UNIVERSIDAD POLITÉCNICA DE MADRID

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA AGRONÓMICA,
ALIMENTARIA Y DE BIOSISTEMAS

CONSUMERS' EMOTIONAL RESPONSE EVOKED BY LOW ALCOHOLIC
BEVERAGES: A METHODOLOGICAL APPROACH

TESIS DOCTORAL

MARÍA MORA GIJÓN

Licenciada en Ciencia y Tecnología de los Alimentos

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EMPRESAS

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SUMMARY

The study of the emotional response triggered by the consumption of foods and beverages has gained significant importance in the last decade. It has been shown that emotions are determinant in the decision-making process, and therefore their study could provide some clues to understand the key drivers of consumers' choices and preferences. This thesis aims at expanding the knowledge related to the emotional response and to the different methodologies used to determine the emotions evoked by wine and beer. To reach this purpose, different studies, grouped in two research areas, have been conducted. On the one hand, the first research area was focused on the study of the relationship of emotions and preferences with intrinsic product characteristics, and extrinsic consumer characteristics such as biological and psychological consumers factors. On the other hand, the second research area aimed at improving and developing methodologies to measure the emotional response elicited by beer and wine consumption.

The material and methods used across the different studies of the present thesis followed a similar structure. A panel of consumers were recruited to measure the emotional response elicited by the consumption of wine or beer samples. The methodology applied to measure the emotional response was based in verbal-self reported questionnaires; sometimes these questionnaires were general lexicons, and other were specific lexicons developed for a specific product category. Depending on the purpose of the study, consumers were characterized according to their extrinsic characteristics: gender, age and/or personality. Finally, data was analyzed using univariate and multivariate statistical methods.

In accordance to the exposed research areas, two main conclusions could be extracted from the present thesis: (1) intrinsic sensory properties of products, and extrinsic consumer factors such as gender, age and personality, affected the emotional response evoked by wines; (2) the new methodological approaches applied in the different studies of this thesis, such as the filtering of emotional terms and the Sorting Task in the development of a specific emotional lexicons, were useful to improve a beer emotional lexicon and to develop a wine emotional lexicon.

RESUMEN

El estudio de la respuesta emocional generada por el consumo de alimentos y bebidas ha adquirido una importancia creciente en la última década. Se ha demostrado la importancia de las emociones en la toma de decisiones y, por lo tanto, su estudio podría proporcionar las claves para encontrar y comprender los factores que determinan las elecciones y preferencias de los consumidores. Esta tesis tiene como objetivo ampliar el conocimiento relacionado con la respuesta emocional evocada por el consumo de alimentos y bebidas, así como mejorar las diferentes metodologías utilizadas para determinar las emociones provocadas por el vino y la cerveza. Para alcanzar este propósito se han realizado diferentes estudios que se agrupan principalmente en dos áreas de investigación. Por un lado, la primera área de investigación se centró en estudiar la relación de las emociones y las preferencias con los factores intrínsecos del producto y con los factores extrínsecos de los consumidores, tanto biológicos como psicológicos. Por otro lado, la segunda área de investigación tuvo como objetivo mejorar y desarrollar metodologías para medir la respuesta emocional desencadenada por el consumo de cerveza y vino.

El material y los métodos utilizados en los diferentes estudios llevados a cabo en la presente tesis siguieron una estructura similar. Se reclutó un panel de consumidores para medir la respuesta emocional provocada por el consumo de muestras de vino o cerveza. La metodología aplicada para medir la respuesta emocional se basó en cuestionarios de léxicos emocionales; siendo en unas ocasiones léxicos generales y, en otras, léxicos específicos. Dependiendo del propósito del estudio, los consumidores se caracterizaron de acuerdo con sus características extrínsecas: género, edad y / o personalidad. Finalmente, los datos se analizaron utilizando métodos estadísticos univariante y multivariante.

De acuerdo con las áreas de investigación expuestas, y los resultados derivados de las mismas se pueden extraer dos conclusiones principalmente: (1) las propiedades sensoriales intrínsecas de los productos, los factores extrínsecos del consumidor tales como el género, la edad y la personalidad del consumidor, afectan a la respuesta emocional evocada por los vinos; (2) las nuevas variantes metodológicas aplicadas a lo largo de la tesis, como el filtrado de los términos emocionales y la aplicación de Sorting Task en el desarrollo de un léxico emocional específico, fueron pasos útiles para mejorar un léxico emocional de la cerveza y para desarrollar un léxico emocional de vino. Ambos léxicos fueron validados con consumidores españoles.

CHAPTER 1. INTRODUCTION

1. GENERAL CONTEXTUALIZATION

Being successful in developing new products depends on fulfilling expectations of consumers' in terms of choices and preferences (Talavera & Chambers IV, 2017). Over 75 % of new products, belonging to food and beverages categories, fail during the first year after being launched to the market (Kemp, Hollowood, & Hort, 2011). Therefore, industry needs to improve its strategies to gain a better understanding of consumer' preferences and choices.

Sensory science helps understanding consumers' perception of a product by studying its properties and the interaction with the human senses. In other words, to study the sensory attributes of products and consumers' preferences is essential for industry to find the key drivers for the optimal design and development of products (Lawless & Heymann, 2010). Measuring the hedonic response elicited by a product is an appropriate method to determine the product acceptance, and therefore it is used across scientific studies to define consumer preferences and potential success. Also, other studies related hedonic response with the sensory and also physico-chemical properties of the product; this information has been useful to obtain further information about the specific sensory characteristics which drives consumers' liking. However, it has been argued that the hedonic response itself is not always enough to explain consumers' choice and attitudes to different food products (Gutjar et al., 2013; Ng, Chaya, & Hort, 2013a; Silva, Jager, Voss, et al., 2017). For example, Ng et al. (2013), in their study about blackcurrant squashes, showed that although hedonic scores were similar among products, emotions were able to discriminate among them. Also, the results showed that there was a link between the emotions and the sensory properties of the products.

One of the aspects which has been explored to differentiate consumers' responses towards food product consumption and choice, beyond liking, has been the emotional response. Damasio (2006) showed that the decision-making process is completely influenced by the role of emotions. His work in the field of neuroscience showed that the emotions were not independent of rationality, both are inseparably and are interlinked in the decision-making process (Damasio, 2006). Emotions have been found to affect eating behavior and different aspects of a product: appearance, flavor, presentation, packaging, and/or consumption context, have an influence on the emotional response (Edwards, Hartwell, & Brown, 2013; Ferrarini et al., 2010; Gutjar et al., 2013; Ng, Chaya, & Hort, 2013b; Torrico et al., 2018). Thus, a deep knowledge about how to measure and understand emotions might be one of the clues to understand

which of the extrinsic and/or intrinsic sensory properties are key drivers of preferences, providing a competitive advantage in the marketplace to industry (M. Ng & Hort, 2015).

Although emotions evoked by food products have been studied from the point of view of their influence in the consumers preferences and choices (Cardello et al., 2012; King & Meiselman, 2010; Laros & Steenkamp, 2005; Ng et al., 2013a; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014) some aspects are still uncertain, such as the role of the emotions in the food choice (Köster & Mojet, 2018). Food choice might seem a simple decision, but it is a complicated process influenced by many interacting factors which aims to explain the question “*why does who eat what, when, and where?*” (Köster, 2009). In the Food Choice Model proposed by Köster & Mojet (2018) emotions are one of the aspects included in the psychological factors together with memory, product expectations, influence of repeated exposure, and also personality (Köster & Mojet, 2018). Emotional response could be influenced by other aspects not directly related with the psychological ones: intrinsic product characteristics, biological and physiological factors such as the age or gender, situational factors, socio-cultural factors and extrinsic product characteristics, as packaging or brand, might modify the emotional response elicited by products, and therefore consumers’ food choice (Köster, 2009).

When looking at the relationship between beverages and emotional response, wine has been shown to be a product highly associated with emotions and also with cultural aspects, mainly in the Mediterranean region (van Zyl, 2016). In the same way, beer has been part of the socio-cultural heritage of central and northern Europe (Nelson, 2005). In the last years, the wine and the beer industry have become more competitive due to the modification of regional drinking patterns (Smith & Mitry, 2007). Because of the globalization, economic changes, and the development of common trade areas, national and drinking cultural borders have become blurry and, as a result, consumer preferences seem to be less driven by the regional traditions (Campbell & Guibert, 2006). To be competitive, wine and beer industry need to implement new strategies to ensure that production of wines and beers are aligned with consumers’ preferences and liking. Studying emotions elicited by wine and beer could be useful for these industries to understand how to differentiate their products through marketing strategies or through the development of new products with specific sensory properties which elicit targeted emotions.

2. SENSORY AND PHYSICO-CHEMICAL PROPERTIES AND HEDONIC RESPONSE

Consumer sensory evaluation has been developed to study consumer preferences in the context of their reaction to a variety of sensory stimuli. The success of a product is determined by the study of consumers' preferences and expectations. Consumer studies are generally conducted on blind conditions with unbranded and coded products, without showing their extrinsic characteristics to understand whether the consumers like one product over another product, or even to investigate which sensory characteristic drives consumers' preference. Although factors such as brand, price, and packaging have an impact on the consumers' preferences, the sensory properties of products need to be accepted to be successful in the marketplace (Lawless & Heymann, 2010).

Different methods have been developed to measure acceptability. The most commonly used have traditionally been the measurement of preference, and the measurement of acceptance (Jellinek, 1964). In preference tests, consumers are requested to rank samples from the most preferred to the least preferred. In the measurement of acceptance, the consumers are asked to rate their liking for the product using a scale. The 9-point hedonic scale is the most used scale ranging from dislike extremely to like extremely (Lawless & Heymann, 2010).

Because of the competitiveness of wine and beer markets, different studies have aimed to find out the relationship among acceptance, sensory properties and physico-chemical compounds. To develop this type of studies, several procedures have been applied which usually include the selection of a representative set of products, evaluation of samples by a sensory descriptive panel, evaluation of samples by different laboratory methodologies, the assessment of consumers' liking, and finally the study of the relationship between the different sensory and physico-chemical parameters with liking (Francis & Williamson, 2015; Frøst & Noble, 2002; Lattey, Bramley, & Francis, 2010; Lund et al., 2009).

Wine literature includes different studies which have investigated the sensory attributes positively and negatively correlated with liking. For example, Frøst & Noble (2002) showed that vanilla, oak, berry and canned vegetables flavors liked significantly more than leather flavors in red wines. Latest studies showed the influence of different sensory properties on consumers liking, identifying different consumers' clusters whose liking was driven by different sensory attributes. Lund et al. (2009) studied consumer preferences on a sample set of ten Sauvignon Blanc wines in 109 consumers. Consumers were grouped into two clusters, one of them presented a positive relationship between liking and sensory attributes such as fruity, capsicum and asparagus flavors, whereas preferences in cluster two were guided by

mineral and bourbon aromas. Lattey et al. (2010) observed that consumers could be grouped depending on their acceptance with different sensory drivers of preference for Cabernet Sauvignon and Shiraz wines. Key sensory attributes such as red berry, floral, caramel and vanilla aroma, acidity, green flavor and astringency were identified. Francis & Williamson (2015) confirmed the heterogeneous character of consumers in their review, in which they showed different consumers' clusters for different types of wine. Also, they concluded that wines without excessive astringency, oak and green flavor, acidity and bitterness would be more accepted than wines that presented off-flavors such as oxidation, sulfur, and/or cork.

