A flavour of emotions

Sensory & emotional profiling of wine, beer and non-alcoholic beer

ANA PATRÍCIA SILVA

Propositions

1. Wine is calm and loving, beer is adventurous and energetic.
   (this thesis)

2. The name of "non-alcoholic beer" is a key part in its failure.
   (this thesis)

3. The lengthy process of scientific publishing is slowing down the progress of science and innovation.

4. Metaphorical meaning of words are more valuable than p-values.

5. Consumers will always provide an answer, even to silly questions.

6. Only the Dutch correctly refer to the weather for their mood status.

Propositions belonging to the PhD thesis, entitled:

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Ana Patrícia Silva
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A flavour of emotions
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To Carolina and Rodrigo

Contents

01.

Chapter 1

General Introduction

Wine and beer are among the oldest alcoholic beverages and the most consumed worldwide (WHO, 2017). These beverages are well known for the sensory pleasure and short terms effects, such as relaxation, mood enhancement and social benefits (Charters & Pettigrew, 2008; Peele & Brodsky, 2000). A recent study suggested that moderate wine and beer consumption may contribute to a general emotional well-being of consumers by e.g. improving mood and reducing mental stress (Schrieks, 2015). However, it remains unclear what are the specific emotions evoked by wine *versus* beer consumption.

From a nutritional perspective, wine and beer are interesting beverages to study since patterns of consumption determine their effects on health and well-being. In some countries, when consumed in moderation, wine and beer are socially accepted as part of a healthy and balanced diet, because of their nutritional profile (FAO, 2017). Non-alcoholic beer is a relatively new beverage in the market and considered a healthier beverage than soft drinks and alcoholic beverages, due to its low caloric composition and absence of alcohol content (Sohrabvandi *et al.*, 2010). Besides the similarities with beer, non-alcoholic beer does not seem to be an appealing beverage to consumers, since patterns of consumption are marginal compared to wine and beer consumption (APCV, 2013; Jongh *et al.*, 2016; OIV, 2012).

One of the main challenges of food research is encouraging consumers to adopt healthier choices to reduce lifestyle-related problems (Grunert, 2016). In light of an increased relevance of moderate/low alcohol consumption in the diet, it is important from a public health perspective to understand consumer´s perception of alcoholic *versus* non-alcoholic beverages. Therefore, we need to know the patterns and habits of consumption as well as the main contextual and psychological determinants that characterise and influence the drinking experience of different beverages.

To understand consumption experiences a relatively new model - conceptual profiling - has been applied to characterise and differentiate different food products (Gutjar, 2015; Ng *et al.*, 2013b; Thomson & Crocker, 2015; Thomson *et al.*, 2010). Conceptual profiling is derived from the combination of the sensory perceptions of a product with its conceptualisations, i.e. functional and emotional cognitive associations that consumers assign to a specific product (Thomson, 2016).

Our understanding of the influence that emotions have on consumption experience is still limited. Therefore, in this thesis we compare sensory and emotion profiles aroused during wine, beer and non-alcoholic beer consumption, focusing on processes that play a role in consumption experience represented in Figure 1. This research will contribute to differentiate the beverages, between and within product categories, providing a better understanding of consumption experience and beverage choice.

This general introduction starts with the context of wine, beer and non-alcoholic beer consumption, followed by a description of emotional and conceptual profiling and how they can be measured. Lastly, the aim and thesis outline are described.
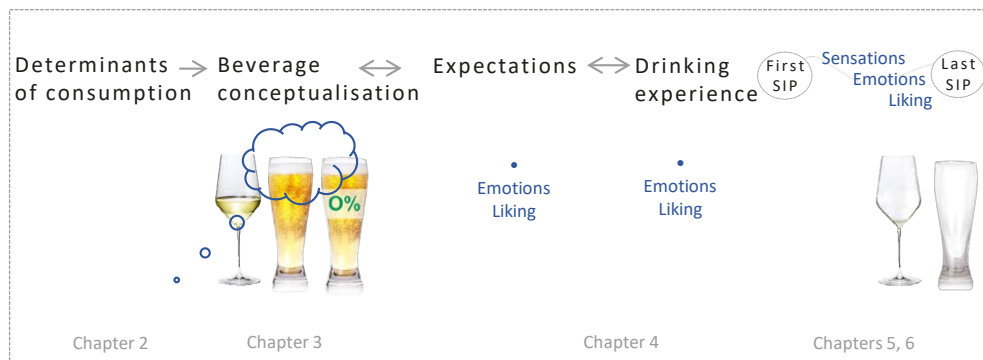

Figure 1 | Schematic overview of the processes of consumption experience approached in this thesis

Contextualisation of wine, beer and non-alcoholic beer consumption

Wine and beer consumption are an integral part of European life and culture, which in part define the diets of many Europeans. Drinking experiences and expectations include a cultural dimension (Peele & Brodsky, 2000). Portugal is classically perceived to be a wine country. It has a long cultural heritage of wine production and consumption, and wine is an important component of the national diet and food culture (Duarte *et al.*, 2010; Panzone & Simões, 2009). The Netherlands is typically perceived as a beer country and considered to have a cultural, social and economic comparable relation with beer (NeBs, 2015).

As there is no universal definition of moderate alcohol consumption, each country has its own guidelines for moderate alcohol consumption which may change over time (FAO, 2017). For instance, Portugal follows the Mediterranean diet, and wine consumption is accepted when it does not exceed two glasses/day for men and one glass/day for women, preferably within a meal (Pinho *et al.*, 2015). However, in the Netherlands the actual guidelines recommend not to drink alcohol or no more than one glass a day (Gezondheidsraad, 2015).

Non-alcoholic beer is a relatively new beverage in the market, has no cultural background, and it is certainly not as popular as wine and beer. On the other hand, due to its low caloric composition and absence of alcohol content, is conceived to be a healthier beverage compared to alcoholic beverages and soft drinks (Sohrabvandi *et al.*, 2010). Nevertheless, non-alcoholic beer does not seem as appealing as wine and beer, since patterns of non-alcoholic beer consumption in Portugal and in the Netherlands are marginal (APCV, 2013; Jongh *et al.*, 2016; OIV, 2012). As defined by Brányik *et al.* (2012), non-alcoholic beer is *just*

a drop in the sea of the overall beer production.

Given the increasing relevance of moderate alcohol consumption in consumer´s diet, it is important from the nutritional point of view, to study and compare consumer perceptions of wine, beer and non-alcoholic beer consumption. To understand consumer experience and beverage choice, we need to know how consumption patterns have evolved over the years in different cultures, and what are the most relevant contextual and psychological factors that influence the drinking experience.

Emotion profiling

Food-evoked emotions

Wine and beer consumption are well known for the pleasure of the flavour, short-term effects as relaxation, and are highly associated with high emotion context, such as social events and celebrations (Charters & Pettigrew, 2008; McCluskey & Shreay, 2011). Indeed, it is established that emotions play a role in the decision-making process and all consumption experiences are directed towards the pursuit of emotions and feelings (Holbrook & Hirschman, 1982).

On the last decade, sensory and consumer research gained a broader and innovative perspective since the field of food-evoked emotions has shown to provide additional consumer insights, beyond sensory measurements (Meiselman, 2015). Despite this expansion, there is no consensus on emotion definition. However, the three major theories of emotion, basic emotion, dimensional and appraisal theories, have a consensual view that an emotion is an event-focused experience, relevant to the person, with a short duration and a quick onset, leading to multiple emotional responses namely: expressions, actions tendency, bodily reactions, appraisal and feelings (Coppin *et al.*, 2016).

Beyond the familiar knowledge that moderate alcohol consumption evokes a relaxation effect and mood enhancement (Charters & Pettigrew, 2008; Peele & Brodsky, 2000; Schrieks, 2015), is not known which emotions are evoked by wine and beer consumption, and how consumption of these beverages contribute for the general emotional perception. Additionally, no specific study has been performed to assess emotions regarding non-alcoholic beer consumption. Studies have demonstrated that emotion profiles of foods and beverages are important not only for product characterisation but also to differentiate similar equally liked products (Gutjar *et al.*, 2013; Ng *et al.*, 2013a; Porcherot *et al.*, 2015; Spinelli *et al.*, 2015). To understand differences in consumption, we need to know what a consumer feels drinking wine, beer and non-alcoholic beer, and this has not been addressed yet.

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Methods in emotion profiling foods

Given the complexity of measuring emotions two main groups of methods emerged to measure food-evoked emotions: implicit and explicit methods (Köster & Mojet, 2015). The implicit methods are measured indirectly and imply that consumers are not able to report their emotional reaction but show a clear evidence of the emotional reaction, such as in facial expressions (Danner *et al.*, 2014) or in physiological measurements (He *et al.*, 2014). Explicit methods are directly measured and describe emotions and feelings that are consciously perceived. They include non-verbal methods, such as PrEmo (Gutjar *et al.*, 2015b), a visual self-report tool, and verbal methods, such as the EsSence Profile (King & Meiselman, 2010), or the Universal Geneva Emotion Odour Scale (UniGEOS) (Ferdenzi *et al.*, 2013), self-report food and odour emotion questionnaires. The latter category, self-report emotion questionnaires, is to date the most used method to measure food-evoked emotions (Cardello & Jaeger, 2016). In the last years most researchers, however, developed product-specific list of emotions (e.g. coffee (Bhumiratana *et al.*, 2014), beer (Chaya *et al.*, 2015) and for wine (Danner *et al.*, 2016; Ferrarini *et al.*, 2010)), mainly because culture and language play an important role on reported emotions (van Zyl & Meiselman, 2015; van Zyl & Meiselman, 2016) and also because general lists may not be sensitive enough to capture subtle differences between similar products. Similar to sensory evaluation, in emotion measurements, meaningful specific terms for the product category should be selected. So far, a specific emotion lexicon to measure and compare emotion responses of wine, beer and non-alcoholic beer consumption has not been developed.

An interest in food-evoked emotion measurement is how emotions evolve over time. Recently a dynamic method was developed, the Temporal Dominance of Emotions (TDE) (Jager *et al.*, 2014) but was not yet applied to wine or beer consumption.

Conceptual profiling

Aside from emotions, consumers assign meanings and cognitive associations stored in memory to a specific food or beverage, defined as conceptualisations (Thomson *et al.*, 2010). Conceptualisations are mostly divided in functional and emotional associations, and both may have emotional connotations that will lead to an emotional response. For example, a product that consumers conceptualise as healthy (functional association) could promote them to feel good (emotional response).

During product experience, the sensory perception of a product will interact with its conceptualisations leading to a certain degree of liking and influencing choice behaviour. Conceptual profiling was applied to differentiate among products of the same category, as chocolates, breakfast drinks and blackcurrant squashes (Crocker & Thomson, 2014; Gutjar, 2015; Ng *et al.*, 2013b), but not yet to wine, beer and non-alcoholic beer. Even though

some functional and few emotional associations of wine and beer consumption can be found in the literature, most studies focus on one beverage, so missing the comparability within the same group of consumers. Moreover, there is a lack of knowledge regarding to non-alcoholic beer consumption. Applying this innovative approach to describe the image of the beverages could give insights for a better understanding of consumption experience and beverage choice, e. g. the reasons why non-alcoholic beer is not widely used by consumers.

We acknowledge the relevance and difficulty to separate out "true" emotions from emotional associations (Cardello & Jaeger, 2016), but that is not within the scope of this thesis. For that reason, we will use the expressions "emotions", "emotion responses", "emotion conceptualisations" to refer to the general concept of feelings related to the beverages, being aware that not all words might represent a "true" emotion, but are certainly relevant for product characterisation.

Expectations

Due to the conceptualisations that consumer assign to products, expectations will be created, i.e. psychological anticipations that something will occur or be experienced (Cardello, 2007). During consumption, consumers compare their expectations to the actual experience, and confirmation or disconfirmation effects (positive or negative) might occur, affecting the next experience with the product, namely, repeated use or rejection (Deliza & MacFie, 1996). The same food or beverage can induce different sensory perceptions depending on consumer expectation at the moment of consumption (for a review see Piqueras-Fiszman and Spence (2015)).

Non-alcoholic beer is the closest beverage to beer, in a sense that both are produced with the same raw materials and non-alcoholic beer simulates sensory visual cues of beer. Intrinsically, the beverages look the same but there is a great effort to improve non-alcoholic beer flavour to make it comparable to beer (Brányik *et al.*, 2012; Catarino & Mendes, 2011). Extrinsically, most brands use comparable bottles and labels, in shape and colour, except product name. Product name can be interpreted as a measure of what consumers expects from the product (Cardello & Jaeger, 2016). Emotional expectations regarding food and odorant names differ from the ones generated by the actual food and odorant, influencing consumer judgement of the actual food or odour (Cardello *et al.*, 2012; Porcherot *et al.*, 2012). The product name "Non-alcoholic Beer" has not yet been studied and may give a rich contribution when compared to the "Beer" name in order to understand consumer´s expectations of the drinking experience.

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Dynamic profiles of sensations and emotions

While eating or drinking, many dynamic processes are involved in flavour release and therefore its perception should be measured dynamically (Dijksterhuis & Piggott, 2000). Temporal dominance of sensations (TDS) is one of the temporal methods that allows to record and measure how several sensations evolve sequentially during consumption (Pineau *et al.*, 2009). TDS shows supplementary information on the sequence of sensations and qualitative changes perceived during consumption that are not measurable with conventional sensory analysis, and has been successful applied in different foods and beverages, including wine and beer (Di Monaco *et al.*, 2014). Recently temporal liking (TL), i.e. liking measured at several points throughout the tasting period, was combined with TDS showing that TL is more discriminative than classical liking, i.e. overall score measured at one point, usually after tasting the product (Schlich, 2015; Thomas *et al.*, 2016; Thomas *et al.*, 2015). In addition, Jager *et al.* (2014) developed a similar method to TDS but to measure emotions - temporal dominance of emotions (TDE), considering that emotions are a continuous process and recursive, according to contemporary appraisal theories (Moors *et al.*, 2013). The authors combined TDS and TDE measurements and showed a relation between sensations and emotions evoked by different types of chocolate.

All the previous food-evoked emotion studies, however, do not consider the temporality occurred during consumption, and the measurements were performed after tasting the samples (Chaya *et al.*, 2015; Gutjar, 2015; Spinelli *et al.*, 2014; Thomson *et al.*, 2010), i.e. statically, capturing the overall emotion perception of the product. This means the information provided is limited to one point of consumption.

Up till now the understanding of the dynamic interaction between sensations and emotions is still limited and regarding wine and beer that topic has not been studied yet. It would therefore be relevant to have insights in how sensations and emotions evolve over consumption and how they interact with dynamic liking, to show information related to the whole wine and beer experience of consumption.

Natural situation of consumption

Most sensory and consumer studies are commonly performed in controlled laboratories environment and tasting the conventional amount of 10-30 mL (for beverages), which certainly serves specific purposes, but does not mimic the real-life drinking situations. Emotions experienced are context dependent (Barrett *et al.*, 2007) as well as food acceptability (Meiselman, 2006). Yet, it is recommended to use real-life situations in food research (Jaeger *et al.*, 2017; Köster, 2003; Meiselman, 2013), such as, to use portions close to the daily life consumption, or to perform studies in real consumption context. The later

has being increasingly applied to study food-evoked emotions (e.g. Danner *et al.*, 2016; Gutjar *et al.*, 2015a; Porcherot *et al.*, 2015).

Aim and thesis outline

This thesis compiles studies that combine measurements of sensory and emotion perceptions of beer, wine and non-alcoholic beer consumption, in two countries, the Netherlands, which by origin is a beer drinking country, and Portugal, a wine drinking country. The overall aim is to contribute to a better understanding of consumption experience and hence beverage choice, by using beverage-evoked emotions, in addition to their sensory perceptions.

This thesis starts with a literature review which identifies determinants for consumption of wine, beer, and non-alcoholic beer, using data on consumption patterns from Portugal and the Netherlands, and reflecting on cultural differences, contextual and psychological factors of consumption (**chapter 2**). In the next two chapters, we investigate conceptualisations between alcoholic *versus* non-alcoholic beverages (**chapters 3** and **4**). In **chapter 3**, we explore which are relevant functional and emotional associations that Portuguese and Dutch consumers have with wine, beer and non-alcoholic beer consumption, using a qualitative approach. We determine a list of twenty-five emotional conceptualisations related to these beverages consumption, which is further validated quantitatively and used in the following studies (**chapters 4, 5** and **6).** In **chapter 4**, we explore further how product name "Beer" and "Non-Alcoholic Beer" affects the conceptualisation of these beverages, comparing consumer expectations to the actual experience of consumption occurred in a bar. Next, to investigate conceptualisations between alcoholic beverages of the same category, temporal measurements during consumption were explored. We study how dynamic sensory and emotion profiles interact with one another and how this affects liking. In **chapter 5**, we compare two similar commercial tasting wines, inviting consumers to drink a glass of wine in a bar. In **chapter 6**, we compare commercial beers with small sensory differences, i.e. that differed only in the intensity of added hop aroma. Finally, in the general discussion, we discuss the main findings of this thesis and reflect on methodological considerations, practical implications and directions for future research (**chapter 7**). An overview of the studies performed is presented in table 1.

Table 1 | Overview of the studies performed in this thesis

	Aim(s) of the study	Method	Context/ Beverages	Participants/ Country
Literature review				
C.2	Review on wine, beer and non-alcoholic beer patterns of consumption in Portugal and in the Netherlands, reflecting on cultural differences, contextual and psychological factors of consumption *Critical Reviews in Food Science and Nutrition 57(7) (2017), 1340–1349*	Review of scientific and public literature	Wine, beer & non-alcoholic beer	-
Conceptual profiles of alcoholic *versus* non-alcoholic beverages, using a static approach				
C.3	To determine the image of NAB and reasons underlying its limited consumption, comparing functional and emotional conceptualisations of NAB with the ones from wine and beer To compare how two cultures, Dutch and Portuguese conceptualise these beverages *Food Quality and Preference 49 (2016) 54–65*	Focus groups	Comfortable, cozy room Wine, beer & non-alcoholic beer	56 wine, beer, non-alcoholic beer consumers Portugal and The Netherlands
C.4	To assess how the product name, "BEER" or "NON-ALCOHOLIC BEER", influenced liking and the emotions elicited, before and after drinking either a BEER or NAB, when the beverages were given to consumers named correctly and incorrectly with respect to their composition *Food Quality and Preference 55 (2017) 58-66*	Questionnaires to measure emotions and liking, before and after drinking	Bar (old brewery) Beer & non-alcoholic beer	155 beer consumers The Netherlands
Conceptual profiles between alcoholic beverages of the same category, using a dynamic approach				
C.5	To explore the sensitivity of temporal dominance of sensations and emotions as well as temporal liking of two similar tasting commercial wines in a multi-sip approach in a bar *Submitted for publication*	Temporal dominance of sensations and emotions and temporal liking	Wine bar Wine	80 wine consumers Portugal
C.6	To study temporal dominance of sensations and emotions as well as temporal liking of three beers with a small sensory difference in hop aroma *In preparation for submission*	Temporal dominance of sensations and emotions and temporal liking	Sensory lab Beer	71 beer consumers The Netherlands

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Chapter 2

Cheers, Proost, Saúde: cultural, contextual and psychological factors of wine and beer consumption in Portugal and in the Netherlands

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Abstract

Wine and beer consumption are an integral part of European culture: Southern Europe is associated with wine and Northern Europe is associated with beer. When consumed in moderation, these alcoholic beverages can be part of a balanced and healthy diet. In the 1990s, non-alcoholic beer, which has no cultural roots, became available in the market. This review identifies determinants for consumption of wine, beer, and non-alcoholic beer, using data on consumption patterns from Portugal and the Netherlands. Since the 1960s the image of Portugal as a wine country declined, whereas the image of the Netherlands as a beer country remained stable. In each country beer is now the most consumed alcoholic beverage and is mainly a men's beverage, whereas wine is the second most consumed and is consumed by both genders. Cultural differences define Portuguese as "outdoors, everyday drinkers", within a meal context, and Dutch as "at home, weekend drinkers". Wine is perceived as the healthiest beverage, followed by non-alcoholic beer, and regular beer. Motivation for consumption is related to context: wine for special occasions, beer for informal occasions, and non-alcoholic beer for occasions when alcohol is not convenient. Moderate wine and beer consumption seems to be surrounded by positive emotions.

This review is relevant for public health, for industry market strategies, and identifies opportunities of future research on drinking behaviour.

Introduction

Wine and beer consumption are an integral part of European life and culture, dating back to before the Roman era (Baeza, 2000, Poelmans and Swinnen, 2011). Wine and beer are embedded within social and cultural traditions that, in part, define the diets of many Europeans. From a nutritional perspective these are interesting beverages to study since patterns of consumption determine whether their effects on health and well-being are positive or negative. Excessive alcohol consumption is well recognized to increase the risk of certain diseases, such as cancers, cirrhosis and neurological problems (Foster and Marriott, 2006). However, when consumed in moderation wine and beer are accepted beverages that form part of a healthy, balanced diet, and lifestyle (Lindberg and Ezra, 2008, Arranz et al., 2012). Presently the median contribution of alcohol to the total energy intake (expressed as per adult per day) is 20,5 g (7%) in Portugal (BAP, 2003-2008) and 15,1 g (5%) in the Netherlands (DNFCS, 2007-2010). Drinking guidelines of both countries for daily alcohol consumption are: up to 42 g for men and 28 g for women in Portugal and, up to 20 g for men and 10 g for women in the Netherlands (ICAP, 2010).

Since the nineties, non-alcoholic beer (NAB) has become more present in the market (Nederlandse Brouwers: NB), partly as a result of drinking and driving concerns (social and legislative) but also as a response to general health concerns, and for religious reasons. This beverage has no cultural background and it is certainly not as popular as wine or beer itself. Nevertheless its presence in the market is an interesting development because NAB provides some of the sensory rewards and health benefits of beer itself, without the delivery of alcohol (Martin et al., 1990, Sohrabvandi et al., 2012).

In order to better understand how wine, beer and NAB consumers choose the beverages they consume, it is necessary to know the main drivers of consumption.

Many studies describe different aspects of alcohol consumption across the world, and these studies reveal that cultural, contextual and psychological factors are determinants of beverage choice (SIRC, 1998, Pettigrew, 2003, McCluskey and Shreay, 2011). However, there is no comprehensive overview of studies giving a clear picture of the different determinants of wine and beer consumption.

The objective of this paper is to review the scientific and public domain literature concerning wine, beer and NAB consumption in two countries that can be considered representative examples of Northern and Southern European culture, namely Portugal and the Netherlands. Within the scope of this review, an attempt is made to characterize the consumption determinants for these beverages which are prevalent in the two countries.

Knowledge of the determinants of consumption is relevant for public health policy and to help companies design marketing strategies.

This review begins by describing the intake of wine, beer and NAB in Portugal and in the Netherlands, covering cultural factors such as consumption patterns and consumer profile (gender, age, income, level of education). Subsequently, contextual factors of consumption are described, concerning occasions and places. Finally, information regarding psychological factors such as motivation for consumption is explored in addition to the perception of consumers concerning health and emotional attributes related to consumption.

The evolution of cultural differences of consumption

Per capita wine and beer consumption over time

In terms of consumption, Portugal is classically perceived to be a wine country and the Netherlands a beer country. In the paragraphs below we will analyse whether or not these stereotypes concur with present consumption figures.

Estimates of the per capita consumption of wine and beer come from different sources. The World Health Organization (WHO) provides the contribution of wine and beer to the total per capita alcohol consumption (figure 1). This indicator is published per year and per country since the 1960s (WHO).
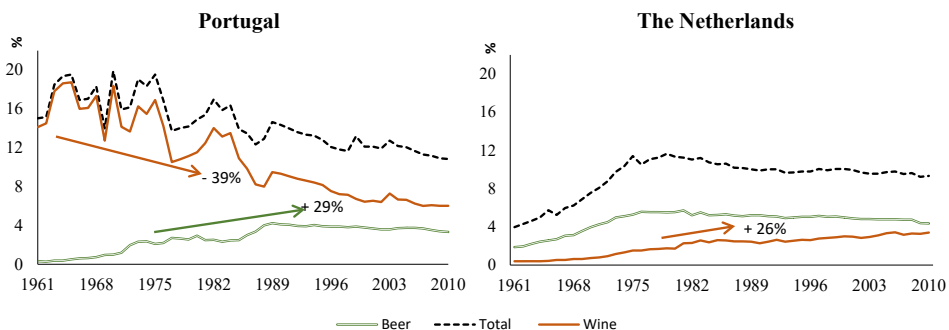

Figure 1 | Contribution of wine and beer to the total per capita alcohol consumption in Portugal and in the Netherlands (in percentage) (WHO).

The WHO figures show that over the period 1960- 2010, marked changes occurred in the patterns of alcohol consumption, in both countries (WHO). In Portugal the contribution of wine to the total per capita alcohol consumption decreased 39%, whereas beer consumption increased 29%. In the Netherlands, wine consumption increased 26% at the cost of spirit consumption (WHO). However the contribution of beer consumption remained stable and is still around 50% (WHO).

Data on the consumption per capita can also be obtained from European or global wine and beer industry organisations – e.g. Brewers of Europe (BoE) and the International Organisation of Vine and Wine (OIV). The data presented in table 1 are derived from these organisations and in this paper they will be called commercial figures.

Table 1 | Mean per inhabitant wine and beer consumption (mL/inhabitant/day), in Portugal and in the Netherlands based on the total amount consumed in the country divided by the total number of inhabitants over the period 2003-2011 (BoE, Instituto Nacional de Estatística: INE, NB, OIV).

	Portugal					The Netherlands				
	2003	2005	2007	2009	2011	2003	2005	2007	2009	2011
Beer (mL/inhabitant/day)	164	168	167	162	145	217	213	212	199	196
Wine (mL/inhabitant/day)	139	128	124	121	121	60	58	61	60	62

The consumption per capita published from commercial figures (table 1) is calculated dividing the total of each beverage sold in the country by the total number of inhabitants, including people of all ages, independent of being drinkers or non-drinkers. Per capita consumption inferred in this way is an overestimation, in one hand, as it does not account for storage and waste. On the other hand is an underestimation because the number of drinkers is far less than the total number of people in a country. These commercial figures, however, can be considered to generally compare between countries.

Based on these figures, during the period 2003-2009, wine consumption decreased in Europe (OIV). Portugal followed this trend with a per capita consumption of 139 mL per day in 2003 and 121 mL per day in 2011 (OIV). Dutch per capita wine consumption has remained constant since 2003 corresponding to half that of the Portuguese in 2011 (62 mL/day) (table 1) (Statistics Netherlands: SN).

Beer consumption across Europe remained relatively stable over the same period, showing a slight decrease in both Portugal and the Netherlands. In Portugal, per capita beer consumption declined 12% over 2003-2011, placing in 2011, the country in fourteenth position in Europe in terms of beer consumption, corresponding to 145 mL/day per capita. In the Netherlands per capita beer consumption declined by 10% over 2003-2011. Its 2011 per capita consumption of 196 mL/day per capita (table 1) placing it in ninth position in Europe in terms of beer consumption.

Another source of consumption figures comes from government statistics. For this review we used the Portuguese Health National Survey (PHNS, 2005-2006) and the Dutch National Food Consumption Survey (DNFCS, 2007-2010). These are reports based on national surveys focusing on individual dietary intake data reported by consumers. In

these studies as in those above inferred from sales data, wine or beer drinking are not mutually exclusive. As shown in table 2, the two countries applied different methodologies for data collection. In Portugal, in the PHNS all family members were interviewed face-to-face about the average per day consumed over the previous week. In the Netherlands, the DNFCS performed individual telephone interviews using two 24-hour recalls to selected people by invitation. Data collection based on interviews may have the disadvantage of under-reporting, a well-known source of systematic error in individual surveys (Ferro-Luzzi, 2002). The under-reported foods vary from study to study and the reason behind it might be because consumers have low involvement with some foods, like snack foods, and those are easily forgotten when reporting daily food consumption (Dop, 2002). Regarding alcohol consumption underreporting can also be explained because it is socially a sensitive topic (Dop, 2002), and people may not wish to admit to drink as much as they do.

Table 2 | Methodology for data collection, total number of participants and number of wine and beer drinkers, of Portuguese and Dutch national surveys (PHNS, 2005-2006, DNFCS, 2007-2010).

Methodology	Participants	Wine drinkers	Beer drinkers
Portuguese Health National Survey (2005-2006) Face-to-face interviews to all members of families	29 098 (>15 <69 years old)	9833	5403
Dutch National Food Consumption Survey (2007-2010) Two 24-hour recalls carried out by individual telephone interviews	2523 (>16 < 69 years old)	496	533

Table 3 shows the consumption per capita as calculated from national surveys. In Portugal, on average, daily consumption of wine drinkers is around 300 mL and 600 mL for beer drinkers. In the Netherlands, the equivalent figures are around 200 mL for wine drinkers and 750 mL for beer drinkers (PHNS, 2005-2006, DNFCS, 2007-2010). From these data values per capita consumption were extrapolated for both countries bearing in mind the percentage of drinkers from the adult population.

Table 3 | Estimate of per capita consumption based on data from national databases (PHNS, 2005-2006, DNFCS, 2007-2010, INE, SN).

	Portugal		The Netherlands	
	wine	**beer**	**wine**	**beer**
Consumption calculated from drinkers inquired in the national surveys (mL/day)	306,4	593,5	186	735,4
Wine or beer drinkers (%) (from the national surveys)	34	19	21	20
Adult population in each country (%)	67		66	
Per capita consumption - national surveys (mL/inhabitant/day)	69,8	75,6	25,8	97,1

Comparing the values from the two sources, i.e. commercial figures (table 1) and national surveys (table 3), there is a notable difference in the figures given of daily consumption, as can be seen in table 4.

Table 4 | Comparison of per capita consumption estimated from different sources (PHNS, 2005-2006, DNFCS, 2007-2010, BoE, INE, NB, OIV).

Per capita consumption	Portugal		The Netherlands	
	wine	beer	wine	beer
1. National surveys (mL/inhabitant/day)	70	76	26	97
2. Commercial figures (mL/inhabitant/day)	128	168	61	212
Ratio between the two sources (1/2) (%)	55%	45%	42%	46%

As previously mentioned, the calculation of per capita consumption was performed considering different primary data, and this has an understandable effect on the final outcome. Values derived from commercial figures are around twice those from national surveys (table 4). This discrepancy may be explained by two main reasons. On one hand, data provided from self-reporting questionnaires might lead to an underestimation of consumption, especially as related to alcoholic beverages. On the other hand, the commercial figures are based on the whole population of a country (including children and other non-drinkers) to calculate per capita consumption. Nevertheless, the ratio between both sources (surveys and commercial figures) is relatively constant between countries and beverages. Hence, it seems acceptable to consider both sources representing a valid basis for comparison purposes even if in absolute terms there is a discrepancy between the data.

The following conclusions are observed from both sources: in Portugal wine consumption is twice as much as in the Netherlands. Beer consumption is far higher in the Netherlands than in Portugal. It is also higher in volume terms, than wine consumption in both countries.

From a health perspective, and in addition to patterns of consumption, it is important to factor in the relative alcohol contents of wine and beer. Wine contains 8-15% of alcohol by volume (German and Walzen, 2000) whereas beer contains 3-6% alcohol by volume (Bamforth 2002). This for Portugal wine contributes more than twice as much to the total alcohol consumed than beer. In the Netherlands beer is the greatest contributor to total alcohol consumption.

Looking at these figures, Portugal may still be considered as a wine drinking country, and the Netherlands as one which prefers beer. However, the difference in consumption patterns between the two countries is smaller than 50 years ago.

2

Non-Alcoholic Beer

A beer can be called non-alcoholic depending on the legal definitions, which can vary between countries. In Portugal NAB must contain less than 0,5% alcohol by volume (Portaria n. 1/96), whereas in the Netherlands up to 0,1% alcohol by volume is permitted (Bierverordening, 2002). This difference in alcohol content (0,4%) might have some effect on consumers´ preferences. Not only because alcohol is an important flavour contributor but also because during the removal of alcohol inevitably other flavour substances are removed (Mieth, 1996).

NAB was introduced to the market in the 1990s (BoE). It is a new beverage compared to wine or beer. NAB was developed mainly to appeal to consumers who would appreciate its health and wellbeing attributes, being strategically positioned between beer and soft drinks, even being presented by one brand as a regenerative sports beverage (DM, 2012). Despite the technological effort in creating innovative dealcoholisation solutions which are less compromising to the flavour of the original beer, NAB has not been a successful product in European markets. In both countries the market share of beer sales for NAB is still very small, corresponding to 2% in Portugal and to 1% in the Netherlands (2011). An exception to this is Spain in which NAB has a market share of beer sales of 10% (2011) (Associação Portuguesa de Cervejeiros: APCV, NB).

It is not possible to present useful data of NAB consumption on the basis of publicly available data. In Portugal no data has been published whilst in the Netherlands, the DNFCS returned 2523 respondents of which only 11 (0,4%) admitted being NAB consumers.

Socio-Demographic profile of wine and beer consumers

Understanding the relations between consumption and consumer drinking profile is helpful for commercial strategies and public policies to be effectively targeted. Consumers' drinking profiles are often described in terms of gender, age, level of education and monthly income (e.g. Pettigrew, 2003, Ramful and Zhao, 2006, Colen and Swinnen, 2011, McCluskey and Shreay, 2011). From table 5 it can be seen that in Portugal, men are the major consumers of wine and they drink twice as much as women. In the Netherlands the gender distribution for wine consumption is fairly equal, both in number of consumers and in amount of wine consumed. In both Portugal and the Netherlands, beer is largely consumed by men and this is also the case in other western societies (Pettigrew, 2002, Ramful and Zhao, 2006, Colen and Swinnen, 2011). The majority of consumers (mode is presented in bold numbers in table 5) drink two glasses of wine or beer per day, with the exception of wine consumption by Portuguese, who drink three. In a worldwide comparison, according to the WHO, Portugal and the Netherlands are countries that present low risk (1 in a 1 to 5 scale) regarding alcohol consumption-related health problems (WHO).

Table 5 | Percentage of consumers, frequency distribution and mean number of glasses of wine (100 mL) and beer (200 mL) consumed per day by gender in Portugal and in the Netherlands (PHNS, 2005-2006, DNFCS, 2007-2010).

Beverage		WINE			BEER			
Country		**Portugal** n=9833		**The Netherlands** n=533		**Portugal** n=5403		**The Netherlands** n=491	
Gender		**M: 69**	**F: 31**	**M: 51**	**F: 49**	**M: 86**	**F: 14**	**M: 83**	**F: 17**
Number of glasses / day	≤ 1	4	9	19	18	13	5	16	**7**
	2	14	**11**	**22**	**20**	**32**	**6**	**20**	4
	3	**19**	6	7	7	18	1	16	2
	4	7	2	2	2	4	0,5	12	1
	5	13	2	1	1	11	1	6	1
	≥6	12	1	0	1	8	0,5	13	2
Average/day		3.6	1.8	1.8	1.9	3.1	1.9	3.8	2.7

n = number of drinkers in the sample; M = male; F = female; In bold the highest percentage of each group (modal value).

The likeliness of an adult being a wine consumer apparently increases with age, starting with 30 years of age or older, reaching the highest percentage in the age group between 50-54 years old (Ramful and Zhao, 2006, Melo et al., 2010). Portuguese and Dutch seem not to be exceptions, as it is shown in table 6 that wine consumers tend to be adults (≥ 35 years). Beer is most likely to be consumed until the middle age (54 years), in which the younger age group (≤ 34 years) has a relevant contribution, especially in the Netherlands (37%). A plausible explanation for this is that beer is normally a comparatively inexpensive beverage with a good price / quality relation which might be more relevant to younger consumers (DM, 2011b). In addition, the language of much beer marketing is considered easy to understand by young people, making it more accessible (DM, 2011b), whereas wine marketing language tend not to be focused on their generation and needs (Thach and Olsen, 2006). Moreover, several studies suggest that wine flavour seems to be the main driver for wine consumption (Zanten, 2005, Pettigrew and Charters, 2006, Charters and Pettigrew, 2008, Jaeger et al., 2009, Duarte et al., 2010, Melo et al., 2010, Bruwer et al., 2012). It is also suggested that age and level of experience play an important role in wine flavour preference (Blackman et al., 2010, Melo et al., 2010). Thus, these arguments may help to understand why younger consumers are more likely to drink beer than wine.

Typically, Portuguese consumers of wine and beer have primary education and low monthly income, whereas the majority of Dutch consumers have an intermediate level of education and higher monthly incomes (table 6). These socioeconomic indices are consistent with the general characterization of the whole population of both countries. For comparison, the modal value of income for Portugal is 905€/month in 2011 (BDPC,

2011) and for the Netherlands 2750€/month in 2013 (Expatax, 2013). Therefore income and level of education are variables that can distinguish between Portuguese and Dutch consumers, but not between wine and beer consumers. Age and gender seem to be the most differentiating factors between wine and beer consumers.

