristics of the *cosy socialisers*. However, for this group, the social context in which a meal is consumed may be even more dominant than the actual dish characteristics. The importance of social context has been extensively described before, by for example Herman, Roth, and Polivy (2003) and Higgs and Thomas (2016). Herman and colleagues described how the presence of other people can stimulate or inhibit food intake, depending on how much these other people eat. Recently, Higgs and Thomas (2016) followed up on this discussion by reporting on the impact of social context on eating behaviour. They state that, in general, we choose and eat our food differently in the company of others, because we find it rewarding to conform to their behaviour. On the basis of the characteristics of our senior clusters, we hypothesised that the latter holds true for older adults as well, but that in certain senior consumer segments (e.g. *cosy socialisers*) this reward may be even stronger than in others. In order to check this hypothesis, the current work could be repeated in a setting in which the social context can be controlled, such as a simulated restaurant environment, by letting people eat alone or in the company

of someone they know or do not know. The current findings suggest that, in the absence of a natural social context, *cosy socialisers* probably evaluate meals less positively, whereas the evaluations of the *physical nutritioners* would be less influenced by this intervention.

Summarising the above, we stress that the current field is still in its infancy and that the current study is a pioneer in tailoring PE meals to senior consumer clusters. Therefore, despite the fact that the current results do not provide direct evidence that our approach was successful, it seems too early to reject it completely. Future studies, as described above, are necessary to further explore the potency of mealtime functionality as a means to develop tailored PE meal concepts.

In addition to the cluster-specific observations, we observed some remarkable findings when focusing on the functional mealtime expectations as such. Our results showed that older consumers, regardless of their cluster membership, considered it important for their dinners to be well liked, and the mealtime functionalities 'habit', 'reward', 'calming', and 'thoughtless eating' seem to be less dominant during this specific mealtime. The importance of hedonic liking has been acknowledged before (den Uijl et al., 2014; Peters, Rappoport, Huff-Corzine, Nelsen, & Downey, 1995; Phan & Chambers, 2016). Peters et al. (1995) explored a food cognition model for actually consumed meals in 18–83-year-old US adults. They concluded that 'health' and 'convenience' are most important at breakfast, whereas hedonic liking is most important at midday and evening meals. In one of our previous studies, we observed a similar pattern when comparing Dutch seniors' mealtime motivations at breakfast, lunch, dinner, and snack times (den Uijl et al., 2014). In the latter study, 'habit' and 'healthiness' proved to be less associated with dinner, but appeared to be more strongly related to breakfast. Hedonic liking was important on all eating occasions, both main meals and snacks. Recently, Phan and Chambers (2016) explored eating motivations on eating occasions using an adapted version of The Eating Motivation Scale (TEMS; Renner, Sproesser, Strohbach, & Schupp, 2012). The authors reported that, for US residents (18–74 years old), liking and pleasure of foods are important, regardless of the eating occasion. The authors also report that breakfast is often consumed out of habit, for health reasons, and for convenience, whereas at dinner consumers more often seek variety. Some mealtime functionalities seem therefore to be specifically related to certain mealtimes and may be universal not only across different age groups, but also across different nationalities.

Another characteristic of the current work, related to the design rather than to the results, is that we opted for a home-use test, in which the dishes were evaluated in the participants' natural eating environment. Meiselman (2006, 2013) referred to such real-life measurements, moving beyond the laboratory, as an important step to further sensory and consumer research. "There is a trade-off between *adequate control*, so that we know what is varying and what is constant, and *real world*, so that we have results which

are relevant to the real world if we want to address real world issues, such as product development and health" (Meiselman, 2013, p. 209). The latter holds true for the current work as well: our home-use approach facilitated the capture of consumer experiences that were as natural as possible. At the same time, it also limited the standardisation of, for example, the dish preparation; we could never be one hundred percent sure that our participants once at home strictly followed our protocol. We anticipated this potentially influencing factor by collecting photographs of the dishes, so that we could get an idea of whether these dishes looked more or less like those in the recipe. Considering the high similarity between the participants' pictures and those in the recipe, we consider this real-life approach to be a strength of this study.

Lastly, when we were focusing on the food products in the current research, it caught our attention that both protein-enriched dishes were generally well liked (around 70 on a 100 mm VAS) by the senior consumers, irrespective of cluster membership. This high appreciation of the protein-enriched dishes is both remarkable and promising, given the low protein awareness of seniors and their increased protein needs (Bauer et al., 2013; Beelen, de Roos, & de Groot, submitted; Maaskant, Doets, & Kremer, submitted; van der Zanden et al., 2014). Maaskant and colleagues (submitted) explored health interest among community-dwelling older adults and reported a low interest in protein-enriched foods. In addition, Beelen et al. (submitted) conducted interviews with malnourished older adults and also observed a low awareness of proteins and malnutrition. Given the importance of liking and food palatability for repeated product choice (de Graaf, Cardello, Kramer, Lesher, Meiselman, & Schutz, 2005), the well-accepted PE dishes (irrespective of the type of protein enrichment) seem to be a potent starting point for further product development. When combined with, for example, adequate cluster tailoring and public health programmes that increase protein awareness, such well-liked PE dishes could ultimately support older consumers to optimise their protein intake.

General conclusion

In conclusion, this study highlights for the first time both the potency and the challenges of tailoring PE dishes to specific older consumer clusters. We showed that congruency between inferred functional meal associations and clusters' functional mealtime expectations does not guarantee an increased 'product–cluster fit'. Nonetheless, future research, incorporating, for example, other carriers or social contexts, is recommended to further our understanding of product tailoring for senior consumer segments.