Regarding the study of sensory attributes of beer and consumer preferences, different papers have been published in the last years. Donadini et al. (2016) investigated, in 550 consumers, the flavor preferences of special beers in three different cultures through a conjoint rating experiment. Their results showed that Polish consumers preferred beers with honey, and tropical fruits flavors, Italian consumers liked more beers with honey, and vanilla aromas, and Spanish consumers preferred vanilla and fruity special beers. Schmelzle, Lindemann, & Methner (2013) evaluated the hedonic response of nine non-alcoholic beers by a panel of 166 beer consumers. They showed that liking in non-alcoholic beers was driven by sweetness and light fruity odor. On the contrary, consumers disliked sour and bitter taste, and malty and animal flavor on non-alcoholic beers. From a physico-chemical point of view, Gonzalez Viejo, Fuentes, Torrico, Godbole, & Dunshea (2019) showed that the presence of the chemical compounds 4-ethylguaiacol and trans- β -ionone drove the consumers' acceptance, whereas styrene was negatively related to consumers liking.

Although hedonic response has been a useful method to predict liking, it is not enough knowledge for the companies to get their products well positioned in the marketplace (Herbert L. Meiselman, 2013). Certainly, the product characterization in terms of sensory properties and liking provides insights about the product differentiation. However, going beyond product characteristic and liking, would facilitate getting other insights about the product performance, the experience, and the value perceived by consumers (Thomson, 2010).

3. EMOTIONS

3.1. Definition

Authors such as King & Meiselman (2010) have described “emotion” as “brief, intense and often focused on a referent” response to a stimulus; Sander (2013) described it as an “event focused, two-step, fast process consisting of 1) relevance-based emotion elicitation mechanism that 2) shape a multiple emotional response”. From a neurophysiology point of view, Damasio (2004) described it such as “bioregulatory reactions that aim at promoting, directly or indirectly, the sort of physiological states that secure not just survival, but survival regulated into the range that humans, conscious and thinking creatures, identify with well-being”. Coppin & Sander (2016) proposed that the multicomponent character of emotions and three additional criteria were appropriate to define what an emotion is. The three different criteria suggested were: (1) emotions are two-step processes composed by an emotion elicitation mechanism and a response mechanism, (2) objects or situations are necessary for emotions to occur, and (3) its duration is brief and has a quick onset. Therefore, according to the length, emotions could be distinguished from other affective states whose duration is longer, e.g.: preferences (liking/disliking), attitudes (predisposition toward specific products) or moods (low intensity and long duration feelings) (Coppin & Sander, 2016).

To understand what an emotion is, and to propose methods to quantify them, it is important to know the different aspects that are part of it. The multicomponent character of emotions is composed by five emotional aspects: the expression, the action tendency, the bodily reaction, the appraisal, and the feeling. Each aspect has an emotional function and also has an impact on different body systems: central nervous system, neuro-endocrine system, autonomic nervous system, and somatic nervous system (Table 1) (Scherer, 2005).

Table 1. Relationships between the components of the emotion, the functions, and the organismic subsystems (Scherer, 2005)

Emotion component	Emotion function	Organismic subsystem and major substrata
Motor expression component (facial and vocal expression)	Communication of reaction and behavioral intention	Action (SNS)
Motivational component (action tendencies)	Preparation and direction of action	Executive (CNS)
Neurophysiological component (bodily symptoms)	System regulation	Support (CNS, NES, ANS)

Table 1. Continuation

Emotion component	Emotion function	Organismic subsystem and major substrata
Cognitive component (appraisal)	Evaluation of objects and events	Information processing (CNS)
Subjective feeling component (emotional experience)	Monitoring of internal state and organism-environment interaction	Monitor (CNS)

Note: CNS = central nervous system; NES = neuro-endocrine system; ANS = autonomic nervous system; SNS = somatic nervous system.

Darwin & Ekman (1872) illustrated the existing relationship between body expression signals and emotions in humans as an adaptive function to deal with different events and survive. From the point of view of the affective psychology, the skeletal motor system is a complex communicative modality that plays an important role in expressing and perceiving emotions (Dael, Mortillaro, & Scherer, 2012). The body expressions that have been found to be related with emotions were: facial expressions, vocal expressions, body actions and postures (P Ekman & Friesen, 1967), but the facial expressions have been the most studied ones. One of the main contributions of Darwin & Ekman (1872) was the description of facial expressions as innate and universal; this universality allows us to recognize them across different cultures and even animal species.

The motivational component of the emotion prepares the individual to act with a specific purpose. In other words, people could tend to feel attracted to something perceived as beneficial or good for them or tend to feel aversion to something perceived as bad for them (Arnold, 1960). Although action tendencies (e.g.: approach, avoidance, domination, submission, etc.) depend on the emotion felt by the individual, approach and avoidance have been the most studied ones (e.g.: Carver, Sutton, & Scheier, 2000; Elliot, Eder, & Harmon-Jones, 2013; Field, Caren, Fernie, & De Houwer, 2011).

Other emotional aspect involved in the emotional response which have been studied are bodily reactions such as: heart rate, blood pressure, skin conductance, temperature, etc. (Quigley, Lindquist, & Barrett, 2014). All these physiological reactions result from changes in the autonomic nervous system (ANS), central nervous system (CNS) and neuro-endocrine system (NES). Coppin & Sander (2016) indicated that bodily reactions or physiological changes supported specific responses for the expression of emotions and the production of action tendencies.

The appraisal is a component of the emotional response that refers to the cognitive process of eliciting emotions (Lazarus & Folkman, 1984). Arnold (1960) stated that, to evoke an emotion, an event must be appraised as something that affects the individual, considering his experience and his aims. In general, the different theories to define emotions and appraisal have contributed to understand the mechanisms that lead the generation and the differentiation of emotions (Coppin & Sander, 2016).

The feeling is the last component of the emotion. According to Porcherot, Delplanque, Ferdenzi, Gaudreau, & Cayeux, (2016) “feelings have a special status, as they integrate all of the other components, provide access to consciousness, and allow interpersonal communication of emotional experiences”. However, in the context of the emotional studies, and in the everyday language, the term emotion often substitutes the term feeling (Porcherot et al., 2016; Spinelli & Monteleone, 2018). This confusion has also been extended to the field of emotions/psychology, where some theories related to emotions belong to feelings (Scherer, 2005). Different models have been published in the literature using different dimensions to describe feelings. The most extended one is the circumplex model of emotions proposed by Russel (1980). This model, which has also been used to explain emotions, represents feelings along two principal bipolar dimensions using a circle with two axes: valence and arousal. The valence is the degree of pleasantness/unpleasantness and the arousal is described by states of alertness/sleepiness. In other models, the arousal dimension has been renamed as the activation dimension (Larsen & Diener, 1992), or engagement/disengagement dimension (Watson & Tellegen, 1985) (Figure 1). In addition, this model has been linked with the core affect (Yik, Russell, & Steiger, 2011). The core affect “refer to the most elementary consciously accessible affective feelings (and their neurophysiological counterparts) that need not be directed at anything” (Russell & Barrett, 1999). Different from emotions, core affects are not necessarily directed or caused by anything, it can be referred to moods or be directed by some event as feelings. The core affect has been considered as important concept that could help to clarify how categories of moods and emotions are interrelated. Yik et al. (2011) developed a 12-Point circumplex model of core affects that integrated the main dimensional models of mood and emotion.

Figure 1. Four descriptive models of affect within a two-dimensional space (Coppin & Sander, 2016)

3.2. Methodologies to measure the emotional response

Some authors have used the multicomponent character of emotions as a starting point to define which methodologies are suitable to measure them (Mauss & Robinson, 2009; Scherer, 2005). Scherer (2005) argued that there is no single gold-standard method for emotional measurement, and only by assessing all components of the emotional response, a comprehensive measure of an emotion could be obtained. Therefore, in an ideal situation, different parameters should be studied: (1) fluctuations in facial and vocal expression and body movements, (2) changes produced in the action tendencies, (3) the bodily reactions generated in the neuroendocrine, autonomic, and somatic nervous systems, (4) variations in appraisal processes in the central nervous system, and (5) the subjective feelings (Scherer, 2005). Table 2 describes the different methods proposed in the literature to measure each emotional component.

Table 2. Emotional components and its measurement

Emotion component		Measurement methodologies
Expression	Face	Facial Action Coding System (FACS) Electromyography (EMG) Automated facial image analysis Thermal analysis of facial muscle contractions
	Voice	Amplitude Frequency
Action tendencies	Explicit	Push and pull reactions (cards, joysticks) Self-reports of action tendencies
	Implicit	Frontal asymmetry by Electroencephalography (EEG) Electromyography (EMG)
Bodily reactions	Autonomous Nervous System (ANS)	Cardiovascular measures (e.g.: heart rate) Electrodermal measures (e.g.: skin conductance) Respiratory activity Pupil diameter
	Subjective perception	“emBODY tool”: consumers color regions whose activity becomes stronger
Appraisal	Explicit	Self-reported questionnaires
	Implicit	Facial expressions Voice Physiological measures (ANS) Brain-imaging methodologies
Feelings	Explicit	Self-reported: verbal or non-verbal measures
	Implicit	Physiological measures (ANS) (e.g.: skin resistance) Brain-imaging methodologies

All the methodologies exposed in Table 2 can be categorized into four main approaches: (1) changes in behavior through facial expression (2) other physiological measures, (3) brain activity, and (4) self-report measures. The following sections describe and exemplify these approaches whilst detailing the emotion components that are addressed by each of them.

3.2.1. Changes in behavior through facial expression

Assuming the emotional estate of the individual by studying his/her actions, gestures body expression and voice is possible. Changes in behavior (e.g.: facial movement, mastication, etc.) are a consequence of voluntary mechanisms and emotional control. That means that the facial muscles spontaneously contract following different characteristics patterns related to the elicited emotions (Lapatki, Stegeman, & Jonas, 2003). Etcoff & Magee, (1992) concluded that, in some cases, facial expression could provide a

more effective communication of emotions than verbal expression. Up to date, the following methods have been used to measure the implicit reactions related to the facial expression:

- Facial Action Coding System (FACS) is a method that aims to recognize the muscle movements involved in facial expression (Paul Ekman & Friesen, 1971). This method requires a long introduction for learning and using it, but is a method that is not dependent of a particular theory of emotions (Coppin & Sander, 2016).
- Electromyography (EMG) measures the electrical activity associated with the activation of specific facial muscle groups. It is a powerful method that can measure muscular activity even when it is not perceptible by the human eyes. The most commonly measure muscles are the zygomatic (corner of the lips) and the corrugator (brow furrowing) (Coppin & Sander, 2016).
- Software packages: Noduls FaceReader; this software reconstructs the face three-dimensionally, based on 491 model points, allowing a robust and reliable measurement of seven facial reaction patterns, representing six basic emotion patterns (“angry”, “happy”, “disgusted”, “sad”, “scared”, “surprised”) and “neutral”.
- Thermal analysis of facial muscle contractions. This is a method that uses thermal imaging to discriminate specific facial temperature patterns related to muscle contractions (Jarlier et al., 2011).

In addition, different aspects could be measured to detect variations in the emotional response associated to voice characteristics. Specifically, differences in the emotional state of the individual can be recognized by variations in melody, intonations, pauses, stresses, and accents of speech (Van den Stock, Righart, & de Gelder, 2007).

3.2.2. Other physiological measures

The neurophysiological components of emotions are reactions resulting from changes in the autonomic nervous system (ANS), central nervous system (CNS) and neuro-endocrine system (NES). The most commonly used indicators used in the literature are (Coppin & Sander, 2016):

- Cardiovascular parameters: heart rate, heart rate variability, systolic and diastolic blood pressure, preejection period, total peripheral resistance.
- Electrodermal parameters: skin conductance level, skin conductance responses.
- Respiratory activity

- Pupil diameter

The major deal of these physiological measures is that they reflect variations in arousal, and in some cases it is necessary to combine some physiological measures to detect differences in the arousal level. Also, the interpretation of changes on physiological measures are difficult to interpret and require additional information. Some of these physiological measures, that allow measuring unconscious emotions, can be cheaper than methods such as brain imaging or face reading, (Coppin & Sander, 2016).