Table 6 | Comparison of Portuguese and Dutch wine and beer consumers' profile (in percentage) (PHNS, 2005-2006, DNFCS, 2007-2010).

Beverage	WINE				BEER			
Country	Portugal n=9833		The Netherlands n=533		Portugal n=5403		The Netherlands n=491	
Gender	**M: 69**	**F: 31**	**M: 51**	**F: 49**	**M: 86**	**F: 14**	**M: 83**	**F: 17**
Educational Level*								
Lower	**56**	23	2	6	**67**	8	11	3
Intermediate	7	4	**44**	41	11	3	**67**	13
University	6	4	5	2	8	3	5	1
Age (years)								
1 (15-34)	10	5	12	10	28	5	**31**	6
2 (35-54)	**34**	15	19	16	**42**	7	30	6
3 (55-69)	25	11	**20**	23	16	2	22	5
Income (€/month)								
Up to 900	**33**	14	1	2	**39**	6	2	2
901 - 1500	21	9	6	10	28	4	12	4
> 1500	15	8	**44**	37	19	4	**69**	11

n = number of drinkers in the sample; M = male; F = female; In bold the highest percentage of each group (modal value); * Lower: ≤ 4 years of education; Intermediate: between lower and university education; University: university degree or frequency ≥ 12 years of school.

Contextual factors

Occasions of consumption

In characterizing drinking behaviour it is interesting to consider consumption over different parts of the week, and in particular weekend *versus* weekdays (figure 2). The weekends are a prime period of alcohol consumption and in the sample of each country only 6% of consumers drink less or did not drink during the weekends. For Dutch consumers, a difference is noted in that they drink more during weekends than weekdays or only drink during weekends (61%) (DNFCS, 2007-2010). In contrast, Portuguese consumers tend to drink the same amount (wine and beer) on weekdays as during the weekend (62%) (PHNS, 2005-2006).
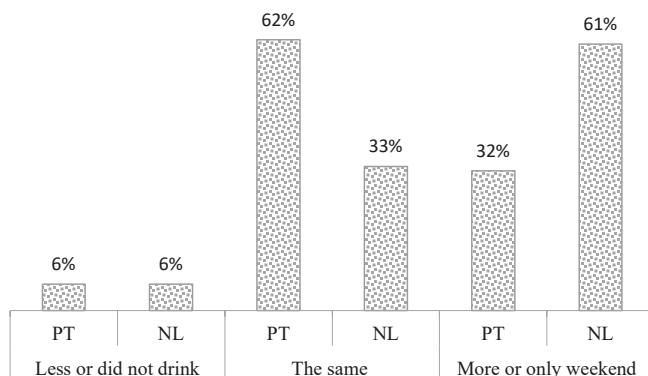
Figure 2 | Comparison of weekdays and weekend consumption of wine and beer in Portugal (PT) and in the Netherlands (NL) (in percentage) (PHNS, 2005-2006, DNFCS, 2007-2010).

In the Netherlands the preferred time of the day for alcohol consumption is the late afternoon and during the evening. Beer is commonly consumed during the late afternoon whereas wine is associated with evening meals. According to the Dutch eating habits, lunch is in general a light and quick meal (Yuksel, 2007). Alcohol consumption during lunchtime in the Netherlands is not common (AICEP, 2008, DNFCS, 2007-2010). This is different from Portuguese eating habits where lunch and dinner are considered to be of equally importance, and for that reason, have equal relevance in relation to wine or beer consumption (PHNS, 2005-2006). Besides main meals, Portuguese also commonly consume alcoholic beverages at night (IPSOS, 2009).

Wine

In general, wine is perceived as complementary to food and is associated with sit-down meals, either at home or in restaurants (Pettigrew and Charters, 2006, DM, 2011b, Thach, 2012). Wine consumption is described as being related to more formal occasions, special occasions and celebrations, being considered a social facilitator to interact with other people (Pettigrew, 2003, Ritchie, 2007, Thach, 2012). Choosing a wine is considered a ritual and wine choice and willingness to pay are influenced by the nature of the occasion (Quester and Smart, 1998, Pettigrew, 2003, Aqueveque, 2006, Ritchie, 2007, Thach, 2012). Wine consumers are willing to pay more for a bottle of wine to take to a dinner party at a friend's house at Saturday night, compared to a bottle of wine to drink at home during the week, by oneself or with one's family over dinner (Quester and Smart, 1998). Worldwide wine is the preferred choice with a meal as a relaxing beverage, at home or in a bar (DM, 2011b).

Beer

Similar to wine, beer consumption is also associated with social events but with more informal occasions, such as barbeques, large music festivals, sports events, high energetic night out with friends, as well as pub culture and friendships (Pettigrew and Charters, 2006, SIRC, 2008, DM, 2011b, McCluskey and Shreay, 2011).

Beer is predominantly perceived to be an everyday beverage for relaxation-oriented occasions as the drinkers commonly use the beverage as a symbol of demarcation between work and non-work hours (Pettigrew, 2003, Pettigrew and Charters, 2006). Beer is also consumed in solitary occasions, like when at home relaxing and watching TV, whereas drinking wine alone is reported less (Pettigrew and Charters, 2006, Kim and Chintagunta, 2012). Beer is classified as a "flexible beverage" as its consumption might or might not be related with eating contexts, alone or with others (Pettigrew and Charters, 2006).

Non Alcoholic Beer

NAB is apparently unrelated to specific consumption places. Consumers do not choose it based on the type of occasion, as with wine or beer, but as an alternative for when they cannot drink alcohol. In general, the main reasons for drinking NAB are because consumers have to drive, for medical reasons or pregnancy (Vlek and Peters, 2012).

Places of consumption

Place of consumption is a reflection of habits of different cultures and contributes to consumption decisions (Pettigrew, 2002).

Referring to wine, it seems that domestic settings, including own homes, and the homes of friends or family, are the most common places for consumption in Portugal and in the Netherlands (AESBUC, 2003, DNFCS, 2007-2010, DM, 2011b). Additionally, in Portugal, restaurants are also considered as an important consumption place (AESBUC[1], 2003), whereas in the Netherlands restaurants are less representative for wine consumption (DNFCS, 2007-2010).

In Portugal, beer sales take place mainly in the on-trade (69%, 2011), which include pubs, clubs, bars, and restaurants. Only 31% of beer sales take place off-trade, through supermarkets, shops and other retail outlets. This is in contrast with the European trend also reflected in the Netherlands, where on-trade beer sales have been decreasing to 26% and off-trade beer sales increasing to 74% (2011). At home is, according to the latest data, the preferred place for beer consumption in the Netherlands (BoE, DNFCS, 2007-2010).

Overall it seems that beverages are used according to the nature of the occasion: wine for special and relaxing moments and with a meal, beer for informal and more energetic

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[1]   The methodology of this study includes 1208 face to face interviews to Portuguese moderate wine consumers

occasions and NAB when it is not convenient to drink alcohol. For Portuguese, wine consumption takes place mainly at home and in restaurants whereas beer consumption takes place mainly in bars, pubs and restaurants. Portuguese consume wine and beer either during lunch, dinner or in the evening, during weekdays or weekends. For Dutch, the preferred moment for wine and beer consumption is in the evening, at weekends and often home related.

Psychological factors

Motivation for consumption

Factors of impact on beverage choice and motivation for consumption may be derived from the drink by itself - drink related – and/or are context related (figure 3).

Wine and beer have different sensory attributes and the choice for one or the other, as a complement of food, seems to be based on creating a balance between food and beverage, providing pleasure (Charters and Pettigrew, 2008, Donadini et al., 2008). Nevertheless, wine is by far the beverage of choice for meal occasions and wine drinkers are more knowledgeable about food and alcohol combinations than beer drinkers (Pettigrew and Charters, 2006, DM, 2011b). The variety of tastes and flavours provided by wine are probably the most significant reasons for wine purchase and consumption for the majority of consumers (Zanten, 2005, Pettigrew and Charters, 2006, Charters and Pettigrew, 2008, Jaeger et al., 2009, Duarte et al., 2010, Melo et al., 2010, Bruwer et al., 2012). For young generations (24-35 years age), however, wine flavour does not seem to be that important and their primary focus is the conviviality and enjoyment that wine drinking provides (Barrena and Sanchez, 2009, Duarte et al., 2010).

Wine and beer have different functional connotations, fulfilling different consumer needs. These functional connotations play a role in choice behaviour. For instance, wine is seen as a social facilitator to interact with other people whereas thirst relief is often mentioned in relation to beer consumption (Yang et al., 2002, Donadini et al., 2008, Barrena and Sanchez, 2009).

The anticipated emotions and feelings associated with the consumption of a beverage is also a motivation for the choice. For instance, wine consumers feel enjoyment when planning to drink wine with food (Pettigrew and Charters, 2006). Comparably beer consumers may expect to relax after drinking a beer (Yang et al., 2002, Kim and Chintagunta, 2012).

There is some evidence showing that wine consumers perceive an emotional benefit from drinking wine that predominates over functional factors (Charters and Pettigrew, 2008, Barrena and Sanchez, 2009). This suggests that consumers' choice might include an emotional component in addition to the product knowledge (Barrena and Sanchez, 2009).

Wine and beer are often consumed in a social context, mainly with friends or family, to socialize, to celebrate and to have fun (SIRC, 1998, McCluskey and Shreay, 2011). In a social context consumption is, to some extent, influenced by peers, friends or family, either to seek approval of the behaviour (Zanten, 2005), image management (Pettigrew, 2002, McCluskey and Shreay, 2011) or to impress others (Melo et al., 2010). Social pressure, mainly used by friends and family, are especially influential in young adults' alcohol consumption (Hall et al., 2004, Ahlström and Osterberg, 2005, Thach and Olsen, 2006, Olsen et al., 2007, Silva et al., 2014).

Rituals are symbolic attitudes involving wine or beer consumption. Those are used to distinguish certain moments or specific contexts, such as the end of the working day or the end of the week, before and after football games, to toast and celebrate special moments in one´s life trajectory (SIRC, 1998, Pettigrew and Charters, 2006, Charters and Pettigrew, 2008, SIRC, 2008, McCluskey and Shreay, 2011).
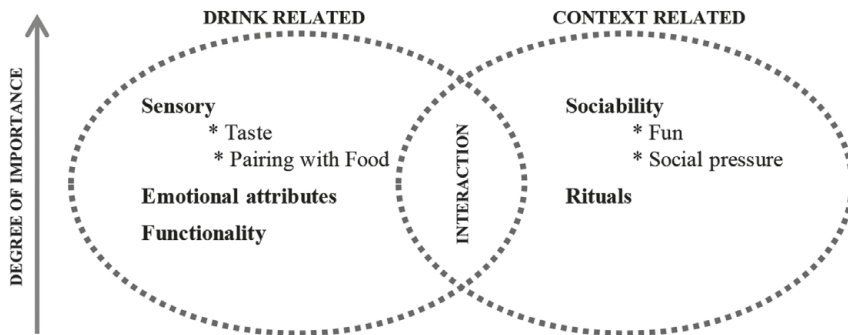

Figure 3 | Main motivational factors for wine and beer consumption and apparent degree of importance (Yang et al., 2002, Pettigrew and Charters, 2006, Olsen et al., 2007, Charters and Pettigrew, 2008, Donadini et al., 2008, Barrena and Sanchez, 2009, Duarte et al., 2010, Melo et al., 2010, McCluskey and Shreay, 2011, Moran and Saliba, 2012).

Motivations for consumption are certainly related with the development of preferences through experience, which seem to be different between wine and beer. This might be influenced by socialisation but might also be related to the effect of learned liking, as a result of repeated consumption - exposure effect - as happens with other foods (Yeomans, 2006). There is some evidence that, for wine drinkers, the evolution of preference is primarily inversely related to sweetness and later directly related with perceived "body" in a wine. In this way consumers' preferences move first over the dimension sweet-not-sweet and later on, along the dimension light-heavy/full (Blackman et al., 2010, Melo et al., 2011). Concerning beer consumption it is commonly argued that beer has an acquired taste and most consumers do not like their first taste of it (McCluskey and Shreay, 2011). Still, to our knowledge, there is no scientific evidence published to demonstrate this effect.

The differences in regional beer production might have an influence in beer consumption preferences, especially in countries like America and Germany. The locally developed beer styles are more available in their region of origin (McCluskey and Shreay, 2011). Also in Northern Europe many pubs offer only two or three local beers which can limit the experience of consumption and consequently limit the exposure effect (McCluskey and Shreay, 2011). This might be applicable, but to a lesser extent to the Netherlands, where beer production is dominated by eight breweries, which together account for over 95% of beer production. The remaining five percent is manufactured by over 120 microbreweries (NB). In Portugal there is a different situation. As 90% of the national market is dominated by two breweries, located in the north and in the centre (APCV), most cafes and bars tend to sell only one brand, so choice is very limited. In general, alcoholic drink preferences tend to vary with age as the taste of the consumers develops. Whereas younger consumers tend to look for a sweeter product the older consumers prefer a more complex taste and unique flavours (Datamonitor, 2012).

From a marketing point of view a distinction is often made between motivations for consumption and motivations for purchase. Referring to purchase behaviour, price and habit or preferred brand are reported to be factors that exert the greatest influence on choice of wine and beer in 19 countries worldwide, including Portugal and the Netherlands (Duarte et al., 2010, DM, 2011c). Overall, consumers perceive price as a quality indicator. Its relative importance, however, is influenced by the context of consumption and level of product involvement (Quester and Smart, 1998, Ritchie, 2007, Charters and Pettigrew, 2008).

The motivations for NAB consumption are less documented, but those reported are very different from those known for alcoholic beverages. Drinking NAB can be related to occasions where consumers cannot or do not want to drink alcohol (Thompson and Thompson, 1996, Vlek and Peters, 2012). Flavour and healthy benefits were found to be the most important motives behind purchase (Thompson and Thompson, 1996, Chrysochou, 2014). In addition, as for wine and beer, the choice of NAB is influenced by drinking companions, family and social groups (Thompson and Thompson, 1996). Amongst Dutch NAB non-consumers this beverage has a drowsy image and flavour is the key factor not to choose this beverage (Vlek and Peters, 2012).

In summary, it appears that wine, beer and NAB serve different purposes and that motivation for consuming either beverage depends on the context of consumption, although sensory and social aspects also carry some weight in the decision.

Perception of health benefits associated with moderate alcohol consumption

Consumers in general are more conscious of the health risks of alcohol consumption than the suggested health benefits (DM, 2011a). Nonetheless, consumers appear to be well aware that drinking wine or beer may lead to positive health outcomes and that the key factor is moderation in consumption (AESBUC, 2003, Zanten, 2005, Ritchie, 2007, Barreiro-Hurle et al., 2008, Wright et al., 2008a, Saliba and Moran, 2010, Yoo et al., 2013). In addition, the presence of alcohol does not seem to be a decisive factor defining the perception of healthiness of beverages, since wine and beer have been considered healthier than soft drinks (Wright et al., 2008a). In general, wine (red or white) is perceived as healthier than beer (Wright et al., 2008b). This might be due to a relative lack of information on the health benefits of beer, since more scientific work has been published on wine than on beer, especially that which is oriented towards the consumer. A popular perception is that beer consumption is responsible for causing a paunch or "beer belly", although scientific evidence does not support this perception when beer is consumed in moderation (Bendsen, 2011). Another reason might be that wine consumption is strongly related to meals, which results in a stronger association with healthiness (DM, 2011a).

From the published literature different attitudes emerge on how consumers perceive the healthiness of wine which may be culturally related: American consumers do not significantly change their behaviour on the basis of health perception and the main attribute that guides wine choice is flavour (Zanten, 2005, Wright et al., 2008b); Spanish would be willing to pay more for resveratrol enriched wine (Barreiro-Hurle et al., 2008) and Australian consumers, who perceived wine as healthy, have a higher frequency but not volume of consumption (Saliba and Moran, 2010).

It appears that consumers perceive NAB as being healthier than regular beer, but also less satisfying in terms of flavour than regular beer (Wright et al., 2008b, Chrysochou, 2014).

In conclusion, consumers are aware of possible health benefits of alcoholic beverage consumption, but that information in itself does not seem to be the main driver of consumption (Zanten, 2005, Wright et al., 2008b, DM, 2011a, Chrysochou, 2014). Ranking the three beverages in this paper, wine is perceived as the healthiest beverage, followed by non-alcoholic beer, and with regular beer as the least healthy (Wright et al., 2008b, Chrysochou, 2014).

Wine and beer related emotional attributes

Emotions and mood play an important role in food choice (Lyman and McCloskey, 2001, Canetti et al., 2002, Gibson, 2006). The interaction between mood and food is based on a bidirectional relationship, which is influenced by a variety of factors such as appetite, sensory effects and social context (Gibson 2006). For instance a good mood can induce a

consumer to choose and drink a high quality wine (Ritchie, 2007). Likewise different foods evoke different emotions both in nature and in intensity (Cardello et al., 2012). Relatively few references exist in the literature concerning emotions and wine or beer consumption (Desmet and Schifferstein, 2008, Ferranini et al., 2010, Kaneda et al., 2011). The few existing ones mainly report on positive emotions in relation to wine and beer (table 7).

Emotions that affect consumers' choices can be linked to intrinsic product attributes such as sensory characteristics (Kuenzel et al., 2010, Thomson et al., 2010). It has been shown that by modulating beer flavour properties, it is possible to accentuate positive emotions elicited while drinking beer (Kaneda et al., 2011). Extrinsic attributes, however, like product name (Cardello et al., 2012) or label (King et al., 2010), can also be linked to emotions. In addition, it has been shown that food products have emotional connotations that when linked to the product identity will assign a meaning to what we experience while eating or drinking (Thomson et al., 2010). This is known as product conceptualisations, which have not yet been explored with wine or beer.

Table 7 | Summary of the studies reporting emotions related with wine or beer consumption published in scientific papers until November 2013.

| Beverages | Methodology | Emotions | | Authors |
		Positive	Negative	
Alcoholic beverages including wine and beer	Self-reported questionnaire based on a set of 22 emotions (11 pleasant / 11 unpleasant)	Amusement, Enjoyment, Love and Pride	None	Desmet and Schifferstein, 2008
Wine (in general)	Exploratory, based on three studies self-reported	Amusing, Curious, Desirable, Elegant, Euphoric, Happy, Interesting, Joyful, Keen, Passionate, Peaceable and Pleasant	Aggressive, Bland, Disgusting and Overwhelming	Ferranini *et al*., 2010
Beer (with different hop and ester aromas)	Measurement of brainwaves related with psychologically evaluated values (positive/negative, arousal and degree of comfort) and sensory evaluation	Relaxed, Refreshed, Peace and Relief	None	Kaneda *et al*., 2011

It seems that the emotional attributes that are related to beer consumption are more of the functional type compared to those related to wine. For instance, attributes elicited by beer consumption such as refreshed and feeling of relief were not cited in connection with wine. Moreover, elegant and interesting are perhaps the two words cited that are most exclusively linked to wine in published studies (table 7). Emotions reported for both wine and beer were peace/peaceful and amusing/amusement.

In summary, the study of emotions elicited by wine and beer consumption is not well explored and seems a promising area of research to gain more insight into beverage choice.

Conclusions

This review summarizes the main determinants of wine, beer and NAB consumption, covering cultural, contextual, and psychological aspects, in Portugal and in the Netherlands, as countries representing Northern and Southern European culture.

Wine is a symbol of Portugal, but since the 1960s wine consumption decreased significantly and beer consumption increased. Perhaps unexpectedly, nowadays beer production and consumption per capita is greater, in volume terms, than for wine. Still, and in the terms of health benefits, it is important to highlight that wine is the greater contributor to total alcohol consumption. For Portuguese, wine and beer consumption is part of their daily habits and is mainly associated with lunch and dinnertime. Beer is mainly consumed outside the home whereas wine is mainly consumed at home and in restaurants.

Beer is a symbol of the Netherlands and patterns of consumption remained almost untouched over the years. Wine consumption however increased. Both beverages significantly contribute to the total alcohol consumption, although beer is the greatest contributor. Dutch are more likely to drink wine or beer at weekends and mainly at home and in the evening.

NAB it is a relatively new beverage, with no cultural roots and consumption is minimal in both countries compared to wine or beer.

Wine is for the older generation and for both genders. Indeed, it is perceived as the healthier beverage, but this is far from being the prime reason for consumption. Flavour, food pairing and sociability seem to be more fundamental drivers for wine consumption. Wine is consumed at formal and special occasions. Interesting, passionate and elegant are some of the positive emotions evoked by wine consumers. Beer is a men's beverage, and is more likely to be chosen by the younger generations. It has a high connection with sociability, amusement and enjoyment, and a close relation with informal and energetic occasions. NAB represents an alternative for occasions where alcohol drinking is not appropriate and/or convenient. It is perceived as healthier than beer and flavour plays an important positive role for consumers and negative role for non-consumers.

This review illustrates the disparity between the amount of research that exists in the public domain concerning wine and beer consumption, where studies on wine outweigh those on beer. Work on NAB is almost non-existent.

The determinants of consumption described in this review contribute to define the actual identity of moderate wine, beer and NAB consumption giving insights to understand patterns of consumption over time and changes in drinking behaviour, in two different cultures. Emotional attributes related with consumption of these beverages are not yet well explored and, in combination with context of consumption and cultural differences, might be an interesting topic to gain more knowledge on beverage choice.

2

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2

Chapter 3

Functional or Emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer consumption

Ana Patricia Silva | Gerry Jager | Roelien van Bommel | Hannelize van Zyl | Hans-Peter Voss | Tim Hogg | Manuela Pintado | Cees de Graaf

Non-alcoholic beer (NAB) may be a healthier alternative to wine and beer consumption, however has little appeal to consumers. Conceptualisations, i.e. functional and emotional associations that consumers have with foods/beverages, were explored to understand how NAB consumption is perceived, and compared to beer and wine conceptualisations in the Netherlands and Portugal. A qualitative study was performed using a focus group approach with moderate consumers of both countries (n = 56). Content analysis followed by correspondence analysis were used to explore conceptualisations. This study showed similar conceptualisations of the beverages in both countries. NAB has a limited conceptual content, which is mostly functional as a substitute. Beer and wine are rich in both functional and emotional content. Wine is associated with positive low arousal emotional responses, such as calm and loving. Beer is associated with positive high arousal emotional responses, such as adventurous and energetic. NAB evokes neutral and negative emotional responses, such as rational, conscious, and disappointed. The difference in conceptualisations of NAB versus beer/ wine might be why NAB is not adopted more widely as a substitute as it does not deliver a comparable emotional response to consumers. NAB should be treated as a beverage in its own right and it might be wise to avoid direct conceptual comparisons with beer. Should the image of NAB be communicated and understood with positive and high arousal associations, such as energetic and convivial, in communication and advertisements, a higher level of congruency between expectation and experience could be achieved.

Abstract

Introduction

Beer and wine are among the oldest and the most consumed alcoholic beverages worldwide and are part of the daily diet of millions of people (WHO, 2014). Non-alcoholic Beer (NAB) on the other hand, is a relatively new beverage that is consumed far less than beer or wine (BoE, 2014). Despite the similar nutritional and sensory profile of beer and NAB, the latter has little appeal to consumers, whereas it may be a healthier alternative, without the alcohol (Sohrabvandi *et al.*, 2010). NAB could be an attractive non-alcoholic replacement for beer and wine. However, the patterns of consumption suggest a lower preference for NAB. Therefore, it is important to understand, the image that NAB presents to consumers and the reasons underlying its limited consumption, within the context of a wider choice of beverages.

The definition of product conceptualisation and its importance, in the framework of this study, is presented in this introduction. Furthermore, a literature review regarding functional and emotional conceptualisations of beer, wine and NAB as well as cultural issues of beer and wine consumption in Portugal and in the Netherlands are described.

Conceptualisations

Thomson *et al.* (2010) proposed that eating and drinking experiences are influenced by two processes that occur in the mind of consumers: the identification of a product via sensory perception (e.g. it is a beer), and the establishment of associations that consumers assign when thinking about a specific food or beverage. The combination of these associations determines the conceptualisations a consumer has of the product. This means that a person´s response to a food or beverage does not only depend on the product itself (intrinsic and extrinsic properties), but also on the associated conceptualisations, in terms of functional (e.g. healthy for me) and/or emotional connotations (e.g. makes me happy) (Gutjar *et al.*, 2015; Ng *et al.*, 2013; Thomson & Crocker, 2014). Being aware of NAB conceptualisations will lead to a better understanding of how and to what extent the functional promise and the emotional response, are perceived by consumers, i.e. if what is expected is consistent with what is experienced, and thus may be used to optimise the sensory profile in order to fulfil the expectation of the consumers (Thomson *et al.*, 2010).

Functional conceptualisations

Functional conceptualisations are defined as functional consequences of what the product might do to us and thus are associations and factors that motivate consumption (Thomson, 2010).

Beer is a thirst quencher associated with informal and relaxing occasions, being a symbol of demarcation between work and non-work hours, in both eating and non-eating social

contexts (Pettigrew & Charters, 2006). Sensory attributes, such as perceived quality, aroma and carbonation, as well as description, context/moment, culture, character and affect are important factors influencing beer preferences and used in the consumer´s mental representation of beers (Aquilani *et al.*, 2015; Sester *et al.*, 2013). Functional associations with wine consumption are: sensory characteristics, to pair with food, specific contexts, status or group identity, as a social facilitator, as a gift, and for ritualistic purposes (Barrena & Sanchez, 2009; Charters & Pettigrew, 2008; Pettigrew & Charters, 2006; Ritchie, 2007). For NAB, functional associations are: avoiding to get drunk, having to drive, as a healthier alternative beverage and enjoying the flavour (Jongh *et al.*, 2014; Thompson & Thompson, 1996). According to Porretta & Donadini (2008) packaging attributes, such as glass format provided with a twist off cap, were nearly five times more important as flavour, in which body and malty were the most relevant attributes. In terms of alcohol content, light beer is positioned between NAB and regular beer. Light beer is perceived as less tasty than regular beer, but even so, the taste seems the main motivation for light beer consumption, followed by health statements and weight management (Chrysochou, 2014).

Emotional conceptualisations

Emotional conceptualisations are associations with an emotional connotation that reflect what the product is communicating to consumers (Thomson *et al.*, 2010). Emotional conceptualisations might lead to an emotion, but might differ from feelings or emotions. Feelings are the different ways people feel, and they could be emotions, moods and attitudes (Meiselman, 2015). Emotions are a specific response to an object or event, and are rapid, intense and last only a short while (Meiselman, 2015). For the emotional product characterization, feelings (including emotions) are studied during product use or immediately after, whereas feelings prior to consumption do not characterise how one feels with the product, but rather they are used to understand what feelings the product leads (Meiselman, 2015). In the scope of this study the expressions "emotional association or emotional response" will be used, being aware that this may or may not be an emotion, according to the definition of Meiselman (2015), but that classification is beyond the aim of this study.

To feel relaxed is probably the most popular emotional association with beer and wine consumption (Charters & Pettigrew, 2008; Yang *et al.*, 2002). Chaya *et al.* (2015) revealed that the emotional response to beer differs depending on certain sensory properties. For instance, a hoppy beer was shown to increase ratings of negative emotional responses (disappointment, disillusionment) and decrease ratings of positive emotional responses (fun, desire).

Barrena & Sanchez (2009) suggested that emotional factors are more important than functional factors in the purchase decision-making process for wine. For pleasure,

enjoyment, to feel relaxed and mood enhancement are the most relevant emotional associations identified to wine consumption (Barrena & Sanchez, 2009; Charters & Pettigrew, 2008). More recently, Ferrarini *et al.* (2010) summarized the emotional response of wine consumption, presenting a lexicon of 16 emotional terms, 12 of which are pleasant, and 4 are unpleasant.

These studies mentioned were performed with Spanish and Italian consumers. As emotions/emotional responses are culturally dependent (van Zyl & Meiselman, 2015) it is of interest to investigate what are the emotional associations that other cultures have in relation to beer and wine, in an exploratory way.

Cultural issues

Following this, culture might affect the general conceptualisations of a food or a beverage once its meanings, exposure and usage might be very different (Rozin, 2005). For instance, the Dutch can be considered closely linked with beer production and consumption from a cultural, social and economic perspective (Nederlandse Brouwers, 2015). The Portuguese on the other hand, are generally considered to have a comparable relation with wine. Portugal is traditionally a wine country, having history and heritage of wine making and wine has remained an important product of the national diet and food culture (Panzone & Simões, 2009). Wine production also has a considerable relevance in the Portuguese economy (Duarte *et al.*, 2010). For NAB, this is different as it has neither affective nor specific roots in both countries.

Aims of the research

Even though functional and emotional associations of beer and wine consumption can be found in the literature, as referred to in the previous sections, there is a lack of scientific work done regarding NAB consumption. Furthermore, most studies focus on beer and wine individually and not comparing them within the same group of consumers.

The main objective of this study was to explore the functional and emotional conceptualisations of NAB and to compare them to those of beer and wine, for moderate consumers from two different cultures: Dutch and Portuguese. Given the importance of context of consumption to differentiate beer and wine choice (Giacalone *et al.*, 2015; Ritchie, 2007), it was decided to include the context of consumption in this study and link it to the functional and emotional associations of the beverages.

The second objective of this study was to compare how Dutch and Portuguese consumers conceptualise beer, wine and NAB consumption, based on their personal and cultural experiences. Given the close relation of the Dutch with beer and the Portuguese with wine, it is expected that cultural factors affect and differentiate the way these cultures conceptualise the beverages.

Results might be used in different perspectives. Describing the image of NAB will help in understanding what the obstacles to a wider usage of NAB are and why it is apparently not an attractive substitute to either regular beer or other popular alcoholic drinks like wine, in situations where consumers do not want to drink alcohol. This in turn gives directions on how breweries could improve NAB and its acceptability. From a public health perspective results can also be useful because NAB is a good alternative not only to beverages containing alcohol, but also to soda and soft drinks high in sugar content. Due to its production and composition NAB is a natural and pure beverage, free from chemical additives, low in calories, and containing several B vitamins, amino acids, minerals and carbohydrates (Álvarez *et al.*, 2001; Sohrabvandi *et al.*, 2010). These are important contributors to a balanced diet and are linked to positive health benefits. In addition, this study will increase our knowledge on what conceptualisations of beer, wine and NAB are perceived by consumers, which may help understand the choice of different beverages. As identified by Locksin & Corsi (2012) the contribution of research regarding wine is the discovery of new marketing aspects. Especially the emotional conceptualisations of the beverages, which are less known, may be used as a new tool of marketing to communicate with consumers.

This study followed a qualitative research procedure and was conducted through eight focus groups interviews performed in the Netherlands and in Portugal. Content analysis on the data gives an overview of beer, wine and NAB conceptualisations, of moderate consumers.

Methods

Methodology

This qualitative study employed focus group interviews as the method for data collection. A focus group (FG) is an interview technique that brings together 6-10 participants and a moderator, in the framework of a structured discussion about a specific topic (Morgan, 1997). The use of FG is especially important when little is known about a topic. This method has been applied in several cross-cultural studies and is gaining importance in consumer behaviour related to food and beverages (de Barcellos *et al.*, 2010; Tan *et al.*, 2015; van Zyl & Meiselman, 2015). This study was approved by the Social and Ethical committee of Wageningen University.

Participants

A general characterisation of the participants is presented in table 1. In total, 56 consumers (30 female, 26 male) were enrolled in this study, of which 54 were regular beer consumers, 54 were regular wine consumers and 28 were regular NAB consumers. The study, which was performed on a purposive sample, included 27 Dutch consumers (16 female, 11 male), and 29 Portuguese consumers (14 female, 15 male). Screening criteria included: age 20-60 years, being a Dutch or Portuguese native speaker, having a good general state of health (self-reported) and being a regular consumer of at least two out of the three beverages. The latter criterion was included to ensure participants' familiarity with at least two beverages, as users, and so they could compare their experiences. For beer and wine, a regular consumer was defined as drinking between 1 alcoholic beverage once a week (minimum) and 2 alcoholic beverages per day for women or 3 alcoholic beverages per day for men (maximum). For NAB a regular consumer was defined as drinking NAB at least once a month. To achieve heterogeneity in each FG, participants were as much as possible, stratified according to age, gender, educational level and beverage consumption. Dutch participants were recruited from Wageningen University and from an external agency of consumer research in the Netherlands. Portuguese participants were recruited from Catholic University in Porto. Participants signed a consent form, received an incentive for their participation and a summary of the results, after the data analysis was completed.

Table 1 | Summary of the demographic profile of the participants

Country	City	FG Code	n	Age (years)	Gender (%)		Educational Level (%)			Consumers (%)		
					M	F	Stud	Low	High	Beer	Wine	NAB
Portugal	A	FG PT P	4	20-60	25	75	50	0	50	75	75	0
		FG PT 1	8	31-60	62	38	0	37	63	100	100	88
		FG PT 2	9	31-60	56	44	0	33	67	100	89	78
		FG PT 3	8	20-30	50	50	100	0	0	100	100	25
The Netherlands	B	FG NL P	4	20-30	0	100	100	0	0	100	100	50
		FG NL 1	8	31-45	50	50	0	50	50	88	100	38
	C	FG NL 2	7	46-60	57	43	0	57	43	100	100	57
		FG NL 3	8	20-30	37	63	100	0	0	100	100	38

Legend: A: Porto; B: 's-Hertogenbosch; C: Wageningen; P: pilot; n: number of participants; M: male; F: female, Stud: actual university students; Low - complete or incomplete secondary school; High - university degree or equivalent

Procedure

Eight FG including taste sessions with moderate consumers of beer, wine and NAB were conducted. Four FG were performed in the Netherlands (Wageningen and 's-Hertogenbosch), and four in Portugal (Porto), in their respective native languages. The first author of this study conducted the FGs in Portugal and participated as an observer in the FGs conducted in the Netherlands, to assure consistency in the procedures. All FGs were audio-video recorded. Prior to conducting the actual FGs, a pilot was performed in each country to test the structure, questions and practical organization of the interviews. These data were also included in the analysis, as only minor changes were made to the discussion guide. All the FGs were performed in the early evening, in both countries, as it is a common time for beer/wine consumption (Silva *et al.*, 2015)

Structure of the FG interviews

The sequence of stages followed in the FG interviews and the structured guides to questioning are presented in table 2. A guide for conducting the FGs was developed and agreed upon by the authors, following the guidelines proposed by Morgan (1997). This guide was developed in English and translated to Dutch and Portuguese by native speakers. During the FG two different stimuli, tasting samples and pictures, were used, aiming to recall previous experiences concerning moments of consumption as well as functional and emotional associations related to beer, wine and NAB.

Table 2 | Summary of the structure interview

Topic (time)	Main questions addressed and stimuli
Introduction (10 min)	Welcome and introduction to the study
	Stimulus 1: Sample tasting (extended through the whole session)
Context (20 min)	*When/where/with whom do you consume beer/wine/NAB?*
Motivation (20 min)	*What does beer/wine/NAB consumption mean to you?*
	What are the main reasons for consumption beer/wine/NAB?
	What comes to your mind when you think about going to drink a beer/wine/NAB?
Emotions (30 min)	**Stimulus 2**: Pictures of faces expressing emotions and situations of consumption
	Free association task about emotions
	How do you feel when you drink beer/wine/NAB?
	What emotions do you associate with the consumption of beer/wine/NAB?
	What are your expectations when you drink beer/wine/NAB?
Summary (10 min)	Summary of the session

The interviews started with an introduction about the aim of the study, after which the participants introduced themselves and were invited to freely taste small amounts of the most popular beers, wines and NAB familiar to each country. The beverages were from different brands, but neither the brands nor the flavour were expected to be evaluated. Water and snacks were also provided. This tasting session was meant to be a stimulus to activate the memories related to the consumption of these beverages. It was also to achieve the most appropriate emotional profile for the beverages, once limited descriptions could be obtained if the participants would not experience the beverages. The samples were available during the whole interview and the participants were free to taste it whenever they wanted (assuring always the recommended limit of moderate alcohol consumption). Before starting the questions, the participants were asked to only answer about the beverages of which they were regular consumers. The first set of questions addressed were about context of consumption, where the participants had to describe moments of consumption (where, when and with whom). The questions were asked separately for each beverage. The next set of questions referred to the motivations for consumption, and the participants shared reasons, meanings and associations they had with the consumption of the beverages. Following this, the participants were presented with a second set of stimuli made up of ten pictures which were shown to all. In response the participants had to perform a free association task. The first five pictures showed different contextual situations with or without people drinking beer and wine, e.g. a group of people smiling and toasting in a bar. In that moment the participants were asked to write in a booklet, individually, what emotions they associated with each picture. Afterwards, five pictures of faces expressing emotions were shown (Ekman *et al.*, 2002). The aim was to relate the emotionality projected in the faces with the different beverages. Participants were asked to associate each picture (each emotion) to the beverages and again write it individually in the booklet. This second stimulus was to target their memories about emotion words and feelings, so that in the third set of questions they easily could describe their emotions and emotional associations with the consumption of the beverages. Questions for this topic were for instance: "how do you feel when you drink …?" or "what emotions do you associate with the consumption of…?". Finally, a summary of the discussion was presented and the participants were thanked for their collaboration.