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Chapter 7

General Discussion

Main findings

We explored two benefit-segmentation approaches: emotion-based and functionality-based, in order to find an actionable and effective basis for tailoring protein-enriched (PE) meals to vital community-dwelling older consumer segments. Following the model of Grunert and van Trijp (2014; Figure 7.1), we expected a better 'product–cluster fit' when the clusters' meal associations (in Figure 7.1: inferred product benefits) are congruent to their mealtime expectations (in Figure 7.1: desired product benefits).

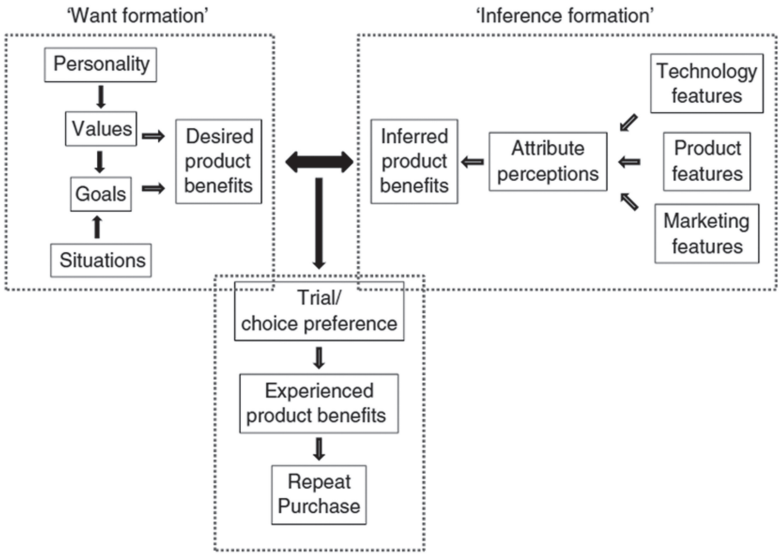

Figure 7.1 A framework on how consumers decide on new products (Grunert & van Trijp, 2014, p. 379).

When focussing on the emotion-based approach, we observed four older consumer segments; *pleasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*. The emotions these subgroups link to their mealtimes differed both in valence (i.e. pleasure-displeasure) and level of emotional arousal (i.e. activation-sleepiness). Following the above model (Figure 7.1), we hypothesised that foods/meals appeal to a particular cluster when they evoke emotions that are in congruency with the cluster-specific emotional mealtime expectations. Therefore, we explored to what extent the valence/arousal differentiation, as observed for *mealtime*-related emotions, could be observed for *food*-evoked emotions as well. We encountered that – irrespective of the method – seniors' self-reported food-evoked emotions did not clearly vary along the dimensions valence/arousal, whereas younger adults' emotions did. Therefore, it seems at this point challenging to identify the meals that evoke emotions congruent to the older clusters' emotional mealtime expectations. For this reason, food/mealtime-related emotions were considered to be not yet actionable enough as a basis for tailoring PE meals to senior consumer subgroups.

When focussing on the functionality-based approach, we observed three older consumer clusters; *physical nutritioners, cosy socialisers*, and *thoughtless averages*. These clusters differed in their functional mealtime expectations, especially regarding their focus on cosiness or physical aspects of the meal. The in-depth interviews provided actionable insights for tailoring PE meal concepts to the functionality-based clusters. These meal concepts were well-accepted by our participants. However, congruency between cluster and meal concept – in terms of functional expectations/associations – did not result in a better product–cluster fit (i.e. a more positive meal experience). Future studies, focussing on e.g. other products, are recommended to further establish the effectivity of mealtime functionality as a basis for tailoring PE meals to older consumer subgroups. Table 7.1 gives an overview of the main findings of this thesis.

Table 7.1 Overview of the main findings of this thesis.

Chapter	Aim	Method	Main findings
The emotion-based segmentation approach:			
2	Describing subgroups of older adults based on their mealtime-related emotions	Consumer segmentation	4 Emotion-based older consumer clusters Mealtime-related emotions of these clusters vary along the dimensions valence and arousal: • *pleasurable averages* • *adventurous arousals* • *convivial indulgers* • *indifferent restrictives*
3	Exploring older adults' food-evoked emotions and compare them to the profiles of younger adults	CLT*: EsSense25 Products: chocolates & gingerbreads	The food-evoked emotions reported by older adults vary less along the dimensions valence & arousal than those reported by their younger counterparts
4	Exploring older adults' food-evoked emotions and compare them to the profiles of younger adults	CLT*: PrEmo tool & Affect Grid Products: chocolates & gingerbreads	The food-evoked emotions reported by older adults vary less along the dimensions valence & arousal than those reported by their younger counterparts
The functionality-based segmentation approach:			
5	Describing subgroups of older adults based on their mealtime functionality	Consumer segmentation & In-depth interviews	3 Functionality-based older consumer clusters: • *cosy socialisers* • *physical nutritioners* • *thoughtless averages*
6	Exploring mealtime functionality for tailoring protein-enriched (PE) meals to older consumer subgroups	Home-use test Products: tailored PE meal concepts	The tailored PE meal concepts were well-accepted by the older adults. However, congruency between the clusters' functional mealtime expectations & functional meal associations did not result in a better 'product–cluster fit'

*CLT: Central location test.

Methodological considerations

Before we elaborate on the result of this thesis it is relevant to take a number of methodological considerations into account.