3.2.3. Brain activity

Changes in brain activity could be associated to motivational changes produced by appraisal and also by the action tendencies.

Electroencephalography (EEG) is an electrophysiological technique suitable for the recording of electrical activity of the human brain. It is a system with a high temporal sensitivity, and therefore allows the evaluation of dynamic cerebral functioning (Britton et al., 2016). The frequency and amplitude of waves are related to different brain activities and can be related to emotion. For example, higher regularity of the rhythm of frontal alpha-waves is associated with positive mood (Kaneda, Kojima, & Watari, 2011). Nevertheless, the major problem of the EEG is the limitation in spatial resolution, and the needs of training for recording, analyzing and interpreting the resulting encephalogram.

Magnetoencephalography (MEG) offers higher spatial resolution than EEG as it measures magnetic, as opposed to electric, fields which are less distorted by living tissue. The combination of high spatial and temporal resolution is ideal for the study of emotion. However, the method is expensive as it requires a very low noise environment or magnetic shielding.

Functional magnetic resonance imaging (fMRI) is an advantageous methodology that allows studying the neural activation in the whole brain. However, although fMRI is a method with a good spatial resolution, it has several limitations in terms of spatiotemporal resolution (Kragel & LaBar, 2016). In a food and beverage context, fMRI has practical issues as it is difficult to present consumers with samples due to the participants being in a confined space.

3.2.4. Self-report measures

Self-report measures are methodologies easier to use, cheaper, and no complex instrument and programs are required to collect and analyze the data (M. Ng & Hort, 2015). This kind of measures requires consumers to consciously select their emotional response to a stimulus, so they can be used in experiments where participants are in a real, evoked or recalled emotion elicitation situation (Coppin & Sander, 2016). Self-reported measures could be used to collect data from different emotional aspects. In this way, specific emotions components from the appraisal, action tendencies and subjective feeling can be assessed. Self-report measures can be either verbal or non-verbal.

3.2.4.1. Non-verbal self-report measures

Non-verbal self-report measures avoid the necessity for language, allowing for potential cross-cultural application. Following the theory of basic emotions, Darwin & Ekman (1872) exposed that facial expressions allows to be recognized across different cultures and animals. Considering the universality of facial expressions, different methods for measuring the emotional response elicited by food products, and which avoid cultural differences, have been developed (e.g.: using PrEmo pictures).

The first instrument developed to be used in the assessment of the emotional response evoked by an object or event was the Self-Assessment Manikin (SAM) (Bradley & Lang, 1994). The SAM is a non-verbal pictorial assessment technique that directly measures the valence and arousal associated with a person's affective reaction to emotional stimuli. The Figure 2 shows the SAM method where the top panel is used to rate the affective dimensions of valence, the middle panel to rate arousal and the bottom panel to measure dominance.

Figure 2. Self-Assessment Manikin methodology (Bradley & Lang, 1994).

Later, Desmet (2003) developed the PrEmo tool (Figure 3). PrEmo is a non-verbal self-report instrument that measures 14 emotions. The 14 emotions are represented non-verbally as expressive cartoon animations with dynamic facial, bodily and vocal expressions and could be classified into pleasant and unpleasant emotions. Specifically, seven of them are pleasant emotions (i.e. desire, pleasant surprise, inspiration, amusement, admiration, satisfaction, fascination), and seven are unpleasant (i.e. indignation, contempt, disgust, unpleasant surprise, dissatisfaction, disappointment, and boredom) (Desmet, 2003).

Figure 3. Inspiration and disgust pictures from PrEmo tool (Desmet, 2003).

Not related to the emotional measurement, but following the same procedure, Churchill & Behan (2010) developed the Mood Portraits. The method includes a visual library of pictures representing moods; consumers are asked to select up to five pictures sample that represents the mood experience they have perceived when exposed to a given stimulus (Churchill & Behan, 2010).

3.2.4.2. Verbal self-report measures

Verbal self-reported measures are methods that imply the use of lists of emotional words to assess the feelings triggered by an event or stimulus. Emotion questionnaires used in food product research usually consist on a list of feelings that could vary in the length and in the nature of used words. This variation depends on the specificity of the lexicon, the product assessed and the consumers' culture.

Historically, some questionnaires have been developed to measure emotional response in the clinical field of psychological research. Maybe the most used are the Multiple Affect Adjective Check List (MAACL) (Zuckerman & Lubin, 1985), the Positive and Negative Affect Scale (PANAS) (Watson, Clark, & Tellegen, 1988), and the Profile Mood States (POMS) (McNair, Lorr, & Droppleman, 1971). However, the psychological lexicons developed for clinical purposes, are not useful to measure the subjective feelings elicited by the consumption of food products. One of the major issues is related to food emotions asymmetry, which postulated that food elicits more positive than negative emotions (Lagast, Gellynck, Schouteten, De Herdt, & De Steur, 2017). Due to the interest of food industry in identifying the critical

drivers of consumer choice and consumption behaviors, the number of emotional questionnaires has grown rapidly during last years.

In the sensory science literature, different generic or product-specific emotional lexicons have been developed to verbally assess elicited emotions when food and beverages are consumed (Table 3 and 4).

Table 3. Overview of generic emotional lexicons in the sensory science literature.

Reference	Instrument	Category	Number of terms	Consumers nationality
Chrea et al. (2009)	GEOS	Smells	36	French (Switzerland)
King & Meiselman (2010)	EsSense	Food products	39	English (EEUU)
Ferdenzi et al. (2011)	LEOS	Smells	37	English (UK)
Ferdenzi et al. (2011)	SEOS	Smells	36	English (Singapore)
Yik et al. (2011)	12-point emotion circumplex structure	Food products	12 points	Non defined
Ferdenzi et al. (2013)	BEOS	Smells	37	Chinese (China)
Ferdenzi et al. (2013)	CEOS	Smells	33	Portuguese (Brazil)
Ferdenzi et al. (2013)	DEOS	Smells	37	English (EEUU)
Ferdenzi et al. (2013)	FEOS	Smells	37	English (EEUU)
Ferdenzi et al. (2013)	UniGEOS	Smells	25	English, French, Chinese and Portuguese
Thomson & Crocker (2013)	Lexicon	Food products	59	English, French, German and Italian
Gmuer, Guth, Runte, & Siegrist (2015)	Lexicon	Food products	49	German
Dorado, Pérez-Hugalde, Picard, & Chaya (2016)	EsSense	Food products	39	Spanish (Spain)
Nestrud, Meiselman, King, Leshner, & Cardello (2016)	EsSense25	Food products	25	English (EEUU)

The first generic emotional lexicon developed was the Geneva Emotion and Odor Scale (GEOS) to help differentiating feelings related to aromas exposure (Chrea et al., 2009). After its publication, the GEOS lexicon was translated into other languages: English from different regions, Chinese and Portuguese (Ferdenzi et al., 2013, 2011). Later on, King & Meiselman (2010) developed the EsSense Profile™, which was composed by a list of 39 emotions associated with products' consumption. Six years later, Nestrud et al. (2016) published a shorter version of the EsSense Profile™, the EsSense25, shorter, but with the same discrimination ability than the previous one. With the same purpose of assessing emotional response triggered from food products, Thomson & Crocker (2013) developed a generic lexicon of feelings suitable to be applied in four different languages: English, French, German and Italian.

Generic lexicons have been demonstrated to be useful methods to discriminate among samples (Dorado, Pérez-Hugalde, et al., 2016; King & Meiselman, 2010; D. M. H. Thomson & Crocker, 2013). However,

when subtle differences want to be detected, specific lexicon are more accurate (Silva, Jager, Van Zyl, et al., 2016). Different authors have published specific emotional lexicons for specific product categories: e.g.: chocolate (Gunaratne et al., 2019; D. Thomson, Crocker, & Marketo, 2010), wine (Danner et al., 2016; Ferrarini et al., 2010; Silva, Jager, van Bommel, et al., 2016) blackcurrant squashes (Ng et al., 2013a), fruit salads (Manzocco, Rumignani, & Lagazio, 2013), chocolate and hazelnut spreads (Spinelli et al., 2014), coffee (Bhumiratana, Adhikari, & Chambers, 2014; Hu & Lee, 2019) and beer (Chaya et al., 2015; Eaton, Chaya, Smart, & Hort, 2019).

Table 4. Overview of specific emotional lexicons in the sensory science literature.

Reference	Instrument	Product	Number of terms	Language
Ferrarini et al. (2010)	Lexicon	Wine	16	Italian (Italy)
Porcherot et al. (2010)	GEOS modified	Perfumery and cosmetics	18	French (Switzerland)
Thomson et al. (2010)	Lexicon	Dark chocolate	24	English (UK)
Manzocco et al. (2013)	Lexicon	Fruit salad	29	Italian (Italy)
Ng et al. (2013a)	Lexicon	Blueberries	36	English (UK)
		concentrated juice		
Bhumiratana et al. (2014)	Coffee Drinking Experience	Coffee	44	English (EEUU)
Spinelli et al. (2014)	EmoSemio	cocoa and hazelnuts cream	23 (sentences)	Italian (Italy)
Chaya et al. (2015)	Lexicon	Beer	12 categories	Spanish (Spain)
van Zyl & Meiselman (2015)	Lexicon	Beverages	66	UK, USA, Australia, New Zealand, Spain and Mexico
Danner et al. (2016)	Australian Wine Evoked Emotions Lexicon (AWEEL)	Wine	19	English (Australia)
Silva, Jager, van Bommel, et al. (2016)	Lexicon	Beer Non-Alcoholic Beer (NAB) Wine	Beer and NAB 32 Wine 29	Dutch (Netherlands) Portuguese (Portugal)
Eaton et al. (2019)	Lexicon	Beer	9 categories	English (UK)
Gunaratne et al. (2019)	Lexicon	Chocolate (C) Milk chocolate (MC) Dark chocolate (DC)	C: (W)10 (A)14 MC: (W)25 (A)23 DC: (W)20 (A)18	Western – W (Australia) Asiatic – A (Asia)
Hu & Lee (2018)	Coffee Drinking Experience	Coffee	83 (Chinese) 80 (Korean)	Chinese (China) Korean (Korea)

There are a huge variety of lexicons, but the selection of the right method requires some considerations: 1) the potential of the method to capture differences, 2) the length of the questionnaire, and 3) the culture of the population who developed/used the method. The ability to detect differences among products will be conditioned by the specificity of the lexicon. Even though generic emotional lexicons could be used to measure the emotional response of any food category (King & Meiselman, 2010; Spinelli

et al., 2014; D. M. H. Thomson & Crocker, 2013), the development of specific lexicons could be more suitable to capture subtle differences in feelings or emotions among samples within a certain product category (Ng et al., 2013a; Silva, Jager, van Bommel, et al., 2016; van Zyl & Meiselman, 2015). The length of the questionnaire will affect the time/effort required by the consumer to complete the task of reporting the emotions elicited by a product (Cardello et al., 2016; van Zyl, 2016). Culture might affect the use, the dimension, the meaning of emotional terms, and also the consumers' familiarity to the product (van Zyl & Meiselman, 2015, 2016). Emotional lexicons should be only used by consumers of the culture for which they were designed.