Data Analysis

Data were transcribed *verbatim*, by the authors that are native speakers from each country. Transcriptions were then translated from Dutch or Portuguese to English. Translations and meanings of emotional terms were agreed upon by at least three authors for each language (APS, MP, TH for Portuguese and GJ, HvZ, HPV and RvB for Dutch). Transcriptions were then imported to NVivo qualitative data analysis software (QSR International Pty Ltd. Version 9, 2010) and content analysed (Miles & Huberman, 1994). Data from transcriptions were coded, i.e., attaching key words, fragments and sentences from the participants'

discourse into categories. A category is a class of elements that are treated as equivalent (Barrett, 2006). Some categories were defined à priori for each beverage, namely: context – where, when and with whom, functionalities, and emotions – positive, negative.

The final categories are presented according to the structure of the interview in the results section. Two authors coded transcriptions individually (APS and RvB). Percentage of coding agreement between them was on average 97%, representing systematic coding reliability. Content analysis techniques were performed in each category, such as counting word frequencies, finding sequences and systematic explanations of the questions addressed and exploring the relations between categories. Frequency of usage is an indicator of the importance of that word/category for the participants in a direct relation, the higher the frequency of a word/category, the more important it is for the participants (Miles & Huberman, 1994). The relative importance of the categories for each group (Dutch and Portuguese) is presented in the results by symbols that differ according to connotation: + has a positive connotation and – has a negative connotation. The number of symbols in each category represents the usage frequency by the participants. One symbol means that the category was coded between 1 to 10 times; two symbols were coded from 11 to 20 times and three symbols were coded more than 21 times.

In order to increase the validity and precision of the study, three well-known techniques of qualitative research were employed in different phases of the study (Barbour, 2001). First, *within-method triangulation* was applied for data collection, i.e. the data were built up from inputs of multiple sources (three different locations) to include a larger variety of consumers' drink experiences, habits and cultural meanings, and to reduce the chances of bias (Modell, 2005). Second, *purposive sampling* was carefully planned according to the aims of the study. Third, *multiple coding* was performed by 2 of the authors during data analysis.

Lastly, to create a clearer image of the conceptual profile of each beverage per country, a correspondence analysis was applied to the data. This method, originated in the social science context, is commonly used to present results of qualitative studies (Sester *et al*., 2013, Ares *et al*., 2015). It explores categorical data in which no specific hypotheses have been formed, allowing us to examine the associations between the variables (Doey & Kurta, 2011). These associations can be visualised in a correspondence map, where proximities between points indicate associations between the variables (Greenacre, 2010). Data were organised in a contingency table displaying the frequencies between the categories achieved (columns) and the beverages per country (rows). The categories achieved were all the groups of words formed and classified in terms of context, functional and emotional conceptualisations. A correspondence analysis was applied to the contingency table allowing to extract and visualise the concept profile of each beverage per country, as it shows what categories are closer related and associated with each beverage. This analysis was performed using the software SPSS (IBM SPSS Statistics 2013, version 22).

Results

Context of consumption, functional and emotional conceptualisations

The twenty-nine categories of context of consumption found in participants' discourse were grouped in the three dimensions previously defined: *when, where* and *with whom*. These categories, their relative importance for the Dutch and Portuguese participants and examples of terms they used are summarized in table 3.

Table 3 | Context of beer, wine and NAB consumption and their relative importance for the Dutch (NL) and the Portuguese (P)

Context	Category	Beer		Wine		NAB		Category specification of individual terms
		NL	P	NL	P	NL	P	
WHEN	Afternoon	++	+++	+	+	0	+	Afternoon, 15h to 18h, before dinner, late afternoon, middle afternoon
	Dinner	++	++	+++	+++	+	+	Dinner, while eating
	Lunch	0	+	0	++	0	+	Lunch
	Evening	+++	+++	+++	+	+	+	Evening, 18h to 24h, after dinner
	Summer	++	++	+	+	+	+	Summer, warm days, warm weather
	Winter	0	0	+	+	0	0	Winter
	Week	+	+	+	+	0	+	Week, Monday, Tuesday, Wednesday, Thursday
	Weekend	++	+	++	+	+	+	Weekend, Friday, Saturday, Sunday
WHERE	A night out	++	+++	+	+	+	+	Going a night out, bar, discotheque, nightclub
	Home	++	+++	+++	++	+	+	Home, my place, student house, Parents 'house, boyfriends 'house, someone else 'house, friends 'house
	With specific food	+	++	+	++	0	+	Beer: snacks, seafood, tidbit, lupin, francesinha, picanha; Wine: quality food, fine dish, slow food, "sardines"
	Watching TV	+	+	0	0	0	0	Watching TV
	Doing Sports	+	+	+	0	+	0	During or after doing sports
	Party	+++	+	++	++	+	+	Party, birthday party, Carnival, Christmas, New Year, Celebration
	Pub/ café	+	+	+	+	0	0	Pub, café
	Restaurant	+	+	++	++	+	+	Restaurant, going out for dinner
	At work	0	0	0	0	0	+	Work
	Beach	+	+	0	+	0	0	Beach
	Terrace	+	+	+	+	+	0	Terrace, lounge, outside
	Reflection moments	0	0	+	+	0	0	Emotional moments, reflecting moments, leisure, romantic moments
	Informal occasion	+	+	+	0	0	0	Barbecue, in the street, festivals
	Formal occasion	0	0	++	+	+	0	Formal occasion, official occasion, special occasion, reception
WITH WHOM	Alone	++	+	+	+	0	+	Alone, myself, my own
	Colleagues	+	+	+	+	+	+	Colleagues, business relations
	Family	+	+	++	+++	+	+	Family, parents, family in law, mother, son
	Friends	++	+++	++	++	+	+	Friends
	Large group	+	+	0	0	0	0	Lot of people, crowd, large group
	Partner	0	0	+	+	0	0	Partner, wife, boyfriend
	Small group	+	0	+	+	0	0	Couple of people, small group

Legend: + (positive connotation) = coded from 1 to 10 times; ++ coded from 11 to 20 times; +++ coded > 21 times

Ten predominant functional conceptualisations for beer, wine and NAB consumption were identified from grouping the twenty categories found in participants' discourse (table 4).

Table 4 | Functional conceptualisations of beer, wine and NAB consumption and their relative importance for the Dutch (NL) and the Portuguese (P)

Functionality	Category	Beer		Wine		NAB		Category specification of individual terms
		NL	P	NL	P	NL	P	
HEDONIC	Food related	++	+++	+	++	+	+	dinner, dish, eat, food, lunch, meal, snacks, good food, tidbit, eat a sandwich, go with food
	Tasty	+++	+	++	++	+ —	+ —	tasty/not tasty, tastier, tasting, taste, flavouring, aromas, please the senses, intense pleasure, fruit flavour, I like the taste, not for the taste, the taste is nice, the taste is good
SOCIAL	Convivial	++	+++	++	+	0	0	convivial, conviviality, social, socialization, socialize, socializing
	Communication	0	0	+	++	0	0	chatting, in-depth conversations, serious talks, beginning of talks
	Company	+	+	+	+	+	+	company, together, feeling of solidarity, belonging, not wanting to differ, drinking along, companionship, pleasure of having company, drinking along, join in, loyalty, to be integrated in the group, to participate
	To celebrate	0	0	+	+	0	0	to celebrate, special occasion, official occasion, more ceremonious, romantic moments, fancier parties
	To have fun	+	+	+	+	+	0	lots of fun, have fun, live the fun, moments of fun
NUTRITIONAL	Thirst-quencher	+++	++	0	0	+	+	Thirst-quencher, refresh, refreshing, refreshment, fresh, freshness, thirsty, if I'm really thirsty, freshness, as a refreshment drink
	Health	0	0	0	0	+	++	to keep me hydrated, is healthier than drinking a soda or a coke, it's not bad for my liver
SUBSTITUTE	Substitute	0	0	0	0	+	++	it's a substitute for water, closest possible to beer, rather than a coke or a seven-up or other junk drinks
FOR THE ALCOHOL	Loosen up	0	0	+	+	0	0	loosen up, bit looser, getting tipsy
EXTEND MOMENTS	To extend moments	0	0	+	+	0	0	extensive dinners, extensive cooking, ritual, sitting, extend convivial moments, drink slower
BREAK MOMENTS	Break between moments	++	+	+	+	0	+	escape the daily rush, left the week behind, come home from work, calm down, doing nicely nothing, forget the whole week, put my mind in "0", break moments
CONVENIENT	Practical	++	+	0	0	0	0	drinkable, easy to drink, easy to transport, to get into the spirit, practical to order, fast drink, informal, convenient, inexpensive drink, practical to drink in a plastic glass, easy to buy in most places.
	Inexpensive	+	+	0	0	0	0	cheap, cheaper, less expensive, price
FUNCTIONAL	Functional	0	0	0	0	+	+	functional, functional choice less based on emotions, helps you to swallow
AVOID ALCOHOL	Avoid Alcohol	0	0	0	0	+++	++	do not want to get tipsy, does not contain alcohol, to move on without being drunk, when I think I shouldn't drink alcohol
	Driving	0	0	0	0	++	++	to drive, when I am the BOB*
	Medication	0	0	0	0	+	+	when you take antibiotics, when you are ill, because pregnancy, on medication
	Keep control	0	0	0	0	++	+	still want to be in control, being aware, certain safety, be conscious, security reasons

Legend: + (positive connotation) or − (negative connotation) = coded from 1 to 10 times; ++ coded from 11 to 20 times; +++ coded > 21 times. *BOB - Designated driver, Dutch expression meaning that a person can't drink alcohol because she/he has to drive while the others can drink alcohol.

More than a hundred (107) emotional terms were evoked, mostly positive (93 terms, 87%). These were grouped, according to similar meanings, in the framework of participants' discourse, resulting in a list of 25 emotional conceptualisations (table 5). The terms were classified as positive or negative, since it is a natural and basic distinction for emotional experience (Schifferstein & Desmet, 2010). In appendix A, emotional terms are translated from Dutch to English and from Portuguese to English.

Table 5 | Emotional conceptualisations of beer, wine and NAB consumption and their relative importance for the Dutch (NL) and the Portuguese (P)

Emotional conceptualisations	Beer		Wine		NAB		Category specification of individual terms
	NL	P	NL	P	NL	P	
Positive							
Adventurous	+	+	0	0	0	0	adventurous, rebel, wild
Amused	+	+	+	+	0	0	amused, playful, less serious, feeling funny, not boring
Calm	+	+	+++	++	+	+	calm, peaceful, quiet, rest, tranquillity
Comforted	+	+	+	++	0	0	comforted, warm, cosy, harmonious
Curious	+	+	0	+	+	0	curious, surprise, discovery
Energetic	+	+	0	0	0	0	energetic, lively, daring, sporty
Excited	+	+	+	+	0	0	excited, euphoric, feeling victory, feeling of ecstasy, exaltation
Exuberant	+	0	+	0	0	0	exuberant
Free	++	+	+	+	0	+	free, flexible, freedom, loosen up, more open, easier, carefree
Friendly	0	+	0	0	0	+	friendly, please your friends,
Fulfilled	0	0	0	+	0	0	personal fulfilment, plenitude
Good	0	+	0	+	0	+	good, well
Happy*	++	+	+	++	+	0	happy*, glad*, geniality
Joyful	+	++	+	+	0	0	joyful, joy, enjoy, merry*
Loving	0	0	++	++	0	0	love, passion, sensual, romantic, intimacy, attention to each other
Pleased	+	++	+	++	0	+	pleased, pleasant, satisfied, delighted, orgasmic, agreeable, satisfaction
Relaxed	++	++	++	+++	0	+	relaxed, relieve stress, it is relaxing,
Responsible	0	0	0	0	+	+	responsible, responsibility
Safe	0	0	0	0	+	+	safe, secure, in control, fearless
Negative							
Grumpy	+	0	0	0	+	0	grumpy, grouchy*, irritated*, bored
Restless*	+	+	+	0	0	0	restless, unreliable, anxious
Sad*	+	0	+	+	0	0	sad
Disappointed*	+	0	+	0	+	+	disappointed, foolish, feeling of loss
Neutral							
Conscious	0	0	0	0	++	+	conscious, consciously, sensible, attention, aware, careful
Rational	0	0	0	0	+	0	rational, ratio, mental

Legend: + (positive connotation) = coded from 1 to 10 times; ++ coded from 11 to 20 times; +++ coded > 21 times; * emotional state of participants also prior to consumption

Correspondence maps – conceptualisation of beer, wine and NAB

Correspondence analysis was applied to a contingency table crossing the categories identified in context, functional, emotional conceptualisations (columns from tables 3, 4 and 5) and the beverages (beer, wine and NAB), per group of consumers (Dutch and Portuguese). Frequency of elicitation was used as data input. The correspondence map (figure 1) illustrates consumers' associations between context, functional and emotional conceptualisations and the beverages, suggesting a highly significant association between the categories and the beverages. Two dimensions explained 82% of the variance between the categories identified and the beverages. Dimension 1 (explained 56% of variance) showed a distinction between the terms evoked by alcoholic (beer and wine) and non-alcoholic (NAB) beverages. Dimension 2 (explained 26% of variance) showed a clear distinction between the conceptualisation of beer and wine. In addition, it can be observed a clear and close correspondence between the Dutch and the Portuguese for all the three beverages, i.e. there is no large cultural distinction on how both groups conceptualise the beverages.

Apart from *at work*, drinking NAB took place in the same contexts of beer and wine, but to a lesser extent, as it presented the lowest number of categories and frequencies associated (table 3). This means that consumption of NAB occurred in restricted occasions, when compared to beer or wine, which presented mostly the same categories. Contrasting with the context of consumption, NAB had the highest number of functional conceptualisations and very different ones from those related to beer and wine (table 4). NAB was seen as a *functional* beverage, mainly to *avoid alcohol*, being a *substitute* when alcohol is not convenient, but also for water and soft-drinks (for health reasons), as becomes clear by reading this statement: "*I rather take a non-alcoholic beer than a coke because I think that is too sweet. And that water is also just water (FGNL 303)".* Beer was classified as a *thirst quencher* and a *convenient* beverage mainly to *socialise*. Drinking wine was associated with *communication*, and used *to celebrate* and to *extend moments*.

Hedonic seemed the most important functional association, with positive connotation for beer and wine. For NAB two opposite opinions were found about its flavour: some participants considered NAB a tasty and pleasurable beverage, whereas to others NAB was not as tasty, as explained here: *"Non-alcoholic beer works like a medicine product. I'm going to drink this because it has interesting health properties but in terms of flavour and taste and pleasure, it's a remedy when compared to an alcoholic beer (FGPT 104)".* Furthermore, some participants mentioned that the flavour of NAB can differ a lot among brands and this is the reason why they only drink a certain brand, and did not show willingness to drink unknown brands.
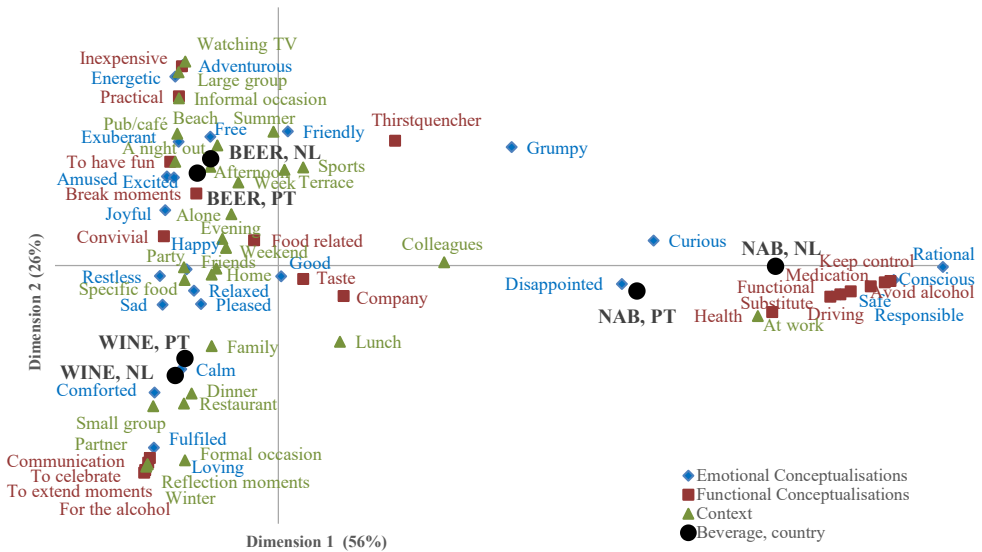
Figure 1 | First two dimensions of the correspondence analysis showing associations between context (▲ green), functional (■ red) and emotional (◆ blue) associations and beer, wine and NAB consumption, in the Netherlands (NL) and in Portugal (PT) (● black)

Beer and wine showed a similar number of emotional associations (wine 29, beer 32 - table 5), and had 15 emotional associations in common, for example: *happy*, *joyful*, *pleased* and *relaxed (table 5)*. However, particular emotional associations were linked to beer, such as: *adventurous*, *energetic* and *free*, whereas wine consumption was more associated with *calmness, loving*, *comforted* and *fulfilled*, as exemplified in this statement: *"Beer brings a different pleasure from wine. Drinking wine is more thoughtful, calmer. The pleasure of beer is more energetic" (FGPTP103).*

Both beverages showed a strong positive emotional profile, but indeed differentiated, as can be seen in figure 1. However, it seems that wine is perceived as more emotional than beer, judging by the interpretation of participants' discourse: *"Wine is more emotional to me, it's more emotional and when we have parties and friends' dinners but mostly it's more about emotion, whilst beer, with or without alcohol, is associated to a specific type of food (FGPT209)". "I also associate wine to emotions. Beer, I don't associate it so much to emotions, but rather just being in a terrace, drinking something cooler (FGPT204)".* NAB seems far from being associated with an emotional beverage, as it was classified as rational and indifferent in terms of emotional responses, as reflected in participants´ discourse: *"I think it is very rational when you drink non-alcoholic beer and that you really think about what you are drinking (FGNL106)", "Yes, that is right, we just said, (drinking NAB) it is mental it is not emotional, it is ratio (FGNL305). "Ah, that's impossible … (NAB and emotions). We're still the same, we drink another pack and we're the same!". "It is not there (the emotions)" (FGPT106).*

NAB evoked more neutral and negative emotional responses, as *rational, conscious* and *disappointed* (table 5), which was quite different compared to beer and wine.

Notably, participants not only reported emotional responses evoked by the beverages during consumption (as they were asked), but also feelings prior to consumption that guided their choice. Wine and beer are used by the participants either to enhance intensity of positive feelings or to decrease intensity of the negative ones. In table 5, terms marked with a star not only express the emotional responses during drinking, but also the feelings of the participants prior to consumption. Participants reported to drink wine to make them feel *happier, more glad* and *merrier*. They expressed to drink beer to become *less grouchy* and *less irritated*. They expressed to drink wine or beer to weaken negative emotions, as stated here: "*I also had a little bit of disappointment or sadness or the feeling of restless. I think I had beer or wine when it can serve to ease the pain a little, to weaken the emotion (FGNL104)*".

Dutch consumers highlighted that special beers (premium) are very much comparable to wine, in context, functional and emotional associations. They reported that special beers are not that suitable to drink at parties (context), and that they like to drink them slowly (functionality). These special beers were associated with intense *happiness, delight,* and *comfort* (emotional terms). It seems that the conceptualisation of special beers is closer to the conceptualisation of wine than of beer.

Discussion

Two main findings can be highlighted from this study. Firstly, moderate alcohol consumers have different conceptualisations of beer, wine and NAB, as is visualised in figure 1. The conceptualisation of NAB is mostly functional, whereas beer and wine are rich in both functional and emotional content. Secondly, the Dutch and the Portuguese participants showed a similar conceptualisation for these beverages, with small differences in the emotional associations.

The qualitative approach used in this study revealed the context, functional and the emotional conceptualisations of beer, wine and NAB consumption, for Dutch and Portuguese consumers. Interpretation of qualitative data required careful consideration of the number of words associated with each beverage and subjective interpretation and judgment of participants' discourse, both the literal and the figurative meanings (Knodel, 1995). The correspondence analysis along with the interpretation of participants' discourse, is a useful way to better understand the conceptualisation of the beverages.

Differences in conceptualisations

Relevant and positive functional association with hedonics exists for beer and wine. Participants drink beer and wine because they like the flavour, which converges with previous research (e.g. Charters and Pettigrew, 2008, Chrysochou, 2014). For NAB consumption this is more complex and consumers seem to be divided in two segments. A sub-group of participants reported that flavour is the main motivation for consumption (segment 1) which is in line with the findings of Thompson & Thompson (1996) for NAB and of Chrysochou (2014) for light beer. However, to other participants the flavour of NAB was definitely not the driver of consumption (segment 2), which is comparable with the findings of Porretta & Donadini (2008), but the primary reason for NAB consumption was to avoid alcohol, as also reported by Jongh *et al*. (2014). In addition, most participants find NAB not as tasty as regular beer and are very brand sensitive. This is also reported by Chrysochou (2014), for light-beers in a study with light-beer consumers. This can be expected because when ethanol is removed from regular beer there is also a loss of other flavour compounds affecting the flavour characteristics, as well as a loss of body and mouth feel (Blanco *et al.*, 2014; Montanari *et al.*, 2009). Flavour composition varies depending on the process of dealcoholisation and perhaps this is the reason why participants are very demanding and faithful to a certain brand. Despite the efforts to develop new technologies to produce NAB (e.g. Catarino & Mendes, 2011), this is a confirmation that product refinement focusing on sensory attributes is required and that the target group of NAB consumers might be divided into two different segments.

The hedonic value associated with NAB could explain the neutral and negative emotional associations surrounding this beverage such as *disappointed, grumpy and rational* (figure 1). In contrast, pleasant emotional associations were reported to be experienced for beer and wine more often than unpleasant associations. This is known as hedonic asymmetry (Schifferstein & Desmet, 2010) and is only verified for beer and wine. People have a positive predisposition to eat and drink products they expect to have a pleasant emotional impact. However, participants did not show this predisposition towards the NAB.

Beer and wine showed different emotional associations in terms of arousal, which is a dimension ranging from calm to excitement, used to characterise emotions in addition to the valence (pleasant/unpleasant) dimension (Russell, 2003). These dimensions, arousal and valence, can be identified in figure 1. Dimension 1 represents valence, pleasant feelings that were associated to beer and wine consumption (alcoholic beverages), such as *pleased* and *joyful*, and unpleasant feelings that were associated with NAB (non-alcoholic beverages), such as *disappointed* and *grumpy*. Dimension 2 represents arousal, and ranges from high arousal terms, such as *energetic, excited, amused,* that were associated with beer, to low arousal terms, such as *calm, loving* and *comforted*, that were associated with wine consumption.

The strong image of NAB as a substitute of beer, in addition to the weak positive hedonic value, might explain the neutral and negative emotional responses and, therefore, the lower frequency of consumption. Some participants described NAB as a *fake beverage*, comparable to something like *plastic flowers*, giving them a feeling of *loss*. These associations reflect the high level of comparison of NAB to regular beer in which the participants' expectations regarding NAB were not fulfilled. To prevent, or at least minimize disappointment, NAB should be treated as a beverage in its own right and it might be wise to avoid conceptual comparisons with beer in advertisement and publicity.

Participants highlighted their loyalty to a certain brand of NAB, and were not eager to try others brands. This seems to be a risk reduction strategy to avoid disappointments related to flavour resulting from different methods of dealcoholisation. Thus, while risk reduction strategies favour choosing beer over wine, as wine is perceived as much more complex (Lacey *et al.*, 2009), brand loyalty due to flavour expectations benefits specific brands of NAB. Developing a NAB that will result in a positive and congruent conceptualisation with the brand is therefore of high importance.

It could also be argued that the lack of positive emotional associations with NAB might be due to the absence of alcohol. Chaya *et al*. 2015 reported that the word *intensity* (similar to *energetic)* was able to discriminate between the non-alcohol and high alcohol beer samples, with the high alcohol content beer rated higher for *intensity*. Our study found that *energetic* is highly associated with beer and not with NAB. Alternatively, the absence of alcohol might not be a strong argument for the lack of positive emotional associations, because other non-alcoholic beverages have been associated with positive and high arousal emotions. For instance, the Amp Energy beverage is classified as a high arousal beverage and Coca-Cola is strongly related with *happiness* (Di Muro & Murray, 2012; Mogilner *et al.*, 2012). These beverages, however, contain caffeine, which is not present in NAB. Caffeine is also known as a mood and arousal enhancer, and in this sense, may be comparable to alcohol (Keast & Riddell, 2007).

If it comes to improving the image of NAB, the neutral and negative emotional associations evoked have to be changed. One way to accomplish this might be, for instance, by introducing *energetic* and *convivial* associations in communication and advertisement while avoiding the direct comparison with beer, especially on the flavour (Holbrook & Batra, 1987).

Mood enhancement was one of the main motivations reported by Charters & Pettigrew (2008) for wine consumption. In our study, we also found that beer and wine are used to enhance the emotional state of consumers, but also to decrease negative feelings, as also reported by van Zyl & Meiselman (2015). If participants are in a positive emotional state they drink to enhance that state. On the other hand, if they are in a negative emotional state they drink to become less negative. This is known as emotionally instrumental eating/

drinking, i.e. eating/drinking in order to regulate or control both positive or negative emotions and it has been proposed as a major motivation for alcohol use (Demmel & Nicolai, 2009; Macht & Simons, 2000). Our findings, however, suggest that the emotional state of consumers might influence the choice of the alcoholic beverage (beer or wine) to reach a desirable emotional state. This is a different situation from emotional responses evoked by product (Meiselman, 2015) and seems to be a relevant topic to explore further for a better understanding of beverage choice.

So far there are no standard methods of food/beverage emotional measurements but there are some studies reporting emotional responses related to specific beverages and a comparison is interesting. Our list of emotional terms (25 words) includes 3 out of 4 emotional terms reported by Desmet & Schifferstein (2008) in relation to alcoholic beverages, namely *amusement, love* and *enjoyment* (included in our list in joyful); 5 out 5 emotional terms reported by Sester *et al.* (2013) related to beer, namely: *happiness, calm, sadness, excited* and *relaxed*; and 4 out of 12 emotional terms reported by Chaya *et al* (2015), namely: *pleasure*, *excitement*, *disappointement* and *intensity* (energetic). However, 4 extra terms from this study are included in their previous list (before clustered), namely: *friendly, relaxed, happy* and *curious*. Some of the terms classified as emotions by Chaya *et al.* (2015) (fun, fresh) were classified as functional associations in this study based on participant´s description. In relation to wine consumption, 7 out of 16 emotional terms reported by Ferrarini *et al.* (2010) are similar to our list, namely: *amusing, happy, joyful, curious, pleasant, euphoric* (included in our list in *excited*) and *passionate* (included in our list in *loving*). One may assume that our list would integrate all the terms from these previous studies, since the beverages are the same. The differences are due to the different methods applied for data collection, the level of familiarity between the participants and the beverages, data analysis or due to cultural differences, as the studies were performed in different countries, and/or due to the language of the respondents (Dutch, French, Spanish, Italian versus Portuguese and Dutch) (van Zyl & Meiselman, 2015). The comparison with other studies support the idea that the development of a list of emotions to apply in cross-cultural studies is relevant to establish which terms are important to all beverages and in all countries/cultures of interest involved (van Zyl & Meiselman, 2015). The lexicon of emotional responses related to beer, wine and NAB found in this study (25 terms) could be used in further quantitative studies to be performed in the Netherlands or in Portugal.

Sester *et al.* (2013), reported that the more familiar consumers are with products, the more episodic memories are retrieved. In addition, Giacalone *et al.* (2015) reported that beer familiarity strongly influences different usage contexts, i.e. familiar beers are associated with sports and outdoor activities, whereas novel ones seemed suitable for formal social occasions. Following this, it can be expected that the relatively low familiarity (in terms of frequency of consumption) of consumers with NAB could be the reason for the low number of associations reported in this study.

Cultural comparison

Despite the strong cultural, social and economic relations between the Dutch and beer and the Portuguese and wine, the results of this study did not reflect a great distinction between the two groups in the conceptualisation of beer, wine and NAB. However, findings are based on a small sample of consumers that might not be representative of the Dutch and the Portuguese cultures. Therefore, this finding needs replication in bigger representative samples before one can generalise this to the general population of both countries.

Regarding the functional conceptualisations no differences were found (table 4) showing that both groups use these beverages for the same purposes. However small differences are reflected in the context of consumption and in emotional conceptualisations. Drinking beer, wine and NAB during *lunch*time is a cultural Portuguese habit (table 3) and is related with their concept of lunch, as a warm, complete and long meal. In contrast, Dutch lunch is usually a quick meal, such as a sandwich, excluding beer or wine consumption(Silva *et al.*, 2015).

For the Portuguese the distinction between drinking beer or wine seems also to be closely related to the *food* that it goes with and to its *taste* (table 4). This seems to be in line with the findings of Ares *et al.* (2015), where it is shown that, between five different cultures, the Portuguese have the highest association between specific foods and alcoholic beverages when describing wellbeing, evoking feelings as *calm, happiness, comfort* and *pleasure*.

For the Dutch participants wine and special beers seem to have similar conceptualisations. This is an interesting outcome to explore further, suggesting that two different product categories (special beers and wine) may compete in similar occasions, evoking similar emotional responses to the consumers. This is in line with Giacalone *et al.* (2015) who reported that unfamiliar beers tend to be perceived as an alternative to wine for dinner. Exploring further in which contexts different classes of beers and wines may compete is important to increase insights in beverage choice and should be a topic of future studies.

Despite the fact that NAB is associated with concepts such as *safe, responsible* and *disappointed*, for the Portuguese participants, *pleasant* and *relaxed* were also evoked, similarly to beer and wine, although in a lesser extent. On the other hand, the Dutch participants mentioned *curiosity*. Especially the latter may lead us to believe that the Dutch participants have some expectations about NAB that are not yet met, giving an opportunity for product development.

In summary, NAB is seen as a substitute for alcoholic beverages but also for soft drinks, for health reasons, because of the high sugar levels that they contain. Seeking a substitute requires the disruption of the unconscious mind, i.e. to break existing habits, e.g. not going for an alcoholic or a soft drink, and find an alternative to fulfil concerns (Lundahl, 2011). This rational process is named seeking behaviour (Lundahl, 2011) and seems applicable to the choice of NAB. Because this beverage is named beer, even without alcohol, the comparison

with regular beer is obvious and likely leads to product expectations that seem not to be met. These expectations might be reflected in the low emotional associations with NAB (e.g. *responsible*, *rational*) that support this assumption. In contrast, the consumption of beer and wine seems to be a sensing behaviour, i.e. arises from sensory cues and is associated with habit (Lundahl, 2011). This behaviour is mostly driven by our unconscious mind and it is related with high positive emotional impact that is stored in the memories associated with the experience. If sensing behaviour is applicable to beer and wine consumption, and seeking behaviour is applicable to NAB consumption, different strategies have to be applied accordingly.

The present research identified the functional and emotional associations that consumers have with beer, wine and NAB, but not the level of each association. Although the frequency of the categories achieved can give us an idea of their importance, they serve to generate hypotheses that need to be confirmed. Further quantitative studies, on a larger sample population would be beneficial to gain a better understanding of consumers' perceptions of NAB and possible cultural differences.

Conclusions

Beer, wine and NAB have different conceptualisations for consumers. Beer and wine have rich conceptual content and are successful beverages. NAB has a limited conceptual content, mostly functional and less emotional, and is not so successful. This may suggest that a beverage needs to evoke a rich and emotional set of positive associations in consumers to succeed. Wine is associated with positive low arousal emotional responses, whereas beer is associated with positive high arousal emotional responses. NAB is neither associated with high nor with low arousal, evoking neutral and negative emotional responses.

This study shows similar conceptualisations of the beverages in both countries, with minor differences. From the product category profile it is beneficial that beer, wine and NAB are perceived with a uniform concept across countries. This means that the same strategies to improve NAB acceptability can be applicable in both countries.

The difference in conceptualisations between NAB and beer/wine might be why NAB is not adopted more widely as it does not deliver a comparable emotional response to consumers. NAB has to be treated as a beverage in its own right, avoiding direct conceptual comparisons with beer, especially regarding the flavour. Product refinement related to the sensory attributes seems to be required. Should the image of NAB be communicated and understood as a more *energetic* and *convivial* beverage in communication and advertisement, a higher level of congruence between expectation and experience could be achieved.

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3

Chapter 4

What's in a name? The effect of congruent and incongruent product names on liking and emotions when consuming beer or non-alcoholic beer in a bar

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This study concerns the expectations, liking and emotions related to the consumption of conventional beer and non-alcoholic beer (NAB), which are related but different products. These beverages are derived from the same raw materials and have undistinguished visual sensory cues. However consumers acknowledge the differences between them in terms of flavour, functional and emotional conceptualisations. Of particular interest here is how prior experience with beer and NAB and the conceptual information this generates in a consumer, can influence his or her response to its consumption in an appropriate setting – a bar. The labelling of a sample as *beer* or *non-alcoholic beer* was employed as a prompt to study the effects on liking and emotions provoked, when drinking a beer or a NAB, in a bar. Over 4 sessions, 155 consumers drank a glass of beer or NAB under two different conditions, labelled either correctly or incorrectly with respect to the actual composition of the sample. Questionnaires were used to rate the liking and emotions prior to and after consumption. The naming of NAB as beer significantly increased the liking and changed one emotion towards a positive direction, namely participants felt more *fulfilled*. When beer was presented as NAB it did not affect the liking but did significantly reduce the intensity of six positive emotions. Participants felt less *comforted*, *exuberant*, *good*, *happy*, *joyful* and *loving*. This study showed that labelling and the conceptual information generated in consumers might influence their response after consumption of these beverages.

Abstract

Introduction

Beer and Non-alcoholic beer

In the wide world of beverages non-alcoholic beer (NAB) is the closest beverage to beer in a sense that both are produced with the same raw materials and NAB provides visual sensory cues that simulate beer (Sohrabvandi et al., 2010). However, the differences between these beverages in terms of flavour, functional and emotional conceptualisations are acknowledged by consumers. BEER evokes positive high arousal emotional responses, such as *adventurous* and *energetic* whereas NAB is seen as a substitute and evokes mainly neutral or negative emotional responses, such as *rational, conscious, and disappointment* (Silva et al., 2016). This raised the question how product names, "BEER" and "NON-ALCOHOLIC BEER", might affect the conceptualisation of these beverages and therefore consumer´s responses to their consumption. This study can be an important contribution from nutritional and social perspectives, to a better understanding of beverage choice, and particularly between alcoholic *versus* non-alcoholic beers. It can also be useful for marketing and product development purposes, in the beverage industry.

Expectations, liking and emotions

Expectations are psychological anticipations that something will occur or be experienced (Cardello, 2007), affect reactions and decisions, sometimes at an unconscious level, and may improve or degrade the perception of a food/beverage even before it is tasted (Deliza & MacFie, 1996). Expectations may be derived from intrinsic properties of a product such as sensory attributes, in which sensory and perceptual systems are involved, or from extrinsic attributes such as product name, which operates via cognitive and psychological mechanisms (Cardello, 2007). When a food/beverage is consumed, the actual experience (AE) is compared by consumers to the expected experience (EE) and when hedonic evaluation of a product is the same as expected (AE = EE) confirmation occurs. However, in the case of discrepancy between experiences (AE ≠ EE), the observed effects can be explained by the assimilation/contrast model proposed by Anderson (1973). Assimilation occurs when consumers adjust their perception of the product to what was expected, attempting to minimize the discrepancy between expected and actual experiences. Assimilation predicts positive disconfirmation when expectations are lower than the actual hedonic evaluation of a product (EE<AE) and negative disconfirmation when expectations are higher than the hedonic evaluation of a product (EE>AE) (Cardello, 2003). Contrast effects, on the other hand, occur when consumers magnify the discrepancy between expected and actual experiences (Yeomans et al., 2008). Sensory expectations of food and beverages based on extrinsic cues have been studied widely (see Piqueras-Fiszman and Spence (2015) for a review). Previous studies suggested that preferences for

specific beers, based on liking scores of blind samples of beers, are influenced primarily through expectations derived from different extrinsic attributes, such as brand (Allison & Uhl, 1964), information regarding manufacturing technology (Caporale & Monteleone, 2004) and information and timing when participants were informed about a secret ingredient added to beer brand (Lee et al., 2006), rather than from the taste experience itself, i.e. from the intrinsic attributes.