Study design

In our studies we predominantly applied explicit methods (e.g. EsSense25, PrEmo tool, interviews). We selected these methods as they fitted our study designs (Meiselman, 2015), such as being suitable for home-use measurements (Edwards, Hartwell, & Giboreau, 2016). Besides, most questionnaires that we selected have been extensively documented in the literature (Gutjar et al., 2014; King & Meiselman, 2010; Ng, Chaya, & Hort, 2013; Steptoe, Pollard, & Wardle, 1995), which enabled us to compare our results to earlier findings in other age groups. The latter is desirable given the limited knowledge on the effect of ageing on food/mealtime-related emotions (Kremer & den Uijl, 2016) and mealtime functionality. However, part of the consumer's food/mealtime experience occurs below the level of consciousness (Barrett, Mesquita, Ochsner, & Gross, 2007; Kahneman, 2003; Köster, 2003; Köster & Mojet, 2015), which means that consumers are not aware of these experiences and per definition cannot report them in surveys or during interviews. One could therefore advocate the use of implicit methods, such as observational measurements (e.g. facial/bodily expressions), physiological measurements (skin conductance response, skin temperature, heart rate, etc.), or reaction-time measurements (e.g. implicit association tasks, lexical decision tasks) (de Wijk, Kooijman, Verhoeven, Holthuysen, & de Graaf, 2012; Greenwald, McGhee, & Schwartz, 1998; Liao, Corsi, Chrysochou, & Lockshin, 2015; Meyer & Schvaneveldt, 1971). However, it seems that – at least for emotion measures – the inconsistent outcomes of such methods (Charles & Piazza, 2009; Kunzmann, Kupperbush, & Levenson, 2005; Seider, Shiota, Wahlen, & Levenson, 2011; Uchino, Birmingham, & Berg, 2010) and the age-related factors (e.g. physical changes of the skin and antihypertensive medication) make it challenging to select an appropriate method and to properly interpret the results. Therefore, systematic research into seniors' physiological measures of food-evoked emotions seems warranted before such measures are applied in the assessment of older adults' food-evoked emotions. To our knowledge, few – if not zero – implicit results have been reported with regard to mealtime functionality. Therefore, further exploration of implicit methods for measuring seniors' mealtime functionality is warranted as well. Details on future research directions related to this topic are presented in the section 'Practical implications and directions for future research'.

Another characteristic of the current studies is that we performed our studies both in a laboratory context (chapter 3 & 4) and in a real life context (chapter 6). This choice imposed a trade-off between control and external validity (Edwards, Hartwell & Giboreau,

2016; Meiselman, 2015). For example, in the studies where we measured food-evoked emotions we did not take into account the natural environment in which a food is usually consumed (i.e. we measured emotions in our sensory lab), whereas this environment might impact on consumer perception (Cardello, Schutz, Snow, Lesher, 2000; King, Meiselman, Hottenstein, Work, Cronk, 2007; Köster, 2009; Meiselman, Johnson, Reeve, Crouch, 2000; Rozin & Tuorila, 1993). However, for these studies the main objective was to compare emotion profiles between two age groups, and with this in mind a naturalistic context did not outweigh the advantages of monitoring and control of test procedures/ products and financial costs (Lawless & Heymann, 2010). When studying functional meal experiences the naturalistic context was included, as this has been described as a crucial factor for capturing actual consumer experiences (Cardello, Schutz, Snow, Lesher, 2000; Jaeger et al., 2016; Köster, 2009; Meiselman, Johnson, Reeve, Crouch, 2000).

Participants

Our results apply mainly to the vital community-dwelling older population and the implications should in first place focus on this target group. Our approach has the advantage that it can help the vital senior group to optimise their protein intake at a relatively early stage of the ageing process. The onset of physiologic and behavioural changes that precede sarcopenia can occur already during the fourth to fifth decade of life (Fielding et al., 2011). It could therefore be effective to support an optimal protein intake in relatively young seniors, so that they have a higher chance to meet their protein requirements and benefit from a maintained physical functioning for as long as possible.

Of course, the implications of the current senior consumer segments may also be relevant for e.g. frail older adults, but application within such populations requires verification first. Having said this, one needs to be aware of the challenges faced when studying frail older adults. This frailer group is characterised by (often severe) physical and/or mental impairments, which makes recruitment and study participation difficult. Such challenges are target group specific and need to be considered at an early stage of the study set-up.

Discussion and interpretation of the main findings

Mealtime-related emotions versus food-evoked emotions of older adults

For older adults, mealtimes appeared to be more emotionally arousing than actual foods. That is, mealtime-related emotions reported by older adults varied along the two dimensions valence and arousal, whereas their food-evoked emotions did not follow this pattern.

These self-reported food-evoked emotion results seem to contrast those of younger adults, showing clear differentiation along the valence/arousal axes for a wide range of foods and methods (Einöther, Baas, Rowson, & Giesbrecht, 2015; Gutjar et al., 2015; Ng, Chaya, & Hort, 2013). These findings trigger the question whether the older group is generally less reactive to arousing food-stimuli than their younger counterparts or whether this group is less likely to report emotional arousal.

When comparing previously self-reported (non-food) arousal responses of younger and older adults it catches the attention that findings are inconsistent and highly depend on e.g. the type of stimulus that is selected. For example, Pearce and Halpern (2015) observed that compared to their younger counterparts, older adults reported lower levels of emotional arousal in response to fearful, happy, and tender music. Also Kunzmann, Kupperbush, and Levenson (2005) showed that seniors reported lower ratings of high arousal emotions after watching arousing medical movies (e.g. eye operation, treatment burn victim, and arm amputation) than the younger group. In contrast, seniors tend to report higher – or at least similar – levels of arousal after watching sad movies related to family loss compared to their younger counterparts (Kunzmann & Gruhn, 2005; Seider, Shiota, Wahlen, & Levenson; 2011; Tsai, Levenson, & Carstensen, 2000). Therefore, it seems that some stimuli, such as family relations and family loss, are more relevant to this age group, and hence are more likely to evoke a – conscious – arousal response. This explanation is supported by the selective optimization with compensation model (Baltes, Baltes, & Baltes, 1990) and the social selectivity theory (Carstensen, 1992). These models tie emotion regulation to life-phase-specific choices (Alea, Diehl, & Bluck, 2004) and stress that seniors tend to focus on emotionally relevant goals. The latter line of thought can be translated to the food-context of the current thesis. It could be that the often encountered central role of food products diminishes with age, whereas other themes (e.g. independence, self-maintenance, and social relations) might become more dominant over the years (Carstensen, 1993; Carstensen, Fung, & Charles, 2003; Harrefors, Sävenstedt, & Axelsson, 2009). The strong link of mealtimes with social interactions and family relations might explain why these 'stimuli' maintain their relevance, and consequently their ability to trigger emotional arousal in older adults.