To develop a lexicon, the most commonly applied methodology is composed of four different steps: 1) terms generation, 2) reduction of terms by removing synonyms and irrelevant terms, 3) grouping of terms into categories to reduce the length of the questionnaire (optional step), and 4) validation of the lexicon with consumers of the specific culture. For the first step (terms generation), three principal approaches have been reported in literature, depending on the source of the emotional terms: a) consumer-led approaches, where consumers generate the emotional terms (Bhumiratana et al., 2014; Chaya et al., 2015; Ng et al., 2013a; Silva, Jager, van Bommel, et al., 2016), b) linguistic-based approaches, where specialists or researchers present an existing list of emotions from literature (Ferrarini et al., 2010; Gmuer et al., 2015; King & Meiselman, 2010), and c) a combination of both methods, where consumers generate the emotional terms with the support of terms from the bibliography (Danner et al., 2016; Manzocco et al., 2013; van Zyl & Meiselman, 2015). Once the terms have been generated, the synonyms should be removed from the list. Also, terms should be checked to ensure that they are true emotions or feelings. Van Zyl & Meiselman (2015) proposed the use of published emotional lists of Laros & Steenkamp (2005) and Clore, Ortony, & Foss (1987). Then a panel of consumers must check the relevance of the emotional words for the studied product. In some cases, additional consumer tests are carried out to rate the elicited emotions by several products with different sensory properties using the emotional terms previously developed. Hierarchical Cluster Analysis is often used to group the different emotions into emotional categories (Chaya et al., 2015)(Chaya et al., 2015; Eaton, 2015). Finally, the resulting lexicon must be validated to confirm its ability to measure the emotional response evoked by the specific product.

Although questionnaires are a limited method that only shows the subjective feelings perceived by the individual, and also not everyone has the ability of accurately report his/her feelings, the use of

questionnaires to measure the emotional response is one of the most suitable methods, and better if combined with other measures.

3.3. Emotions and beverages

Due to changes in the consumption drinking patterns and the boom of the wine and beer industries around the world, the industry has been demanding new strategies to stay in the market and increase competitiveness. Nowadays, product differentiation is the most used tool, but wine and beer are not easy products to differentiate in terms of intrinsic characteristics. However, differentiation could be focusing, rather than in the functional or technical benefits, in the perceived benefits through the emotional response (Barrena & Sanchez, 2009; Silva, Jager, van Bommel, et al., 2016).

On the one hand, the study of the emotional response in beverages have demonstrated to be an important factor because of, in most cultures, beverages have been proven to reduce negative feelings (van Zyl & Meiselman, 2016). Van Zyl & Meiselman (2016) found that for UK, USA, Australia, New Zealand, Spain, Mexico, Portugal and Brazil consumers, their favorite beverage reduced the negative feelings. On the other hand, to ensure success in the market, the expectations and reality of the product should be aligned as much as possible; in this sense, the development of products that perfectly fit their emotional benefit as announced in their advertising, as promoted with brand and packaging could be a suitable strategy (Ng et al., 2013b).

Another strategy is the study of the relationship between sensory properties and emotional response. Ferrarini et al. (2010) proposed characterizing wines by making associations between sensory and emotional profiles to improve the products' position in the market. Also, Silva (2017) studied the relationship between the emotional responses elicited by two wines and their respective sensory properties. Both, Ferrarini et al. (2010) and Silva (2017) suggested that products with similar sensory properties evoked similar emotions in consumers.

Wine and self-reported emotional response has been widely studied across literature (Table 5). The culture has a huge impact on the emotional response. In that sense, several lexicons for wine have been developed for different languages and cultures. The first wine lexicon was developed for Italian consumers (Ferrarini et al., 2010). It was composed by 16 adjectives to describe the emotions and feelings elicited by the consumption of wine. The final terms selected could be divided into two categories: high/low arousal and high/low pleasantness. Also, most of the 16 terms were classified as positive

emotions. Years later, Silva, Jager, van Bommel, et al. (2016) carried out a qualitative study to identify the functional and emotional properties of beverages such as wine, beer and non-alcoholic beer. With the information obtained in the focus groups session, the authors developed emotional lexicons to measure the emotional response to wine, beer and non-alcoholic beer for Dutch and Portuguese consumers. Results from the focus group revealed that wine was associated with positive low arousal emotional responses, as calm and loving. The other specific lexicon developed for wine consumption was the Australian Wine Evoked Emotions Lexicon (AWEEL) (Danner et al., 2016). The AWEEL was composed by a set of 19 emotions, 11 of them with positive valence, and 8 with negative valence.

Table 5. Summary of the studies related to the self-reported emotional response evoked by the consumption of wines.

Methodology	Paper	Authors
Development of a self-reported questionnaire	The emotional response to wine consumption	Ferranini et al. (2010)
focus groups to study functional and emotional properties of Wine, Beer and Non-alcoholic beer	Functional or emotional? How Dutch and Portuguese conceptualize beer, wine and non-alcoholic beer consumption	Silva, Jager, van Bommel, et al. (2016)
Australian Wine Evoked Emotions Lexicon (AWEEL)	Context and wine quality effects on consumers' mood, emotions, liking and willingness to pay for Australian Shiraz wines	Danner et al. (2016)
Australian Wine Evoked Emotions Lexicon (AWEEL)	Effects of immersive context and wine flavor on consumer wine flavor perception and elicited emotions	Jiang, Niimi, Ristic, & Bastian (2016)
Australian Wine Evoked Emotions Lexicon (AWEEL)	"I like the sound of that!" Wine descriptions influence consumers' expectations, liking, emotions and willingness to pay for Australian white wines	Danner, Johnson, Ristic, Meiselman, & Bastian (2017)
Australian Wine Evoked Emotions Lexicon (AWEEL)	Wine consumers' subjective responses to wine mouthfeel and understanding of wine body	Niimi, Danner, Li, Bossan, & Bastian (2017)
Lexicon based on Silva et al., 2016	Temporal dominance of sensations, emotions, and temporal liking measured in a bar for two similar wines using a multi-sip approach	Silva et al. (2018)
ScentMove™	Wine-related aromas for different seasons and occasions: Hedonic and emotional responses of wine consumers from Australia, UK and USA	Ristic et al. (2019)
PANAS scale	Does the product test really make a difference? Evidence from the launch of a new wine	García-Milon, Martínez-Ruiz, Olarte-Pascual, & Pelegrín-Borondo (2019)
Lexicon adapted from Ferrarini et al., 2010	The influence of consumer involvement in wine consumption-elicited emotions	Calvo-Porrá, Ruiz-Vega, & Lévy-Mangin (2019)

Concerning the study of emotional response to beer, different authors have published different lexicons and methods to analyze the emotions elicited by beers (Table 6). Chaya et al. (2015) developed the first published beer specific lexicon for the Spanish population, using consumers' focus groups methodology. Finally, they grouped the resulting lexicon of 44 single terms into 12 emotional categories. Using the

same approach, Eaton (2015) established an English version for British beer consumers. In an attempt to measure the efficiency of clustering emotions by cluster analysis, Eaton et al. (2019) compared a full version of a beer lexicon for British consumers with the reduced version. The reduced version proved to be the best option to measure the emotional response. Dorado, Chaya, Tarrega, & Hort (2016), Beyts et al. (2017), Yang, Dorado, Chaya, & Hort (2018) and Nijman et al. (2019) applied the reduced version to study the emotional response elicited by beers in British consumers. Silva, Jager, van Bommel, et al. (2016) also developed two beer consumer led lexicons for Dutch and Portuguese consumers using a focus group methodology. Cardello et al. (2016), Jaeger, Cardello, Chheang, et al. (2017), Jaeger, Cardello, Jin, et al. (2017) and Jaeger et al. (2019) applied a variant of the 12-point emotion circumplex method of Yik et al. (2011) to reduce the time/effort to capture emotions related to beer. In short, different methods have been developed to measure the emotional response elicited by the beer consumption in different cultures.

In addition, authors have investigated different approaches and methods to facilitate the task when reporting emotions.

Table 6. Summary of the studies related to the self-reported emotional response evoked by the consumption of beer.

Methodology	Study	Authors
Development of a self-reported questionnaire	Developing a reduced consumer-led lexicon to measure emotional response to beer	Chaya et al. (2015)
Development of a self-reported questionnaire	Developing an effective approach to measure emotional response to the sensory properties of beer	Eaton (2015)
Focus groups to study functional and emotional properties of Wine, Beer and Non-alcoholic beer	Functional or emotional? How Dutch and Portuguese conceptualise beer, wine and non-alcoholic beer consumption	Silva, Jager, van Bommel, et al. (2016)
Lexicon proposed by Eaton 2015	The impact of using a written scenario when measuring emotional response to beer	Dorado et al. (2016)
Variation of the 12-point emotion circumplex method (Yik et al., 2011)	Cognitive and emotional differentiators for beer: An exploratory study focusing on “uniqueness”	Cardello et al. (2016)
Lexicon based on Silva et al., 2016	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	Silva et al. (2017)
Lexicon proposed by Eaton 2015	A comparison of self-reported emotional and implicit responses to aromas in beer	Beyts et al. (2017)
Variation of the 12-point emotion circumplex method (Yik et al., 2011)	Product uniqueness: Further exploration and application of a consumer-based methodology	Jaeger, Cardello, Jin, et al. (2017)

Table 6. Continuation

Methodology	Study	Authors
Variation of the 12-point emotion circumplex method (Yik et al., 2011))	Holistic and consumer-centric assessment of beer: A multi-measurement approach	Jaeger, Cardello, Chheang, et al. (2017)
Lexicon proposed by Eaton 2015	The impact of PROP and thermal taster status on the emotional response to beer	Yang et al. (2018)
Development of a self-reported questionnaire	Comparing a full and reduced version of a consumer-led lexicon to measure emotional response to beer	Eaton et al. (2019)
Lexicon proposed by Eaton 2015	The effect of consumption context on consumer hedonics, emotional response and beer choice	Nijman et al. (2019)
Variation of the 12-point emotion circumplex method (Yik et al., 2011)	Supplementing hedonic and sensory consumer research on beer with cognitive and emotional measures, and additional insights via consumer segmentation	Jaeger et al. (2019)

4. FOOD CHOICE AND EMOTIONS

Food choice is a behavior that involves the selection of foods for consumption. This behavior is influenced by many interacting factors. Some authors have defined the interacting factors by seven “W” questions: WHO drinks or eats WHAT, in WHICH combination, WHEN, WHERE, WHY and with WHICH effects (Köster & Mojet, 2018). In that framework, factors such as biology, physiology, and/or psychology are related to the WHO question; the WHAT question is determined by food sensory attributes, perception, economy, and/or expectations; other factors such as sociology, marketing, consumer science, memory and/or psychology are linked with the WHERE, WHEN and WHY questions. In other words, to understand eating and drinking behavior, consumers’ insights, consumer diversity, and complex interactions of the many factors of food choice that range from the sensory, physiological and psychological responses of individual consumers to the interactions between social, environmental and economic influences, should be considered as central themes (Figure 4).

Figure 4. Food choice model, factors that influence eating and drinking behavior and food choice (Köster, 2009)

Food industries demand information about consumer behavior to design products better aligned with their preferences, needs and choices. Studies to measure the effect of other factors more than sensory

properties or liking, have been developed in the last years. For example, the effect of the context on liking (Meiselman, Johnson, Reeve, & Crouch, 2000). Meiselman et al. (2000) showed that the acceptability of meals could vary depending on contextual effects, the expectations they produce, and the combination of both factors, among others. Also, much attention has been focused on the possible influence of emotions triggered by food products over food choice (Gutjar et al., 2015). Gutjar et al. (2015) found that emotions elicited by food products could provide new information, such as the relationship between positive emotions and food choice, suggesting that emotions can contribute with liking in the explanation of choice behavior. Next section presents the updated studies which aim at explaining the interaction of elicited emotions with other food choice factors, such as sensory attributes of food products, consumer gender, consumer age and consumer personality.

4.1. Intrinsic product characteristics and emotions: sensory attributes

Different authors have studied the relationship between sensory properties of food products and emotions (Chaya et al., 2015; Jager et al., 2014; Mojet et al., 2015; Ng et al., 2013a; Silva et al., 2019; D. Thomson et al., 2010). Specifically, Thomson et al. (2010) associated the feelings powerful and energetic with cacao flavor in dark chocolate, Jager et al. (2014) found that the emotion energetic was associated with mint flavor in chocolate, Chaya et al. (2015) discovered that less pleasant emotions were related to sweetness in beers, Mojet et al. (2015) concluded that positive emotions elicited by yogurts were associated to vanilla flavor, and Silva et al. (2019) found positive correlations between herbal flavor and sadness and between citrus flavor and disappointment for beer products.