The assessment of product-evoked emotions, rather than liking only, has recently gained popularity amongst researchers with the general aim of characterizing consumer´s responses to food and beverages (e.g. Cardello et al. (2012); King et al. (2010); Porcherot et al. (2012); Spinelli et al. (2015); Thomson et al. (2010)). Chaya, C. et al. (2015b) studied the emotional response to beer in three different conditions: blind (liquid only), packaging (only) and informed (liquid plus packaging). The authors suggested that sensory properties drove the emotional responses in the blind condition, e.g. the more carbonated beers evoked more pleasant emotions and sweeter beers were associated with less engaging emotions. In the packaging condition this effect was even stronger, resulting in better differentiation between products in terms of emotion profiles. Information from the packaging related to alcohol content might have influenced emotional responses, as low alcohol beers were associated with less activated emotions and alcoholic beers were associated with more activated emotions. The study described was performed with consumers tasting a small amount of beer and it is not known what emotional change is triggered by drinking a whole glass of beer or NAB. Evaluating and comparing feelings before and after product experience can reveal which feelings are connected to the product and how they evolve (Meiselman, 2015). For example, Porcherot et al. (2015) investigated feelings before and after drinking an alcoholic aperitif showing that the most familiar variant of the beverage was associated with a greater decrease in negative mood states. The measurement of emotions before and after product experience is identified as a possible verification for the factual contribution of emotion measurement in consumer research (Köster & Mojet, 2015).

Aims and hypotheses of the study

The primary objective of this study was to assess how the product name, "BEER" or "NON-ALCOHOLIC BEER", influenced liking and the emotions elicited, before and after drinking either a BEER or NAB, when the beverages were given to consumers named correctly and incorrectly with respect to their composition. It was hypothesized that the product name "BEER" or "NAB" would have a stronger effect on consumers' responses than the actual flavour of the beverage. It was anticipated that the responses would follow the expectations triggered by the product name, which would be in line with either a positive or negative assimilation effect (Anderson, 1973).

The second objective was to investigate the emotional response induced by drinking either a BEER or NAB, i.e. comparing the emotional response before and after drinking BEER or NAB, when product name and beverage content were congruent.

When measuring self-reported emotions it is important that the emotion terms offered are relevant for the product category and culture (van Zyl & Meiselman, 2015). Therefore, different emotion lists have been developed for different beverages (e.g. for wine - Ferrarini et al. (2010), for coffee – Bhumiratana et al. (2014) and for blackcurrant juice – Ng et al. (2013a)). The emotional terms used in the present study are the outcome of a previous qualitative study reporting the emotional associations of Dutch consumers with BEER and NAB consumption (Silva et al., 2016). Using this list in the present study allowed the validation of the methodology by measuring emotional associations with BEER and NAB, adding quantitative data and capturing variations between the beverages for different moments (before and after drinking).

Given the importance of context of consumption for liking and emotional measurements (de Graaf et al., 2005; Meiselman, 2006; Piqueras-Fiszman & Jaeger, 2014) and specifically for beer (Dorado et al., 2016), this study was performed in a realistic consumption context, a café/bar, as it is one of the main places where beer consumption occurs (Silva et al., 2015). The use of a realistic testing situation increases the validity of the measurements of a study (Köster, 2003).

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Materials and methods

Participants

One hundred and fifty-five moderate beer consumers (between 1 and 16 glasses of beer / week), were recruited in Wageningen, the Netherlands for this study. Gender and age group were equally represented (50% males, 50% females, 50% 18-34 years and 50% 35-65 years old). Level of education varied from vocational education (seventeen participants, 11%), bachelor degree (forty participants, 26%) and post-graduate degree (master or higher) (ninety-eight participants, 63%). Eighty-two participants (53%) were familiar with NAB, drinking on average 3 glasses per month. All participants were healthy and had a normal (self-reported) ability to taste and smell. Pregnant or lactating women and people taking prescribed medication were excluded. Participants were allowed to register for the study alone or with others. One hundred and one (65%) participants performed the study with friends, family or partners and the group size varied from 2 to 4 people. The other 54 participants (35%) registered individually and performed the study alone. All participants signed an informed consent statement before the study began and received a small reimbursement for their participation. The study protocol was submitted to and positively evaluated by the medical ethical committee of Wageningen University.

Beverages

The beverages in this study, BEER and NAB, were commercially available products, which are familiar to Dutch consumers. The brand was not revealed to the participants. All bottles of each product (beer or NAB) belonged to the same production batch and were used within three months after production. Beverages were served between 5° and 6° C in unbranded glasses of 300 mL. Samples were dispensed by an experienced professional, to ensure that a glass of BEER could not be distinguished from a glass of NAB by appearance alone. In the glass the beverages had a similar colour, level of carbonation and amount of foam. However, the beverages differed in terms of nutritional values, beer containing per 100 mL: 40 Kcal, 2.5g carbohydrates, from which less than 0.4g were sugars, 0.3g fibre, 0.5g protein, less than 0.01g salt and 5% (vol.) alcohol. For the same volume NAB had 23 Kcal, 5.4g carbohydrates, from which 3.4g were sugars, less than 0.5g fibre, 0.3g protein, less than 0.02g salt and no (0.0%) alcohol.

Liking and emotion measurements

A questionnaire was used for data collection. It started with the following introduction: "Welcome to the *Feel like a beer?* (in Dutch "Zin in een biertje?") study. Today you are going to drink a BEER xxx (three digit code) (or Today you are going to drink a NON-ALCOHOLIC BEER xxx). Please answer all questions below by putting a clear vertical mark on the line scales."

Liking was rated on a 100-mm visual analogue scale, with end anchors, "dislike extremely" and "like extremely". Participants rated liking twice, once before drinking the beverage while anticipating that they were going to drink a "BEER" or a "NAB" - expected liking - and once after drinking the beverage - actual liking.

A list of 25 emotion terms related to BEER and NAB consumption was used in this study. The question addressed was the same for both rating moments (before and after drinking) and was based on the study of King & Meiselman (2010): "*Below you will find words which describe different kinds of moods and feelings. Using the line scale please describe how you FEEL RIGHT NOW*". Emotion terms were rated on a 100-mm visual analogue scale, with end-anchors: "not at all" and "very much". Emotion terms were presented in random order, but the order was the same for all the participants.

Study design

This study had a 2x2x2 within-subjects design. The factors were: 1) rating time: before and after drinking; 2) product name: "BEER" and "NAB" and 3) beverage: BEER and NAB (table 1). Participants were blind to the real objective of the study; instead they were told that the aim of the study was to investigate emotions elicited by different types of beer.

The product name "BEER" or "NAB" was provided in two conditions: corresponding or not corresponding to the actual content of the beverages: BEER or NAB, without participants' knowledge. The aim was that participants would think they drank the beverages as described to them via the questionnaire, e.g. "Today you are going to drink a BEER (xxx 3 digit code)". In this study the product name represents only the product *category* name, as no brand information was given and the beverages were served in unbranded glasses. The comparison between beverages with the same name but different content facilitated studying the effect evoked by sensory properties, whereas the comparison between beverages with different names, but with the same content, facilitated studying the effect of product name perception. The comparison of the responses for the same beverage without manipulation, i.e. product name corresponding to the correct beverage, before and after drinking facilitated studying the effect of the beverage on emotional responses. This approach of manipulating product name and alcohol content has been used in a previous study on wine (Meillon et al., 2010).

The study consisted of four sessions, with an interval of one week between sessions. During each session participants received either a glass of BEER or NAB, which was said to be "BEER" or "NAB", corresponding or not corresponding to the actual content of the beverage. The order in which participants were presented with the combinations of product names and beverages across the sessions was randomized and counterbalanced.

Table 1 | Experimental design of the study showing the combinations of three independent variables: rating time (before *versus* after drinking), product name ("BEER" *versus* "NAB") and beverage (BEER *versus* NAB) (2x2x2).

Rating time		Before drinking (BE)		After drinking (AF)	
Product name		"BEER"	"NAB"	"BEER"	"NAB"
Beverage	BEER	BE_"BEER"_BEER	BE_"NAB"_BEER	AF_"BEER"_BEER	AF_"NAB"_BEER
	NAB	BE_"BEER"_NAB	BE_"NAB"_NAB	AF_"BEER"_NAB	AF_"NAB"_NAB

Procedure

The study took place in café/bar *Onder de Linden*, one of the oldest cafés in Wageningen, the Netherlands, recognised as a well-known place to drink beer. The usual ambience of the bar was kept unchanged during the experiment. Sessions were performed on four consecutive Tuesdays, between 17h to 21h, which is a normal time for beer consumption in the Netherlands (Silva et al., 2015).

Participants were invited to come to the bar in groups of 20 people at a time and in time intervals of 30 minutes. As soon as they arrived at the bar they had to check-in, which occurred in a different room from the bar interior. After showing their identification,

participants received the instructions on questionnaire completion and how to perform the test. The questionnaires were provided on paper, in Dutch and were designed using EyeQuestion software (Logic8 BV). Participants were then invited to go to the main room of the bar, to choose a table to sit and to start to complete the first questionnaire (before drinking). In the instructions to the participants it was highlighted that both questionnaires (at the beginning and at the end) had to be completed individually, without talking to others and sharing opinions. However, talking was allowed while drinking as long as it was not about the characteristics of the beverages. After completion of the first questionnaire, the beverage was served. Participants were free to finish the whole glass or not and no minimum amount was required. Once they finished they completed the second questionnaire and were thanked for their participation.

Data analysis

Statistical analyses were performed using SPSS 22.0 (IBM, New York, USA) and Microsoft Excel 2013/XLSTAT (XLSTAT Version 2015.5.01.23234, Addinsoft, Inc., Brooklyn, NY, USA).

Potential order effects of beverage presentation across the four sessions were checked by comparing the mean scores for liking and for each emotion, per condition, per session, using a general linear model univariate ANOVA with order effect as a fixed factor (Gutjar et al., 2014; King et al., 2013). This procedure revealed no indications of systematic beverage order effects on the evaluation of liking or emotion scores (data not reported). Therefore, the effect of the order of presentation of the beverages was not considered in further analyses.

Mean liking and emotion scores were calculated for the 8 possible combinations, combining the 3 independent variables: rating time (before, after), product name ("BEER", "NAB") and beverage (BEER, NAB). Main effects and interactions were tested for liking scores and for each emotion, using repeated measures ANOVA. Subsequently, paired t-tests comparisons using Bonferroni´s correction were used to reveal significant differences between liking scores (16 comparisons, p=0.05/16=0.003).

Repeated measures ANOVA was performed with 4 independent variables: rating time (before and after drinking), product name ("BEER" and "NAB"), beverage (BEER and NAB) and emotions (25 emotional terms) to evaluate the main effects and interactions on emotion scores followed by paired t-tests comparisons using Bonferroni correction to reveal significant differences (p<0.003). The same procedure was then repeated for each emotion separately, to reveal for which emotions the effects and interactions reached significance (p<0.003).

In addition, a Multiple Factor Analysis (MFA) was performed. MFA yields observations described in several sets of variables (Escofier & Pagès, 1994). This method has been

shown to be valuable to explain emotional data deriving from different conditions (Gutjar et al., 2015).

Applying MFA to the variables of this study allowed to illustrate and compare the data sets of emotional responses elicited before and after drinking for each beverage in each condition, i.e. when product name corresponded or did not correspond to the beverage. For this analysis the mean emotion scores across participants for each condition were generated. The result was a 4 x 25 emotion data matrix (before drinking) and a 4 x 25 emotion data matrix (after drinking), which were used for MFA. The R_v coefficient was calculated as a measurement of correlation between emotional responses before and after drinking.

Results

Effect of product name on liking

The mean scores and standard errors of liking per beverage under each condition are presented in figure 1. Results showed that rating time, product name and beverage type all had a main effect on liking scores. Liking was higher when based on the prior information of the product name, compared to after consuming the product ($F(1, 154) = 50.4$, $p < 0.003$); the name "BEER" induced higher liking scores than the name "NAB" ($F(1, 154) = 86.7$, $p < 0.003$) and the beverage BEER induced higher liking scores than the beverage NAB ($F(1, 154) = 62.7$, $p < 0.003$). In addition, the results showed two significant 2-way interactions: rating time x product name ($F(1, 154) = 20.7$, $p < 0.003$) and rating time x beverage type ($F(1, 154) = 62.7$, $p < 0.003$) and a significant 3-way interaction rating time x product name x beverage type ($F(1, 154) = 4.2$, $p = 0.041$). This indicates that liking increased or decreased depending on the specific combination of rating time, product name and beverage type, as reflected in figure 1. Liking of "NAB"_NAB (56) was significantly higher based on product name than on the flavour (43) ($p<0.003$). This was not the case for BEER as no significant differences were found between expected (68) and actual liking (65) of "BEER"_BEER ($p<0.003$). Liking scores were significantly higher after drinking NAB named as "BEER" (49), than after drinking NAB named as "NAB" (43) ($p<0.003$). However, the liking scores when BEER was named "NAB" (61) were significantly higher than for NAB named "NAB" (43) ($p<0.003$) and not significantly different from BEER named "BEER" (65) ($p = 0.039$).
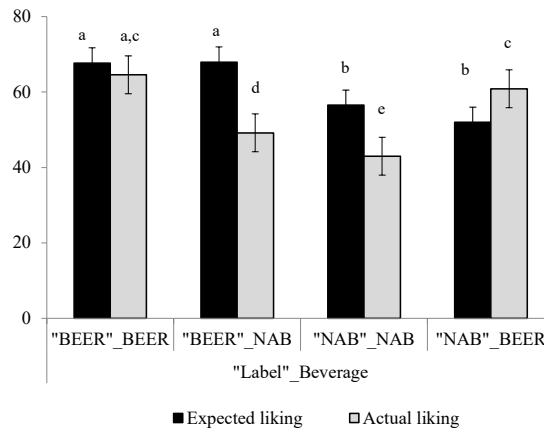
Figure 1 | Expected (before drinking) and actual (after drinking) mean liking scores of BEER and NAB. Liking was measured with a 100-mm visual analogue scale and anchored "dislike extremely" and "like extremely"; lines above the bars represent the standard error of the mean (SEM); a, b, c, d, e - bars with different letters mean that the values are significantly different (p<0.05).

Additionally, the effects of education level of participants, company (alone *versus* with company), NAB consumption (NAB consumers *versus* NAB non-consumers), age (younger *versus* older group) and gender, on liking scores were analysed. Results showed that education level (F(4, 150) = 2.293, p = 0.062), company (F(1, 153) = 0.896, p = 0.345) and NAB consumption (F(1, 153) = 1.027, p = 0.313) did not have an effect on liking. However age group and gender did have an effect on liking scores, namely that younger participants rated liking higher than older participants (F(1, 153) = 9.641, p = 0.002), and female participants rated liking higher than male participants (F(1, 153) = 9.716, p = 0.002).

Effect of product name on emotional responses

The mean scores of each emotion for each beverage in every condition are presented in table 2. Results showed that rating time, product name and beverage type all had a main effect on emotions. It was observed that rating time had an effect on 15 emotions out of 25 (60%) (F(1, 148) = 18.3, p<0.003), namely *amused, calm, comforted, conscious, curious, disappointed, excited, exuberant, fulfilled, grumpy, rational, relaxed, restless, responsible and safe* (all emotions p<0.05). Product name ("BEER" *versus* "NAB") had an effect on 19 emotions (76%), (F(1, 148) = 6.73, p<0.003), namely: *adventurous, amused, comforted, curious, disappointed, energetic, excited, exuberant, free, friendly, fulfilled, good, happy, joyful, loving, pleased, relaxed, sad* and *safe* (all emotions p<0.05). Beverage type had an effect on five emotions (20%), (F(1, 148) = 2.71, p<0.003), namely *curious, disappointed, fulfilled, pleased* and *safe* (all p<0.05). A significant 2-way interaction occurred between rating time x beverage type with an effect on 16 emotions (64%) (F(1, 148) = 6.99, p<0.003), namely: *adventurous, amused, comforted, conscious, disappointed, excited, exuberant, free, fulfilled, good, grumpy, happy, joyful, loving, pleased* and *responsible* (all emotions p<0.05).

Table 2 | Mean values of emotions elicited in each condition. Emotions were measured with a 100-mm visual analogue scale and anchored "not at all" and "very much"

Emotions	Rating Time	"BEER"_BEER	"BEER"_NAB	"NAB"_NAB	"NAB"_BEER
Adventurous (+)	Before	58,6	59.1	54.7	55.5
	After	59.1 [a]	56.5	52.2 [a, b]	56.6 [b]
Amused (+)	Before	65.2 [a]	65.9	65.5	63.0 [b]
	After	69.4 [a,c]	66.5	64.5 [c]	67.2 [b]
Calm (+)	Before	63.2	62.9 [a]	63.7	64.4
	After	64.6	67.6 [a]	66.6	65.3
Comforted (+)	Before	65.9 [a]	66.8	65.1	64.4
	After	71.0 [a,b,c,d]	67.9 [d]	64.2 [b]	66.5 [c]
Conscious (0)	Before	68.1 [a]	67.7	67.0	66.5
	After	62.8 [a]	66.2	64.8	63.7
Curious (+)	Before	73.0 [a,f,g]	69.7 [b]	66.8 [c,f]	65.7 [d,g]
	After	62.2 [a,e]	59.2 [b]	55.4 [c,e]	59.0 [d]
Disappointed (-)	Before	20.5	18.9 [a,c]	25.4 [c]	23.8
	After	21.9 [b]	27.1 [a]	30.8 [b,d]	24.1 [d]
Energetic (+)	Before	61.7	60.9	58.6	58.6
	After	62.6 [a]	61.3	57.7 [a]	59.8
Excited (+)	Before	48.6	50.5 [a]	47.6 [b]	45.0
	After	47.6	43.9 [a]	42.4 [b]	44.9
Exuberant (+)	Before	53.1 [a]	53.1	50.1	48.1
	After	58.9 [a,b,c,d]	54.1 [d]	50.5 [b]	52.6 [c]
Free (+)	Before	69.3	70.4	68.9	66.7
	After	71.4	69.7	68.6	68.5
Friendly (+)	Before	74.0	73.4	71.5	71.5
	After	74.5	73.0	71.6	72.0
Fulfilled (+)	Before	62.6 [b]	64.1	61.8	61.9 [e]
	After	70.2 [a,b,f]	66.1 [d,f]	59.9 [a,c,d]	66.7 [c,e]
Good (+)	Before	71.8 [d]	71.9	71.2	70.5
	After	74.8 [a,b,c,d]	70.7 [a]	69.7 [b]	70.4 [c]
Grumpy (-)	Before	22.0 [a]	19.2	21.2	22.6
	After	17.7 [a]	20.1	21.0	19.2
Happy (+)	Before	69.8 [d]	68.9	67.2	66.9
	After	72.8 [a,b,c,d]	68.6 [c]	66.4 [a]	67.3 [b]
Joyful (+)	Before	66.0 [c]	66.7	64.8	63.4
	After	70.1 [a,b,c,d]	66.2 [d]	63.9 [a]	64.9 [b]
Loving (+)	Before	67.1	67.4 [c]	65.9	64.3
	After	69.0 [a,b]	67.0	65.0 [a]	65.6 [b,c]
Pleased (+)	Before	69.1	69.6 [d]	65.4	65.4
	After	72.0 [a,b]	65.3 [b,d]	62.6 [a,c]	68.4 [c]
Rational (0)	Before	67.4 [a]	64.3	66.1 [b]	66.0
	After	61.8 [a]	63.2	62.9 [b]	63.8
Relaxed (+)	Before	67.9	67.8	66.1	65.6
	After	71.5	70.5	68.1	68.9
Responsible (+)	Before	64.9 [a]	63.7	65.9	65.6 [b]
	After	60.4 [a]	63.4	64.2	61.7 [b]
Restless (-)	Before	35.1	35.5	32.5	33.1
	After	30.6	30.8	29.5	30.4
Sad (-)	Before	16.1	16.5	17.9	18.8
	After	14.9	17.5	17.8	17.6
Safe (+)	Before	77.1	75.6	74.4 [a]	75.1
	After	75.0	73.6	72.3 [a]	73.5

Legend: "product name"_beverage, example: "BEER"_NAB means named as beer but the beverage was NAB; emotions were classified in positive (+), negative (-) and neutral (0); values with similar lowercase superscripts are significantly different within the same emotion across conditions according to pairwise comparisons with Bonferroni correction (p<0.003).

To compare the emotions elicited before and after drinking the beverages in each condition, MFA plots are displayed (figure 2 a,b,c). The first two dimensions explained 93% of the variance. Figure 2a shows the global MFA with the emotional response before and after drinking. Figure 2b shows the position of the beverages in the emotional space in each condition. They are distinguishable from one another as each beverage per condition is positioned in one of the quadrants of the graph. Combining the information of figures 2a and 2b, it is shown that the same product name had a different emotion profile, depending on whether or not it corresponded to the actual content of the beverage. In addition dimension 1, which explains 66% of the variance, shows: a) negative emotions such as *sad*, *disappointed* and *grumpy* on the left side of the graph, associated with the product name "NAB" and b) positive emotions such as *amused, joyful* and *excited* on the right side, associated with the product name "BEER". Dimension 2 explains 27% of variance, with the majority of the emotions above the line referring to the condition after drinking (AF), and the majority of the emotions below the line referring to the condition before drinking (BE). Figure 2c shows the projection of the beverages in each condition as mean points, depicting two partial points, representing before and after drinking. The R_v coefficient between before and after drinking is relatively low (0.50) which is reflected in the great distance between those partial points and in a different emotional space.

Different emotion profiles were also obtained after drinking the beverages with different names. NAB named as "NAB" ("NAB"_NAB) was associated with negative emotions after drinking, such as feeling *sad*, *grumpy* and *disappointed*. When the same product was named "BEER" ("BEER_NAB) a shift to the positive side of the first dimension was observed. BEER named as "BEER" ("BEER"_BEER) was associated with positive emotions after drinking, such as *fulfilled, exuberant* and *comforted*. When the same product was named "NAB" ("NAB"_BEER) a shift to the right side of the first dimension was observed. In order to determine further which emotions changed significantly due to the product name, the mean emotion scores of the beverages in different conditions (see table 2 were compared. Paired *t*-tests using Bonferroni correction were performed for each emotion separately to reveal significant differences (p<0.003). Comparing the two conditions after drinking, namely "BEER"_BEER (column 3, table 2) with "NAB"_BEER (column 6, table2), results showed that when BEER was named "NAB" six positive emotions decreased significantly after drinking and participants felt less *comforted,* less *exuberant,* less *good*, less *happy*, less *joyful* and less *loving* (p < 0.003). When NAB named "BEER" (column 4, table 2) was compared with NAB named "NAB" (column 5, table 2), only one out of 25 emotions changed after drinking, in that participants felt more *fulfilled* (p < 0.003).
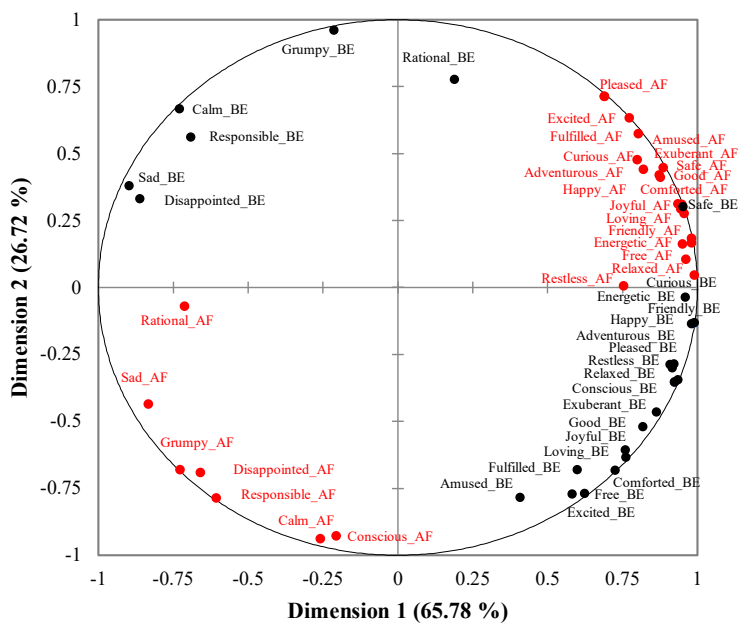
Figure 2a | Representation of the first two dimensions of the MFA showing (a) the global analysis of emotional response before (in black, and ending with _BE) and after drinking (in red, and ending with _AF).
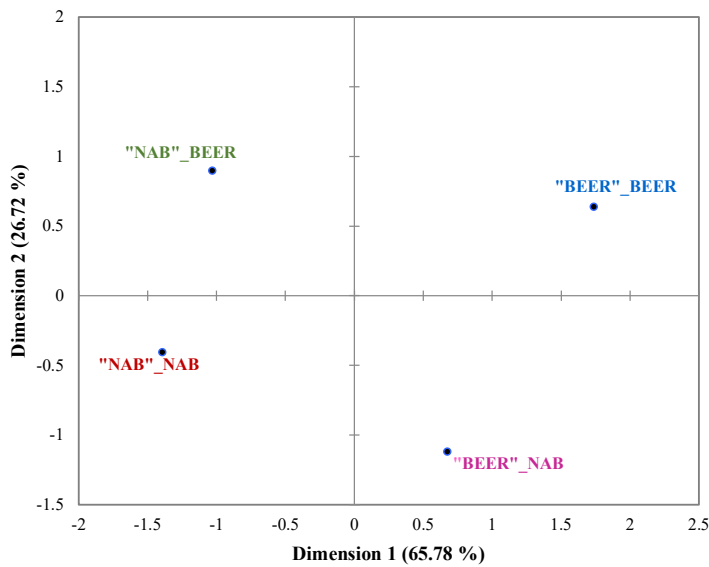
Figure 2b | Representation of the first two dimensions of the MFA showing the position of beverages in the emotional space in each condition.
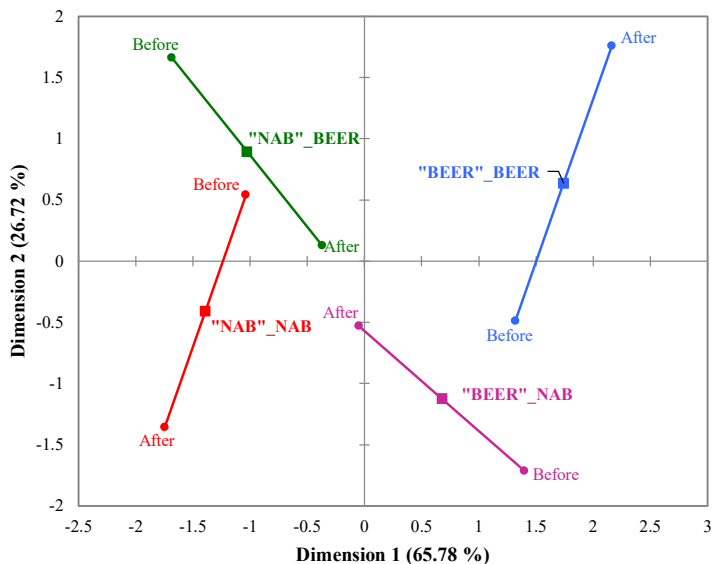
Figure 2c | Representation of the first two dimensions of the MFA showing the projection of the beverages onto the global analysis in each condition as mean points, depicting two partial points, representing before and after drinking.

Effect of drinking BEER or NAB on emotional responses

Before drinking BEER ("BEER"_BEER or "BEER"_NAB) or NAB ("NAB"_NAB or "NAB"_BEER) the emotion profile was the same for both beverages, except for feeling *curious* which was significantly higher before drinking BEER, but this difference was not consistent in both sessions in which the product name "BEER" was presented. In figure 3 the emotional changes after drinking "BEER"_BEER and "NAB"_NAB can be seen. Drinking "BEER"_BEER resulted in a more positive emotional state (see column 3, before and after, table 2). Twelve of the 25 emotions changed significantly, from which seven positive emotions increased and one negative emotion decreased. The only positive emotion which decreased after drinking "BEER"_BEER was *curious*. Drinking "NAB"_NAB affected how participants felt towards a more negative and neutral state with four emotions changing significantly (out of 25). Participants felt less *excited*, *rational, safe* and *curious* after drinking "NAB"_NAB.

SIGNIFICANT DIFFERENCES BEFORE *versus* AFTER DRINKING
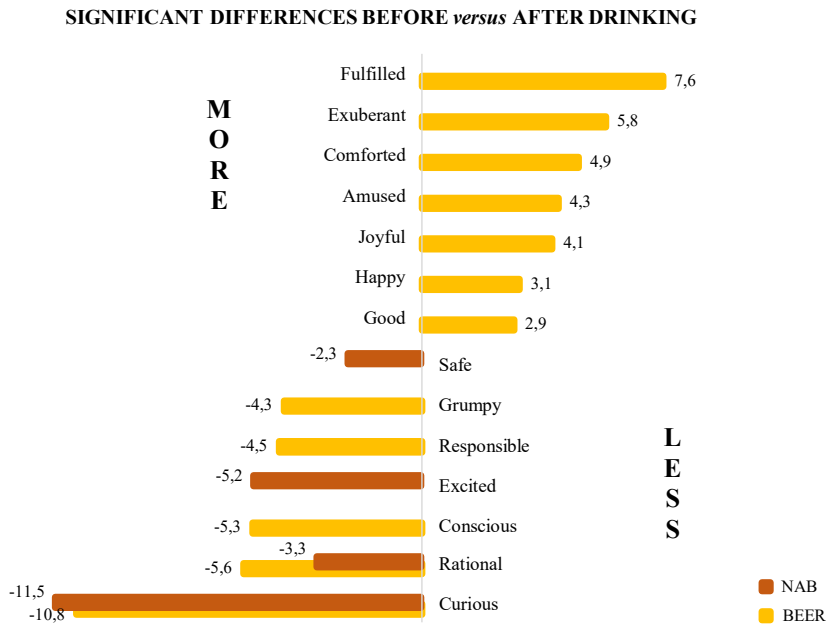
Figure 3 | Significant differences in mean emotions scores elicited before and after drinking BEER and NAB when product name corresponds to the beverage (p<0.003).

Discussion

This study aimed to assess how the product name, "BEER" or "NAB", influenced liking and the emotions elicited before and after drinking each beverage in a natural context of consumption, namely a bar. The product name influenced liking scores but only when NAB was named "BEER". In addition, particular emotions changed depending on the product name. More specifically one positive emotion increased when NAB was named "BEER" whereas six positive emotions decreased when BEER was named "NAB". Drinking BEER (named as "BEER") had a strong and positive effect on the emotional responses after drinking, whereas after drinking NAB (named as "NAB") the emotional responses changed slightly to a negative direction. These main findings are discussed below.

Effect of product name on liking

Results showed that participants liked NAB significantly more when this beverage was named "BEER". This change in liking seems to be a reaction to the product name rather than to the flavour of NAB. As an extrinsic attribute, the product name is a powerful tool in the communication between products and consumers, creating specific sensory

expectations through prior associations and experiences of consumption (Cardello, 2007). Without product name manipulation, the average score of liking for NAB is below the mid-point of the scale (< 50), showing a general dislike of NAB compared to beer, as also demonstrated by Chaya, C et al. (2015a). The expectations of drinking a NAB were more positive than the actual experience for both liking and emotions, showing a negative disconfirmation of NAB consumption that might lead to product rejection (Deliza & MacFie, 1996). This outcome suggests that the intrinsic properties of NAB did not fulfil the expectations of consumers, even for those that are familiar with NAB, and that consumers relied on product name to drive their response in terms of liking. In contrast, expected and actual liking of BEER (named as "BEER") did not differ, meaning that BEER delivered what consumers expected. This confirmation of expectations leads to satisfaction and probably to a repeated product use (Deliza & MacFie, 1996). This is certainly partly due to the intrinsic properties of BEER, that were not affected by either naming it "NAB" or by distractive environmental factors, such as the music playing in the bar (Stafford et al., 2012). The liking of BEER, therefore seems to be triggered by the flavour rather than by the product name, in contrast to NAB and to previous studies in which the liking of beer was triggered primarily by external attributes. However, in those studies the content of the beverage and the product name were congruent and extrinsic attributes were different from those used in this study, which may explain the differences in the results (Allison & Uhl, 1964; Caporale & Monteleone, 2004; Lee et al., 2006) . Liking expectations are determined in part by specific memories of similar experiences, but these effects seem to depend on the frequency with which the food was consumed in the past, as suggested by Robinson *et al.* (2013). These authors showed that one week after a disappointing food experience, expected liking for that food was reduced, but only if the food was eaten infrequently. In the present study most consumers were only moderately familiar (53%) or not familiar (47%) with NAB, so this might play a role in the low appreciation and disappointment associated with consumption.

Effect of product name on emotional responses

Comparing emotional responses before and after drinking BEER which was named "NAB" led to a stronger and negative effect on the emotional responses, reflected by a decrease of six positive emotions. Liking of the beverage did not change significantly but it is relevant to mention the negative effect that the product name "NAB" had on participants' feelings, including the perception of feeling less *comforted* and less *good*. The value of measuring emotions is emphasised here as emotions provided additional information to distinguish the same beverage when named differently, which was not observed by liking alone. In different studies it was also shown that emotions provide new information not captured by liking scores (Gutjar et al., 2015).

The product name "BEER" slightly changed the emotional responses to NAB in a more positive direction, making participants feel more *fulfilled*. In addition, participants also liked NAB significantly more when it was named "BEER".

The product name "BEER" and the content of BEER, positioned this beverage in the pleasant/positive and high arousal emotional space, supporting the findings of previous studies (Chaya, C. et al., 2015b). The product name "NAB" and the content of NAB positioned this beverage in the unpleasant/negative and low arousal emotional space. One could speculate that responses to NAB might be different if participants were intrinsically motivated to drink NAB. For example, if they chose NAB to drink at a party because they had to drive home. This situation could yield more positive emotional responses.

Effect of drinking BEER or NAB on emotional responses

When measuring liking as single parameter, NAB and BEER could be differentiated both before and after drinking. Measuring emotions on the other hand, could discriminate BEER from NAB but only after drinking. The lack of discrimination of the emotion profiles before drinking might be explained by a number of reasons. In this study, beverage choice was absent, as participants were told what beverage they would drink in each session and the beverages were offered to the participants for free. This supports the hypothesis that when choice is involved emotions can play a deeper role. Alternatively, before drinking, the feelings evoked by the whole context due to the atmosphere of the bar itself may have added to the feelings triggered by the product name, not allowing a discrimination between beverages. In addition, before drinking no other information besides the product name "BEER" or "NAB" was given. Brand and packaging are important extrinsic elements that in a real situation of consumption or purchase play a role and result in emotional effect, contributing to differentiate the conceptual profiles of products (Sester et al., 2013; Thomson & Crocker, 2014).

The lack of discrimination between the emotion profiles before drinking can be seen as a baseline for the measurement of emotions, and as such enables the comparison of the emotion effect that each beverage had on participants. After drinking BEER the emotion profile shifted to a more intense and positive general state whereas drinking NAB changed it slightly to a negative state. Apart from feeling *less curious*, which is a logical outcome once a product has been tried, the most notable changes were: feeling *more fulfilled* after drinking BEER and feeling *less excited* after drinking NAB.

It is likely that the emotional changes before *versus* after drinking the beverages are due to the intrinsic properties of the beverages and those were well differentiated by consumers even when the product name did not correspond to the beverage. It is tempting to argue that the different emotional changes were due to the different alcohol content between beverages, however there are many other components important for the organoleptic

properties of the beverages that differ between them (Blanco et al., 2014). It is possible that alcohol had a physiological effect among the less tolerant consumers and contributed to the enhancement of positive and engagement feelings (Chaya, C. et al., 2015b; Demmel & Nicolai, 2009) but this conclusion cannot be proved by this study. The idea that a beverage contained alcohol might have triggered some emotional speculation.

Strengths and weakness

This study showed a good validation of the lexicon used to measure emotions related to beer and NAB in Dutch consumers as it was possible to discriminate between the beverages and also between before and after drinking. However, further research is needed to validate product discrimination within product category, as for example testing different kinds of beer or NAB.

Furthermore, it is important to measure complete portions of a product in order to describe the full effect on liking and emotions. Testing in the right atmosphere, in this case in a bar, instead of a laboratory experiment is important, especially for products which are consumed for leisure and relaxation. This novel approach might produce more relevant results as recently highlighted by Cardello et al. (2016).

Conclusions

The expectation created by a single word, namely "BEER" and "NAB" with no associated brand or packaging, changed how much consumers liked a beverage and the intensity of the emotions evoked by it. The hypothesis that the product name would have a stronger influence than the actual flavour on the response of participants, both in terms of liking and emotions, seems not to be completely confirmed as the influence depended on which product name was used. When the product name did not appeal to consumers, such as NAB, it appeared to influence the pre-disposition of consumption to the product.

Liking and emotions, proved to be complementary for product characterisation. The added value of food-evoked emotions is highlighted as liking did not always differentiate beverages before and after drinking, but emotions clearly did differentiate the perceptions of consumers regarding the product name and the beverages. After product experience, the emotional profile of the beverages changed significantly. In further studies it might be relevant to study what happens while drinking, i.e. how dynamic sensory and dynamic emotional profiles interact with one another and how this affects liking over consumption time.