Alternatively, it is also possible that self-reporting methods are less suitable to pick up food-related arousal – if any – in the older group. Kuijsters, Redi, de Ruyter, and Heynderickx (2015) reported that older adults show clear physiological arousal responses when exposed to activating room ambiance (i.e. a room with blue lighting). The latter finding was however not supported by changes in the self-assessment manikin arousal ratings (SAM; Bradley & Lang, 1994). This disconnection of physiological arousal and self-reported arousal has been reported by others as well (Kunzmann & Gruhn, 2005; Kunzmann, Kupperbusch, & Levenson, 2005; Neiss, Leigland, Carlson, & Janowsky, 2009; Tsai, Levenson, & Carstensen, 2000). Therefore, it could be that with advancing age physical arousal is less clearly 'expressed' in conscious subjective responses, similar to other age-related declines (e.g. sensory, memory). However, taking into account the relatively-well preserved emotion system of older adults (see introduction on 'emotional ageing'), it seems more likely that the disconnection between physiological and self-reported arousal reflects a certain cohort effect (see discussion Windsor, Burns, & Byles, 2012). Some of our participants grew up during or directly after World War II, which might have influenced their current view on food (i.e. no fussing about food, be grateful for what is on your plate; do not waste food). To date it is unclear whether our observations apply mainly to the current older adult cohort, or whether they will also become apparent in younger persons as they age.

Emotion-based versus functionality-based segmentation approach

We explored two benefit segmentation approaches (emotion-based and functionality-based) as starting points for tailoring PE meals to older consumer segments. These approaches shed new light on the heterogenic nature of the older adult group, as it appeared to be not only heterogenic in terms of psychographics and gerontographics (Leventhal, 1991; Morgan, 1993; Moschis, 2003), but also in terms of emotional and functional mealtime expectations. Nonetheless, the question remains whether it is possible to select one segmentation approach as most actionable (i.e. practically achievable) and effective (i.e. resulting in a better 'product–cluster fit') for tailoring PE meals to senior consumer segments.

On first sight, our mealtime-evoked emotion segments seem to provide guidelines for developing products tailored to the emotion-based clusters; i.e. in order to meet the mealtime expectations of the emotion-based clusters products should evoke emotions varying in valence and arousal. However, for various self-reporting methods (i.e. EsSense25, PrEmo tool, Affect Grid) we encountered that seniors' *food*-evoked emotions cannot as easily be differentiated along the dimensions valence and arousal as *mealtime*-related emotions. Following the model of Grunert and van Trijp (2014) (Figure 7.1), it is therefore at this point challenging to establish which products evoke emotions that are in congruency with seniors' emotional mealtime expectations, let alone to establish whether this congruency can result in more product success.

Furthermore, we noticed during our test sessions that seniors experience food-evoked emotions as 'more difficult to capture' than mealtime functionalities. During the in-depth interviews seniors could express their functional expectations regarding mealtimes and PE foods well; whereas they often mentioned to find it 'a bit strange' to rate e.g. how mild they felt after consuming a product. The latter issue has been reported by Jaeger, Cardello, and Schutz (2013) and Ruark, Vingerhoeds, Kremer, Nijenhuis-de Vries, and Piqueras-Fiszman (2016) as well. In these studies, some (older) participants also considered filling out an emotion questionnaire in relation to actual foods/food names to be strange and difficult.

The above issues underline that at this point we do not seem to understand seniors' food-evoked emotions and their measurement methods well enough in order to apply them to tailor actual food products to older consumer clusters. Taken into account the challenges faced when applying other (implicit) emotion measuring methods (see section on 'study design'), we recommend more fundamental research that e.g. studies the link between seniors' physiological and self-reported emotions and stimulus-dependency of (food-evoked) emotions, before applying food/mealtime-related emotions to tailor PE meals to older consumer segments.

In contrast, our mealtime functionality approach showed to be more actionable, since the functional associations that we aimed to trigger with our tailored meal concepts were 'picked-up' by the senior participants. Moreover, these tailored meal concepts were well-accepted by the older adults. Given the important role of hedonic food liking in food intake and (repeated) food choice (de Graaf et al., 2005; Gutjar et al., 2015), our meal concepts seemed therefore to be a proper starting point for further development. However, in contrast to our expectations, our approach did not yet show to be an effective tailoring strategy, since congruency between functional mealtime expectations and functional meal associations did not result in higher product appeal or higher consumer satisfaction. Mealtime experience and mealtime satisfaction/success are probably much more complex and depend on more factors than considered in the current study (see also Köster, 2009, Figure 1). Congruency between only one of the many influencing factors (in this case: functional expectations) might therefore not be enough to positively impact on mealtime experience.

In spite of that, we still consider this functionality-based approach to be most promising, since it provides practical guidelines for developing tailored PE meal concepts (i.e. the approach is actionable). Moreover, taking into account the novelty of our approach, we observed several factors that should first be further explored (e.g. product dependency; for details see section on 'practical implications and directions for future research'), before a final judgement on effectiveness of the functionality-based approach can be given.