4.2. Consumers biological factors and emotions: gender and age

Biological aspects of consumers, such as gender and age, have been demonstrated to have an impact on the emotional response.

Different emotional response between male and female consumers have been found in the literature. v King, Meiselman, & Carr (2010) demonstrated that, in general, female consumers rated emotions stronger than male consumers. Similarly, Diener, Sandvik, & Larsen (1985), and Kring & Gordon (1998) reported that women express emotions at a higher level than men. However, it was demonstrated that this pattern was food category dependent. Chaya et al. (2015) showed in their study that beer elicited higher emotion ratings in men than in women for some emotion categories (Classic, Desire, Disappointment, Indifference, Mildness and Nostalgia). Nevertheless, this behavior was reversed for the

category Intensity. Other studies illustrated a similar pattern: men reported higher positive emotions for comfort foods (Dubé, LeBel, & Lu, 2005), meals (Edwards et al., 2013) non-alcoholic wine (Parra, Galmarini, Chirife, & Zamora, 2015) and recalled typical and memorable meals (Piqueras-Fiszman & Jaeger, 2015) than women.

Also, some authors have found age differences: young adults reported more extreme scores across the two dimensions of emotions, valence and arousal, whereas old adults reported more neutral scores, only varying on the valence dimension (den Uijl, Jager, de Graaf, Meiselman, & Kremer, 2016; den Uijl, Jager, Zandstra, de Graaf, & Kremer, 2016; Montepare & Dobish, 2014). In other studies, it has been found that older people reported more positive emotions than younger ones, for example in beers (Chaya et al., 2015), comfort foods (Dubé et al., 2005), and recalling typical and memorable meals (Piqueras-Fiszman & Jaeger, 2015). In a general study carried out by Edwards et al. (2013), young consumers were found to be more exigent about food than older people. In a qualitative study developed by Silva, Figueiredo, Hogg, & Sottomayor (2014) young adults stated that the older they were, the more interested in wine they would be. Similarly, Melo, Colin, Delahunty, Forde, & Cox (2010) reported that age and consumers' drinking lifetime defined wine flavor preferences, increasing wine consumption through consumer's life.

4.3. Consumers psychological factors and emotions: personality

Emotions play an important role in the decision-making process (Damasio, 2006), but emotions have been shown to be influenced by individual differences such as age, education, culture, socio-economic status, and personality (Prescott, 2017). Köster (2009) and Keller & Siegrist (2015), reported that personality, among others, could influence people's food choice. Personality is described as the traits which capture "patterns of thinking, feeling, and behaving" (APA, 2018). Also, some authors have confirmed that perception, and therefore hedonic and emotional responses, were affected by personality traits (Herz, 2011; Samant & Seo, 2018; Scott, Burgess, & Tepper, 2019). In addition, Prescott (2017) pointed out that granularity or alexithymia traits had an impact on the perceived or elicited emotions. Finally, Letzring & Adamcik (2015) and DeNeve & Cooper (1998) showed that the Extraversion dimension was positively related to positive affect or emotions, and the Neuroticism dimension was positively related to negative affect or emotions. In relation with the study of the personality's effect on the food elicited emotions, Samant & Seo (2018) provided evidences that the traits Extraversion and Neuroticism affected the emotional responses and contributed to predict overall liking and preferences of basic taste stimuli.

5. OBJECTIVES

5.1. General aim

The purpose of this thesis is to expand the knowledge related to the different methodologies used to determine the emotional response elicited by cultural-related alcoholic beverages such as wine and beer. To achieve this general aim, different specific objectives were defined and classified in two main research areas. The first area had the objective of studying the relationship of emotions and preferences with the intrinsic characteristics of the product, and also with the biological and psychological factors of consumers. The second research area was focused on the improvement and development of methodologies to measure the emotional response elicited by beer and wine consumption in consumers.

5.2. Specific objectives

- Research area 1:
 - To investigate the relationship between the emotional response and the sensory properties of wine, focusing on consumers' gender and age differences, through the use of a general emotional lexicon.
 - To study the relationship between personality traits and emotional response elicited by different wine samples.
- Research area 2:
 - To improve a consumer-led beer lexicon by using a practical approach to reduce the number of emotional terms.
 - To test the suitability of a rapid method application such as sorting task, for emotional lexicons development, using a wine emotional lexicon as a case study.

CHAPTER 2. MATERIAL AND METHODS

1. EXPERIMENTAL DESIGN OF THE THESIS

For improving the existing methodology to study the emotional response to beer and wine, different research projects have been developed, each one associated with a publication (Figure 5).

GENERAL AIM	To expand the knowledge related to the different methodologies used to determine the emotional response elicited by wine and beer			
SPECIFIC OBJECTIVES	To explain the relationship between emotions and wines' sensory characteristics, and to understand the effect of gender and age in wine preferences and evoked emotions	To find out the relationship between personality traits and emotional response elicited by different wines	To improve a consumer-led emotional lexicon of beer through a methodology to reduce the number of emotional terms.	To test the suitability of a rapid method application such as sorting task, for emotional lexicons development, using a wine lexicon as a case study
SAMPLES	6 wines	6 wines	10 beers	7 wines
CONSUMERS	n = 208 characterized by gender and age	n = 175 characterized by personality (Big5)	n = 83	Development (222) Testing (185)
LEXICON DEVELOPMENT			Filtering of terms (van Zyl et al., 2015)	L I. Conventional approach L II. Rapid-method approach
LEXICON	EsSense 25 (Nestrud et al., 2015)	EsSense 25 (Nestrud et al., 2015)	Beer lexicon (Chaya et al., 2015)	Lexicon I Lexicon II
STUDY AND CHAPTER	Study 1 (Chapter 3)	Study 2 (Chapter 3)	Study 3 (Chapter 3)	Study 4 (Annex I)

Figure 5. Outline of the experimental design of the thesis

2. GENERAL MATERIAL AND METHODS' STRUCTURE

The material and methods used across the different steps of the thesis followed a common structure. A panel of consumers were recruited to measure the emotional response elicited by the consumption of wine or beer samples. The methodology applied to measure the emotional response was based in verbal-self reported questionnaires; sometimes these questionnaires were general lexicons, and other were specific lexicons developed for a specific product category. Depending on the purpose of the study, consumers were characterized according to their extrinsic characteristics: gender, age and/or personality. A general description of the methodology applied in the different studies is explained below.

2.1. Samples

Beers or wines were selected to carry out the different studies. The samples were chosen with the criterion of as varied as possible in terms of sensory properties. In the beer study, samples were modified to enhance different flavors. However, in the wine studies, commercial wines with different sensory properties were selected. To ensure the sensory variation, in some cases samples were characterized using descriptive sensory analysis by a trained panel.

2.2. Consumers

A panel of consumers was selected for each investigation. To participate in the study, only one requirement was needed: to consume wine or beer at least once per month.

To expand the knowledge of the influence of consumers' intrinsic factors on the emotional response, consumers were characterized according to their gender, age and/or personality traits. A sociodemographic form was built to recover gender and age data. Personality traits were measured using the Big Five Inventory questionnaire (BFI) (John & Srivastava, 1999) that measures the Big Five dimensions of the personality: Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N).

2.3. Procedure

A common procedure structure was followed in the different studies.

In the tasting session, first, consumers were asked to complete a sociodemographic questionnaire where gender and age information were requested. Also, depending on the aim of the study, after completing

the sociodemographic form, consumers were asked to fill the Big Five Inventory questionnaire (BFI) (John & Srivastava, 1999). Second, consumers evaluated the different samples, and they were asked to report the hedonic and emotional response elicited by their consumption. A set of 3-digit coded blind samples were randomly assigned to each consumer. To avoid the first position effect, the first sample of the set was always a warm-up sample (Dorado et al., 2016; Wakeling & MacFie, 1995). Also, to avoid carry over effect, water and breadsticks were provided for palate cleansing between samples. After tasting each sample, consumers were first asked about the acceptability of the product and then about the emotions that it elicited. Acceptability was measured with the 9-point hedonic scale, where 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. Emotional response was assessed using different questionnaires (Figure 5). The measure of emotions elicited by the consumption of wine or beer was collected using linear scales anchored from 'very low' to 'very high'. Moreover, emotional terms were randomized to each consumer to avoid bias.

2.4. Statistical analysis

Different univariate and multivariate analyses were carried out in the different studies.

Regarding univariate analysis, the analysis of variance or ANOVA, followed by Tukey test when needed, were used in the different studies. ANOVA test is used to partition the observed variance of a variable into components attributable to different sources of variation, it aims at finding out if the obtained results are statistically significant or not.

Two multivariate methods have been mainly used: Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA). These techniques are used to describe data sets of many observations characterized by many variables. PCA is a technique used to reduce the dimensionality of a data set, to find the latent causes of its variability and order them by importance. The new dimensions are linear combinations of the original variables. The PCA is based on the idea of identifying the directions in the multivariate variable space which explains the maximum variance. The distance of a variable to the axis measures the quality of that variable. Variables which are far from the origin are well represented in the plot. Being far from the origin, if the variables are close to each other it could be due to a high correlation. The projection of the samples in the same space could help to understand which samples are similar among them, and differ from the others and which variables are responsible of those similarities and/or differences. HCA define homogeneous groups of individuals or samples based on their characteristics. This technique groups individuals or objects, being the objects of the same cluster more similar to each

other than with other objects of another cluster. Therefore, HCA maximizes the homogeneity of individuals or objects within the same cluster, while maximizing heterogeneity between agglomerates.

3. METHODOLOGY OF STUDY 1: Emotional response to wine: sensory properties, age and gender as drivers of consumers' preferences

Study one aimed at 1) explaining the relationship between emotions and wines' sensory characteristics, and 2) understanding the effect of gender and age in wine preferences and evoked emotions. To achieve these objectives, two different phases have been defined in the experimental design. One of them focused on evaluating the set of wines by a trained panel, and the other aimed at assessing the consumer's response (hedonic and emotional) to the consumption of the proposed samples. The experimental design is shown in Figure 6.

Figure 6. Experimental design study 1

3.1. Samples: wine selection

Six commercial wines were selected with the aim of covering a wide range of sensory properties. The selection was based on three different criteria: 1) type of wine, 2) type of grape and 3) age of wine. To ensure that wines were varied in sensory characteristics, they were evaluated by a trained panel.

To assess wines using the quantitative descriptive analysis technique, the panel was trained in 10 representative aromas (*strawberry, blackberry, apple, vanilla, clove, floral, pineapple, licorice, banana and herbaceous*), 1 taste descriptor (*acidity*), and one mouthfeel sensation (*astringency*) through 14 one-hour sessions. After the training the performance of the panel was assessed by a 3-way ANOVA (reference, assessor, session, and the interactions reference x assessor and reference x session). The results from the statistical analysis revealed a good consistency, reproducibility and discrimination of the

trained panel. Once the performance of the panel was verified, the sensory evaluation of the six wines was conducted in three sessions, using a balanced design with unstructured 15-cm line scales that were anchored 1.5 cm from the ends of both extremes with the labels “low” and “high”, respectively. To avoid carry-over effects water and breadsticks were used as palate cleansers.

3.2. Consumers

A total of 208 consumers (48.5% men and 51.5% women) were recruited for the consumer evaluation phase. To study the effect of age, consumers were classified into three age groups: young adults aged 18-35 (44.9%), middle-aged adults aged between 36 and 55 (29.3 %), and adults older more than 55 (25.9%). To participate in the study, consumers had to drink wine at least once per month.