Acknowledgement

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Chapter 5

Temporal dominance of sensations, emotions and temporal liking measured for two similar wines using a multi-sip approach

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Cees de Graaf | Manuela Pintado | Gerry Jager

Abstract

Wine has a strong cultural connection with Portugal and therefore an emotional connotation, but sensory research has mainly focused on wine flavour while the emotional component of wine consumption has been less explored. Previous studies measured emotions statically, i.e. at a fixed time point after consumption and using a single bite/sip approach. However, eating and drinking are dynamic processes where both sensory and emotion attributes evolve over time during multiple bites/sips. This study aimed to explore the sensitivity of temporal dominance of sensations (TDS), emotions (TDE), and liking (TL), to reveal parts of the process that otherwise might remain hidden, to differentiate between two commercial, comparable tasting wines. A full portion, i.e. a glass of wine, in an appropriate consumption context (a bar) was served to eighty consumers, in two different sessions. It was shown that temporal dominance of sensations and emotions captured small differences between equally liked wines, showing the sensitivity of the method to distinguish similar products, and giving a broader understanding of the consumers´ perception of wines. Results of TDS across multiple sips clearly differentiated the wines as the differences of dominance of sensory attributes were exclusively perceived for each wine. In TDE three dominant emotions characterised and differentiated the wines, with special relevance for the one emotion. The impact of wine consumption on emotions was perceived similarly in all stages of consumption whereas the sensory impact changed in the different stages of consumption, highlighting the importance of using a full portion approach to differentiate between similar products. Several explanations are discussed to understand this outcome: similarities between products; differences in the perception process of sensory and emotion attributes; effect of culture on emotions reported and influence of contextual factors. Additionally, an effect of the consumption context on liking is observed. Wines were more liked in the bar, but context did not contribute to a better differentiation on liking between the wines. In competitive markets, food product development is in need of methods able to accommodate dynamic changes in experiences that occur over time, and sensitive to capture subtle differences among products. Temporal dominance of sensations and emotions seems to be promising and suitable for that purpose.

Introduction

Wine has a strong cultural and social connection with Portugal and therefore an emotional connotation (Mora & Moscarola, 2010; Silva *et al.*, 2015). Wine producers and sensory researchers have considered wine flavour to be one of the main criteria for wine choice by consumers (Lockshin *et al.*, 2006). Eating and drinking are, however, more than sensory experiences, they are also emotional ones (Bisogni *et al.*, 2007; Gibson, 2006; Piqueras-Fiszman & Jaeger, 2016). Measuring food-evoked emotions has been shown to be a relevant tool to complement sensory and liking measurements when aiming at differentiating between products of the same category (Gutjar *et al.* (2015); Spinelli *et al.* (2015), Ng *et al.* (2013)). However, the emotion component of wine consumption is less explored in the literature. It has been shown that consumers perceive emotional benefits of drinking wine that are partly derived from the sensory experience of wine flavour ((Barrena & Sanchez, 2009); Mora and Moscarola (2010), Ferrarini *et al.* (2010), Silva *et al.* (2016)). Recently Danner *et al.* (2016) and Jiang *et al.* (2016) actually measured emotions evoked by different wines and in different contexts of consumption. These studies used questionnaires and rating scales to measure the intensity of emotions. Emotions were measured statically, i.e. at one point after tasting and using a small sample of wine. According to contemporary appraisal theories, however, emotions are defined as a continuous process and are recursive (Moors *et al.*, 2013). From our previous research we know that the intensity of emotions differ significantly before and after experiencing a product (Silva *et al.*, 2017), which means that emotions evolve over time while drinking. To our knowledge, temporal measurements have been used to determine how wine sensations evolve (Meillon *et al.*, 2009; Meillon *et al.*, 2010; Sokolowsky & Fischer, 2012; Sokolowsky *et al.*, 2015), but no published studies have measured emotions evoked by wine over time. A dynamic approach might be important because it could reveal part of the emotion process that would remain hidden with more static methods (Jager, 2016). Additionally, it could be a powerful method to differentiate between wines and to complement classic sensory measurements. Combining the measurement of emotions, sensations and liking over time, might be a significant step forward in the characterisation of different types of wines and help to better understand wine choice and consumption, which is valuable information for consumer and marketing sciences and for the beverages industry.

Temporal dominance of sensations (TDS), temporal dominance of emotions (TDE) and temporal liking (TL)

Temporal dominance of sensations (TDS) is a method that is able to capture how sensory attributes simultaneously evolve over time (Pineau *et al.*, 2009) and it has been applied in different foods and beverages (Di Monaco *et al.*, 2014). In TDS participants are asked to select, from a given list of sensations, the one that triggers most attention at a given

moment over time. TDS showed the effect of partial alcohol reduction on the sensory modification of Merlot and Syrah red wines that was not shown by classical sensory profiling (Meillon *et al.*, 2009). In another study TDS was able to capture differences in sensory attributes caused by different skin contact treatments of crushed grapes during white wine production, which were not revealed by descriptive analysis or time-intensity methods (Sokolowsky *et al.*, 2015). Recently TDS studies also explored the measurement of temporal liking (TL), i.e. liking measured at several points throughout the tasting period, showing that TL is more discriminative than classical liking, i.e. overall score of liking measured at one point, usually after tasting the product (Thomas *et al.*, 2015b). Based on the concept of TDS, Jager *et al.* (2014) developed temporal dominance of emotions (TDE), to evaluate how food-evoked emotions simultaneously evolve over time. TDE applies the same concept of temporal dominance as TDS, but the sensory attributes are replaced by emotions. The authors showed that TDS and TDE discriminated among five different plain and flavoured chocolates. Results showed that the temporal evolution of sensory and emotion attributes were related. For flavoured chocolates mainly flavour attributes and positive emotions were dominant whereas for plain chocolates, textural and taste attributes were dominant and accompanied by more negative emotions.

For product development the interest in understanding emotions is often focused on products that are similar in nature, for example to decide which of the several prototypes developed fits a desirable concept (van Zyl, 2016). Additionally, the method to measure emotions in the process of product development must be sensitive and able to discriminate between products with smaller differences (van Zyl, 2016).

With this knowledge, the present study combined approaches and collected data using TDE + TL and TDS + TL using two similar tasting wines, with the same consumers in two difference sessions.

Consumption context

Given the importance of increasing the validity of the measurements performed in studies on the prediction of real life consumer behaviour (Jaeger *et al.*, 2017; Köster, 2003; Meiselman, 2013), this study included two aspects that simulated a natural situation of wine consumption. Firstly, the amount of sample tasted matters, as tasting a small sample is limited in the amount of information given, and does not translate to wine drinking in daily life. Tasting a full portion is becoming more and more important in sensory and consumer research, and has been recently applied in different studies combined with temporal measurements, showing an added value compared to a single intake evaluation (Galmarini *et al.*, 2016; Thomas *et al.*, 2016; Zorn *et al.*, 2014). Therefore, a full portion, i.e. a glass of wine of 80 mL was tasted in current study. Secondly, wine consumption can be explicitly related to a situation or context of consumption (Jaeger *et al.*, 2010). So this

study took place in a wine bar, as it is an appropriate place for wine consumption and one of the social settings where wine is consumed (Silva *et al.*, 2015). It is known that the place of consumption, might have an effect on liking (Hersleth *et al.*, 2003), on emotions (Danner *et al.*, 2016) and consequently choice of alcoholic beverages (Giacalone *et al.*, 2015; Sester *et al.*, 2013) and consumption volume (Wansink, 2004). Considering this, the effect of context on consumers' responses should not be neglected.

Aim of the study

The aim of this study was to explore the sensitivity of temporal measurement of sensations, emotions and liking using two similar tasting wines and a multi-sip approach while drinking a glass of wine in a bar.

Materials and Methods

Product information: wines

Two commercial DOC white wines from 2015 from the Dão region in Portugal, were studied hereafter named DV and CB. Wines were from the same wine producer and had both 13% alcohol (v/v). The wines were selected because of their closeness in intrinsic attributes, i.e. grape variety and winemaking process. The composition regarding grape variety and amount is slightly different, although the major variety is the same for both wines: DV contains 72% *Encruzado*, 18% *Bical* and 10% *Verdelho* and CB contains 80% *Encruzado* and 20% *Verdelho*. Regarding the winemaking process, part of the fermentation of CB takes place in oak barrels whereas DV fermentation occurs mainly in stainless steel tanks. Most extrinsic elements of these wines are very different, namely the label, bottle and price, but those were not included in this study, since the intrinsic dimensions of a wine are perceived to be overall more important for wine quality than extrinsic characteristics (Charters & Pettigrew, 2007). Wines were presented blind and served at 10ºC-12ºC in tulip shaped glasses, each containing 80 mL of wine.

Wine flavour profile

To ensure that two similar wines were selected, a triangle test was performed with 47 wine consumers (not participating in the temporal study), aiming to know whether consumers perceived the wines as significantly different or not different. The test was performed in individual booths at the sensory facilities of Catholic University in Porto and followed the procedure described by Lawless and Heymann (2010). Participants were presented with three samples of wine and had to identify the sample that differed from the other two. Wines were coded with three digit' codes, served in tulip shape dark glasses at 10ºC, each

containing 20 mL of wine. Additionally, participants were asked which of the wines they preferred and how much they like it, scoring them on a nine -point, Likert scale.

Results of the triangle test showed 21 correct and 26 incorrect answers, which according a binomial test indicated that the wines were perceived as not significantly different. Additionally, 19 participants preferred the wine CB, 27 preferred the wine DV (and one participant did not answer) and no significant differences between these proportions were observed. The average liking score ± standard deviation for wine CB was 5.2 ± 1.5 (n=45) and for wine DV was 5.3 ± 1.5 (n=46). A t-test showed that the liking of the wines was not significantly different. Overall consumers perceived the wines as not significantly different and therefore we used these wines to explore the sensitivity of the temporal measurements.

Analytical measurements, including GC-MS (gas chromatography – mass spectrometry) and HPLC (High Performance Liquid Chromatography) were performed on the two wines, mostly to investigate the pattern of volatiles, which are important for the aroma of the wines, and of the polyphenols, which are important for the mouthfeel. It was observed that wine CB had a higher concentration aroma-active in terpenes compared to wine DV, although since the concentrations are close to the taste threshold the impact of the difference on the taste of the wine will not be very significant (data not shown). This underlines the comparability of the wines, which was observed in the sensory session as well.

Attribute selection

The selection of the sensory and the emotion attributes is a key procedure for a TDS/TDE measurement as it determines the response range of consumers. Following the guidelines of Pineau *et al.* (2012) a list of ten attributes for each measurement, i.e. ten for sensations and ten for emotions, was defined. Subsequently it was assured that the attributes selected were used in everyday language so that consumers would easily understand the meaning of the attributes presented.

Sensory attributes

To select and describe the most relevant attributes for each wine, a session with seven regular white wine consumers was performed. Regular consumers were defined as ranging from drinking one glass of white wine per week to two glasses a day. The flavour profiling technique described by Lawless and Heymann (2010) was used. For each sample, consumers tasted the wines blinded and wrote down the attribute names and/or descriptions that were perceived in flavour (overall or notes). Then, in a group discussion, the ten most relevant attributes for the sensory characterisation of both wines were chosen based on consensus among consumers (see Table 1). The selected attributes matched with the sensory information available in the back label of the bottles.

Emotion attributes

Emotion attributes related to wine consumption were adopted from our previous qualitative study in which twenty-five terms were compiled as the most representative of emotion associations of wine consumption for a group of Portuguese and Dutch consumers (Silva *et al.*, 2016). In order to select the ten most relevant (out of the 25) emotion attributes, a survey was performed with 426 Portuguese wine consumers (136 men and 290 women, aged between 18 and 70 years old). Consumers were asked to imagine a situation where they were drinking wine and to rate-all-that-apply (Ares *et al.*, 2014) in each emotion term to what extent they perceived a change in that emotion after consumption. The rating scale used was: much less, less, slightly less, slightly more, more, much more, and not applicable/no change. Based on the frequencies of the responses for each emotion, ten terms were selected to be used in this study (data not published yet) (see Table 1).

Table 1 | List of sensory and emotion attributes translated from Portuguese to English

	Portuguese	English
SENSORY ATTRIBUTES	Álcool	Alcohol
	Maçã/pêra	Apple/pear
	Amargo	Bitter
	Lima/Limão	Citrus
	Seco	Dry
	Minerais	Mineral
	Ácido	Acid
	Doce	Sweet
	Folhas verdes/vegetais	Vegetal
	Madeira	Woody
EMOTION ATTRIBUTES	Divertido/a	Amused
	Confortado/a	Comforted
	Desiludido/a	Disappointed
	Energético/a	Energetic
	Livre	Free
	Completo/a	Fulfilled
	Alegre/feliz	Happy
	Agradado/a	Pleased
	Relaxado/a	Relaxed
	Triste	Sad

Participants

Eighty Portuguese consumers (41 men, 39 women), 39 aged between 20 and 35 years and 41 between 36 and 62 years, were recruited for this study. Participants were all moderate consumers, i.e. they drink on average 1.7 glasses of wine per occasion, ranging from 3-4 times/week to one time per fortnight. Regarding the degree of involvement with wine in general, 29 participants considered themselves as wine "*connoisseurs*" and the others

51 considered themselves just as "consumers". They had a normal ability to taste and smell (self-reported) and had no previous training in sensory evaluation. They signed an informed consent form before the start of the study and were reimbursed for their participation. This study was submitted and positively evaluated by the medical ethical committee of Wageningen University, The Netherlands.

Measurements: TDS/TL and TDE/TL

Temporal dominance of sensations/emotions is a technique in which consumers evaluate a product over time, providing two types of information: the duration of a given attribute as dominant and the sequence of dominant attributes while drinking. Consumers have to select from a set of attributes, the one that, at a given moment in time, captures their attention most along the whole process of drinking. In this study both types of attributes were used: sensory and emotion, according to the procedure described below. The ten selected attributes were presented at the same time on a computer screen and dominance of each attribute was recorded. Sensory and emotion attributes were not mixed and sessions occurred on different days. Consumers had to click the "START" button as soon as they drank the first sip of wine. Then they had to select the attribute that was dominant at that moment by clicking on the attribute button. As soon as a consumer perceived another attribute as dominant, he/she was asked to click on that attribute button until another attribute became dominant. Consumers were free to select the same attribute several times or never use an attribute. Attributes were presented in random order across consumers but remained the same for a given consumer during the evaluation. Once clicked, an attribute was highlighted for three seconds. The time until the next attribute was selected was recorded for each consumer and for each wine. This allowed the calculation of the duration of dominance per attribute per consumer per wine. For a new sip they had to click the button "NEW SIP" and then continued to evaluate the dominant attributes. The button "NEW SIP" recorded the time at which consumers drank a new sip. When they finished the glass of wine and no longer perceived any attribute as dominant, they were instructed to click on the button "STOP" and had to wait at least four minutes before receiving the next wine. TL was also collected while drinking a glass of wine. A nine-point liking scale ranging from "I do not like it at all" to "I like it very much" was available in the same screen as the sensory and emotion attributes, allowing to perform the tasks simultaneously. Consumers were free to select liking scores whenever they wanted throughout the tasting, and to change the liking score every time they perceived a change in liking. For the whole glass they were instructed to score liking at least once. The protocol used was first introduced by Schlich (2015) and Thomas *et al.* (2015a) to evaluate simultaneously the dynamic of sensations and temporal liking. In this study, the referred protocol was extended to include also the dynamic of emotions and temporal liking.

Procedure and experimental design

This study took place in the wine bar, *Prova* (Porto, Portugal) in two sessions performed on two consecutive week days. Consumers performed the test individually using computers and data were recorded using TimeSens® software version 0.93.122.904 (INRA, Dijon, France). To ensure that consumers understood and could identify the different attributes, the list of sensory and emotion attributes as well as their descriptions, was sent to all consumers via e-mail two days before the first session and they were asked to read it carefully. This list was also available during the experiment. The study design was balanced across consumers for the order of the wines´ presentation as well as for the type of session and sets of attributes (TDS/TDE). Before starting the first session (day 1), each consumer received an individual explanation and demonstration on how to use the program. Consumers performed TDS/TL or TDE/TL with a glass of water (dummy sample) to familiarize themselves with the computer program and the methodology. Following this, the real experiment started. Each consumer had to perform either the TDS/TL or the TDE/TL while drinking a glass of the first wine. After finishing the first wine and before drinking the next one, consumers were instructed to rinse their mouth with water and eat some crackers and had to wait at least four minutes to proceed. The second test, was similar to the first one, selecting TDS/TL or TDE/TL while drinking a glass of the second wine. In the second session (day 2) consumers followed the same procedure as in the first day. In summary, sessions of TDS and TDE were not mixed, so in one day consumers only performed one type of session, either TDS for both wines or TDE for both wines.

Data analysis

Data were analysed using TimeSens® software, IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. and Microsoft Excel 2013/XLSTAT (XLSTAT Version 2015.5.01.23234, Addinsoft, Inc., Brooklyn, NY, USA).

Sample size - multi-sip approach

Consumers were given one glass of wine at a time and were free to drink it with a different number of sips, finishing the glass or not, without any control of the time they needed to drink it. They were asked to drink at least four sips, but not all did it. For the analysis of the temporal measurements of sensations and emotions, three sips were considered: the first, the second and the last sip. The first sip represents the beginning of the drinking experience and the first contact with the wine; the second sip represents the continuity of the drinking experience and the last sip represents the end of the drinking experience, so the last sensations and emotions that the product evoked. Sixty-nine consumers performed the test as required and behaved in a similar way, e.g. they took at least three sips of each wine. The other eleven participants took fewer than three sips and were excluded from further analyses.

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Representation of dominance rates - TDS/TDE curves and difference curves

TDS and TDE data is commonly represented by dominance curves in which dominance rate of each attribute is represented over time. The dominance rate is calculated dividing the number of citations an attribute was given at a certain moment by the number of judges times the number of replications (Pineau *et al.*, 2009). All the values are then compared to a significance level to differentiate results that are due to chance from results that come from agreement among participants. The chance level is the dominance rate that an attribute can obtain by chance and the significance level is calculated based on a binomial test (Pineau *et al.*, 2009). An attribute is considered dominant when it is above the significance level. If the attribute is between chance and significance level, it can be considered as having a tendency towards dominance. TDS/TDE difference curves were built to compare the wines. The difference curves are the result of subtracting dominance rates at each time point from one wine to the other, and are plotted when the difference is significantly different from zero.

ANOVA and MANOVA of dominance durations of attributes

The average of the total duration of dominance of attributes was calculated from the total duration over which an attribute was dominant for each participant. TDS and TDE data were analysed using an ANOVA model by attribute duration, with "wine" and "sips" as fixed factors. A two-way MANOVA test was performed to evaluate if there was a multivariate product effect. The MANOVA F-value was obtained according to the Hotelling-Lawley statistic (Peltier *et al.*, 2015). To visualize the results of MANOVA, canonical variate analysis (CVA) was applied. In the CVA bi-plot product points (first and last sip of each wine) were projected on descriptive arrows (sensory and emotion attributes) (Peltier *et al.*, 2015) allowing interpretation of the relative location of the sips/wines and the sensory and/ or emotion attributes. All attributes were included in this analysis, and not only those considered significant different. Ellipses around product mean represent the distribution of consumers' duration scores around each product. To find significance differences a multivariate t-test, the Hotelling test, was used to conclude on pairwise product differences.

Temporal liking (TL)

TL was recorded per wine and per session (sensory and emotion). Overall liking was calculated averaging all the scores obtained for a wine per session. TL with time standardized between 0 and 1 was calculated at a group level per session and per wine. The time at which the first liking score was given corresponded to the time 0, and the time at which the last liking score was given corresponded to the 1.

Results

Temporal measurements of sensations and emotions

Consumers performance – duration of consumption, number of citations and sips

For TDS and TDE, the average (± SD) of the duration of wine consumption was 251 (± 132) sec and 237 (± 123) sec, respectively. The average number (± SD) of citations (number of clicks) was 15 (± 10) for sensory attributes and 15 (± 12) for emotion attributes. The average number (± SD) of sips was 5 ± 2 for both TDS and TDE. For these three parameters, no differences between sessions and between wines were found (LSD, all p>0.05), showing consistency between sessions and across wines on how consumers on a group level performed the tests.

Curves of dominant sensory and emotion attributes over time - TDS and TDE curves

The TDS/TDE curves per sip, for both wines are presented in Figure 1. For wine CB, at first sip *acidity* had the highest dominant rate. The second sip was characterised by three main dominant attributes, *alcohol*, *dry* and *bitter*. At the last sip *alcohol and bitter* were dominant mostly at the beginning, evolving to *acidity and dry*. *Dry* was the most dominant attribute until the end. *Sweetness* was perceived by few participants in the first and second sips. Regarding wine DV *acidity* had the highest dominance rate on the first sip and *sweet* was less dominant at the very beginning. The second sip was characterised by *acidity* in the beginning evolving to *alcohol* in the middle but ending again with *acidity*. *Sweetness* and *dryness* had lower dominance rates at the middle. On the last sip *acidity* and *alcohol* were again dominant, very similarly as in the second sip. However, *vegetal* was perceived by few participants in the middle and *bitterness* appeared for the first time at the very end of drinking this wine.

Regarding emotions, the same three emotions were dominant for the wines, and all were present in the three sips. With the first sip of wine CB, *pleased* was highly dominant. *Comforted* was also dominant, but more at middle/end and less dominant than *pleased*. *Relaxed* was slightly dominant. With the second sip, *pleased* and *comforted* were again dominant but now *relaxed* reached a peak in the middle. The last sip was characterised by dominance of *relaxed*, and *pleased* and *comforted* were less dominant. With the first sip of wine DV *pleased* and *relaxed* were the most dominant emotions, and *comforted* was less dominant. With the second sip, dominance rates for *pleased* and *relaxed* decreased and *comforted* reached a peak during the middle stage. For the last sip, the most dominant emotions were again *pleased* and *relaxed*. *Comforted* was slightly dominant in the very beginning of the last sip.

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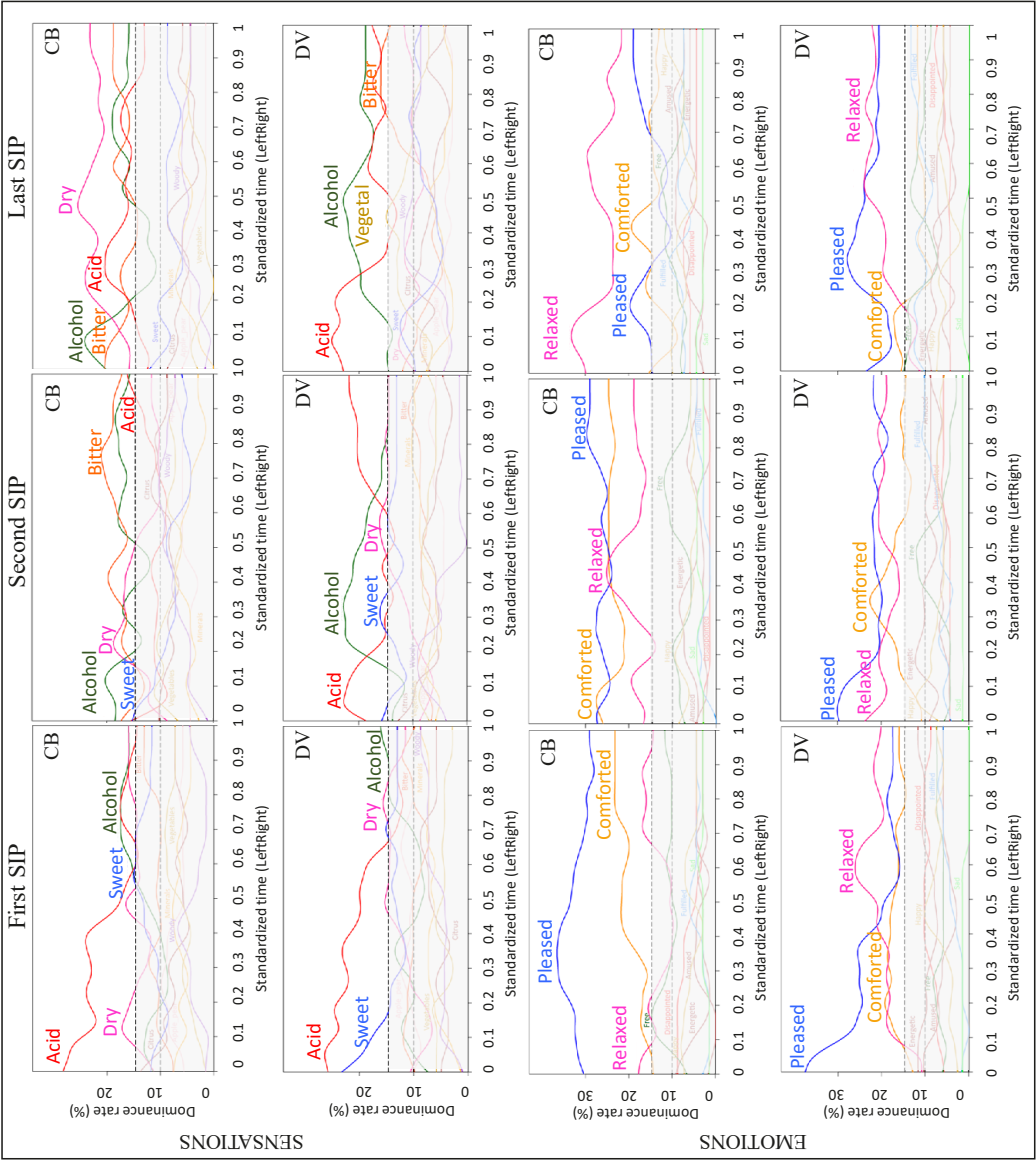
Figure 1 | Temporal dominance of sensations and emotions for the first, second and last sip of the wines
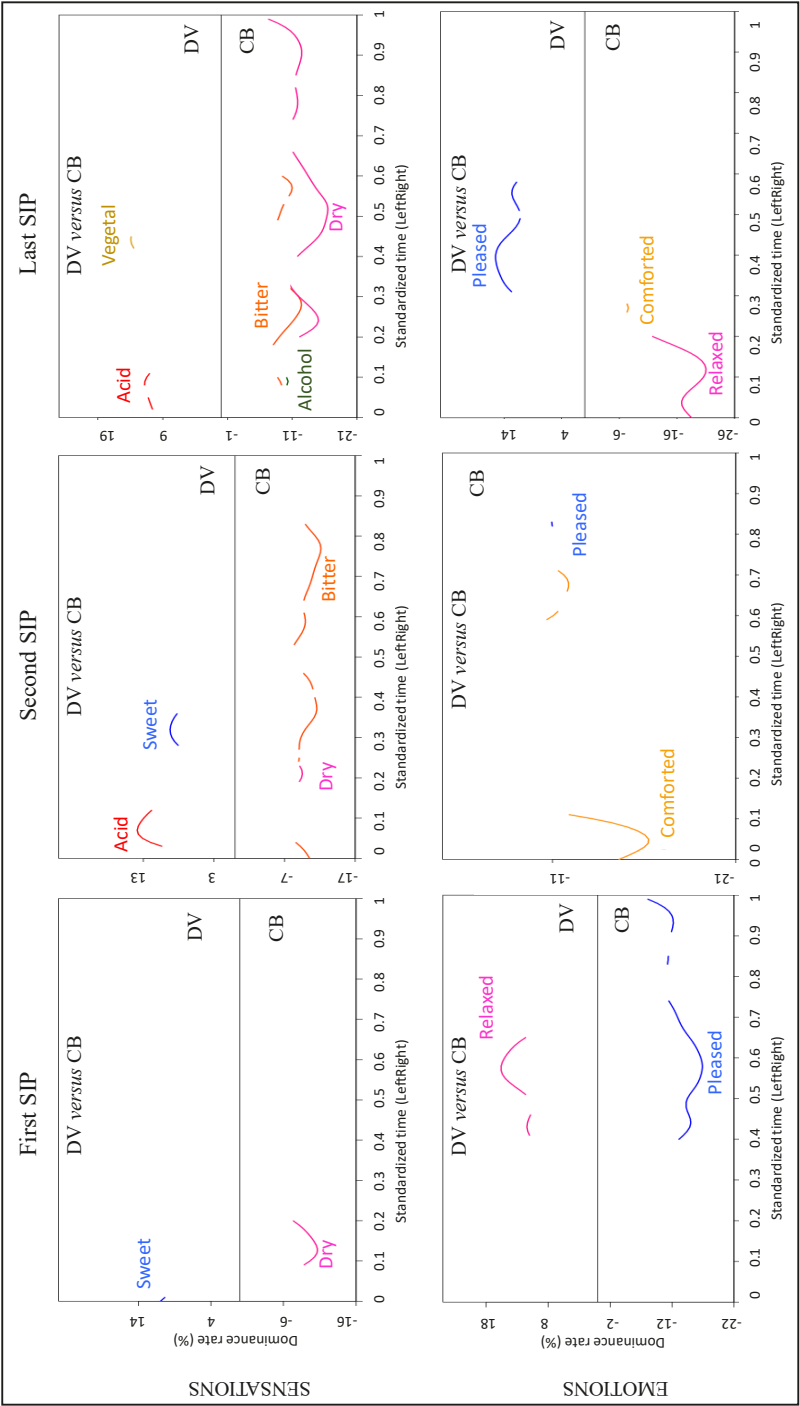
Figure 2 | Difference curves for dominant duration of sensory and emotion attributes for the wines

Differences between wines in temporal sensory and emotion profiles - TDS and TDE difference curves

Figure 2 depicts the difference curves of dominant sensations and emotions between wines. Wine DV, in the beginning of the first and second sips was higher in dominance rates of *sweet* and *acid.* On the last sip, *vegetal* was a distinguishable dominant attribute between wines, being more dominant in wine DV than in CB. For wine CB *dry, bitter* and *alcohol*, were significantly more dominant than in wine DV.

Regarding the temporal evolution of emotions, the same emotion attributes became dominant for both wines. However, differences were observed for the time periods when they were dominant. *Relaxed* was dominant at the beginning of wine DV whereas for wine CB it was at end. *Pleased* was dominant at beginning of the wine CB and at end of wine DV. *Comforted* was the differentiating emotion since it was since it was more dominant on the wine CB in the beginning of the second sip and in the middle of the last sip.

Overall, a greater number of sensory attributes were perceived as dominant compared to the number of emotions perceived as dominant (six *versus* three). It was also observed that a greater number of dominant attributes that differentiate the wines appeared during the last sip, i.e. two sensory attributes on the first sip *versus* five attributes on the last sip, and two emotion attributes on the first sip *versus* three on the last sip. Globally dominance rates of emotions (approximately up to 40%) were greater than dominance rates of sensations (approximately up to 30%), in both wines.

Differences between wines based on durations of dominance of attributes

Total duration

MANOVA for total duration of dominance of sensory and emotion attributes per wine and per sip are presented in Table 2. No significant differences were found for the total duration of dominance of sensory attributes and emotion attributes and for total sip duration (all p-values > 0.05).

Attribute dominance durations

ANOVA results of Table 2 showed that *bitter* had an effect at product level (F=4.68, p=0.03), i.e. the duration of *bitterness* was significantly higher for wine CB compared to wine DV (15s *versus* 6s). *Acidity* had a significant effect at sip level (F=2.54, p=0.03), as it was longer dominant within the first sip but did not differentiate the wines as the effect was observed between the first and the other sips in both wines. Regarding duration of dominance of emotions, it was observed that *fulfilled* was significantly higher for wine DV than for wine CB (7s *versus* 3s) (F=3.97, p=0.05). The duration of dominance for *energetic* was more than double for wine DV compared to wine CB, which is a significant difference at p< 0.1 (9s *versus* 4s) (F=3.00, p=0.09).

Table 2 | ANOVA/MANOVA results for the total duration of dominance per attribute for wines and sips (in seconds). Mean values and standard errors for each wine globally and per sip.

	Attributes	Wines (globally)			Sips CB			Sips DV			
		CB	DV	F-wines	First	Second	Last	First	Second	Last	F-sips
SENSATIONS	Alcohol	17 ± 3	20 ± 4	0.23	5 ± 1	7 ± 2	6 ± 2	4 ± 1	9 ± 2	7 ± 3	0.86
	Apple/pear	5 ± 2	7 ± 2	0.44	1 ± 1	2 ± 1	1 ± 1	4 ± 1	2 ± 1	1 ± 0.4	1.70
	Bitter	**15^a ± 3**	**6^b ± 2**	**4.68****	4 ± 1	**7^c ± 2**	5 ± 2	**2^d ± 1**	**2^d ± 1**	**2^d ± 1**	1.72
	Citrus	9 ± 3	8 ± 2	0.02	2 ± 1	4 ± 1	2 ± 1	4 ± 2	2 ± 1	2 ± 1	0.70
	Dry	15 ± 3	13 ± 3	0.24	5 ± 1	6 ± 2	4 ± 1	5 ± 2	4 ± 1	3 ± 1	0.39
	Mineral	5 ± 2	10 ± 5	0.94	2 ± 1	2 ± 1	1 ± 0.5	6 ± 4	3 ± 1	1 ± 1	0.97
	Acid	12 ± 3	14 ± 2	0.31	**7^c ± 2**	**3^d ± 0.5**	**3^d ± 1**	**7^c ± 2**	**4^{c,d} ± 1**	**3^d ± 1**	**2.54****
	Sweet	12 ± 4	13 ± 3	0.09	4 ± 1	2 ± 1	6 ± 3	5 ± 1	6 ± 2	2 ± 1	1.03
	Vegetal	5 ± 1	7 ± 2	1.06	2 ± 1	2 ± 1	0.4 ± 0.2	2 ± 1	3 ± 1	2 ± 1	0.91
	Woody	7 ± 4	5 ± 3	0.06	2 ± 1	4 ± 2	1 ± 0.4	2 ± 1	2 ± 1	2 ± 1	0.64
	Overall	102 ± 10	103 ± 10	0.07	33 ± 4	38 ± 4	29 ± 6	41 ± 6	36 ± 4	27 ± 3	1.63
EMOTIONS	Amused	4 ± 1	5 ± 1	0.31	1 ± 0.5	2 ± 1	1 ± .5	2 ± 1	2 ± 1	1 ± 0.3	1.08
	Comforted	17 ± 3	17 ± 3	0.00	6 ± 2	8 ± 2	4 ± 1	6 ± 1	6 ± 2	6 ± 2	0.81
	Disappointed	3 ± 1	3 ± 1	0.01	2 ± 1	1 ± 0.4	1 ± 1	1 ± 0.5	1 ± 1	1 ± 0.3	0.41
	Energetic	**4^a ± 1**	**9^b ± 3**	**3.00***	**1^c ± 0.4**	**2^c ± 1**	**1^c ± 0.5**	**6^d ± 2**	**2^c ± 1**	**1^c ± 0.3**	**2.60***
	Free	7 ± 2	8 ± 3	0.17	2 ± 1	3 ± 1	2 ± 1	2 ± 1	2 ± 1	4 ± 2	0.39
	Fulfilled	**3^a ± 1**	**7^b ± 2**	**3.97****	**1^c ± 0.3**	1 ± 0.5	1 ± 0.4	1 ± 1	**3^d ± 1**	**3^d ± 1**	1.61
	Happy	6 ± 2	6 ± 1	0.04	2 ± 1	3 ± 1	2 ± 1	2 ± 0.5	3 ± 1	2 ± 0.5	0.77
	Pleased	21 ± 3	20 ± 3	0.09	7 ± 1	9 ± 2	5 ± 2	8 ± 2	6 ± 1	6 ± 2	0.93
	Relaxed	17 ± 4	20 ± 4	0.36	6 ± 3	7 ± 1	5 ± 1	7 ± 2	7 ± 2	6 ± 1	0.47
	Sad	2 ± 1	1 ± 1	0.67	1 ± 1	1 ± 0.5	0.2 ± 0.1	0.2 ± 0.2	0.2 ± 0.2	1 ± 1	0.18
	Overall	84 ± 8	96 ± 9	0.95	29 ± 3	34 ± 3	22 ± 3	35 ± 4	32 ± 3	29 ± 5	0.89

Legend: significant F-values highlighted in bold (** = p<0.05, * = p<0.1). Means with different superscript letters in the same row are significantly different: a, b between wines and c, d between sips.

Relationship between sensory and emotion attributes

To analyse the relationship between the duration of sensory and emotion attributes for wines, a MANOVA test was performed, considering the first and the last sips of each wine and all sensory and emotion attributes. The first two canonical dimensions of the joint CVA is shown in Figure 3. Dimension 1 explained 43% of variance and revealed the difference between the wines. Dimension 2 explained 32% of variance and separate the first from the last sips. According to the Hotelling-Lawley test there is no multivariate product effect (F=1.04, p=0.40). However, when the first and the last sips were compared wines differed significantly on last sip (Hotelling test, p<0.001) but not on first sip (p=0.06). This can also be visualised by the ellipses surrounding the product/sip means, which are well separated on last sips.