Hedonic liking of PE meal concepts

In the studies of this PhD thesis we gained understanding of older adults' attitudes towards protein-enriched foods and meals. We encountered that it is possible to enrich well-known meals (in our case: kale mash) with protein, without compromising on hedonic liking. The latter is remarkable taking into account seniors' low awareness of their protein needs (Maaskant, Doets, & Kremer, submitted; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014) and their low willingness to purchase PE food (van der Zanden, van Kleef, de Wijk, & van Trijp, 2015). It could be that the type of task selected, i.e. reporting willingness to buy versus reporting actual experience, is of influence here. When reporting willingness to purchase, the focus may be more on the protein enrichment, whereas in the case of actual meal experience other factors (e.g. intrinsic product characteristics, situational factors, psychological factors; Köster, 2009) may impact on meal perception as well. As a result the current PE meal concepts might have been experienced more positively than hypothesised from the above literature.

Practical implications and directions for future research

Even though we did not observe an increased success when our tailored meal concepts were congruent to the clusters' functional mealtime expectations, we still see the value of further developing these meal concepts. In the end, we were able to enrich well-known meals with protein, without compromising on hedonic liking. The latter finding holds potential, taking into account the positive influence of hedonic liking on product choice and product experience (de Graaf et al., 2005; Gutjar et al., 2015). Our approach of adding protein-rich ingredients to established recipes, in order to increase protein content of the dish, may therefore inspire companies, such as Hello Fresh and Ahold. These companies could add a number of meal-boxes to their assortment with recipes and ingredients of protein-enriched meals. Our concepts may also be applied by chefs from caterers and institutes/companies, like Meals on Wheels, Unilever Food Solutions, and Sodexo, by providing PE versions of their existing meals. Such tasty and nutritious meals may support an optimal protein intake of older adults.

Another practical implication of the current work is the translation of older consumer segment characteristics to marketing/communication strategies, rather than to actual meal concepts. Our studies showed four emotion-based senior consumer clusters (mainly differing in mealtime-related emotional valence/arousal), and three functionality-based consumer clusters (mainly differing in cosiness/physical mealtime-orientation). Marketers could take these cluster characteristics into account when targeting campaigns at older consumers. In order to do so, they could for example customise music (Groenland & Schoormans, 1994; Lundqvist, Carlsson, Hilmersson, & Juslin, 2008; Västfjäll, 2002) or visual

cues (e.g. colour hue, type of pictures; Gilbert, Fridlund, & Lucchina, 2016; Oberascher & Gallmetzer, 2003). Such strategies reflect a more holistic approach, in which the commercial (where the food/meal is part of) evokes a certain experience that matches the (emotional/functional) mealtime expectations of the older consumer (Desmet, Fokkinga, Ozkaramanli, & Yoon, 2016). Desmet et al. (2016) stressed the importance of such a 'context for experience', since "consumer product experience is often not 'about' the product, but about activities and situations in which the product is consumed."

In addition to these practical applications, the outcomes of the current thesis also raise some suggestions for follow-up projects. In the previous chapters we already touched upon the study-specific directions for future research. In the following paragraphs we will elaborate on the directions that apply to this thesis as a whole.

An important direction for future research is to better understand the product dependency of older adults' food-evoked emotions and functional associations. In our studies we observed that the emotions that older adults associate with their mealtimes differ along the dimensions valence and arousal, whereas those associated with actual foods (chocolate, gingerbread) do not. Also, we countered that functional associations could be inferred to our kale mash meal concepts. All products tested in this thesis were selected carefully, taking into account e.g. product familiarity, consumption frequency (King & Meiselman, 2010), availability of flavour variants, and suitability for protein enrichment. However, it would be relevant to further explore whether these results are also observed when products other than kale mash, chocolate and gingerbread are selected. Such products/meals should preferably be healthy and frequently consumed by older adults (such as dairy products) (van der Zanden, van Kleef, de Wijk, & van Trijp, 2014; Vella, Stratton, Sheeshka, & Duncan, 2013), since such products have been reported to be 'suitable' for protein enrichment by older adults before.

Furthermore, we recommend further exploring the influence of (social) context on meal perception of older adults. We applied food ingredients and recipe cues to trigger functional associations. This approach takes the consumer expectations and the product into account, but not the actual (social) context in which the products are eaten. Nevertheless, the social context and meal ambiance might be important factors for meal perception, in particular for some older consumer subgroups (e.g. *cosy socialisers*). Previous studies have shown the positive impact of social interactions and improved meal ambiance on e.g. quality of life, dietary intake, and risk for malnutrition (e.g. Desai, 2007; Mathey, Vanneste, de Graaf, de Groot, van Staveren, 2001; Nijs, de Graaf, Siebelink, Blauw, Vanneste, Kok, & van Staveren, 2006; Nijs, de Graaf, van Staveren, and de Groot, 2009; Simmons & Schnelle, 2004). However, these latter studies focussed on frail (institutionalised) elderly, whereas to our knowledge few – if not zero – studies take into account the vital community-dwelling older group. Therefore, it would be worthwhile to explore the influence of improved meal ambiance on

meal experience of vital community-dwelling older adults. Such a project could for example take a technological approach, using mobile devices with online communication tools or immersive virtual reality (Guttman et al., 2015; Khosravi, Rezvani, Wiewiora, 2016; Porcherot, Delplanque, Ischer, de Marles, & Cayeux, 2015). One of the experiments within such a project could be a home-use test, similar to the one described in chapter 6 of this thesis, but now extended with a social condition (where seniors consume their meals together with others; real life, immersive virtual reality, or via skype) and non-social condition (where the seniors consume their meals alone). Alternatively, one could take an approach more similar to that of Nijs et al. (2006), focussing on the eating environment factors, such as table dressing (tablecloths, full cutlery, and subtle flower arrangements). Based on the findings of the current thesis one would expect that (virtual) social company and enhanced eating environment have a strong positive influence on the meal experience of social oriented eaters, whereas they might have less impact on the meal experience of other functionality-based clusters.