3.3. Procedure

Consumers were first required to fill out a sociodemographic form. Second, they were required to attend a session where seven 3-digit coded blind samples of wine (15 mL) were presented at the same time. The first sample was a warm-up sample to avoid the first position effect (Dorado et al., 2016; Wakeling & MacFie, 1995), and afterwards, the six commercial wine samples were presented. The order of presentation of the six samples was randomly assigned. After tasting each wine, consumers were first asked about the acceptability of the wine, and then about the elicited emotions by the sample. Liking data were collected by means of the 9-point hedonic scale, where 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. In the case of emotions, EsSense25 lexicon terms (Nestrud et al., 2016) were back-translated into the Spanish language (Dorado et al., 2016). Each emotion was rated using a 10-cm line scale (with vertical lines at 0.5 cm from the ends of the line and labels “very low” and “very high” at the left and right extremes, respectively). To avoid carry-over effects water and breadsticks were used as palate cleansers. Also, consumers were asked to wait for a minimum of 1 minute between products.

3.4. Data Analysis

Sensory evaluation of the wines was assessed by a 3-way ANOVAs (wine, assessor and session, and the interactions wine x assessor and wine x session) followed by a Post hoc test Tukey HSD.

To compare the discrimination among wines by the consumer (liking and emotions), 3-way ANOVAs were used (wine, gender and age, and the interactions wine x gender and wine x age) followed by a Post hoc

test Tukey HSD. To summarize the emotional map of the wines, and relate it to the sensory descriptors, the multivariate methods PCA and HCA were also carried out. Finally, to understand the effect of the gender and/or age on the consumers' response, PCA and HCA on the different market segments were conducted to investigate the latent structure of the data in the emotions significant for these effects.

4. METHODOLOGY OF STUDY 2: Effect of personality on the emotional response elicited by wines

The purpose of the study 2 was to find out the relationship between personality traits and emotional response elicited by a set of wines. Considering this objective, the study was designed including a consumer test to measure the consumers' response triggered by a set of wines, hedonic and emotional, in which consumers' personality was also assessed. Figure 7 shows the experimental design of the study.

Figure 7. Experimental design study 2

4.1. Samples: wine selection

Six commercial wines were selected. To ensure a wide range of sensory properties, samples were characterized by a trained panel. Wine characterization was conducted in the study 1.

4.2. Consumers

A consumer panel of 175 volunteers, 48% men ($n = 84$) and 52% women ($n = 91$), range age from 18 to 70 years old, was recruited to conduct the consumer study. The screening was conducted taking into consideration that participants had to consume wine at least once per month.

4.3. Procedure

First of all, consumers were asked to complete a sociodemographic form followed by the Big Five Inventory questionnaire (BFI) (John & Srivastava, 1999). The BFI was composed by 44 statements that consumers had to rate using a 5-point scale (from 1 = strongly disagree to 5 = strongly agree). Second, wine samples (15 ml) were served simultaneously, all of them labelled with three-digit random codes. The first sample was a warm-up sample to avoid the first position effect (Dorado et al., 2016; Wakeling & MacFie, 1995), and afterwards, the six commercial wine samples were presented. The order of presentation of the six samples was randomly assigned. After tasting each wine, consumers were first asked about the acceptability of the wine and then about the emotions it elicited. Liking data were

collected by means of the 9-point hedonic scale, where 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. For determining the elicited emotions, EsSense25 lexicon terms (Nestrud et al., 2016) were back-translated into the Spanish language (Dorado et al., 2016). Each emotion was rated using a 10-cm line scale (with vertical lines at 0.5 cm from the ends of the line and labels “very low” and “very high” at the left and right extremes, respectively). Water and breadsticks were provided for palate cleansing between samples, and consumers were asked to wait for a minimum of 1 minute between products to minimize carry-over effects.

4.4. Data Analysis

Internal consistency of each dimension of BFI questionnaire was verified using the Cronbach’s alpha. To define different consumers clusters according to personality traits, a HCA was done. Differences among personality clusters were verified by 1-way ANOVA followed by a Post hoc test Tukey HSD. Personality cluster was the main factor, and consumers' means of each personality dimension were the dependent variables.

To compare the effect of personality on liking and emotional response elicited by wines, 2-way ANOVAs (wine, personality and the interaction wine x personality) followed by Tukey test were performed for the significant factors. To summarize the emotional map elicited by the samples, and relate it to the personality dimensions, a PCA was carried out using the means of the significantly different emotions identified among consumers’ personality segments.

5. METHODOLOGY OF STUDY 3: Improvement of an emotional lexicon for the evaluation of beers

The objective of the study 3 was to improve an emotional lexicon previous developed by Chaya et al. (2015) using a methodology to reduce the number of terms removing the non-emotional words. To achieve this purpose a “improved procedure” was designed (Figure 8).

Figure 8. Step by step approach for developing the beer consumer defined lexicon

5.1. Samples: beer selection

A sample set of 10 beers were selected for this study. Samples and sample preparation were the same as reported in Chaya et al. (2015). All 10 samples had been evaluated by the University of Nottingham’s trained expert beer panel. The assessments revealed significant differences between the spiked and control samples, indicating that the samples differed in their sensory properties.

5.2. Procedure to improve the lexicon and to group terms

The initial list of the emotional terms generated by the focus groups in Chaya et al. (2015) was compared with the emotional lists published by Clore et al. (1987) and Laros & Steenkamp (2005) following the method proposed by van Zyl & Meiselman (2015). After the terms were verified on the emotional list,

beer samples were evaluated by a panel of 17 consumers to cluster the emotional terms into emotional categories. Consumers tasted the beer samples and rated each evoked emotional term. A warm-up sample (the same as control) was tasted and rated to minimize first position effect (Dorado et al., 2016; Wakeling & MacFie, 1995). Then, 10 beer samples were served in random order. Rating was done on a 15 cm continuous line scale anchored at 1.5 cm from the line ends from 'very low' to 'very high'. Emotional terms were also randomized for each consumer to avoid bias.

5.3. Consumers

A panel of 83 Spanish beer consumers (aged 18-60), who consumed beer at least once a week, were selected.

5.4. Procedure to test the improved lexicon

The consumers panel were first asked to fill out a sociodemographic form. Second, they were required to attend a session where the warm-up sample and the beer samples were served, randomizing the 10 samples, all of them labelled with three-digit random codes. After tasting each sample, consumers were first asked to rate the overall liking on a 9-point scale. Then, they had to read all of the terms associated with each emotion category, and to rate the intensity of their feelings on a 15 cm linear scale, anchored at 0.5 cm from the line ends from "very low" to "very high". To minimize bias, the order of emotion categories was randomized for each consumer.

5.5. Data analysis

To group similar emotions into categories according to the consumers' assessment of the beer samples an HCA was applied on the average ratings for each emotional term of the 10 beer samples. To compare the discrimination among beers by the emotional response a mixed ANOVA using beers as a fixed effect and consumer as a random effect. Post-hoc tests for sample effect were conducted using Tukey's HSD. To explore relationships between emotion categories and beer samples, PCA was performed on the average ratings of each emotion category. Liking was used as supplementary (non-active) variable in the analysis.

6. METHODOLOGY OF STUDY 4: Comparison of methods to develop an emotional lexicon of wine: Conventional vs Rapid-method approach

6.1. Samples

Seven different commercial wines of different wine styles (red, rosé, white, sparkling white, sparkling rosé, sweet and semi-sweet wines) were selected for this study in order to have as much sensory variation as possible.

Table 7. P-values and means scores of the sensory descriptors of wine samples.

Sensory attributes	1 Red wine (2012)	2 Sparkling rosé wine (2017)	3 Rosé wine (2017)	4 Sparkling white wine (2017)	5 Red wine (2014)	6 Semi-sweet white wine (2017)	7 Red wine (2017)	p-value
Flowers	0.906 c	2.719 bc	2.356 bc	3.800 ab	0.381 c	5.438 a	1.983 bc	< 0.0001
Violet	1.719 a	1.275 a	1.944 a	0.931 a	0.912 a	1.044 a	2.375 a	0.1402
Clove	1.563 ab	0.156 b	0.769 ab	0.381 b	1.406 ab	0.244 b	2.096 a	0.0002
Pepper	1.163 ab	0.169 b	0.275 b	0.200 b	2.319 a	0.138 b	2.179 a	< 0.0001
Licorice	0.631 a	0.550 a	0.575 a	0.844 a	0.256 a	0.675 a	0.821 a	0.8315
Lemon	0.150 a	0.475 a	0.425 a	1.331 a	0.119 a	1.113 a	0.550 a	0.0377
Blakberry	2.569 a	1.150 abc	0.450 bc	0.281 c	2.019 ab	0.169 c	0.800 bc	< 0.0001
Raspberry	1.800 a	1.338 a	1.694 a	0.187 a	1.944 a	0.406 a	1.829 a	0.0238
Strawberry	1.200 ab	1.638 ab	2.256 a	0.425 b	0.969 ab	0.681 ab	2.092 a	0.0049
Blueberry	1.981 a	0.956 a	1.144 a	0.300 a	1.463 a	0.275 a	1.642 a	0.1217
Peach	0.163 a	0.888 a	0.869 a	1.256 a	0.212 a	1.063 a	0.654 a	0.1617
Apple	0.150 c	0.487 bc	0.731 bc	2.275 a	0.106 c	1.794 ab	0.742 bc	< 0.0001
Pineapple	0.081 c	0.631 bc	0.494 c	2.844 a	0.119 c	2.119 ab	0.512 c	< 0.0001
Banana	0.475 a	1.088 a	0.425 a	1.263 a	0.106 a	1.050 a	0.742 a	0.2239
Tea	0.563 a	0.263 a	0.219 a	0.100 a	0.438 a	0.113 a	0.608 a	0.2105
Nut	0.600 a	0.119 a	0.625 a	0.425 a	0.425 a	0.144 a	0.663 a	0.6015
Vanilla	1.706 a	1.138 a	0.950 a	1.363 a	1.150 a	1.100 a	2.179 a	0.4149
Coffee	0.344 a	0.888 a	0.244 a	0.100 a	0.994 a	0.100 a	0.338 a	0.0663
Butter	0.988 a	0.506 a	0.319 a	0.738 a	0.181 a	0.388 a	0.417 a	0.3828
Mushroom	0.613 ab	0.150 b	0.219 ab	0.100 b	0.994 a	0.313 ab	0.325 ab	0.0209
Acidity	4.794 a	1.194 c	4.438 a	4.519 a	3.513 ab	1.756 bc	5.483 a	< 0.0001
Sweetness	0.706 b	4.994 a	1.513 b	1.638 b	0.575 b	5.494 a	1.279 b	< 0.0001
Astringency	4.681 a	0.750 b	1.750 b	1.844 b	5.813 a	1.281 b	4.275 a	< 0.0001
Carbonation	0.956 b	2.475 ab	0.906 b	4.675 a	1.125 b	1.088 b	0.421 b	< 0.0001

Different letters within the same row indicate different post-hoc groupings by Tukey's HSD ($p < 0.05$). Numbers in bold mean $p < 0.05$.

Descriptive sensory analysis was conducted by a trained panel. ANOVA followed by a Post hoc test Tukey HSD was done to ensure diversity of sensory properties across wines. Details of the samples used in the study are reported in Table 7.

6.2. Consumer-led lexicons development

A total of 222 consumers participated in the lexicons' development procedure. Different steps were followed to develop both emotional lexicons (lexicons I and II). The procedures are described in Figure 9.

Figure 9. Flow chart of the lexicon development by both approaches

The initial steps related to the generation, filtering, and reduction of terms were common for both lexicons (n=161).