Temporal liking (TL)

Descriptive analysis and ANOVA of liking scores per session and overall are presented in Table 3, and liking scores over standardized time are graphically presented in Figure 4. The overall liking did not differ between wines, but there was a session effect (F=5.49, p=0.02). Wine DV was significantly less liked during the sensory session than during the emotion session (p=0.04).

Liking appeared to be consistent at the beginning and at the end of the glass, as the variation between first and last score was very small (average 0.2). However, the amplitude of individual liking measurements varied on average by one point, meaning that consumers changed their liking while drinking a glass of wine.
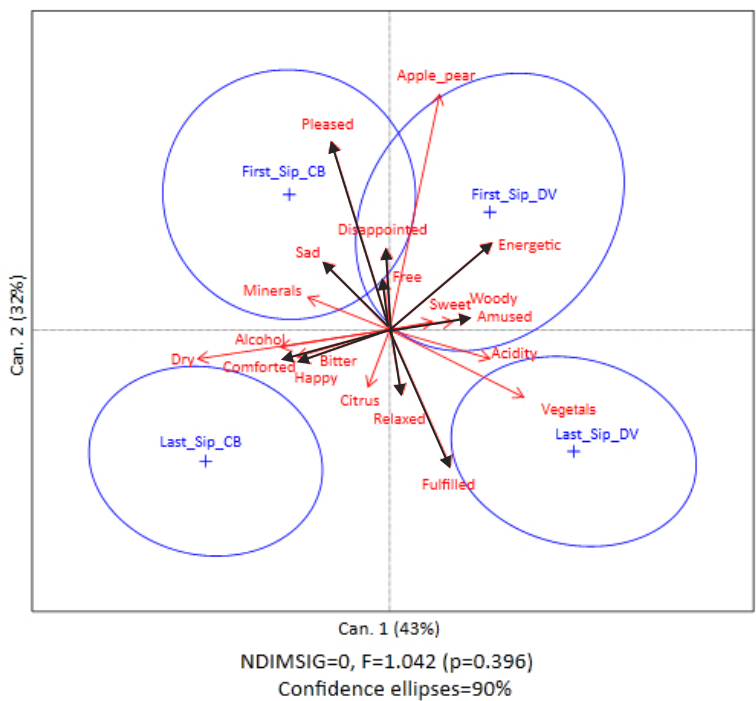
Figure 3 | Joint CVA plot combining sensory and emotion dominance durations for the first and the last sips of the wines

Table 3 | Descriptive analysis and ANOVA of liking scores and standard error of the mean per session and overall

Wines / Session		Mean ± SEM	First - Last	Max-Min	n (evaluations)
CB / Sensory		6.4[b] ± 0.2	-0.1	0.9	5
CB / Emotions		6.7[b,c] ± 0.2	-0.3	1.0	6
DV / Sensory		6.4[b] ± 0.2	-0.3	1.0	5
DV / Emotions		6.9[c] ± 0.2	-0.1	0.8	5
F-session	5.49*				
overall CB		6.6[a] ± 1.3	-0.2	1.0	6
overall DV		6.7[a] ± 1.3	-0.2	0.9	5
F-wines	0.25				
F-wines x session	0.36				

* Significant at p<0.05. Different letters within a column mean significant differences (p<0.05)
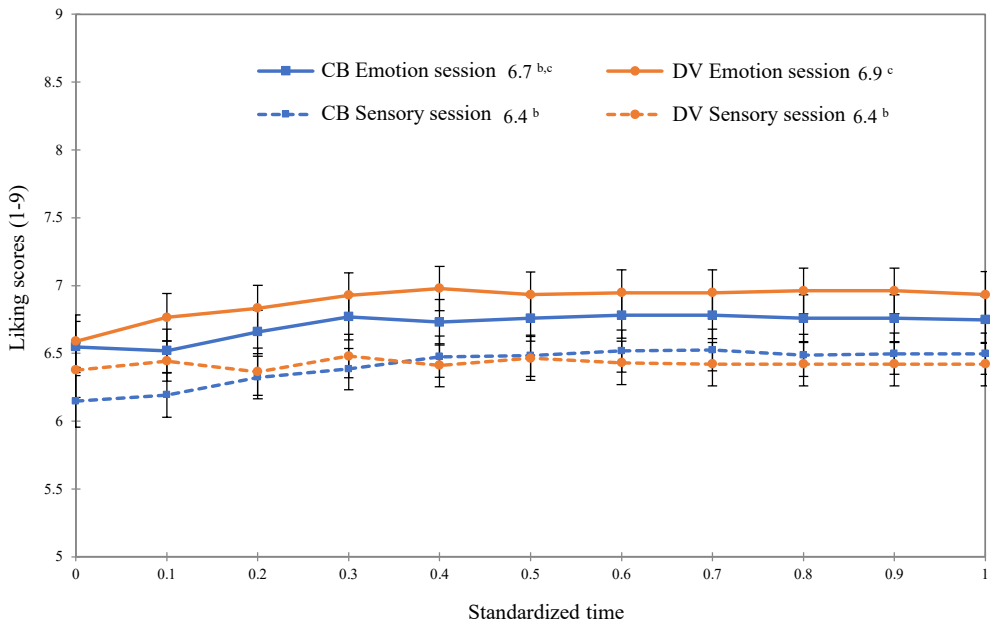
Figure 4 | Representation of the liking scores over time standardized for each session of both wines

Overall liking measured at the sensory lab was compared to overall liking measured in the bar. A very significant difference was observed, and both wines were better liked when tasted in the bar: DV_{lab} = 5.3 *versus* DV_{bar} = 6.7 (F=43.9, p<0.001), CB_{lab} = 5.2 *versus* CB_{bar} = 6.6 (F=48.9, p<0.001). However, there were no significant differences in liking between wines, either in the sensory lab or in the bar.

Discussion

Temporal measurements of sensory and emotion attributes combined with a multi-sip approach resulted in a better differentiation between equally liked wines that, judged by a triangle test, were perceived as not significantly different. The interpretation of the differences in emotion profiles based on dominant attributes were rather limited when compared to the differences in sensory profiles, since emotion profile were more uniform over time. Consumption context greatly affected overall liking, that is the wines were more liked in the bar compared to in a lab, but context did not contribute to a better differentiation in acceptability between the wines. These findings are discussed in more detail below.

Temporal measurements of sensory and emotion attributes

TDS resulted in a clearer differentiation between wines than TDE, in the sense that differences of dominance of sensory attributes were exclusively perceived for each wine, that is the wine CB was more dominant in *alcohol*, *dry* and *bitter*, whereas wine DV was more dominant in *acidity*, *sweet* and *vegetal*. This shows that the sensory descriptors defined by consumers using simple sensory vocabulary (section 2.3.1), compared to experienced wine experts or trained panellists, which are using better definitions for sensory attributes and are trained (Hopfer & Heymann, 2014; Mueller *et al.*, 2010), were valuable to differentiate the wines. In TDE three dominant emotions characterised the consumption of both wines: *relaxed, pleased* and *comforted*. *Relaxed* and *pleased* are associated with wine consumption in general (Charters & Pettigrew, 2008), and although differences in dominance were perceived, its meaning is vague since consumers felt more *relaxed* in the beginning with the wine DV and more *pleased* at the end of consumption, and the other way around for the wine CB. Of more relevance to distinguish the wines, is that during the middle and final stages of consumption, they felt significantly more *comforted* with wine CB than with wine DV (Figure 2).

Consequently, differences in emotion profiles based on dominant attributes were rather limited compared to the differences in sensory profiles. Several explanations can justify this outcome: the similarities between products, differences in the perception process of sensory and emotion attribute, the effect of culture on emotions reported, the specific list of emotion terms, and the influence of contextual factors on the evaluations. Regarding the products, our results suggest that in the absence of a large difference in flavour in equally liked products, the same emotions caught the most attention of consumers for the two wines, and similar emotion profiles evolved in qualitative terms. Additionally, in sensory evaluation consumers are focused on the product tasting through a rational thinking and a conscious monitored process. On the other hand, emotion responses are

intrinsic to the person, more subjective and self-declaratory. So more an intuitive thought process (Kahneman, 2003) and therefore more difficult to report than sensory evaluation (Thomson, 2016). It is very different to judge a product or to judge our own feelings. Moreover, Portuguese consumers seem to be less emotionally involved with wine than Brazilian or Mexican consumers and showed more emotional reaction to beer and spirits than for wine (van Zyl & Meiselman, 2016). This might be because wine has been an integral part of Portuguese life for hundreds of years and is not viewed in the same way as it might be in some countries, where it may be consumed for different reasons. So, this cultural effect on emotions reported might also be translated in our results. Of relevance is also the number of attributes to use in temporal measurements which should be restricted to ten (Pineau *et al.*, 2012). Therefore participants are forced to choose within the attributes presented, which influences the results in a certain direction (Jager *et al.*, 2014). This shows how difficult and important it is to use the right words for a specific product. Although our selection of emotion terms is well supported by a qualitative study performed with Portuguese consumers, other emotion terms, excluded from the list presented on this study but also associated to wine consumption, such as *contented, frustrated and warm,* could contribute to better discrimination between the wines in terms of emotion profile. Another considerations that might have affected reported emotion responses include the psychological state of participants at the moment of consumption (Di Muro & Murray, 2012), previous experiences of white wine consumption (Desmet & Schifferstein, 2008), and the atmosphere of the place of wine consumption (Edwards *et al.*, 2016; Schrieks *et al.*, 2014). It could be that the similarity between emotion profiles of the wines that evolved while drinking were affected by the combination of some, or all, of the factors previously cited, thus not permitting the highlighting of differences derived from the sensory properties of the wines.

Temporal versus static measurements of emotions

A direct comparison among studies that measured beverage-evoked emotions is difficult, due to the different conditions of the experiments and emotion words used. However it seems relevant to consider the contribution of temporal and static measurements of emotions to differentiate similar beverages.

Danner *et al.* (2016) developed the Australian Wine Evoked Emotions Lexicon and applied it in a questionnaire, in different settings, including a restaurant. Wines were tasted blind and results showed that a gold-medal wine elicited more intense positive emotions, such as *calm, contented, enthusiastic, happy, nostalgic, optimistic, passionate, relaxed* and *warm hearted* in comparison to wines graded as one of the three lower quality levels. However, the gold-medal wine was better liked than the three other wines, that did not differ on liking. Among those three wines one emotion, *surprised*, differed. Using the same method

and lexicon, but different wines and immersive contexts of consumption, Jiang *et al.* (2016) also found that the most liked wine elicited more intense positive emotions than the least liked wine. Porcherot *et al.* (2015) using a static method for measuring emotions did not find any significant difference in short term emotion responses among three equally liked fruit variants of an alcoholic aperitif consumed during a meal in a restaurant. In our previous study, after drinking beer or non-alcoholic beer in a bar, emotion profiles were different as was acceptability between the beverages (Silva *et al.*, 2017). Based on these studies performed using static measurement of emotions and natural consumption contexts, it seems that when the products are equally liked emotion profiles obtained at one point of consumption are hardly or not distinguishable. In the current study, using temporal measurement of emotions of equally liked wines consumed in bar, the whole emotion experience of drinking a glass of wine was revealed, which is not achievable using static measurements. It was observed that the same positive and low arousal emotions were dominant in all stages of consumption. This uniformity in emotion profile while drinking, e.g. not feeling *pleased* only in the beginning or at the end of consumption but in all stages of consumption, might be representative of consumer´ satisfaction. Also, it was observed that during the middle and final stages of consumption, *comforted* feelings distinguished between the wines, and in total duration of dominance *fulfilled* and *energetic* also distinguished the wines. The temporal measurement of emotions allowed to capture subtle differences between the wines. In certain stages of product development process researchers are interested in methods that are sensitive to capture subtle differences among products (van Zyl, 2016), therefore it would certainly be valuable to explore TDE further in order to confirm its validity and reliability.

Multi sip approach is important to differentiate similar wines

Temporal measurements of sensations and emotions combined showed that, based on evaluation of the first sip only, participants perceived the wines as more similar compared to what they reported after drinking a whole glass. Indeed, the first and last sips differed on dominance of certain attributes, e.g. *vegetal* for wine DV and *alcohol* and *comforted* for wine CB (Figure 2). This is likely to be related to the flavour release over time, which in beverages like wine is recognised to vary as a function of time, since the bottle is opened until the after taste, usually getting better over the course of the sensory experience (Lawless & Heymann, 2010). The information given by the first sip is important because it translates the first sensory and emotion impact that wines have on consumers. However, these wines could not be differentiated based on first sip, but were differentiated on the last sip (Figure 3). To some extent this is in agreement with previous research that stated that first impressions based on a single evaluation can be poor predictors of preference and choice (Köster *et al.*, 2003). Since more differences were observed as the number of sips increased, our findings suggest the importance of using a full portion approach to differentiate between similar products.

Effect of consumption context on liking

A large effect on liking by the context of the tasting was observed, but the two wines were equally liked independently the place where the tasting occurred. In the lab significantly lower liking scores were observed compared to the more real-life context of drinking the wine in a social-recreative environment like a bar. Even in the bar there were liking differences which are likely to be related to the task the respondents completed. While evaluating emotions, higher liking scores for the same wine were obtained than when measuring sensory attributes using the exact same methodology. It could be argued that the sample size tasted might have had an effect since a lower amount was given in the sensory lab (20 mL *versus* 80 mL). However, it is not likely because the liking scored in the lab was still lower than the liking of the first sip scored in the bar, and both were based on a similar amount of wine. This outcome is in line with the results of Hersleth *et al.* (2003) and de Graaf *et al.* (2005) that also found higher liking scores in appropriate settings of consumption than in the lab. However it is contradicting the results of Danner *et al.* (2016), who found four wines to be equally liked in a highly controlled laboratory setting, in a restaurant or at home, and with the results of Jiang *et al.* (2016) in which no significant differences on liking were observed in two wines using two immersive contexts.

From our findings consumption context greatly affected overall liking, that is the wines were better liked in the bar, probably due to its appropriateness for wine consumption, but consumption context did not contribute to a better differentiation of the wines´ acceptability. However, this topic deserves further research before one can generalise the effect of consumption context on consumers´ wine liking ratings, as there seems to be no consensual conclusion in the current literature, as highlighted by Danner *et al.* (2016).

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Limitations and further research

Despite individual instructions and a practise session, fourteen percent of the participants did not perform the task as expected. It could be that they did not understand the task proposed, as for example some participants alternated to take a sip with the selection of one attribute during the whole test. This shows that the method is complex to perform with consumers and there is a need to simplify the procedure and/or a more effective practising prior to the measurements. We added additional complexity to the procedure as we did not instruct on the number of sips that each consumer would drink nor defined a specific time between each sip, as we thought this procedure would be more in line with natural behaviour. In other studies, where the number of sips and time between sips was controlled, this difficulty was not reported (Zorn *et al.*, 2014). As also proposed by Thomas *et al.* (2016), in further research using this method, the number of sips should be limited and within specific times. We think that on one hand this will help consumers to perform the test and, on the other hand, will facilitate the analysis of the results creating a balanced dataset and also easier time standardization between participants.

Conclusions

This study aimed to explore the sensitivity of temporal measurements of sensations, emotions and liking to differentiate between two comparable tasting wines, using a multi-sip approach and a realistic consumption context - a bar.

It was shown that using temporal dominance of sensations and emotions small differences of equally liked wines were captured, showing the sensitivity of the method to distinguish similar products, and giving a broader understanding of consumers´ perception of wines. Additionally, it shows that there was a large effect effect of the context of tasting on liking. In a real-live context of drinking wine with social recreative environment, like a bar, wines were better liked. It also highlights the importance of using a full-portion approach, combined with temporal measurements of sensations and emotions, to differentiate between similar products, as more differences were observed as the number of sips consumed increased.

This study shows that the evolution of emotions was more uniform during consumption than for the sensory properties. This means that the emotion impact of wine consumption was perceived similarly in all stages of consumption whereas the sensory impact changed in the different stages of consumption, especially towards the end of the drinking process. For these wines, the same positive and low arousal emotions were dominant in all stages of consumption, i.e. from the beginning until the end. This emotional uniformity during wine drinking might be linked to the overall level of consumer 'satisfaction and it would be interesting to test this link as hypothesis.

In competitive markets, food product development is in need of use research methods able to accommodate dynamic changes in experiences that occur over time (Schifferstein, 2015), and sufficiently sensitive to capture subtle differences among products, in order to create products with high emotion impact and to have a broader understanding of the emotion perception of similar products. Temporal dominance of sensations and emotions seems to be promising and suitable for that purpose.

Acknowledgment

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Chapter 6

Effect of adding Hop aroma in beer – temporal sensory, emotion and liking measurements

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Food evoked emotions have been mostly studied using static measurements, thereby possibly missing part of the emotion process during consumption. Aiming to advance in the applicability of food-evoked emotion research, temporal measurement of emotions of beer in a controlled sensory matrix was explored.

This study compared commercial beer that differed only in added hop aroma intensity: control beer (0% aroma), low_c beer (0.08% aroma) and high_c beer (0.16% aroma), using temporal dominance of sensations (TDS), emotions (TDE) and temporal liking (TL). Seventy-one beer consumers consumed a glass of each beer while performing TDE+TL and TDS+TL, on consecutive days in a sensory lab.

Hop aroma induced a differentiated TDS profile: *cereal* was dominant for the control beer, *herbal* was dominant on beers with added hop aroma with *floral* mostly dominant in the high_c beer, but did not induce changes in liking. Based on the total duration of dominance of emotions the beers were not discriminated, however they were discriminated based on the temporal trajectory of emotions.

Temporal dominance of emotions allowed to see that in the beginning of consumption of the high_c beer, disappointed was not dominant like in the other beers, but instead three positive emotions, relaxed, pleased and happy, were dominant. Besides disappointed the other beers showed a positive emotion in the beginning, relaxed or pleased. This was probably due to the addition of a higher concentration of hop aroma that had a positive impact mostly in the beginning of consumption. TDE showed the change in valence of dominant emotions during consumption and specifically at which part of the consumption experience this change takes place. This information might be used in the future to link to purchase intent and choice.

Abstract

Introduction

The different odours and flavours in food and beverages are not perceived independently during consumption and their interaction will determine what consumers perceive and prefer (Prescott, 2015). The interaction of the different product components results in a unique matrix of sensory and emotion attributes for each product that relates to dynamics in liking over consumption. Previous studies showed that different fragrances when experienced in isolation, that is not as part of a food matrix, had different degrees of relevance for the way participants felt. For instance, citrus aroma elicited *energetic-invigorated-clean* emotions in panellists, whereas oriental-vanilla aroma made them feel *disgusted-irritated-unpleasantly-surprised* (Porcherot et al., 2010). As aromas are usually experienced as part of a product matrix, it is relevant to investigate whether the effect of adding a specific aroma to a beverage matrix, will influence acceptability and emotions. Most previous studies that combine sensory and emotion measurements used commercial food products with a fixed composition in which the sensory properties where not manipulated (Bhumiratana *et al.*, 2014; Gutjar *et al.*, 2015; Ng *et al.*, 2013; Spinelli *et al.*, 2015; Thomson *et al.*, 2010) and with some exceptions (Jager *et al.*, 2014; Silva *et al.*, submitted) almost all used static measurements of emotions, i.e. emotions were reported at one point of consumption, before and/or after tasting and using questionnaires. In the current study, we controlled the amount of aroma added to beer to investigate if there is an effect on evoked emotions, using temporal measurements.

Sensory and emotion measurements of beer

Beer consumption is highly associated with the Dutch culture and with situations with a significant emotional impact, such as in a bar with friends or at social events. Beer therefore has strong emotion connotations (Silva *et al.*, 2016). Previous research has shown that different commercial beers and different flavoured beers evoke different emotion responses and can be differentiated based on emotion profiles (Beyts *et al.*, 2017; Cardello *et al.*, 2016; Chaya *et al.*, 2015a; Chaya *et al.*, 2015b; Eaton, 2015). These studies aimed to understand the relationship between sensory attributes and emotion responses to beer, and have made a valuable contribution to food-evoked emotion research. However, its conclusions are based on a small amount of sample tasted, which does not translate into beer consumption in daily life. These studies combined analytical measurements of sensory properties performed with trained panels with affective measurements of feelings performed by consumer panels.

Beers have distinct sensory profiles due to the variety of hops used in its production (Inui *et al.*, 2013). Hop is one of the core beer components and responsible for the bitterness and hop aroma of beers (Wunderlich & Back, 2009). During beer production a further

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addition of hop products is beneficial to increase the flavour and aroma in the final beer as the volatile oils will not be boiled while brewing (Pavsler & Buiatti, 2009). It seems relevant to know how sensations and emotions evolve over time, following the addition of different amounts of the same hop aroma in beer. However, many dynamic processes are involved in flavour release and therefore its perception should be measured dynamically (Dijksterhuis & Piggott, 2000).

Temporal measurements - dominance of sensations, dominance of emotions and liking

While drinking beer the flavour perception changes over time and temporal measurements of sensations were able to characterise those perceptions (Oladokun *et al.*, 2016; Vázquez-Araújo *et al.*, 2013). Temporal dominance of sensations (TDS) is a method in which several sensory attributes are recorded sequentially over time (Pineau *et al.*, 2009). During the tasting of a product participants have to select from a given list at the computer screen the most dominant attribute, i.e. the one that triggers most of the attention at a certain moment. At any moment that their perception changes another attribute can be selected. The frequency and the durations of the sensations are recorded allowing product characterisation based on the duration of dominance of attributes. Temporal measurements of liking (TL) has been used in combination with TDS (Thomas *et al.*, 2016; Thomas *et al.*, 2015). In TL scores are collected at several moments while participants taste the samples, thereby reflecting the acceptability of the product over the whole experience of consumption. TL measurements were compared to classical liking measurements, i.e. overall liking measured at one point of the tasting, and TL was shown to be more discriminative. Recently, Jager *et al.* (2014) developed a similar method to TDS, replacing sensory attributes with emotions – Temporal dominance of emotions (TDE). TDS and TDE were applied to study different flavoured chocolates showing that sensory and emotion attributes were related. Recently the method was applied in a real context of consumption, showing to be sensitive to capturing small differences in wines which were equally liked (Silva *et al.*, submitted). However, it is not known how emotions evolve over time and how they interact with sensations and liking while drinking beer. Our previous research showed that after drinking a glass of beer emotions evoked changed towards a more positive direction, i.e. comparing emotions evoked before and after drinking a glass of beer, the intensity of seven positive emotions increased and the intensity of one negative emotion decreased (Silva *et al.*, 2017). Previous studies that measured emotions evoked by beer applied either explicit measurements, statically using questionnaires, or implicit measurements, applying physiological and/or facial expressions (Beyts *et al.*, 2017; Cardello *et al.*, 2016; Chaya *et al.*, 2015a; Chaya *et al.*, 2015b; Dorado *et al.*, 2016; Silva *et al.*, 2017; van Zyl, 2015; van Zyl *et al.*, 2013). Emotions being a continuous and recursive process (Jager, 2016; Moors *et al.*, 2013), the use of temporal measurements of

emotions in combination with temporal measurement of sensations and temporal liking seem to be a plausible approach since it would reveal part of the processes that would be hidden with static measurements. Studying both sensory and emotion attributes of similar products, i.e. differing in one component only, might allow an understanding of a possible relationship and thereby contribute to future product development. The knowledge can be used to improve and predict the emotion profile of a food or beverage, which is valuable information for consumer and marketing research and for the food/ beverages industry.

Aim of the study

This study aimed to compare three samples of regular beer with small sensory differences in hop aroma intensity, using temporal dominance of sensations (TDS), emotions (TDE) and temporal liking (TL). It is hypothesized that the beer with the highest hop aroma would show an increase in the duration of dominance of certain attributes, such as *floral*, as well as certain positive emotions, such as *pleased*, allowing a distinction from the other samples. Aiming to advance in the applicability of temporal dynamics of food-evoked sensations and emotions, the same consumer panel evaluate both sensations and emotions evoked by the beers. A multi-sip approach in combination with temporal measurements was applied, since tasting a small amount of a product is not representative of the whole experience of consumption. This study will increase the knowledge of how dynamic sensory and dynamic emotion profiles interact and how this relates to liking.

Materials and methods

Product, aroma and attribute selection

Beer

A regular available commercial beer (5% v/v alcohol) of a familiar brand in the Netherlands was selected for this study. Samples of beer with added hop aroma were prepared with the commercial beer as the control product. The beer brand was not revealed to participants.

Attributes and aroma selection

Eight regular beer consumers were recruited to participate in a session organized in the facilities of the Human Nutrition Department of Wageningen University. For this study, a regular beer consumer was defined as between one glass per week, to a maximum of two glasses per day for women and three glasses per day for men. The first aim of this session was to select which out of three hop aromas would be used for the study on the temporal

measurements. The commercial names of the hop aromas tested were: *Mount Hood*, *Cascade* and *Lubelski* (Givaudan, the Netherlands). Samples were prepared according the procedure described below (section sample preparation). The second aim of the session was to reach consensus about the sensory and emotion attributes that best characterised each sample, for use in the temporal measurements. Attribute selection is an important step for temporal measurements as not more than ten to twelve attributes should be evaluated (Pineau *et al.*, 2012). For the sensory attributes selection, an initial list of thirteen sensory attributes of beer flavour was collected from the literature (Meilgaard *et al.*, 1979) and from the aromas´ technical description. For the emotion attributes selection, an initial list of fourteen conceptualisations related to beer consumption (Silva *et al.*, 2016) was selected. This emotion conceptualisation list was validated in previous research to measure emotions evoked by beer consumption (Silva *et al.*, 2017). After the introduction about the session aims, participants were given four samples of 80mL of different beers: three beers with different hop aromas added and the control beer (no aroma added), all coded with three digit codes. Samples were served in a random order across participants, in beer glasses at 4ºC. Participants were asked to drink the first sample and to rank the ten most applicable sensory attributes from the list (1 - most applicable to 10 - least applicable). Subsequently participants had to rate the liking on a nine-point Likert scale. Next, they were asked to use check-all-that-apply for the emotion attributes that they felt were most relevant while drinking or after drinking each sample. This procedure was repeated for each sample. Finally, participants had to select the most preferred sample out of the three beers with added aroma. After the individual assignment, a discussion group was guided by the panel leader to achieve consensus on the selection of the sensory and emotion attributes that best characterised each sample.

The beer with added *Mount Hood* aroma was preferred by seven out of eight consumers, was also the one most liked and evoked more positive emotions. Therefore, *Mount Hood* was the aroma selected for the study and its related sensory and emotion attributes are presented in Table 1 with an explanation of each term and the translation from Dutch to English.

Table 1 | Description of the sensory and emotion attributes used to characterise the beers in Dutch and in English

	In Dutch	In English	Description / explanation
SENSATIONS	Bitter	Bitter	Caffeine
	Graan	Cereal	Breakfast cereals, bread, toast
	Citrus / Lemon	Citrus / Lemon	Grapefruit, orange, lime, lemon, lemon grass
	Bloemig	Floral	Rose, elderflower, chamomile blossom, jasmin, apple blossom, geranium
	Fruitig	Fruity	Fruits like apples, berries, banana
	Honing	Honey	Very sweet substance, such as nectar or syrup
	Noten / Hout	Nutty / Woody	Wood, walnuts, nuts, hay, leather, woodruff, incense, myrrh, resin
	Zuur	Sour	Taste associated with acid
	Herbal / Kruidig	Herbal / Spices	Aniseed, liquorice, fennel, juniper, marjoram, tarragon, dill, lavender
	Zoet	Sweet	Sugar
EMOTIONS	Geamuseerd	Amused	Diverted, showing that something is funny
	Behaaglijk	Comforted	A feeling of consolation, feeling good
	Teleurgesteld	Disappointed	When your expectations are not fulfilled, sensation of frustration
	Energiek	Energetic	Having or showing energy
	Vrij	Free	Feeling not limited or controlled, unrestrained, disinhibited
	Voldaan	Fulfilled	Satisfaction, completed
	Blij	Happy	Feeling joy or glad, contentment, delighted
	Tevreden	Pleased	Pleasure
	Ontspannen	Relaxed	Relieved from tension or anxiety, without worries
	Verdrietig	Sad	Sorrow or unhappiness

Sample preparation

Sample preparation was done four hours in advance of the beginning of the test, with the following sequence: 1) the bottles were opened, 2) the aroma was added manually using micropipettes and immediately after 3) the bottles were recapped using a manual machine; 4) each bottle was carefully inverted three to four times and 5) transferred to a cold storage (4^oC). The aroma was not added to bottles of the control beer, but for reasons of standardization, the bottles of the control beer were submitted to the same process of sample preparation. Each sample was recapped with new caps of different colours and coded with three digits. The amount of aroma added followed the guidelines of the technical information of the producer. In summary, for the temporal measurements three samples were prepared: the control beer, with no added aroma, so corresponding to the regular commercial beer; the low concentration beer (low_c) with 0.08% of the *Mount Hood* aroma added, and the high concentration beer (high_c) with 0.16% of the *Mount Hood* aroma added. Participants received 100ml of each beer, coded with three digits, and served in beer glasses at 4 C^o.

Experimental design and procedure

Participants

Seventy-one healthy, moderate beer consumers were recruited from the database of Human Nutrition of Wageningen University, the Netherlands (35 men, 36 women, 43 in the age range of 18-35 years, 28 in the age range of 36-65 years). Frequency of beer consumption was on average (± SD) 0.9 (± 0.8) glasses of beer per day. All participants were native Dutch speakers, had a normal appetite, normal ability to taste and smell, were not following a restricted diet and were not using medicines incompatible with alcohol consumption. Pregnant women were excluded. None of the participants had previous training in sensory evaluation of beer or had used the TDS/TDE methodology. Participants gave written informed consent before the study began and at the end received a small reimbursement to thank them for their participation. This study protocol was submitted to and positively evaluated by the Medical Ethical Committee of Wageningen University.

Experimental design and measurements of TDS, TDE and TL

This study was performed in two sessions that occurred on consecutive days, from 17h to 21h, and took place in the sensory lab of the Restaurant of the Future (Wageningen, The Netherlands). The sixteen sensory booths were equipped with computers. Data were recorded using the TimeSens® software package version 0.93.122.904 (ChemoSens, Dijon, France). Participants had to evaluate three beers with the TDE+TL and TDS+TL methods in two sessions, one session for sensory on one day and one session for emotions on another day. The order of the sessions was randomized across participants. In both sessions participants also evaluated TL for the beers at the same time as they performed TDE or TDS. In the first session participants attended a ten minutes presentation, to explain the procedure, to give instructions for the test and to clarify any questions they had. After the introduction, participants were allocated to the booths. First they received a water sample to practise and to get familiar with the method. Following this, the test started and participants received the beers in a sequential monadic way to taste and evaluate. The order of product presentation was randomized across participants. On the second day, a short recap of the method was done before the testing took place.

Procedure of each session

As soon as participants drank the first sip of the beverage they had to click the "START" button on the computer screen and select the attribute (sensory or emotional, depending on the session) that they felt to be dominant. When the dominant perception changed, participants had to indicate the new dominant sensation or emotion by clicking the relevant button, until perception ended. Participants were free to choose the same attribute several times or never to select an attribute. In addition, participants were asked

to indicate their liking of the beverage throughout the tasting on an eight-point hedonic scale ranging from "extremely disliked" to "extremely like". Participants were instructed to score liking at least one time for each sip but were free to change the score at any time they perceived some liking change. Participants were free to drink the beverages as they liked until they finished the glass but were asked to click the button "NEW SIP" every time they had a new sip. Between samples they were forced to wait two min. Water and crackers were available to eliminate aftertaste between samples.

Data analysis

Data were analysed using the TimeSens© software and IBM SPSS Statistics for Windows, Version 22.0. (Armonk, NY: IBM Corp.).

Consumers´ global performance – duration of consumption, number of sips and of citations

Statistical descriptive analyses on how participants performed in each session and differences in parameters of drinking behaviour were tested using ANOVA, namely for: total duration of consumption, total number of sips and number of sensory and emotion attributes used.

Temporal dominance curves and difference curves

Temporal dominance curves (TDS and TDE) were generated by TimeSens©, and gave a graphical representation of the percentage of participants that selected the attribute as dominant at a given time. The dominance rate is calculated dividing the number of citations an attribute was given at a certain moment by the number of judges (Pineau *et al.*, 2009). All the values are then compared to significance level to differentiate results that are due to chance from results that come from agreement among participants. An attribute is considered dominant when it is above the significance level. If the attribute is between chance and significance level, it can be considered to have a tendency towards dominance. The higher the dominance rate for an attribute, the better agreement among participants.

TDS and TDE difference curves were generated to compare samples and are the result of subtracting time by time dominance rates of one sample from that of another, and are plotted only when the difference is significantly different from zero (p=0.05). This analysis is useful for descriptive purposes and provides an understanding of the difference between two TDS or TDE profiles.

Analysis of duration

Duration of sensations and emotions were analysed using ANOVA, with dominance duration as variable, to evaluate the differences among beer samples based on sensory and emotion attributes. A MANOVA was performed to evaluate if there was a multivariate

product effect. The MANOVA-F was obtained according to the Hotteling-Lawley statistic (Peltier *et al.*, 2015). To visualize the results of MANOVA, canonical variate analysis (CVA) was applied. In the CVA bi-plot graph, product points (beers) were projected on descriptive arrows (attributes) (Peltier *et al.*, 2015) allowing interpretation of the relative location of the beers and the sensory and/or emotion attributes. All attributes were included in this analysis. Ellipses around product means represent the distribution of consumers' duration scores around each sample. To find significance differences a multivariate post-hoc t-test namely the Hotelling test, was used to conclude on pairwise beer differences.

Relationship between TDS and TDE

The temporal dominance curves and CVA plots for TDS and TDE were visually inspected and compared for similarities in patterns. To complement this comparison a joint CVA of sensation and emotion attributes was performed allowing to identify possible associations between sensations and emotions in discriminating between the beers.

Temporal liking

Liking scores were analysed using a two-factor analysis of variance (ANOVA), namely: product and sip, to identify differences of liking scores between the samples and possible interactions between product x sip. Subjects and all respective interactions were considered as random factors. Where significance was established (p<0.05) the LSD post hoc test was used to identify pairwise differences. Temporal liking at five different time points is presented, corresponding to the average of the first five sips.

Results

Temporal measurements of sensations and emotions

Consumers global performance – duration of consumption, number of sips and of citations

No significant differences were observed between beers regarding total duration of consumption and on number of sips. On average (± SD) each session lasted 116 s (± 47) and consumers took 5 (± 1) sips. On average, the number of citations (number of clicks) was significantly higher for sensations than for emotions, 32 (± 20) *versus* 26 (± 15) (F=4.32, p=0.04).

Temporal dominance of sensations and emotions curves

TDS curves for the sensory attributes of the three beers are shown in the upper row of Figure 1. *Bitter* has the highest dominance rate of sensations in all beers throughout consumption. *Cereal* was mostly dominant in the control beer during the second half of

consumption, but hardly reached significance in the beers with added aroma. Instead *herbal* was perceived as dominant in beers with added aroma, namely in the last stage of consumption of the low_c beer and in an earlier stage of consumption of the high_c beer. Sweetness was dominant only in the beginning for the control beer. Fruity reached dominance in the middle stage of the control beer and in the beginning of the high_c beer. *Floral* was dominant at the end of consumption of the high_c beer.

TDE curves for emotion attributes of the beers are shown on the bottom row of Figure 1. *Relaxed* and *pleased* are dominant emotions for all beers throughout consumption, although in different stages. For the control beer these emotions are mostly dominant at the middle and end stages of consumption, whereas for the high_c beer they evolve from the beginning. *Disappointed* was dominant at the beginning of the control and low_c beers, whereas for high_c beer it appeared in the middle stage of consumption. *Fulfilled* was dominant in the end stage of all beers. In the beginning of consumption of the high_c beer, *happy* reached dominance which did not happen in any stage of the other beers.

Temporal dominance of sensations and emotions - difference curves

TDS difference curves indicated significant differences in duration of dominance for sensory attributes between pairs of beers and are shown in Figure 2 (upper row). The control beer induced higher rates of dominance of *cereal* during the second half of consumption compared to the low_c beer. The control beer induced higher rates of dominance of *bitter* and *cereal* compared to the high_c beer, which instead induced higher rates of dominance of *herbal* and *floral*. The low_c and the high_c beers were distinguishable in dominance rates of *bitter*, which was higher in the low_c beer. The highest number of sensory attributes perceived as different in dominance was observed between the control and the high_c beer.