Also, the currently available tools for measuring food-evoked emotions and mealtime functionalities are a point of attention for future research. As discussed in the section 'study design', we applied self-reporting methods, such as surveys and interviews, which might have disadvantages related to their cognitive/explicit nature (Barrett, Mesquita, Ochsner, & Gross, 2007; Kahneman, 2003; Köster, 2003; Köster & Mojet, 2015). However, in the case of (food-evoked) emotions, it seems at this point challenging to select a suitable alternative to the explicit tools, due to inconsistent outcome measures and age-related factors (see section 'study design' and Charles & Piazza, 2009; Kunzmann, Kupperbush, & Levenson, 2005; Seider, Shiota, Wahlen, & Levenson, 2011; Uchino, Birmingham, & Berg, 2010). Therefore, it seems relevant to systematically examine the dependency on stimulus, method, and chronological age of e.g. physiological emotion measurements. In the case of mealtime functionality, tools can be further developed by exploring observational methods. One could make use of for example pictures or video material of older adults' meal preparations and actual meals. Information obtained from such media is less dependent of self-reporting and could provide insight in older adults' functional mealtime expectations. In addition, these observational outcome measures could serve as an interesting – alternative – benefit-segmentation basis, including the observed meal-related characteristics as segmentation parameters.

Lastly, we stress that the current field of older consumers, emotions and mealtime functionality is still in its infancy, and hence studies – including the current studies – are typically cross-sectional. Therefore the current results may be prone to cohort effects; i.e. successive age cohorts may differ in their food and mealtime experiences at the same chronological age, due to e.g. environmental, nutritional, societal, economic, and political differences. As discussed earlier, the generation that lived through World War II probably

differs in its food and mealtime norms from the post-war generation that grew up with an abundance of food choices. Longitudinal studies that measure e.g. mealtime functionality over the years are needed to better understand the influence of ageing as such on mealtime experiences.

Conclusions

From this research project we obtained two novel segmentation approaches for describing the heterogeneous group of vital community-dwelling older consumers; 'emotion-based' and 'functionality-based'. Our emotion-based segmentation approach appeared to be less actionable for tailoring (PE) meals to older consumer clusters, given the challenge to identify foods that evoke the desired emotional mealtime benefits of these subgroups. In contrast, the functionality-based segmentation was more actionable and proved to be a potent starting point for the development of tailored PE meals. These tailored PE meal concepts were well-accepted by senior consumers. However, congruency between clusters' functional mealtime expectations and functional meal associations did not result in an increased 'product–cluster fit'. We recommend future studies, incorporating e.g. other foods/meals, to further explore mealtime functionality as a basis for tailoring PE meals to senior consumers.

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Summary

The population of older adults is worldwide rapidly growing. For these people dietary proteins are of special interest, as they do not always have an adequate protein intake. The latter is troublesome given the risk for negative outcomes related to an inadequate protein intake, such as sarcopenia. In addition, this older group is highly heterogeneous, due to long and divergent life experiences and ageing processes. It would therefore be relevant to tailor protein-rich foods to subgroups of older persons, as a first step in empowering them to better meet their food requirements.

The aim of this thesis was to find an actionable (i.e. practically achievable) and effective (i.e. resulting in a better 'product–cluster fit') basis for tailoring protein-enriched (PE) meals to vital community-dwelling older consumers. To this end, we explored two benefit-segmentation approaches: emotion-based and functionality-based. We first described older consumer subgroups on the basis of their mealtime-related emotions and mealtime functionality (i.e. functional mealtime expectations). Subsequently, we explored the extent to which these emotion-based and functionality-based approaches can be applied to tailor PE meals to the older consumer subgroups. We expected a better 'product–cluster fit' (i.e. a more positive meal experience) when the clusters' meal/product associations are congruent to their mealtime expectations.

Chapter 1 provides background information on protein intake and healthy ageing, heterogeneity of the older population, emotional ageing, food-evoked emotions, and mealtime functionality. Additionally, the research aim and the outline of this thesis are presented.

In chapter 2, 3 and 4, we explored the emotion-based approach. In **chapter 2** we described older consumer segments on the basis of their mealtime-related emotions. We conducted an online survey in which vital community-dwelling older adults reported their mealtime-related emotions and mealtime functionality. Using a hierarchical cluster analysis, we described four emotion-based older consumer clusters: *pleasurable averages, adventurous arousals, convivial indulgers*, and *indifferent restrictives*. The emotions that these segments associate with their mealtimes varied along the two dimensions valence and arousal.

We hypothesised that meals appeal to the latter emotion-based clusters when they evoke emotions congruent to the cluster-specific emotional mealtime expectations. However, to identify the meals/foods evoking such emotions, food-evoked emotions need to be measured. In chapter 3 and 4, we therefore conducted two central location tests (CLTs) to explore older adults' food-evoked emotions. In the **chapter 3** we applied the EsSense25 method for measuring participants' emotions evoked by different types of gingerbread and chocolate. In **chapter 4**, we applied the PrEmo2 tool and the Affect Grid to measure participants' emotions evoked by the same products. From both CLTs we learned that the variation in valence-arousal as observed for mealtime-related emotions was not observed for emotions related to actual food products. The latter makes it challenging to identify

products that evoke emotions congruent to the mealtime expectations of the emotion-based clusters.