6.2.1. Procedure for generating terms

Nine focus groups were employed to generate the emotions related to wine consumption. 99 participants (aged from 20 to 85 years old), who consumed wine at least once a month took part in this part of the study.

Each focus group session was divided into three parts following the procedure of Chaya et al. (2015). In the first part, a short explanation of the objective of the focus group was presented. Then, participants were instructed about the difference between emotions and mood. During the second part, to stimulate emotions elicitation, a warm up exercise was conducted using different pictures and prompt cards (Ng et al., 2013a). Participants were indicated to watch each picture and answer individually the question “how do you feel after watching this picture?”. Once all consumers were ready, a discussion was done to collect all the elicited emotions. During the third part of the focus groups, consumers repeated the same process of the second part, but using different wines instead of pictures/cards. Each consumer received a triad of samples (10 ml each) randomly assigned from the set of wines (see Table 7); he/she was indicated to taste them and also to describe how they felt when drinking each sample in a written questionnaire. To avoid carry-over effects, consumers were asked to give a minimum of a one-minute break between wines. In addition, each participant received unsalted crackers and mineral water as palate cleansers. Later, emotions and feelings were discussed and collected in an initial list of terms, being the kickoff for the lexicon development.

6.2.2. Filtering and reduction of terms

The initial list of the emotional terms was checked and verified to remove synonyms and terms which were not considered emotions or feelings by the research team. The list was checked following the method of van Zyl & Meiselman (2015) in which each term was compared with the emotional lists published by Clore et al. (1987) and Laros & Steenkamp (2005) containing 564 and 50 terms, respectively. The terms generated in the focus groups sessions that were not included in the reported lists were removed.

To reduce the number of emotional terms included in the filtered list, two different procedures for determining their relevance were also conducted: a relevance test (RT) and a grouping of irrelevant terms (GIT). To do so, two consumers’ panels were recruited. All of them had to consume wine at least once a week. For the RT, 30 consumers were asked to rate each emotion term according to the question: “In your opinion, are the following terms relevant to describe how do you feel when consuming wine?”. A

10 cm linear scale, anchored from “absolutely irrelevant” to “absolutely relevant”, was used for the rating. Terms with a mean ‘relevance’ score lesser than 33 % were considered as not relevant and then excluded from the lexicon. For the GIT, 32 consumers received the list of emotions and were asked to remove all terms that they considered irrelevant when consuming wine. Those terms which were rejected by ≥ 30 % of consumers were removed from the lexicon list.

6.2.3. Grouping of terms into emotions categories

6.2.3.1. Conventional approach

Using the approach of Chaya et al. (2015), the seven wines (Table 7) were evaluated by a panel of 33 consumers. Participants tasted each wine sample and rated each evoked emotional term from the list obtained after the filtering and reduction task. A warm-up sample was used to minimize the first position effect (Dorado et al., 2016). Wines were served in random order according to a Complete Balanced Block design. Rating was conducted using a 10-cm continuous line scale anchored from ‘very low’ to ‘very high’ using Compusense® Cloud software (Compusense Inc., Guelph, Ontario, Canada). To minimize bias, the emotions were presented in a randomized order for each consumer.

A Hierarchical Cluster Analysis (HCA) was conducted with the averaged ratings of each emotional term to group similar emotions into categories. Terms were grouped using Euclidean distance and the Ward’s criterion of aggregation. Once emotions were grouped into categories, the research team used triangulation to propose a category name for each group. Final emotional categories and its names were supervised by a psychologist from the University of the Basque Country (UPV/EHU). Internal consistency of each category was verified by the Cronbach’s alpha coefficient.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

6.2.3.2. Rapid-method approach

To study the possibility to simplify the development of an emotional lexicon, another grouping procedure was investigated. The procedure, based on the rapid method named sorting task (Chollet, Valentin, & Abdi, 2014), used a semantic approach to cluster emotions and feelings into categories. A consumer panel of 28 wine consumers participated in this task. Each consumer was asked to group the emotions or feelings from the filtered and reduced list using the criteria of joining emotions with similar meaning for them. For this purpose, consumers were asked to think in a wine consumption context. Participants were free to propose as many groups as they considered necessary. The distances between emotions

obtained from consumer classifications were analyzed by Multidimensional Scaling (MDS). The MDS treated proximities as Euclidean distances showing an Eigen-decomposition for a n-dimensional representation space. To determine the correct number of dimensions needed to obtain a faithful representation of data, stress should be low, and Shepard diagram should be as linear as possible (Addinsoft, 2019).

Once the dimensions' configuration was determined, HCA was performed to group similar emotions into categories. Dimensions were grouped using Euclidean distance and the Ward's criterion of aggregation. In the same manner as in the conventional procedure, categories were named using the information collected in the focus groups, thanks to the psychologist assessment. Also, the Cronbach's alpha coefficient was used to ensure that the resulting categories had internal consistency.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

6.3. Testing of lexicons

6.3.1. Consumers

A panel of 185 consumers (51% males, mean age of 51 years old) participated in the testing procedure. The consumer's panel was randomly split into two groups to test lexicon I (conventional approach) or lexicon II (rapid-method approach).

6.3.2. Testing procedure

Seven wine samples were presented to consumers (Table 7) in random order using a Complete Balanced Block design. After tasting each wine, consumers were first asked to rate the overall liking on a 9-point scale. Then, they had to read all the terms associated with each emotion category and rate the intensity of their feelings on a 10-cm linear scale, anchored from 'very low' to 'very high'. Data collection was done using Compusense® Cloud software (Compusense Inc., Guelph, Ontario, Canada). To minimize bias, the order of the emotion categories was randomized for each consumer. Also, a warm-up sample was introduced (Dorado et al., 2016; Wakeling & MacFie, 1995) to avoid the first position effect.

6.3.3. Data analysis

Responses to each emotional category were input in ANOVA tests such as dependent variables and using "wine" as a factor. Post-hoc tests for "sample" effect were conducted using Tukey's HSD.

Principal Component Analysis (PCA) was performed on the averaged ratings of each emotion category to explore the relationships between emotion categories and wines. Liking was used as supplementary (non-active) variable in the analysis.

HCA was carried out using the averages of each wine emotional category. The cluster analysis was based on the Euclidean distance, and the Ward algorithm was used as the agglomerative method.

To determine the relationship among the emotion categories, the wines, and the two lexicons, a Multiple Factor Analysis (MFA) was conducted with the mean ratings of each emotion category. Again, liking was used as supplementary variable. The RV coefficient was also calculated to compare the emotional maps of wines obtained with both lexicons.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

CHAPTER 3. PUBLISHED ARTICLES

STUDY 1

Emotional response to wine: sensory properties, age and gender as drivers of consumers' preferences

María Mora, Elena Urdaneta and Carolina Chaya

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Emotional response to wine: sensory properties, age and gender as drivers of consumers' preferences

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KEYWORDS

Emotional response; EsSense25; sensory; age; gender; wine.

HIGHLIGHTS

- Different wine sensory profiles trigger different emotional responses in consumers.
- EsSense 25 was able to capture differences in emotional response elicited by wines.
- The sensory profile of Rosé wine was more similar to white wines than to red wines.
- The emotional profile of Rosé wine was more similar to red wines than to white wines.
- The gender and age of consumers played a significant role on wine differentiation.

ABSTRACT

Previous research has shown the relevance of studying consumers' emotional response to products for product development and as a marketing tool to attract the widest range of consumers. This study aims (1) to explain the relationship between emotional and sensory traits of wine products and (2) to understand the effect of gender and age in wine preferences and evoked emotions.

Six different commercial wines with very different sensory properties were selected. Sensory analyses performed by a trained panel of 11 assessors were used to describe wines. Degree of liking and emotional response were rated by a consumer panel (n=208) drawn from different age segments using a modified version of EsSense25. The results showed that EsSense25 was able to measure emotional response in the set of studied wines. Also, sensory and emotional profiles of the same set of wines revealed a relationship between attributes like fruity and floral and positive emotions, and licorice, clove and vanilla and neutral and negative emotions. Differences in emotional response by gender and age were found: in general, men reported higher scores on significant emotions than women for all the wines, but women, although they gave generally lower ratings than men, reported greater differences between the wines and were able to discriminate among the wines regarding emotions such as joyful. Also, regarding age segments, all of the wines evoked significantly higher scores in older adults than in middle-aged and young adults for most emotional terms. However, young adults showed higher discrimination between wines than the other age groups, in terms of emotional responses towards the set of wines tested in this study.

1. INTRODUCTION

Wine has been considered a meal accompaniment for the best moments and has symbolic value (Barrena & Sanchez, 2009) as a product that creates an association between emotions and aspects of culture (van Zyl & Meiselman, 2016).

In recent years, through the effects of globalization, economic changes, pursuit of pleasure and the development of common trade areas, regional drinking patterns have been influenced and modified (Smith & Mitry, 2007). Incrementally, national and cultural borders have become blurred. As a result, consumer preferences for types of alcoholic beverages, particularly wine, seem to be less driven by regional traditions and more by globalization, the mixing of cultures and the opening of the markets (Campbell & Guibert, 2006).

All of these aspects have established a new competitive environment in the wine industry. Old World wine producers, such as Italy, France and Spain, have been challenged in all foreign markets by New World producers, like Australia, New Zealand, Chile, the USA, Argentina and South Africa. New World producers have implemented strong marketing strategies with the aim of attracting the widest number of consumers (Campbell & Guibert, 2006).

Thus, to be competitive, the wine industry needs new strategies to ensure the production of wines that are liked by consumers. Through these strategies, wine producers should seek to open new markets and offer each target consumer a specific product.

Wine products vary widely in sensory properties, which can trigger very different responses in the consumer. This diversification could be taken into account for the identification of new market segments. One of the aspects usually found to differentiate consumer responses towards food product consumption, beyond liking, is emotional response. Meiselman (2015) concluded in his study that the introduction of food-evoked emotions in sensory consumer research provides the industry with additional consumer insights. Studies carried out by Barrena & Sanchez (2009) and Silva, Jager, van Bommel, et al. (2016) showed that consumers discriminate between products more for their emotional benefits than for their technical or functional properties. Therefore, the study of consumer preferences and emotional responses could provide solutions for making their products more competitive to the wine industry (Silva, 2017) by using the emotional characterization of beverages as a new marketing tool to connect with consumers (Barrena & Sanchez, 2009; Silva, Jager, van Bommel, et al., 2016).

In the absence of other information related to the stimuli, food-evoked emotions in blind tastings are linked to sensory attributes. It is known that there are specific sensory attributes linked to particular emotions. For example, Thomson, Crocker & Marketo (2010) associated *powerful* and *energetic* with *cacao* flavor in dark chocolate, Jager et al. (2014) found that *mint* flavor in chocolate was associated with the emotion *energetic*, Chaya et al. (2015) discovered that *sweetness* in beers was related to less pleasant emotions, Mojet et al. (2015) concluded that *vanilla* flavor in yogurt was related to positive emotions, and Silva et al. (2017) found positive correlations between *herbal* flavor and *sadness* and between *citrus* flavor and *disappointment* for beer products.

According to the suggestion that emotional aspects are strongly linked to sensory experience and that those emotions could determine the preference for a product, Ferrarini et al. (2010) proposed characterizing wines by making associations between sensory and emotional profiles as means to improve the products' position in the market. Silva et al. (2017) studied the relationship between the emotional responses elicited by two similar wines and the sensory properties of each one. They suggested that in similar sensory products, the same emotions caught the most consumer attention. To the authors' knowledge, there is currently no information about how different wine sensory attributes could be demonstrated to elicit a different emotional response.