Significant differences in the dominance durations of emotions were found between the control and high_c beers, in which in the middle stage, the control beer induced higher rates of dominance of *relaxed* whereas the high_c beer induced higher rates of dominance of *pleased* (Figure 2, bottom row). The low_c beer induced higher rates of dominance of *disappointed* compared to the high_c beer at the beginning of consumption. No differences in dominance rates of emotions were observed between the low_c and the control beer.

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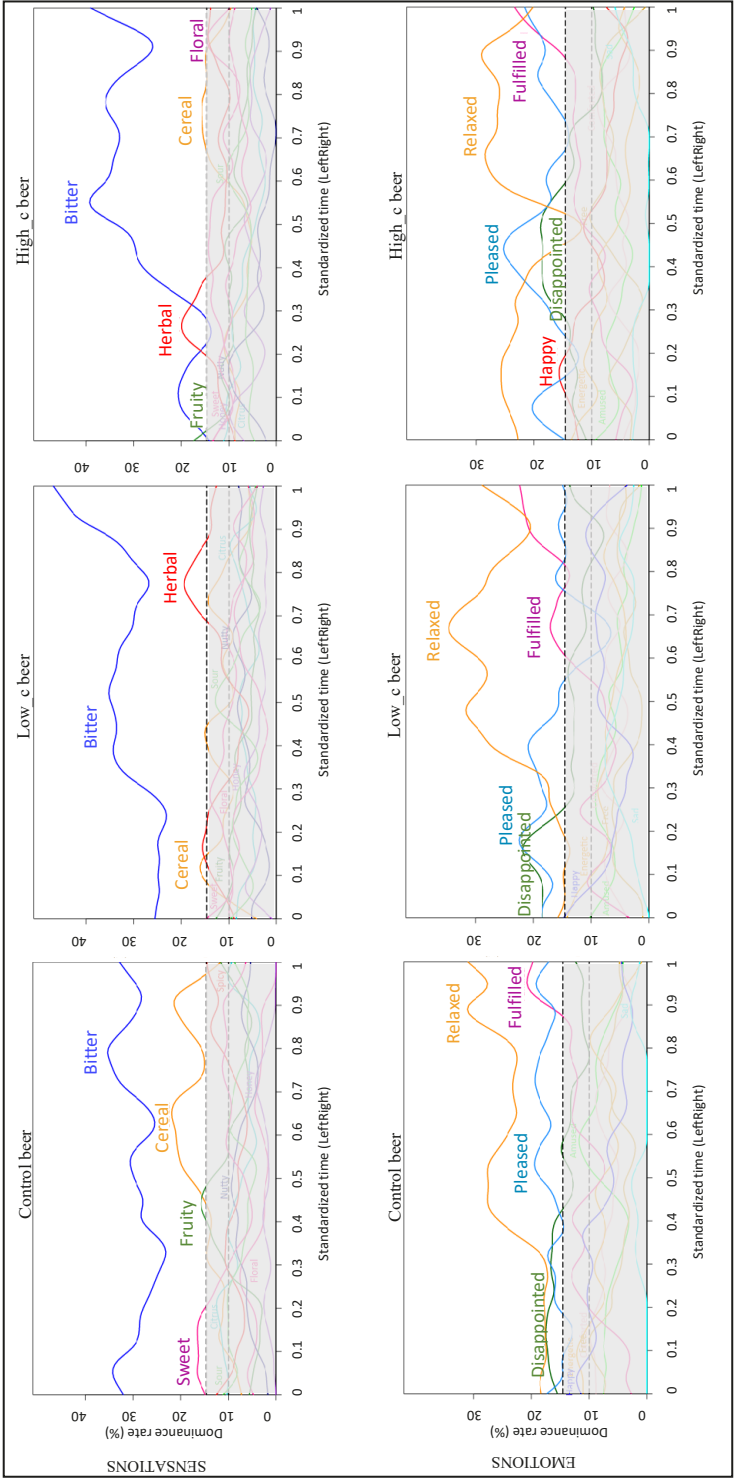
Figure 1 | Graphical representation of the temporal dominance of sensations (upper row) and emotions (bottom row) for the three beers. Legend: grey shadow is below the significance level and dominant attributes are above the significance level.
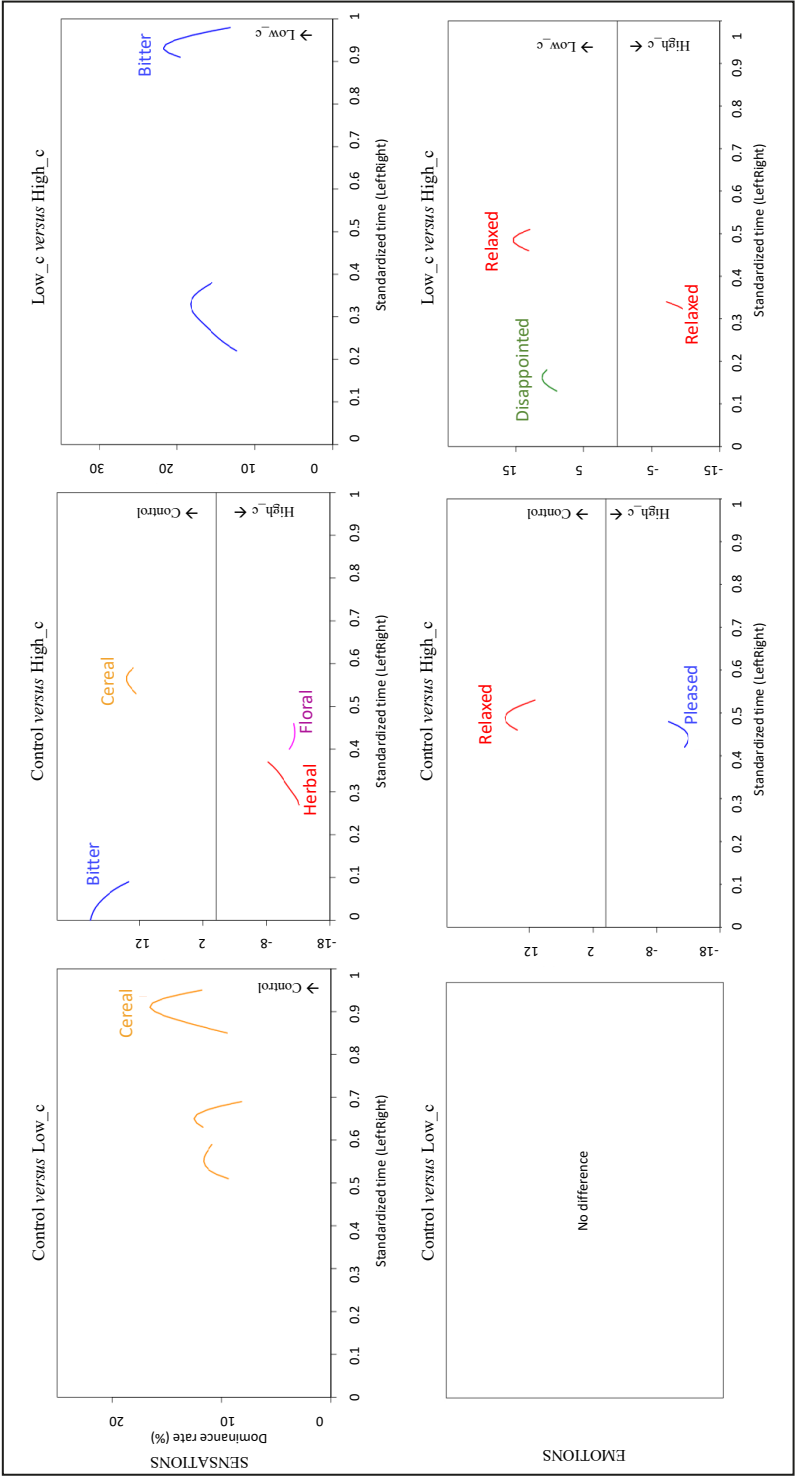
Figure 2 | Graphical representation of the differences of temporal dominance of sensations (upper row) and emotions (bottom row) between the three beers

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Total duration of dominance of sensations and emotions

Analysis of the total duration of dominance per attribute are presented in Table 2. For sensations, dominance durations for *cereal* and *floral* were significantly different among the beers. As the concentration of hop aroma increased the total duration of dominance of *cereal* decreased whereas the dominance of *floral* increased. These results are congruent with the dominance curves, showing agreement among participants. Several trends in differences are also observed. For example, *honey* and *spicy*, were higher in dominance in beers with added aroma. In contrast, *citrus* flavour decreased in dominance in beers with added aroma. No differences were observed among beers for total dominance duration of emotions. A trend difference is observed, in which the low_c beer had higher duration of dominance of *sad*, compared to the control beer. This did not reach significance in the temporal curves, meaning that was perceived only for a group of participants. The overall duration of dominance for sensations was significantly higher compared to the overall duration of dominance of emotions (F=9.59, p=0.002).

Table 2 | ANOVA of durations of sensations and emotions per beer (in seconds, mean ± SEM)

		Beers			
		Control	Low_c	High_c	F-values
SENSATIONS	Bitter	20 ± 2.7	22 ± 2.8	19 ± 2.6	0.29
	Cereal	**11^a ± 1.7**	7 ± 1.6	**5^b ± 1.1**	**3.65***
	Citrus / Lemon	**5^c ± 1.2**	4 ± 1.0	**3^d ± 0.7**	1.18
	Floral	**2^a ± 0.8**	5 ± 1.2	**6^b ± 1.4**	**3.01***
	Fruity	6 ± 1.4	4 ± 0.9	6 ± 1.3	0.75
	Honey	**1^c ± 0.4**	2 ± 0.9	**3^d ± 0.8**	1.55
	Nutty / Woody	4 ± 1.2	5 ± 2.9	2 ± 0.7	0.72
	Sour	6 ± 1.4	4 ± 0.9	4 ± 1.3	0.65
	Herbal / Spices	**5^c ± 1.1**	**9^d ± 1.8**	7 ± 1.8	1.80
	Sweet	6 ± 1.2	4 ± 0.8	5 ± 1.1	1.00
EMOTIONS	Amused	3 ± 1.0	3 ± 0.7	3 ± 0.8	0.10
	Comforted	3 ± 0.9	3 ± 1.1	3 ± 0.7	0.25
	Disappointed	6 ± 1.4	6 ± 1.2	6 ± 1.5	0.04
	Energetic	3 ± 0.9	4 ± 1.6	4 ± 1.0	0.07
	Free	3 ± 0.8	2 ± 0.8	3 ± 0.8	0.32
	Fulfilled	6 ± 1.2	7 ± 1.3	6 ± 1.3	0.20
	Happy	4 ± 1.0	6 ± 1.7	4 ± 0.8	0.73
	Pleased	11 ± 1.6	9 ± 1.5	12 ± 2.4	0.66
	Relaxed	13 ± 1.7	12 ± 1.5	14 ± 1.8	0.40
	Sad	**0.5^c ± 0.2**	**2^d ± 1.0**	1 ± 0.3	1.69
OVERALL	Sensations	66 ± 4.2	66 ± 5.3	60 ± 3.9	0.36
	Emotions	53 ± 3.2	54 ± 3.3	56 ± 3.7	0.01

Legend: SEM - standard error of the mean. Significant F-values are highlighted in bold (p<0.05). Means with different letters in the same row are significantly different between beers (a, b p<0.05 and c,d p<0.1)
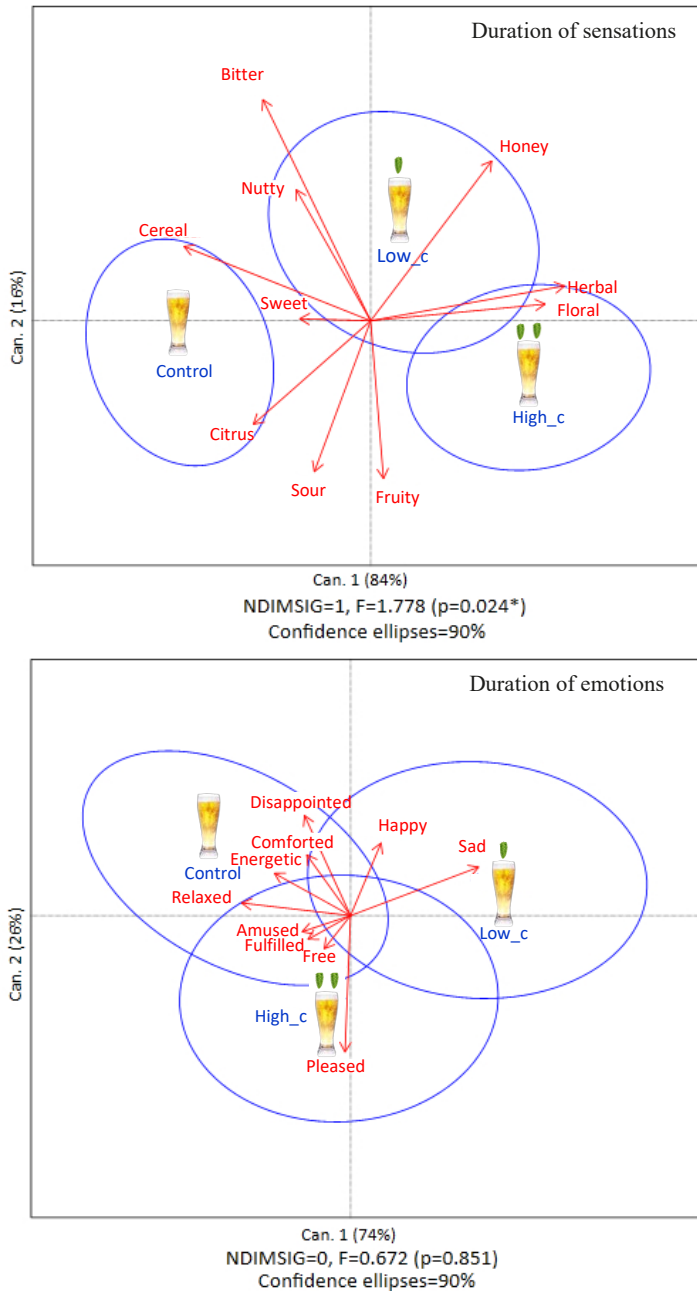
Figure 3 | CVA biplot of dominance of duration of sensations (left panel) and emotions (right panel).

The top panel of Figure 3 depicts a CVA plot on duration of sensations in which a multivariate effect was observed (F=1.78, p=0.02). The first canonical dimension explained 84% of the variance and reflects the effect of the aroma since it separates the control

beer (no aroma added) from the beers with added aroma. Dimension 2 explained 16% of variance and distinguishes the low_c beer from the high_c beer, reflecting the effect of the concentration of aroma added. Although two of the confidence ellipses have a small overlap, according to the *Hotelling test* the three beers were significantly different from each other (all p<0.05).

The bottom panel of Figure 3 depicts a CVA plot on duration of emotions indicating no significant multivariate effect. The *Hotelling test* showed that the beers were not significantly different from each other which can also be seen from the intersection of the confidence ellipses.

Relationship between sensations and emotions

Combining the total duration of dominance of sensory and emotion attributes in a joint CVA plot (Figure 4) a significant multivariate effect was observed (F=1.42, p=0.06). Dimension 1 reflects again the effect of aroma separating the control beer from the beers with added aroma, and explained 78% of variance. Dimension 2 explained 22% of variance and differentiated between the low_c beer and the high_c beer, reflecting the effect of the concentration of aroma added. The joint CVA indicates a similar pattern as the separate CVA for the duration of sensory attributes (Figure 3, left panel).
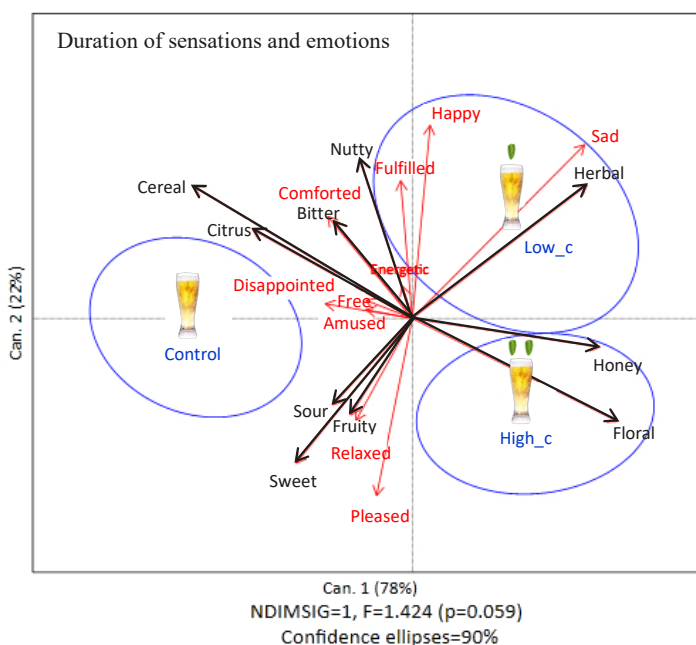
Figure 4 | Joint CVA of sensations and emotions dominance durations

Temporal liking

Descriptive statistics and ANOVA of the overall mean liking scores for the beers and per sip is presented in Table 3. ANOVA yielded no effects for product, sip or interaction product x sip on liking. In addition, no significant differences were found between the first and the last liking scores. However, within each subject a variation occurs while drinking, as the difference in mean liking between maximum and minimum scores for a given beer is one, meaning that consumers changed their liking scores while drinking. Still, overall the addition of aroma did not induce a systematic change in liking scores over consumption for the three beers, which were equally liked.

Table 3 | Descriptive analysis and ANOVA of the mean liking scores for the beers overall and per sip

Beer	Overall	Sip_1	Sip_2	Sip_3	Sip_4	Sip_5	Number of evaluations	Máx-Min	First-Last
Control	5.4 ± 0.04	5.4 ± 0.1	5.4 ± 0.1	5.4 ± 0.1	5.3 ± 0.1	5.5 ± 0.1	5.5	1	0.2
Low_c	5.5 ± 0.05	5.5 ± 0.1	5.4 ± 0.1	5.5 ± 0.1	5.4 ± 0.1	5.7 ± 0.1	5.5	1	0.1
High_c	5.3 ± 0.05	5.4 ± 0.1	5.4 ± 0.1	5.4 ± 0.1	5.5 ± 0.1	5.2 ± 0.2	5.5	1	0.4

Legend: standard error of the mean is presented after the mean. ANOVA showed no significant differences.

Discussion

This study aimed to discriminate three samples of regular commercial beer that differed only in intensity of hop aroma, using temporal dominance of sensations (TDS), emotions (TDE) and temporal liking (TL).

Results showed that adding different concentrations of hop aroma in beer induced a differentiated dynamic sensory profile without changing the liking of the beers. Temporal evolvement of emotions revealed changes in the valence of emotions during the drinking experience, showing a shift from negative to positive emotions as the amount of aroma increased. Main results are discussed below.

Overall, the addition of this hop aroma variety influenced the perception of other compounds of beer. It largely decreased the dominance of *cereal* and *sweet*, delayed the dominance of *bitterness* and increased the dominance of *herbal* and *floral*, in later stages of consumption. Temporal sensory profiles of the three beers translated correctly the sensations expected by the addition of the hop aroma, showing that consumers differentiated the beers well based on the dynamics of the sensory attributes. Measuring the dominance of sensations while drinking a glass of beer showed to be a useful methodology to reveal that the sensations related to the aroma, such as *herbal* and *floral* evolve only in a later stage of consumption, which would not be revealed using static measurements.

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The first emotional impact perceived when consumers took the first sip of the high_c beer is positive for all consumers, and they perceived three dominant positive emotions, including *happy* that was exclusively dominant for this beer. However, in the other beers, a negative and a positive emotion are dominant immediately at the first sip. In the middle stage of consumption, a negative and a positive emotion are dominant in the high_c beer, whereas in the other two beers two positive emotions are dominant. By the end of consumption, consumers perceived the same three positive emotions in all beers, and no negative emotion was perceived as dominant. This is an important finding, because the last moments of an eating experience have a large influence on memory and are good predictors of repeated consumption of a food product (Higgs, 2016; Robinson *et al.*, 2011). However, food choice is influenced by the beginning, the end and the peaks of enjoyment of past experiences of consumption, known as primacy, recency or peak effects, respectively (Rode *et al.*, 2007). Since we see that negative emotions are dominant in the beginning of consumption of two beers, and positive emotions at the end for all three beers, further research would be beneficial to understand which of the moments of beer consumption most determines beer choice.

Static measurements considering only overall scores on intensity would not fully convey the perception of consumers. On the other hand, using a small amount of beer to measure emotions would give an incomplete emotion profile and could lead to hasty conclusions. The peaks of dominance of positive emotions for these beers are towards the end of consumption, probably because it is when the full complexity of a product is perceived. This may be different for other beers or other food products.

Temporal dominance of emotions showed to be a useful methodology to reveal changes in valence of dominant emotions while drinking a glass of beer. A direct comparison of emotions captured by static and dynamic methods is suggested as further research, to understand of and how the measurements relate to each other.

Beers could be well discriminated based on the total duration of dominance of sensations, which was not observed for emotions. Combined data of TDS and TDE did not show a better discrimination among the beers compared to TDS alone, which limits the usefulness of the total duration of dominance of emotions to discriminate similar products. Although was possible to observe a relationship between sensations and emotions based on joint CVA plot, those do not convey if the relationship occurs at the same moment of consumption, therefore those results must be interpreted together with the temporal curves. For example, *herbal* was positively correlated with *sad*, but *sad* was not a dominant emotion. The same way, *disappointed* was positively correlated with *citrus*, but *citrus* was never dominant.

Other studies have shown a relationship between sensory and emotions on beers. For example, Chaya *et al.* (2015a) have shown that for a group of Spanish consumers, beer with added hop aroma increased the intensity of negative emotions such as *disappointment*

and decrease the intensity of positive emotions, such as *fun*, when compared to a control beer. For a group of English consumers, Beyts *et al.* (2017) have shown that beer with added hop aroma evoked pleasantness emotions. Several reasons could explain this outcome but perhaps the most probably is because Spanish consumers do not like hop flavoured beer as much as English and Dutch consumers do. As shown by Cardello *et al.* (2016) familiarity with beer tasting play a role in emotional associations. Comparably, in other studies the same ingredient, i.e. a sensory specific attribute, in different food matrixes showed to evoke different emotion responses, e.g. in studies with chocolates, cocoa was associated with high arousal feelings, such as energetic and powerful, in one study and with low arousal feelings, such as calm and bored, in another study (Jager *et al.*, 2014; Thomson *et al.*, 2010).

Overall, it seems possible to establish ingredient/sensory-emotion relationship in food and beverages, but these relationships are product-dependent and consumer-dependent so results cannot be generalised.

The addition of hop aroma yielded different sensory profiles but had no effect on the hedonic evaluation (liking) of the beers, as they were equally liked overall and during consumption. This might be explained because the aroma selected and amount added were appropriate to beer per se, and consumers did not show a distinct preference for any of the beers. However, from the changes perceived in emotion profiles over time, it is clear that consumers do not feel the same way while drinking the beers, even though the hedonic evaluation did not differentiate the beers. The outcome that temporal liking while drinking a beer is stable over time is complementary, and to a certain extent in line, with findings from a previous study, demonstrating that liking scores for beer before (expected liking) and after (actual liking) did not change (Silva *et al.*, 2017). This confirmation effect is linked to consumer satisfaction and with repeated use (Deliza & MacFie, 1996), is now extended to the whole experience of beer consumption.

Strengths and limitations

In temporal measurements, the number of attributes should be restricted to ten (Pineau *et al.*, 2012), and this can be a limitation for the measurement of emotions. The number of terms in most emotion lists varies from 25 to 39, because with longer questionnaires, there are more chances to capture subtle variations in emotional experiences of similar products (Cardello & Jaeger, 2016). Although the selection of emotion terms used in this study was carefully done (see section 2.1), it could be that using other emotion terms, also relevant to beer consumption, as for example *exuberant, curious* and *grumpy* (Silva *et al.*, 2017), would have evoked different emotion profiles which may have resulted in a different conclusion. A recommendation to overcome this issue could be to present in the same button, a group of emotion terms organized by emotion categories, instead of presenting a single emotion in each button. Using a long list of emotion terms or its related short list of emotion categories yielded comparable results and discrimination, as demonstrated with Geneva Emotion and Odor Scale (GEOS) (Porcherot et al., 2010).

In this study a larger portion was used instead of a small sample, to increase the chances of product differentiation and capturing sensations and emotions more representative of the whole experience of beer consumption. A multi-sip approach showed an added value compared to a single intake evaluation (Galmarini *et al.*, 2016; Thomas *et al.*, 2016; Zorn *et al.*, 2014).

This study contributed to extend the work and the knowledge of using measurement tools to assess emotional responses to food products from the same product category. It shows that temporal dominance is a method that can capture small differences in sensations and in emotions in products with a similar sensory matrix and that are equally liked. New products are normally developed from several prototypes that differ in the proportion of ingredients in small amounts. Therefore sensitive and accurate methods are needed to understand subtle differences along the whole experience of consumption (Schifferstein, 2015; van Zyl, 2016).

Conclusions

The present study investigated how sensations, emotions and liking evolve and interact during beer consumption. It was shown that temporal dominance of sensations and emotions evolve differently during consumption, even in beverages equally liked. In terms of total duration of emotions the beers were not discriminated, however the trajectory of emotions showed different profiles. Using temporal dominance of emotions seems to add value to sensory and consumer research, since it identifies in which part of consumption changes in the valence of emotions takes place, which might be a determinant for future choices. Further research is needed to study which of the moments of consumption are the most determinant for beer choice.

These findings could be applicable in food-related emotion research and have potential for new product development.

Acknowledgment

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Chapter 7

General Discussion

The research presented in this thesis focused on sensory and emotion profiles of wine, beer and non-alcoholic beer consumption. This final chapter starts with an overview of the main findings, followed by a section on methodological considerations and a discussion and interpretation of the main findings. Finally, practical implications and directions for future research and conclusions are given.

Main Findings

Before measuring sensory and emotion perceptions regarding wine, beer, and non-alcoholic beer, we first reviewed the literature to identify main determinants of consumption of these beverages, using data from Portugal and the Netherlands (chapter 2). In terms of consumption, since the sixties, the image of Portugal as a wine country declined, whereas the image of the Netherlands as a beer country remained stable. In each country, beer is the most consumed alcoholic beverage, whereas the wine is the second most consumed. Beer is mainly a man´s beverage and wine is consumed by both genders. Non-alcoholic beer represents about 1,5% of the beer market share. Cultural differences define Portuguese as "outdoors, everyday drinkers", mostly during lunch and dinner, and Dutch as "at home, weekend drinkers", preferably at late afternoon and evening. The interaction between contextual factors, such as sociability and rituals, and the beverages characteristics, such as sensory aspects, functional and emotional attributes are main determinants for its consumption. There is limited data in the literature neither on non-alcoholic beer consumption, nor on the emotions evoked by all three beverages.

Based on these findings, we performed a qualitative study to explore the conceptualisations of the three beverages, in terms of functional and emotional associations (chapter 3). It was shown that wine, beer and non-alcoholic beer have different conceptualisations, which are similar between Dutch and Portuguese consumers. Wine and beer are rich in both functional and emotional content. Wine is mainly associated with positive low arousal emotional responses, such as calm and loving, and beer is predominantly associated with positive high arousal emotional responses, like adventurous and energetic. Non-alcoholic beer has a limited conceptual content, which is mostly functional as a substitute, to avoid alcohol consumption and keep in control. Regarding the limited emotional conceptualisations, the emotions that were reported for non-alcoholic beer were neutral and negative, such as rational, conscious and disappointed.

We further explored the conceptualisations of beer and non-alcoholic beer, studying expectations based on the product name versus the actual flavour of these beverages, when the beverages were given to consumers named correctly and incorrectly with respect to their composition (chapter 4). We found that drinking a non-alcoholic beer named as "NON-ALCOHOLIC BEER" made consumers feel less excited after drinking. When

the same beverage was named "BEER" consumers liked it more and felt more fulfilled after consumption. Drinking a beer named as "BEER" changed emotional profile towards to a more positive direction since after drinking consumers felt more: fulfilled, exuberant, comforted, amused, joyful, happy and good, and less grumpy. When the same beverage was named "NON-ALCOHOLIC BEER" emotional profile changed towards to a less positive direction since after consumption consumers felt less: comforted, exuberant, good, happy, joyful and loving. Incongruent conditions lead to responses between congruent conditions for beer, which was the most liked beverage and evoked the most positive profile, and non-alcoholic beer, which was the less liked beverage and had the less positive profile.

To investigate emotional changes during consumption, and how they interact with changes in sensations, we used temporal dominance of sensations, temporal dominance of emotions and temporal liking and compared beverages with small differences in sensory characteristics (chapters 5 and 6). Both studies showed that the consumption experience is different in samples that are equally liked by consumers. In chapter 5, we show that two similar tasting wines evoked the same three dominant emotions, namely: pleased, relaxed and comforted, which in total duration of dominance did not differ. However, the temporal trajectory evolved differently in each wine, showing that e.g. on the second sip comforted feelings had a higher dominance rate for one wine compared to the other. The emotion profile of wine consumption was more uniform in all stages of consumption whereas the sensory profile gradually evolved through the different stages of consumption, especially towards the end of the drinking process. More differences were observed between the wines as the number of sips consumed increased. There was a large effect of consumption context on liking, and the wines were better liked in a bar than in a sensory lab. However, in both settings liking between the wines did not differ. In chapter 6 we show that temporal dominance of emotions allowed to see that in the beginning of consumption of the most aromatic beer, disappointed was not dominant like in the other beers, but instead three positive emotions, relaxed, pleased and happy, were dominant. Besides disappointed the other beers showed a positive emotion in the beginning, relaxed or pleased. This was probably due to the addition of a higher concentration of hop aroma that had a positive impact mostly in the beginning of consumption. Table 7.1 presents an overview of the main findings of this thesis.

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Table 7.1 | Overview of the main findings of this thesis

Literature review		
C.2	Aim	Review on wine, beer and non-alcoholic beer patterns of consumption in Portugal and in the Netherlands, reflecting on cultural differences, contextual and psychological factors of consumption *Critical Reviews in Food Science and Nutrition 57(7) (2017), 1340–1349*
	Findings	• Since the sixties, the image of Portugal as a wine country declined, whereas the image of the Netherlands as a beer country remained stable • In each country beer is the most consumed alcoholic beverage and is mainly a man´s beverage, whereas wine is the second most consumed and is consumed by both genders; non-alcoholic beer represents ~ 1,5% of the market share of beer • Cultural differences define Portuguese as "outdoors, everyday drinkers", within lunch and dinner, and Dutch as "at home, weekend drinkers", preferably at late afternoon and evening • The interaction between contextual factors, such as sociability and rituals, and the beverages characteristics, such as sensory aspects, functional and emotional attributes are main determinants for its consumption • Limited literature available regarding non-alcoholic beer and on emotions evoked by all three beverages
Conceptual profiles of alcoholic *versus* non-alcoholic beverages, using a static approach		
C.3	Aims	To determine the image of non-alcoholic beer and reasons underlying its limited consumption, comparing functional and emotional conceptualisations of non-alcoholic beer with the ones from wine and beer. To compare how two cultures, Dutch and Portuguese, conceptualise these beverages *Food Quality and Preference 49 (2016) 54–65*
	Findings	• Beer and wine are both functional and emotional. Beer mainly evokes positive and high arousal emotion responses, such as energetic and adventurous. Wine mainly evokes positive low arousal emotion responses like calm and loving. Non-alcoholic beer is mostly functional, as a substitute, to avoid alcohol consumption and to keep in control. Its limited emotion responses are negative and neutral, such as disappointed, rational and conscious • Dutch and Portuguese consumers have similar conceptualisations of the beverages
C.4	Aim	To assess how the product name, "BEER" or "NON-ALCOHOLIC BEER", influenced liking and the emotions elicited, before and after drinking either a beer or non-alcoholic beer, when the beverages were given to consumers named correctly and incorrectly with respect to their composition *Food Quality and Preference 55 (2017) 58-66*
	Findings	• Drinking a non-alcoholic beer named as "NON-ALCOHOLIC BEER" made consumers feel less excited after drinking. When the same beverage was named "BEER" consumers liked it more and felt more fulfilled • Drinking a beer named as "BEER" changed emotional profile towards to a more positive direction since after drinking consumers felt more: fulfilled, exuberant, comforted, amused, joyful, happy and good, and less grumpy. When the same beverage was named "NON-ALCOHOLIC BEER" emotional profile changed towards to a less positive direction since after consumption consumers felt less: comforted, exuberant, good, happy, joyful and loving • Incongruent conditions lead to responses between congruent conditions for beer, which was the most liked beverage and evoked the most positive profile, and non-alcoholic beer, which was the less liked beverage and had the less positive profile
Conceptual profiles between alcoholic beverages of the same category, using a dynamic approach		
C.5	Aim	To explore the sensitivity of temporal dominance of sensations and emotions as well as temporal liking of two similar tasting commercial wines in a multi-sip approach in a bar *Submitted for publication*
	Findings	• Both wines evoked the same three dominant emotions, namely: pleased, relaxed and comforted, which in temporal trajectory evolved differently in each wine, allowing a differentiation • The emotion profile of wine consumption was more uniform in all stages of consumption whereas the sensory profile changed in the different stages of consumption, especially towards the end of the drinking process • We observed a large effect of consumption context on liking, and wines were better liked in a bar than in a sensory lab. However, in both settings the wines did not differ based on liking
C.6	Aim	To study temporal dominance of sensations and emotions as well as temporal liking of three beers with a small sensory difference in hop aroma *In preparation for submission*
	Findings	• Hop aroma induced differentiated temporal dominance of sensations but did not induce changes in liking • The total duration of dominance of emotions did not discriminate between the beers, but the temporal trajectory of emotions did • Temporal dominance of emotions allowed to see that in the beginning of consumption of the high_c beer, disappointed was not dominant like in the other beers, but instead three positive emotions, relaxed, pleased and happy, were dominant. Besides disappointed the other beers showed a positive emotion in the beginning, relaxed or pleased

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Methodological considerations

Before we discuss and interpret the main findings of this thesis it is relevant to take some methodological considerations into account.

Participants

In emotion and conceptual profiling, it is recommended to include participants that are users of the products under study (King & Meiselman, 2010; Thomson *et al.*, 2010). Non-users would provide different information, as they tend to associate more negative and less positive emotions to the products under study (King & Meiselman, 2010). We selected only participants that were moderate but regular consumers of the beverages. For all studies the selection of participants was balanced in gender and age (18-35 years and 36-65 years). In our first study, a qualitative research, Dutch and Portuguese consumers were included. In the next studies related to beer consumption, only Dutch consumers took part. In the study related to wine consumption, only Portuguese consumers were included. For the aim of this thesis, we selected an appropriate sample of consumers to study wine, beer and non-alcoholic beer consumption.

Study design - Qualitative approach

Qualitative research methods are valuable in providing rich descriptions of phenomena and conducting initial explorations, in topics not covered by the current literature (Sofaer, 1999). Although functional associations regarding wine, beer and non-alcoholic beer consumption can be found in the literature, they were not discussed in a comparative way, since most studies look at the beverages independently. No emotional associations regarding non-alcoholic beer were found in the literature, and for wine and beer only at a very generic level. Emotions are product, culture and language dependant, so it is recommended to develop a specific lexicon involving the products and consumers from the countries where the studies will be performed (van Zyl & Meiselman, 2015). A disadvantage, however, is that using specific developed lists of emotions does not allow a direct comparison with other studies. On the other hand, general lists might not be sensitive enough to capture subtle differences between products.

Given this, we use a qualitative approach to explore functional and emotional associations regarding wine, beer and non-alcoholic beer consumption, and to develop a list of emotion associations regarding the three beverages to use in subsequent studies (chapter 3). The aim was to develop a list that included words meaningful to consumers for the beverages characterisation. Indeed, our list allowed a distinction between and within beverage categories.

In this study data were collected in different locations (two countries, three cities) until saturation was achieved. We used an adequate sample of frequent consumers (n=56) and multiple data coding was performed. Therefore, different techniques were applied to guarantee validity and precision of our study.

Study design - Quantitative approach

Explicit and implicit measurements of emotions assess different parts of the emotion process, i.e. explicit measurements only capture part of the emotion process, i.e. the conscious part of emotion whereas implicit methods capture emotional responses that occur below the level of consciousness (Köster & Mojet, 2015). Explicit methods proved to be effective and efficient to differentiate food-evoked emotions between and within different products categories, and are easier to use in a real context of consumption than most implicit methods. Given this, we decided to use only explicit measurement of emotions in our studies, being conscious of its limitation to be capturing only associations that consumers are aware of and can report. Implicit measurements such as observational methods, facial expression analysis or physiological measures of the autonomic nervous system could be incorporated in future studies to include unconscious processes.

We used a self-report questionnaire to statically evaluate the intensity of emotions in two different moments: regarding expectations triggered by the product name, just before drinking, and regarding the actual experience, immediately after drinking (chapter 4).