In chapter 5 and 6 we explored the functionality-based approach. In **chapter 5** we re-analysed the online survey data described in chapter 2, now taking mealtime functionality as a starting point for describing older consumer segments. We additionally conducted in-depth interviews with a subgroup of survey participants, in order to get further insights regarding their functional mealtime expectations and their attitudes towards proteins and protein-enrichment. We encountered three functionality-based older consumer segments; *physical nutritioners, cosy socialisers,* and *thoughtless averages.* The *cosy socialisers* value the social interactions and cosiness during their mealtimes, whereas the *physical nutritioners* focus more on the health and nutrient aspects of meals. *Thoughtless averages* have the least distinctive mealtime expectations.

Based on the insights obtained in chapter 5, we developed two PE meal concepts in **chapter 6**, one tailored to the functional mealtime expectations of *cosy socialisers* and one to those of the *physical nutritioners*. Subsequently, we conducted a home-use test in which cosy socialisers and physical nutritioners prepared, consumed, and evaluated the tailored meal concepts. In the first week the participants prepared a non-tailored/non-PE warm-up meal. In the two subsequent weeks they prepared – in randomised order – the cosy and physical meal concepts. The participants reported their expectations and experiences with the meal concepts (e.g. expected liking, actual liking, taste, smell, satisfaction). These meal concepts were well-accepted by the participants. In addition, the cosy meal concept was also experienced as 'traditional', whereas the physical meal concept was perceived as 'healthy', 'trendy', and 'energising'. However, congruency between functional mealtime expectations and functional meal associations did not result in a better 'product–cluster fit'.

In **chapter 7** we discuss the main findings and conclusions of this thesis. Given the challenge to identify congruency between the meal associations and the mealtime expectations of the emotion-based clusters, we consider the emotion-based approach to be not yet actionable enough as a basis for tailoring PE products to older consumers. In contrast, the functionality-based approach appeared to be more promising, since the functional meal expectations could be translated to well-accepted tailored PE meal concepts. However, we could not – yet – confirm the effectivity of our functionality-based approach, since congruency between functional meal associations and functional meal expectations did not result in a more positive meal experience. Future studies, focussing on e.g. other meal types, are recommended to further explore mealtime functionality as a basis for tailoring PE meals to older consumer subgroups.

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Proost, Cheers, Skål!

Louise

About the author

Curriculum vitae

Louise den Uijl was born in Vlissingen (NL) on 3 May 1989. After completing secondary school (Atheneum mgr. Frencken college) in 2007, she studied Nutrition and Health at Wageningen University. She received her cum laude bachelor degree in 2010. After that she enrolled in the Double Degree Sensory Science MSc programme, a joint programme of Wageningen University and Copenhagen University. During this programme she studied for six months at Copenhagen University, Denmark. In 2012, she received her MSc degree after completing her thesis on texture-specific satiety and internship at the sensory team of FrieslandCampina Innovation in Wageningen.

In 2012, Louise was appointed as a PhD candidate at Wageningen UR Food and Biobased Research and the department of Human Nutrition of Wageningen University in the project 'novel protein foods, what do elderly need, what do they want?' Her research focussed on the development of tailored protein-enriched foods for older consumer subgroups, as described in this thesis.

During her PhD project, Louise joined the educational programme of Graduate School VLAG. She attended several (inter)national conferences and courses, and was involved in teaching activities. She supervised BSc and MSc students in their thesis projects. In addition to the activities directly related to her PhD project, Louise co-authored a book chapter on emotional ageing, and she published an additional study in collaboration with Nutricia Research. Furthermore she was member of the Newtrition committee. In 2016, she was awarded with the prestigious E3S Eurosense student award by the European Sensory Science Society.

List of publications

Peer reviewed publications

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. (2016). Self-reported food-evoked emotions of younger adults, older normosmic adults, and older hyposmic adults as measured using the PrEmo2 tool and the Affect Grid. *Food Quality and Preference, 51*, 109–117.

Kremer, S., **den Uijl**, L.C. (2016). Studying emotions in the elderly. In: Meiselman, H. L. (Eds.) *Emotion Measurement*. Woodhead Publishing, UK.

den Uijl, L. C., Jager, G., de Graaf, C., Meiselman, H. L., & Kremer, S. (2015) Emotion, olfaction, and age: A comparison of self-reported food-evoked emotion profiles of younger adults, older normosmic adults, and older hyposmic adults. *Food quality and Preference, 48*, 199-209.

den Uijl, L. C., Kremer, S., Jager, G., van der Stelt, A. J., de Graaf, C., Gibson, P., Godfrey, J., & Lawlor, J. B. (2015). That's why I take my ONS. Means-end chain as a novel approach to elucidate the personally relevant factors driving ONS consumption in nutritionally frail elderly users. *Appetite, 89*, 33-40.

den Uijl, L. C., Jager, G., de Graaf, C., Waddell, J., & Kremer, S. (2014). It is not just a meal, it is an emotional experience – A segmentation of older persons based on the emotions that they associate with mealtimes. *Appetite, 83*, 287-296.

Submitted publications

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. Applying mealtime functionality for tailoring protein enriched meals to older consumer segments. Submitted to *Food Quality and Preference*.

den Uijl, L. C., Jager, G., de Graaf, C., & Kremer, S. Cosy or nutritious proteins? Exploring mealtime functionality of vital community-dwelling older adults through consumer segmentation and a means-end chain approach. Submitted to *Appetite*.

Abstracts and presentations

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. Applying mealtime functionality for tailoring protein enriched meals to older consumer segments. Eurosense, Dijon France, September 2016. *Poster presentation*.