Given that drinking is a dynamic experience in which sensations and emotions evolve over time temporal measurements are the most suitable to capture consumer perception during consumption. In the past, time intensity methods were largely applied, but they are very time consuming, since only one attribute is evaluated at a time (Lawless & Heymann, 2010). More recently temporal dominance of sensations gained more interest as it allows to record several attributes sequentially during consumption (Pineau *et al.*, 2009). Jager *et al.* (2014) developed a similar method to temporal dominance of sensations, replacing sensory attributes by emotions – temporal measurement of emotions. In recent studies of temporal dominance of sensations, liking was also measured over time – temporal liking – showing to be more discriminative compared to a single overall liking measurement (Schlich, 2015; Thomas *et al.*, 2015; Thomas *et al.*, 2016).

Since we aim to study how sensations and emotions evolve and interact and might explain liking during consumption, we combined temporal dominance of sensations, temporal dominance of emotions and temporal liking (chapters 5 and 6).

In our studies, we used a within-subject design to minimize systematic variation effects, so the effect of our experimental conditions would be more apparent. On the other hand, practice effects, i.e. familiarity with the experimental situation, and boredom effects can

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be attached to a within-subject design. To avoid practice effects, we could have used a between-subject design, but then the statistical power would decrease. In our studies participants were randomly assigned to the samples and conditions, which in turn were counterbalanced, contributing to avoid order and thus practice effects (Field, 2009).

Most studies combine consumers´ emotion responses with sensory profiles defined by trained panels (Chaya *et al.*, 2015a; Gutjar *et al.*, 2015; Spinelli *et al.*, 2015; Thomson *et al.*, 2010). In our studies, sensory and emotion attributes were defined by consumers, so using consumer language. We also use the same consumers for both emotion and sensory measurements (chapters 5 and 6), to allow a direct comparison (Jager *et al.*, 2014; Schouteten *et al.*, 2015).

Natural situation of consumption

Most sensory studies are performed in controlled laboratory settings and using a small sample (10-30 mL) (Lawless & Heymann, 2010). However, the need for research to be more ecologically valid has been highlighted, as for example conducting research in real contexts of consumption (Jaeger *et al.*, 2017; Köster, 2003; Meiselman, 2013), and some studies have been following that trend (Danner *et al.*, 2016; Gutjar *et al.*, 2015; Porcherot *et al.*, 2015b). Our studies were performed both in laboratory context and in real context of consumption, depending on the aim of the studies. A controlled laboratory setting was needed to keep consumers focused only on the intrinsic properties of the beers that differed in the amount of hop aroma (chapter 6). Therefore, a neutral environment was considered more suitable than a natural context of consumption, where other factors would affect consumers´ responses. However, for emotion measurement responses are highly context-dependent (Barrett *et al.*, 2007) and we believe that to understand consumer behaviour it is important to account for these context effects. Therefore, the other studies were performed in a real context of consumption to capture the actual emotion associated with the experience of consumption.

There has been an increased interest in studying multiple bites/sips of a product to better understand the descriptive sensory temporality (Galmarini *et al.*, 2016; Thomas *et al.*, 2016; Zorn *et al.*, 2014). A multi bite/sip approach can reveal sensations and emotions that evolve only at the end of consumption of the product, which by using a small portion will not be detected. In addition, tasting a single sip does not mimic a real-life situation of consumption. To understand wine and beer consumption experiences we aimed to perform the studies as close as possible to a natural situation of consumption. Therefore, and considering guidelines for alcohol consumption, our participants tasted between one and three samples per session, of 100 mL and 300 mL for beer and 80 mL for wine, served in appropriate glasses.

Discussion and interpretation of the main findings

Conceptual profiles of alcoholic versus non-alcoholic beverages

We have shown that conceptual profiling is a useful tool to characterise consumption experience, and that consumers perceive different emotional benefits when drinking different beverages. Wine and beer have rich conceptual content, both in functional and emotional associations, whereas non-alcoholic beer has a limited conceptual content, which is mostly functional. Although wine and beer consumption evoked mostly pleasant emotions (Desmet & Schifferstein, 2008), these beverages seem to have different emotion profiles in terms of the arousal dimension.

When thinking about wine consumption, consumers associated this with feelings, such as calm, comforting and loving, which are positive low arousal feelings. When actually drinking a wine in a bar, the same three low arousal positive emotions, pleased, relaxed, comforted, were dominant in all stages of consumption. In equally liked wines, the evolvement of emotions while drinking was more uniform over time than the evolvement of sensations, which shows a graduate cumulative effect of sensations not observed for emotions. This can be different for other wines and more studies are needed to be able to generalise results. However, it could contribute that the Portuguese consumers seem to be less involved with wine consumption than what would be expected from consumers of a wine nation. This was described in a recent study showing that Portuguese are less emotionally involved with wine than Brazilians or Mexicans (van Zyl & Meiselman, 2016). Interestingly, looking at the emotion associations that consumers from Italy, Australia and Portugal have regarding wine, only few emotion descriptors are in common for the three cultures, such as happy and loving/passionate (Danner *et al.*, 2016; Ferrarini *et al.*, 2010; Silva *et al.*, 2016). Specific emotion words were encountered exclusively in each group, such as warm hearted and contended for Australians, desirable and euphoric for Italians and comforted and fulfilled for Portuguese. Even though these consumers belong to "wine cultures", wine is not perceived in the same way.

When thinking about beer consumption, consumers generally associated this with high arousal feelings, such as energetic, exuberant and amused. When actually drinking a beer in a bar consumers perceived a positive change in emotional profile, increasing the intensity of emotions such as fulfilled, exuberant, comforted and amused and feeling less grumpy. However, this could be different using other types of beers or measuring in other cultures. Beers with different sensory characteristics have different emotion profiles (Beyts *et al.*, 2017; Chaya *et al.*, 2015a; Chaya *et al.*, 2015b; Eaton, 2015). Other factors, such as familiarity with beer taste might influence the emotion responses, as shown by (Cardello *et al.*, 2016). Familiar beer tastes were associated to more passive emotion responses compared to

novel beer tastes, which were more associated with active emotion responses. Static measurements of emotions are useful when the aim is to distinguish between different beer types but for product development is important to focus on more subtle differences that might occur during consumption and not be captured by static measurements. We have shown that the dynamic emotion profile of beers with small differences in sensory characteristics evolved differently during consumption, even in beers equally liked. This gives new perspectives for emotion future research.

When thinking about non-alcoholic beer consumption, a strong image as a substitute of beer, with a weak hedonic value and neutral and negative emotional responses such as rational, conscious and disappointed, are the most relevant associations that come to the consumer´s mind. When drinking non-alcoholic beer in a bar, a negative disconfirmation occurs, i.e. the consumers expect to like it more than they actual do, which may lead to product rejection (Deliza & MacFie, 1996). Emotionally, consumers feel less excited after drinking a non-alcoholic beer, and emotions do not change positively. As wine and beer have a positive emotion profile, it could be argued that the lack of positive emotional content of non-alcoholic beer is due to the absence of alcohol. However, other non-alcoholic beverages were found to be associated with positive and high arousal emotions. For example, Amp Energy beverage was classified by a group of Canadian consumers as a high arousal beverage (Di Muro & Murray, 2012) and Coca-Cola has a strong image as the "happiness drink" as underlined in their slogan "Taste the feeling". Our research shows that beverage choice is not only about the sensory content but also about emotions evoked by the image of the beverages in consumers´ mind, including emotions evoked by the product name. Probably, the best example of a functional drink is Red Bull, which does not do well in tasting tests but its emotional content associated with the slogan "Gives you wings" has built a strong image and made it one of the most successful non-alcoholic beverages in the world (Gschwandtner, 2017). Comparing the conceptual profiles of the beverages we can better understand the importance of the balance between functional and positive emotional conceptualisations for the success of a product. The lack of positive emotional content of non-alcoholic beer might explain why it has not yet been widely chosen by consumers as it does not deliver a comparable emotional response to wine and beer.

We have shown that memories of previous experiences with the beverages, triggered by product name, influenced the perception of the actual experience of consumption. Product name influenced both liking and emotions. How consumers form memories of consumption experiences seems important in explaining future choices (Higgs, 2016; Robinson *et al.*, 2013). The product name "non-alcoholic beer" loaded in the negative/ unpleasant dimension of the emotion profile, indicating that memories and past experiences with non-alcoholic beer were not so positive, which will influence future choices. A strategy is creating and communicating an image of a more energetic and convivial beverage.

Conceptual profiles between alcoholic beverages of the same category

We used a novel approach to measure the evolvement of emotions during beverage consumption – the temporal dominance of emotions (Jager, 2016) – and observed that the experience of consumption is different, i.e. sensations and emotions evolved differently, within a product category, even if consumers like the beverages equally. A change in valence of emotions, i.e. from negative to positive emotions, occurred after the first sip of the beer with the higher concentration of hop aroma. This is relevant because food choice is influenced by the beginning, the end and the peaks of enjoyment of past experiences of consumption, known as primacy, recency or peak effects, respectively (Rode *et al.*, 2007). For example, consumers who experienced a pleasant end of a yogurt remembered it to have been a significantly more enjoyable experience compared to a group of consumers who had the same yogurt but with a pleasant beginning and a bland end version (Robinson *et al.*, 2011). However, memory is also dependent of the type of food eaten and we need further research to understand which of the moments of beer consumption most determines beer choice. Temporal dominance of emotions allowed to see an improvement in the beginning of consumption by adding hop aroma to beer, not shown by liking measurements.

Context of consumption

We have performed studies in real contexts of consumption and showed that consumption context is important to understand consumption experience, affecting both liking and emotion measurements. The lack of emotion discrimination between product names before drinking beer/non-alcoholic beer in a bar and the similarity in dynamic emotion profiles of wines consumed in a bar could well reflect the emotions evoked by the atmosphere of the place in which the studies were performed. In our wine study a difference in liking was observed between measuring in a sensory lab and a bar. For emotion measurements, it seems clear that there is an effect of context of consumption (Barrett *et al.*, 2007; Danner *et al.*, 2016; Edwards *et al.*, 2016; Porcherot *et al.*, 2015b) but the difficulty remains in understanding which emotions are evoked by the product and which emotions are evoked by the atmosphere of context itself, and how they correlate. For liking measurements, in literature there are contradictory conclusions, since some studies found an effect (de Graaf *et al.*, 2005; Hersleth *et al.*, 2003) and others did not (Danner *et al.*, 2016; Jiang *et al.*, 2016). The importance of consumption context in eating behaviour is not questionable, however a clear theory to explain the effect of context in the measurements is still missing.

Practical implications and directions for future research

A practical implication of the current work is for the development of healthier versions of already existing food or beverages. Industries that want to launch healthier versions of their products in the market, e.g. low-sugar, low-salt or low-alcohol content, could consider different aspects highlighted in our studies. Successful products seem to have a balanced attachment of functional and emotional associations, thereby healthier versions of products should not be developed only focused on their functionalities, but also evoking positive emotional meaning. It seems important to create a positive and independent image of healthier versions of food products, by for example attaching positive emotional meaning to specific occasions of consumption in marketing campaigns, communicating positive emotion benefits of consumption and positive branding. Otherwise consumers always will be looking for the same sensory reward as the original version, that probably will not be there, since healthier versions of food products often have a lower hedonic evaluation. Moreover, consumers will constantly remember that they are eating or drinking a *substitute*, which might not be their first choice and will probably evoke negative feelings. A careful selection for product name seems to be relevant. In our study the effect that a single word, as the product name, had on consumer responses was demonstrated at two levels. It increases how much consumers like a product and affects the way they feel after consumption, i.e. evoking emotional changes in the positive direction. The product name can be used as a strategy to nudge consumers to healthier choices.

Another application of our work is for product formulation to improve already existing products or to create new products. We showed that the addition of different concentrations of hop aroma in beer, induced changes in the sequence of emotions evoked during beer consumption. Emotion tests may be used to test small ingredients changes in formulation and to help identify whether the changes result in positive or negative outcome for product formulation. The literature is limited in this area of application since most companies might use this information confidentially to have advantage against its competitors (King, 2016). This topic is relevant to create healthier versions of products with a comparable emotional content as the original version, as well as to create more appealing. To increase our knowledge on this area, a future project could evaluate the emotion profile of new healthier prototypes of products during consumption and correlate data with actual choice of these prototypes.

The currently available tools for measuring food-evoked emotions are a point of attention for future research. As discussed in the section of study design we applied explicit measurements, statically and dynamically, but these only assess the conscious component of emotions. However, many choices occur at the unconscious level (Köster, 2009), and therefore it would be relevant to increase our understanding of unconscious feelings related to the experience of consumption by using implicit measures. Facial expressions

to measure emotions have been applied in beverage consumption studies, but results did not show a clear added value compared to explicit methods (Beyts *et al.*, 2017; Danner *et al.*, 2014; van Zyl, 2015). However, it could be because these implicit measurements were performed in a lab context, as they are difficult to perform in a real context of consumption. To overcome this issue future research could combine implicit methods with immersive virtual reality, which is a computer simulation that immerses consumers in almost real environments. This approach has been applied in some studies, such as a virtual shop for wine choice (Bazoche *et al.*, 2015), drinking a beer in a bar (Guttman *et al.*, 2015) and smelling scents in different contexts (Porcherot *et al.*, 2015a) allowing a better understanding of consumer feelings and preferences. To gain knowledge on the role of consumption context in beverage choice, a future project could explore different situations of consumption of the same beverage, at the beach, at a party, at home, given by immersive virtual realities, e.g. using 3D-glasses, measuring explicitly and implicitly emotions and correlating the data.

During this PhD project, we compared conceptual profiles of alcoholic *versus* non-alcoholic beverages using wine, beer and non-alcoholic beer. It would be of great interest now to compare conceptual profiles within the non-alcoholic beverages category and include direct measures of beverage choice. A future project could include the measurement of emotions evoked by different beverages, such as non-alcoholic beer, radler, soft drinks and fruit juices, and correlate them with short and long term measurements of beverage choice.

Conclusions

Wine, beer and non-alcoholic beer are not just beverages consumed for their sensory aspects. They have an elaborated conceptualisation map in consumers mind and they evoke positive and negative emotions that evolve during consumption. A balance between functional and positive emotional conceptualisations seems to be important for product success.

To understand beverage choice, it is important to consider the influence of memories and previous experiences related to the product. These can be attached to its product name and generate expectations. Indeed, the name of a product was shown to influence the actual experience of consumption. It changes how much consumers like a beverage and how do they feel after consumption.

During consumption, sensations and emotions evolve differently in similar tasting beverages that consumers equally liked. The temporal trajectory of dominant emotions revealed that changes occurred, which cannot be detected by static measurements and might be linked to future beverage choices.

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This thesis contributed to extend the work of food-evoked emotions measurements. Both static and dynamic emotion measurements revealed information not shown by liking measurements. An integrative approach of sensations, emotions and liking measurements is beneficial for a better understanding of product usage and experience of consumption.

Our knowledge regarding the relationship between sensory specific characteristics and food-evoked emotions is still very limited and further research is needed, but we believe that this is the way to achieve that the healthier choice is also experienced as the *happier* choice.

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Summary

Summary in Portuguese

Acknowledgement

About the Author

List of publications

Overview of training activities

Summary

Wine and beer consumption are an integral part of European life and culture and well known for the sensory pleasure and short term effects, such as relaxation and mood enhancement. Non-alcoholic beer is considered a healthier beverage, due its composition and absence of alcohol. However, it does not seem to be appealing to consumers, since patterns of consumption are marginal compared to wine or beer consumption. Given the increasing relevance of moderate alcohol consumption in consumer´s diet, it is important from the nutritional point of view, to study and compare consumer perceptions of wine, beer and non-alcoholic beer consumption.

The aim of this thesis was to contribute to a better understanding of consumption experience and hence beverage choice, by using beverage-evoked emotions, in addition to their sensory perceptions. To this end, we measured emotions statically, before and after consumption and dynamically, during consumption.

Chapter 1 provides background information on wine, beer and non-alcoholic beer consumption, conceptual and emotional profiling, dynamic profiles of sensations and emotions and natural situations of consumption. Additionally, the research aim and thesis outline is presented.

In **chapter 2** a literature review is presented on patterns of consumption of wine, beer and non-alcoholic beer in Portugal and in the Netherlands, reflecting on cultural differences, contextual and psychological factors that drive consumption. Since the sixties, in terms of consumption, the image of Portugal as a wine country declined, whereas the image of the Netherlands as a beer country remained stable. In each country, beer is the most consumed alcoholic beverage, wine is the second most consumed and non-alcoholic beer represents about 1.5% of the beer market share. Cultural differences define Portuguese as "outdoors, everyday drinkers", mostly during lunch and dinner, and Dutch as "at home, weekend drinkers", preferably at late afternoon and evening. The interaction between contextual factors, such as sociability and rituals, and the beverages characteristics, such as sensory aspects, functional and emotional attributes are main determinants for its consumption.

In **chapter 3**, through a qualitative study in Portugal and in the Netherlands we explored the conceptualisations of wine, beer and non-alcoholic beer, in terms of functional and emotional associations. Portuguese and Dutch have similar conceptualisations of the beverages. Beer and wine are rich in both functional conceptualisations, e.g. to socialise and pair with food, and in emotional content. For example, beer is associated with adventurous and energetic and wine is associated with calm and loving. Non-alcoholic beer is mostly functional as a substitute, to avoid alcohol. Its limited emotional associations are negative and neutral, such as disappointed and conscious. The difference

in emotional conceptualisations of non-alcoholic beer versus beer/wine might be why non-alcoholic beer is not adopted more widely as a substitute as it does not deliver a comparable emotional response to consumers.

In **chapter 4**, we studied how the product name, "BEER" or "NON-ALCOHOLIC BEER", influenced liking and the emotions elicited, before and after drinking either a beer or non-alcoholic beer, when the beverages were given to consumers named correctly and incorrectly with respect to their composition. Drinking a non-alcoholic beer named as "NON-ALCOHOLIC BEER" made consumers feel less excited after drinking. When the same beverage was named "BEER" consumers liked it more and felt more fulfilled after consumption. Drinking a beer named as "BEER" changed emotional profile towards to a more positive direction since after drinking consumers felt more: fulfilled, exuberant, comforted, amused, joyful, happy and good, and less grumpy. When the same beverage was named "NON-ALCOHOLIC BEER" the emotional profile changed towards to a less positive direction since after consumption consumers felt less: comforted, exuberant, good, happy, joyful and loving. This means that both product name and beverage content affect consumer´s responses.

In chapters 5 and 6 we used temporal dominance measurements to study how dynamic sensory and emotion profiles interact with one another and how this affects liking during consumption experience.

In **chapter 5**, we compared two similar tasting commercial wines, inviting consumers to drink a glass of wine in a bar. We observed that dynamics of sensations and dynamics of emotions discriminated equally liked wines. The emotion profile of wine consumption was perceived similarly in all stages of consumption whereas the sensory impact changed in the different stages of consumption, especially towards the end of the drinking process. We observed an effect of consumption context on liking, as both wines were significantly better liked in a bar than in a sensory lab. Still, in both settings wines were equally liked.

In **chapter 6**, we compared commercial beers that differed only in the intensity of added hop aroma. Hop aroma induced differentiated sensory dynamic profiles but did not induce changes in liking. Temporal dominance of emotions allowed to see that in the beginning of consumption of the most aromatic beer, disappointed was not dominant like in the other beers, but instead three positive emotions, relaxed, pleased and happy, were dominant. Besides disappointed the other beers showed a positive emotion in the beginning, relaxed or pleased.

The general discussion is presented in **chapter 7**, which describes the main findings and conclusions of this PhD thesis. We showed that wine, beer and non-alcoholic beer have an elaborated conceptualisation map in consumers´ minds and they evoke positive and negative emotions, that evolve during consumption. A balance between functional and

positive emotional conceptualisations seems to be important for product success as well as the product name. During consumption, sensations and emotions can evolve differently in similar tasting beverages that consumers equally liked. Our knowledge regarding the relationship between sensory specific characteristics and food-evoked emotions is still very limited and further research is needed, but we believe that this is the way to achieve that the healthier choice is also experienced as the *happier* choice.

Summary in Portuguese

O consumo de vinho e de cerveja são parte integral da vida e da cultura Europeia. Estas bebidas são conhecidas pelo seu prazer sensorial, e o seu consumo em moderação é geralmente associado a momentos de descontração e boa disposição. A cerveja sem álcool é considerada uma bebida saudável, devido à sua composição e ausência de álcool. No entanto, não parece ser uma bebida apelativa para os consumidores, uma vez que os padrões de consumo são marginais em comparação com os padrões de consumo de vinho ou cerveja. Dada a crescente relevância do consumo moderado de álcool na dieta alimentar, é importante, sob o ponto de vista nutricional, estudar e comparar a perceção dos consumidores sobre o consumo de vinho, cerveja e cerveja sem álcool.

O objetivo desta tese é contribuir para o conhecimento da experiência de consumo de vinho, cerveja e cerveja sem álcool, e consequentemente, para a sua escolha, através das emoções que evocam, adicionalmente à sua perceção sensorial. Com essa finalidade, as emoções foram medidas antes e depois do consumo, com medições estáticas, e durante o consumo, com medições dinâmicas.

O **capítulo 1** providência informação sobre o consumo de vinho, cerveja e cerveja sem álcool, perfis conceptuais e emocionais, perfis dinâmicos de sensações e de emoções e situações naturais de contexto de consumo. Adicionalmente, é apresentado o objetivo e linhas de investigação da tese.

No **capítulo 2** é apresentada uma revisão de literatura sobre os padrões de consumo de vinho, cerveja e cerveja sem álcool, em Portugal e na Holanda, refletindo diferenças culturais, contextuais e fatores psicológicos que motivam o consumo. Desde os anos sessenta, que em termos de consumo, a imagem de Portugal como "wine country" diminuiu, enquanto que a imagem da Holanda como "beer country" permaneceu relativamente estável. Em cada um destes países, a cerveja é a bebida alcoólica mais consumida, estando o consumo de vinho em segundo lugar, e a cerveja sem álcool representa cerca de 1.5% da cota de mercado da cerveja. As diferenças culturais definem os Portugueses como "consumidores diários, fora de casa", maioritariamente durante as refeições de almoço e jantar, enquanto que os Holandeses são "consumidores de fim de semana, em casa", preferivelmente à noite. A interação entre fatores contextuais, tais como os rituais e a sociabilidade, e as características das bebidas, tais como os aspetos sensoriais, funcionais e emocionais, são identificados como os principais determinantes de consumo destas bebidas.

No **capítulo 3**, através de um estudo qualitativo efetuado em Portugal e na Holanda, exploramos a conceptualização do vinho, cerveja e cerveja sem álcool, em termos de associações funcionais e emocionais. Os Portugueses e Holandeses apresentam conceptualizações semelhantes sobre estas bebidas. A cerveja e o vinho são ricos em conceptualizações funcionais, e.g. para socializar e para acompanhar determinadas

refeições, e em associações emocionais. Por exemplo a cerveja é associada a emoções tais como aventureiro e energético, e o vinho é associado a calmo e amoroso. A cerveja sem álcool tem maioritariamente associações funcionais, como substituto, quando o objetivo é evitar o consumo de álcool. As suas associações emocionais são negativas e neutras, tais como sentir-se desiludido e consciente. A diferença entre as conceptualizações emocionais da cerveja sem álcool *versus* cerveja/vinho poderá ser o motivo da cerveja sem álcool não ser mais frequentemente consumida, uma vez que a sua resposta emocional não é comparável à da cerveja ou vinho.

No **capítulo 4**, estudamos como é o que o nome do produto "CERVEJA" ou "CERVEJA SEM ÁLCOOL" influencia a preferência e as emoções evocadas, antes e depois do consumo de uma cerveja ou de uma cerveja sem álcool, quando as bebidas são apresentadas aos consumidores correta ou incorretamente com respeito à sua composição. Beber uma cerveja sem álcool chamada de "CERVEJA SEM ÁLCOOL" levou a que os consumidores se sentissem menos animados depois do consumo. Quando a mesma bebida foi chamada de "CERVEJA" os consumidores gostaram mais e sentiram-se mais completos depois do consumo. Beber uma cerveja chamada "CERVEJA" alterou o perfil emocional numa direção positiva uma vez que depois do consumo os consumidores sentiram-se mais completos, mais confortados, mais divertidos, mais alegres e felizes, e menos mal-humorados. Quando a mesma bebida foi apresentada como "CERVEJA SEM ÁLCOOL" o perfil emocional mudou numa direção menos positiva uma vez que depois do consumo os consumidores sentiram-se menos confortados, menos felizes e alegres e menos amorosos. Isto significa que ambos, o nome do produto e o seu conteúdo, influenciam as respostas dos consumidores.

Nos capítulos 5 e 6 usamos medições temporais de dominância para estudar como é que os perfis sensoriais e emocionais interagem um com o outro e como é que isso afeta a preferência durante a experiencia de consumo.

No **capítulo 5**, comparamos dois vinhos comerciais, semelhantes no seu sabor, e convidamos os consumidores a beber um copo de vinho num bar. Observamos através da dinâmica das sensações e das emoções que os vinhos são diferenciados, embora a preferência dos consumidores por estes vinhos não seja diferente. O perfil emocional de consumo de vinho foi percecionado de modo semelhante em todas as fases de consumo, enquanto que o perfil sensorial se foi alterando, especialmente no final da experiencia de consumo. Observou-se ainda um efeito do contexto de consumo na medição da preferência, e ambos os vinhos foram mais apreciados no bar comparativamente ao laboratório sensorial. Ainda assim, ambos os vinhos foram igualmente apreciados independentemente do contexto de prova.

No **capítulo 6**, comparamos amostras de uma cerveja comercial que se diferenciavam apenas na quantidade de aroma de lúpulo adicionado. O aroma adicionado induziu diferentes perfis sensoriais mas não diferentes preferências. A dominância temporal das

emoções permitiu ver que na fase inicial de consumo da cerveja mais aromática, a emoção *desiludido*, não era dominante, o que aconteceu nas outras amostras. Por sua vez três emoções positivas eram dominantes: *relaxado, agradado* e *feliz*. Para além de *desiludido*, as outras cervejas mostraram dominância de uma emoção positiva no inicio de consumo, *relaxado* ou *agradado*.

A discussão geral é apresentada no **capítulo 7**, no qual são discutidos os principais resultados e as conclusões desta tese de doutoramento. Foi mostrado que o vinho, cerveja e cerveja sem álcool têm um elaborado mapa de conceptualizações na mente dos consumidores, e que evocam emoções positivas e negativas que evoluem durante o consumo. O balanço entre conceptualizações funcionais e emocionais parece ser importante para o sucesso de um produto, assim como o seu nome. Durante o consumo, sensações e emoções podem evoluir de modo diferente em bebidas com sabor semelhante e que os consumidores preferem de igual modo. O nosso conhecimento sobre a interação entre as características sensoriais e as emoções evocadas pelos alimentos/bebidas é ainda muito limitado e mais investigação é necessária, mas acreditamos estar no caminho certo para descobrir como é que a escolha mais saudável é também a que faz os consumidores sentirem-se mais felizes.

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And now it is time to express my sincere acknowledgment to all that contributed to this emotional journey.

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And now that this emotional journey is ending, I come back home with a warm heart and look forward for what life will bring me next!

Cheers, Proost, Saúde e até sempre!

Patrícia

"Never be ashamed, he said. Accept what life offers you and try to drink from every cup. All wines should be tasted; some should only be sipped, but others, drink the whole bottle.

How will I know which is which?

By the taste. You can only know a good wine if you have first tasted a bad one."

Paulo Coelho, Brida

About the Author

Ana Patricia Silva was born on 24th of December 1974 in Nazaré in Portugal. After completing her graduation in Food Engineering in 1997 at the College of Biotechnology of Catholic University in Portugal (ESB-UCP), she started working in the food company *Panike,* setting up the department of research and new product development.

In 1999, Patricia was invited to be academic director of a private high school in at ESB-UCP, coordinating technical and regular courses for under-graduated students. From 2011 to 2013 she coordinated master courses in the academic services at Catholic University.

In 2010, she finished a Master Thesis in Science and Food Technology at ESB-UCP. Her topic was a qualitative application of the theory of planned behaviour related to young adults and wine consumption. From 2011 to 2015 Patricia collaborated in three European projects at ESB-UCP, planning, coordinating and performing tasks related to sensory and consumer research.

Since 2011 she has been representing ESB-UCP in the European Sensory Network (ESN), in which she has been collaborating in several large cross-cultural studies. In 2015, she was appointed as a member of the ESN management board, as secretary, actively participating in the strategy of this association and in the organization of the bi-annual meetings.

In 2013 Patricia was appointed as a PhD candidate at the Division of Human Nutrition of Wageningen University, in the Netherlands, in collaboration with ESB-UCP. Her research focused on the measurement of emotions elicited by wine, beer and non-alcoholic beer consumption, for a better understanding of consumption experience and beverage choice, as described in this thesis.

During her PhD project, Patricia joined the educational programme of the Graduate School VLAG. She attended several international conferences and courses, was involved in teaching activities and supervised MSc students in their thesis projects. In 2015, she was awarded by the Dutch Beer Institute, the Netherlands, for the best scientific work in the field of "Beer and Health promotion". In 2016, Patricia received a PhD Student´s award by the research committee of the 7th European Conference on Sensory and Consumer Research, Elsevier, Dijon, France.

List of Publications

Peer-reviewed publications

Silva, A., Jager, G., Voss, H.-P., van Zyl, H., Hogg, T., Pintado, M., & de Graaf, C. (2017). What's in a name? The effect of congruent and incongruent product names on liking and emotions when consuming beer or non-alcoholic beer in a bar. *Food Quality and Preference*, 55, 58-66.

Silva, A., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. (2016). Functional or emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer consumption. *Food Quality and Preference*, 49, 54-65.

Silva, A., Jager, G., van Zyl, H., Voss, H.-P., Pintado, M., Hogg, T., & de Graaf, C. (2017). Cheers, Proost, Saúde: cultural, contextual and psychological factors of wine and beer consumption in Portugal and in the Netherlands. *Critical reviews in food science and nutrition*, 57(7), 1340–1349.

Silva, A., Franco, M.I. Mady, C, Pallet, D. Tomlins, K. Bennett, B., Sottomayor, M. (2016). Drivers of acceptance of a new beverage in Europe. A conjoint analysis study. *Beverages*, 2(2), 12.

Silva A, Figueiredo I, Hogg T, Sottomayor M. (2014). "Young adults and wine consumption a qualitative application of the theory of planned behaviour. *British Food Journal*. Volume 116 Issue 5.

Ana I.E. Pintado, Maria J.P. Monteiro, Régine Talon, Sabine Leroy, Valérie Scislowski, Geneviève Fliedel, Danielle Rakoto, Isabelle Maraval, Ana I.A. Costa, **Ana P. Silva**, Dominique Pallet, Keith Tomlins, Manuela M.E. Pintado. (2015). Consumer acceptance and sensory profiling of reengineered kitoza products. Food Chemistry. 198, 75-84.

Submitted publications

Silva, A., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C. Pintado, M & Jager, G. Temporal dominance of sensations, emotions and temporal liking measured for two similar wines using a multi-sip approach. *Submitted.*

Silva, A., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C. Pintado, M & Jager, G. Effect of adding Hop aroma in beer – temporal sensory, emotion and liking measurements. *In preparation.*

Thomas, A., Chambault, M., Dreyfuss, L., Gilbert, C. C., Hegyi, A., Henneberg, S., Knippertz, A., Kostyra, E., Kremer, S., **Silva, A. P.**, Schlich, P. Measuring temporal liking simultaneously to Temporal Dominance of Sensations in several intakes. An application to Gouda cheeses in 6 Europeans countries. *Submitted*.

Abstracts and oral presentations

Silva, A., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C. Pintado, M & Jager, G. Temporal dominance of sensations, emotions and temporal liking measured for two similar wines using a multi-sip approach. 58th Meeting of European Sensory Network, Windsor, UK, April 2017. *Oral Presentation*.

Silva, A., Jager, G., Voss, H.-P., van Zyl, H., Hogg, T., Pintado, M., & de Graaf, C. Drinking a beer in a bar. The role of expectations in liking and emotions. 7th European Conference of European Conference on Sensory and Consumer Research. Dijon, France, September 2016. *Oral Presentation.*

Silva, A., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. How product name influences liking and emotions when drinking beer or non-alcoholic beer. British Feeding and Drinking Group Conference. London, UK, April 2016. *Oral Presentation.*

Silva, A., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. Functional or emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer. 6th European Conference of European Conference on Sensory and Consumer Research, Copenhagen, Denmark, September 2016. *Poster Presentation*.

Silva, A., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. Functional or emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer. XV Congresso de Nutrição e Alimentação. Porto, Portugal, May 2016. *Poster Presentation*.

Silva, A., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. Functional or emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer. 11th Pangborn Sensory Science Symposium, Gothenburg, Sweden, August 2015. *Poster Presentation*.

Silva, A., Jager, G., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. Comparing two methods to measure emotions elicited by beer, wine and non-alcoholic beer. British Feeding and Drinking Group Conference, Wageningen, the Netherlands, April 2015. *Poster Presentation*.

Silva, A., Jager, G., van Zyl, H., Voss, H.-P., Hogg, T., Pintado, M., & de Graaf, C. Emotions and consumption behaviour. Workshop ´Changing consumer behaviour to promote healthier and more sustainable diets´. College of Biotecnhology Catholic University, Porto, Portugal, January 2015. *Oral Presentation*.

Silva A., Jager G., van Bommel R., van Zyl H., Voss H-P, Pintado M., Hogg T., de Graaf K. Emotional and functional conceptualisations for beer, wine and non-alcoholic beer consumption in The Netherlands and in Portugal. British Feeding and Drinking Group Conference, Portsmouth, UK, April 2014. *Oral Presentation*.

Silva A., Figueiredo I, Hogg T, Sottomayor M. Young adults and wine consumption: perceptions, attitudes and behaviour. XVI Oenometric Congress of Vineyard Data Quantification Society. Namur, Belgium, May 2009. *Oral Presentation*.

Silva A., Franco, M., Freitas MQ., Monteiro, MJ, Cissé, M., Pallet, D., Bennette, B. Tomlins, K., Pintado M., M. Sottomayor. Acceptability Factors for a traditional African bissap juice in European Context. EFFoST, Montpellier, France, 2012. *Poster Presentation*.

Overview of completed training activities

Discipline specific courses and activities	Organizer and Location	Year
Sensory perception and food preference	Wageningen University, NL	2013
Workshop ´Understanding Senior Consumer Perception- Behaviour- Needs´	European Sensory Network, Valencia, Spain	2013
Annual Meetings British Feeding and Drinking Group	British Feeding and Drinking Group, Portsmouth, UK, Wageningen University, NL, University of Roehampton, London, UK	2014-2016
Sensory evaluation and food preferences	Copenhagen University, Denmark	2014
6th and 7th Eurosense: European Conference on Sensory and Consumer Research	Elsevier, Denmark, France	2014, 2016
Seminar ´Innovative solutions in sensory and consumer science: practical applications´	Campden BRI and European Sensory Network, Hungary	2014
Master Class ´Psychology of health and environmental behaviour. Priming´	Wageningen School of Social Sciences, NL	2015
Symposium 'Decision-making in the food domain: from brain to behaviour change'	Nutritional Neuroscience Lab, UMC Utrecht, NL	2015
Workshop ´Changing consumer behaviour to promote healthier and more sustainable diets´	Universidade Católica Portuguesa, Porto, Portugal	2015
Workshop ´Wellbeing´	European Sensory Network, Napoli, Italy	2015
11th Pangborn Sensory Science Symposium	Elsevier, Gothenburg, Sweden	2015
XV Congresso de Nutrição e Alimentação	Associação Portuguesa de Nutricionistas, Porto, Portugal	2016
General courses and activities	**Organizer and Location**	**Year**
Basic Statistics	Graduate School PE&RC, Wageningen, NL	2013
Data analysis: Temporal Drivers of Liking	INRA, Dijon, France	2014
Techniques for writing and presenting a scientific paper	Wageningen Graduate School (WGS), NL	2014
Multivariate analysis for food data/scientists	Graduate School VLAG, Wageningen, NL	2014
Course Interpersonal Communication for PhD candidates	WGS, Wageningen, NL	2015
Presenting with impact	WGS, Wageningen, NL	2016
Reviewing a scientific paper	WGS, Wageningen, NL	2016
Optional courses and activities	**Organizer and Location**	**Year**
Meetings of European Sensory Network	European Sensory Network, Germany, Spain, Norway, Hungary, Italy, Iceland, Austria, NL	2013-2016
Meeting of the European Project ´AFTER´	Universidade Católica Portuguesa, Porto, Portugal	2014
Master course of ´Psychology of Food Choice´	Wageningen University, NL	2013
Meetings of the sensory science & eating behaviour group	Human Nutrition Department, Wageningen, NL	2013-2017

Colophon

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