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. Applying mealtime functionality for tailoring protein enriched meals to older consumer segments. Symposium Eating in the elderly, pleasure and health in everyday life, at home and in nursing homes, Institute Paul Bocuse, Lyon France, June 2016. *Oral presentation.*

den Uijl, L. C., Jager, G., de Graaf, C., Kremer, S. Cosiness or Nutrients? Exploring mealtime functionality of vital community-dwelling older adults through consumer segmentation and a means-end chain approach. British feeding and drinking group meeting, London UK, April 2016. *Oral presentation*.

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. Silver food-evoked emotions? The application of the PrEmo2 tool and the Affect Grid to measure self-reported emotional responses to food products of seniors and adults. Monell chemical centre, Philadelphia USA, October 2015. *Oral presentation*.

den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. Silver emotion methods? Exploring methods for measuring food-evoked emotions in older adults. Pangborn conference, Goteborg Sweden, August 2015. *Oral presentation*.

den Uijl, L. C., Jager, G., de Graaf, C., Meiselman, H. L., & Kremer, S. Emotion, olfaction and age. Food-evoked emotions of older normosmic persons, older hyposmic persons, and adults. British feeding and drinking group meeting, Wageningen The Netherlands, April 2015. *Poster presentation*.

den Uijl, L. C., Jager, G., de Graaf, C., & Kremer, S. The silver protein meal. IPOP meeting, Friesland Campina Innovation, Wageningen The Netherlands, November 2014. *Oral presentation*.

den Uijl, L. C., Kremer, S., Jager, G., van der Stelt, A. J., de Graaf, C., Gibson, P., Godfrey, J., & Lawlor, J. B. That's why I take my ONS, Means-end chain as a novel approach to elucidate the personally relevant factors driving oral nutritional supplement consumption in nutritionally frail elderly users. Eurosense, Copenhagen Denmark, September 2014. *Poster presentation*.

den Uijl, L. C., Jager, G., de Graaf, C., & Kremer, S. nPro- Nieuwe eiwitrijke producten. Bijeenkomst Nederlands Academie van Voedingswetenschappen, Wageningen The Netherlands, April 2014. *Oral presentation*.

den Uijl, L. C., Jager, G., de Graaf, C., Waddell, J., & Kremer, S. Novel protein foods: What do elderly need, what do elderly want? British Feeding and drinking group meeting, Portsmouth UK, March 2014. *Oral presentation*.

den Uijl, L. C., Jager, G., de Graaf, C., Waddell, J., & Kremer, S. Segmentation based on meal experience in vital independent living elderly subjects. European Sensory Network meeting, Valencia Spain, October 2013. *Oral presentation.*

den Uijl, L. C., Jager, G., de Graaf, C., Waddell, J., & Kremer, S. Segmentation of vital independent living elderly consumers based on meal experience. European Sensory Network meeting, Valencia Spain, October 2013. *Poster Presentation.*

Radio and Television presentations

Radio interview: BNR nieuws radio, "Bij 55-plus gaat after eight erin als koek" http://www.bnr.nl/nieuws/wetenschap/156065-1601/bij-55-plus-gaat-after-eight-erin-als-koek 7 January 2016.

Radio interview: Nieuwe feiten (radio 1 BRT, Belgium), "What do older adults like?" http://www.radio1.be/programmas/nieuwe-feiten/wat-vinden-oudere-mensen-lekker 12 January 2016.

Television interview: Hallo Nederland (OmroepMax), "Taste preferences young and old can differ" http://tvblik.nl/hallo-nederland/11-januari-2016. 11 January 2016.

Overview of completed training activities

Discipline specific courses and conferences	Organiser and location	Year
Regulation of energy intake: the role of product properties	Graduate school VLAG, Wageningen NL	2012
Nationale voedingscongres	Alliantie voeding Gelderse Vallei, NL	2013
Voeding als medicijn voor ouderen	RIVM, Bilthoven NL	2013
Drivers of liking	The institute for perception, Brussel BE	2013
ESN workshop elderly	European sensory network, Valencia ES	2013
Symposium healthy ageing	Wageningen UR, Wageningen NL	2013
Eurosense (European conference on sensory and consumer research)	Elsevier, Copenhagen DK	2014
British feeding and drinking group	LJMU School of psychology, Portsmouth UK	2014
PhD-course sensory evaluation and food preferences	KU-LIFE, Copenhagen DK	2014
British feeding and drinking group	Wageningen University, Wageningen NL	2015
Pangborn sensory science symposium	Elsevier, Goteborg SE	2015
British feeding and drinking group	University of Roehampton, London UK	2016
Eurosense (European conference on sensory and consumer research)	Elsevier, Dijon FR	2016
Symposium Eating in the elderly	Institute Paul Bocuse, Lyon FR	2016
General courses and activities	**Organiser and location**	**Year**
VLAG PhD week	Graduate school VLAG, Wageningen NL	2012
Teaching and supervising thesis students	Graduate school VLAG, Wageningen NL	2013
Scientific writing	Wageningen Graduate School, NL	2013
Master class longitudinal data analysis	Graduate school VLAG, Wageningen NL	2013
Project and time management	Wageningen Graduate School, NL	2014
Mobilising your scientific network	Wageningen Graduate School, NL	2014
Multivariate data analysis of food	Graduate school VLAG, Wageningen NL	2014
Survival guide to peer review	Wageningen Institute of Animal Sciences, NL	2015
Career perspectives	Wageningen Graduate School, NL	2016
Optional courses and activities	**Organiser and location**	**Year**
Preparation of research proposal	Wageningen NL	2012
PhD study tour to USA	Wageningen UR, Wageningen NL	2015
Meetings Sensory science & Eating behaviour group and Consumer science & Health group	Wageningen UR, Wageningen NL	2012-2016

Colophon

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