It has been argued that the conventional hedonic response itself is not enough to explain consumers' response to products (Gutjar et al., 2013; Ng et al., 2013a; Silva, Jager, Voss, et al., 2017). Research conducted by Silva et al. (2017) found that emotions and liking were complementary for product characterization. However, while it is not always possible to differentiate products based on the degree of liking by the consumer, it is possible through the study of emotions. Ng, Chaya, & Hort (2013a) showed that some products with the same hedonic scores do not have the same emotional response and that emotions discriminated between products beyond hedonic response. That is why many lexicons have been developed in order to study the emotional response elicited by food products. King & Meiselman (2010) created the first emotional lexicon for food products, called the EsSense Profile. Shortly after, Thomson & Crocker (2013) developed a single lexicon, in four languages, capable of being used in any product category for consumer research and product development. In addition, a shorter version of EsSense (EsSense25) was developed by Nestrud, Meiselman, King, Leshner, & Cardello (2016). Only Ferrarini et al. (2010), Silva, Jager, van Bommel, et al. (2016), Danner et al. (2016) and Jiang et al. (Jiang et al., 2017) have developed a specific lexicon for Italian, Dutch and Portuguese, and Australian wine

consumers, respectively. To the authors' knowledge, there is no previous work on a general lexicon to be applied to wine products.

Apart from the sensory differences among products, other factors linked to consumers could be included in a study of emotional response. Few papers have shown the effect of gender, age, education level and monthly income on consumer-evoked emotional response to wine (Barrena & Sanchez, 2009; Jiang et al., 2017; Silva, Jager, van Zyl, et al., 2017).

On the one hand, no effect of gender on wine consumers' responses has previously been found (Silva, Jager, van Zyl, et al., 2017), but looking at other food products, the relationship between gender and emotions is unclear. The literature shows that the effect of gender on emotional responses towards food depends on the product category (Chaya et al., 2015; Dubé et al., 2005; Edwards et al., 2013; King et al., 2010; Parra et al., 2015; Piqueras-Fiszman & Jaeger, 2015).

On the other hand, according to Silva, Jager, van Zyl, et al. (2017), the effect of age on wine preferences depends on the previously lived experiences evoked by the sensory perception. Therefore, age and consumers' drinking lifetime define wine flavor preferences, with a linear increase in wine consumption over a consumer's life (Melo et al., 2010; Silva et al., 2014; Silva, Jager, van Zyl, et al., 2017). Silva et al. (2014) concluded that a group of young adults generally perceives that the older they are, the more interested in wine they will be. In another study, Silva, Jager, van Zyl, et al. (2017) stated that wine is a beverage meant for an older generation. It was also demonstrated that young adults drink wine for reasons related to disinhibition and social status, while older people use it as a social catalyst, to evoke memories and traditions (Barrena & Sanchez, 2009).

In the study of the relationship between age and emotions, it has been shown that regardless of whether an EsSense profile or PrEmo tool is used to gather self-reported emotions, young adults reported more extreme scores in emotions that varied along the valence and arousal dimensions, while old adults gave more neutral scores, varying only along the valence dimension (den Uijl, Jager, de Graaf, et al., 2016; den Uijl, Jager, Zandstra, et al., 2016; Montepare & Dobish, 2014). Other authors have found that older people reported more positive emotions than younger ones with regard to beer (Chaya et al., 2015) and comfort foods (Dubé et al., 2005), recalling typical and memorable meals (Piqueras-Fiszman & Jaeger, 2015). The study carried out by Edwards et al. (2013) showed that young consumers were more critical about food than older people.

In short, given the competitive environment in the wine industry, studying wine preferences or liking is not enough. Analyzing the emotional response and the differences associated with age and gender for each type of wine could be a clue for the industry regarding its market strategy. This case study explores the relative influence of sensory properties and consumers' age and gender on the emotional response to wine products, by means of both univariate and multivariate analysis approaches. The work could contribute to a better understanding of consumers' emotional response. To the author's knowledge, this has not yet been investigated.

This research is focused on different commercial wines covering a wide range of sensory properties, in order to investigate (1) the relationship between emotional and sensory traits of products and (2) the differences in emotional response by gender and age for each type of wine.

2. MATERIALS AND METHODS

Two different phases have been conducted in order to achieve the objectives of the research: sensory evaluation by a panel of trained assessors and consumer evaluation (hedonic and emotional response) by a panel of consumers.

2.1. Wine selection

Six commercial wines (table 8) were selected with the aim of covering a wide range of sensory properties. The selection was based on three different criteria: 1) type of wine, 2) type of grape and 3) age of wine.

Table 8. Description of the used wines

Code	Type of wine	Grape	Aging	PDO	Alcoholic degree v/v (%)
1	White	Verdejo	Young (2015)	Rueda	13.5
2	White	Chardonnay	Young (2015)	Navarra	13
3	Rosé	Garnacha	Young (2015)	Navarra	13.5
4	Red	Tempranillo	Reserva (2012)	Rioja	12.5
5	Red	Tempranillo	Reserva (2013)	Rioja	13.5
6	Red	Tempranillo	Reserva (2012)	Ribera del Duero	14

2.2. Sensory evaluation

In order to characterize the six wines, a panel of 11 assessors (5 women and 6 men) was trained. The panellists were staff and researchers from the School of Agricultural, Food and Biosystems Engineering at the Universidad Politécnica de Madrid, Spain.

The panel had already been trained to assess wines using the quantitative descriptive analysis technique for previous projects. However, to ensure reliability and accuracy of the data, the panel attended an additional 14 one-hour training sessions. Judges were trained in the detection and recognition of tastes, mouthfeel sensations and odors, and in the use of scales. The judges were asked to use the total length of the scale when necessary, as the perceived attribute intensities during training on the spiked references would probably be much higher than for commercial wines and this could help in the subsequent statistical analysis.

During the training sessions, 10 representative aromas, 1 taste descriptor and 1 mouthfeel sensation were presented. The Wine Aroma Wheel (Noble et al., 1987) was used as the reference standard, but different modifications were made (table 9) during the training process. In relation to taste and mouthfeel sensations, judges were trained in acidity and astringency, according to ISO 8586-1:2014 (ISO, 2014).

Table 9. References used during the training process (based on Noble et al. (1987))

Attribute	Reference	Base wine ⁽¹⁾
Strawberry	1-2 crushed fresh or frozen strawberries	Red
Blackberry	7 drops blackberry aroma extract	Red
Apple	Slice fresh apple, 5 mL apple juice	White
Vanilla	1.5cm vanilla pod slip in half	White, Red
Clove	Soak one whole clove for 10-20 min and remove	White, Red
Floral	7 drops of orange blossom extract	White
Pineapple	2-4 mL freshly opened canned pineapple juice	White
Licorice	2.5 cm slice black licorice	White, Red
Banana	1 10mm slice fresh banana	White, Red
Herbaceous	4 crushed grape stems	White

⁽¹⁾ In 25 mL wine

Panelists scored the attributes by means of unstructured 15-cm line scales that were anchored 1.5 cm from the ends of both extremes with the labels “low” and “high”, respectively.

In each session, attributes were randomly presented in two intensities: one low with a base wine and one high according to the references described in table 9. Glasses were coded and covered with aluminum paper to avoid the influence of visual cues during aroma evaluation. Statistical evaluation of the panel was assessed by 3-way ANOVA (reference, assessor and repetition and the interactions reference x assessor and reference x repetition). The results are not shown. The results of the analysis showed good discrimination of attributes by a significant effect of reference (p-value < 0.0001). During the training process, no effect of assessor, repetition, or the double interaction reference x assessor, reference x

repetition was found, achieving good consistency and reproducibility of the panel by the end of the training process. The only exception was for the clove attribute, which showed a significant interaction of reference x assessor. The assessor who was not consistent with the whole panel was identified, and his/her data were not included in the evaluation of this attribute for the wines.

Once the performance of the panel in terms of discrimination, reproducibility and consistency was verified, the sensory evaluation of the six wines was conducted in three sessions according to a balanced design. All attributes were rated on unstructured line scales, as in the training process. Products (15 ml) were presented in a wine tasting glass according to ISO 3591:1977, all at the same time, with a minimum of 1 min break between the products to ensure no carry-over effects. Bias due to order effects was controlled by assigning a random order of presentation of the products to each panelist. Water and breadsticks were used as palate cleansers. All tests belonging to the sensory evaluation were conducted in the same week of spring, at room temperature, under Northern Hemisphere daylight and in individual booths. Sensory evaluation of the wines was assessed by 3-way ANOVA (wine, assessor and repetition and the interactions wine x assessor and wine x repetition). Table 10 shows the means of the different attribute analyses by wines and p-values.

Table 10. Means and p-values of wine effect by sensory attribute

Wine	Strawberry	Blackberry	Apple	Vanilla	Clove	Floral
1	0.47	0.73	4.82	0.43	0.01	5.85
2	0.86	0.49	5.94	0.81	0.00	7.42
3	7.42	4.42	1.24	4.37	1.55	4.75
4	2.71	6.07	0.02	6.80	10.08	0.29
5	2.54	6.02	0.01	7.55	7.67	1.12
6	4.38	7.52	0.00	5.05	7.77	1.08
p-value	0.0010	0.0003	0.0000	0.0000	0.0000	0.0000
Wine	Pineapple	Licorice	Banana	Herbaceous	Acid	Astringent
1	6.45	0.03	8.24	3.39	6.88	2.70
2	6.65	0.01	7.77	4.34	6.83	2.78
3	2.19	1.64	3.38	1.33	6.93	2.75
4	0.01	5.90	0.29	0.01	6.84	7.76
5	0.03	5.71	0.00	0.01	7.85	7.44
6	0.02	4.53	0.01	0.01	6.96	9.55
p-value	0.0000	0.0000	0.0000	0.0001	0.4845	0.0000

2.3. Consumer evaluation

2.3.1. Consumer sample

Consumers were recruited by posters in the Faculty and surrounding facilities and by email. The only requirement was to be wine consumers at a rate of at least once per month. The consumers panel, consisting of 208 consumers (48.5% men and 51.5% women), consumed red, rosé or white wines.

To study the effect of age, consumers were classified into three age groups: young adults aged 18-35 (44.9%), middle-aged adults aged between 36 and 55 (29.3 %), and older adults aged more than 55 (25.9%).

2.3.2. Consumer tests

Consumers were first required to fill out a sociodemographic form, including consumption frequency of red, white and rosé wines.

Second, they were required to attend a session where seven 3-digit coded blind samples of wine (15 mL) were presented at the same time. The first sample was a warm-up sample to avoid the first position effect (Dorado, Pérez-Hugalde, et al., 2016; Wakeling & MacFie, 1995), and afterwards, the six commercial wine samples were presented. The order of presentation of the six samples was randomly assigned. Water and breadsticks were provided for palate cleansing between samples, and consumers were asked to wait for a minimum of 1 min between the products to minimize carry-over effects.

To collect the hedonic and emotional data, a questionnaire was developed. FIZZ software was used to create a questionnaire in which emotions were randomized for each consumer.

After tasting each wine, consumers were first asked about the acceptability of the wine and then about the emotions it elicited. This order was chosen to avoid bias (King, Meiselman, & Thomas Carr, 2013). Liking data were collected by means of the 9-point hedonic scale, where 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. In the case of emotions, EsSense25 lexicon terms (Nestrud et al., 2016) were back-translated into the Spanish language (Dorado, Pérez-Hugalde, et al., 2016). An additional term, “curious”, was included as it was reported to be an important emotion for wine in unpublished research (Cuesta, Chaya, & Pérez, 2010). Each emotion was rated by means of a 10-cm line scale (with vertical lines at 0.5 cm from the ends of the line and labels “very low” and “very high” at the left and right extremes, respectively).

2.4. Data Analysis

Statgraphics (Centurion XVII version) and XLSTAT (2014.6.05 version) programs were used for statistical analysis. A significance level of 0.05 was used for all of the tests.

2.4.1. Consumer test analysis

To compare the discrimination among wines by the consumer (degree of liking and 26 emotions), 3-way ANOVAs were used. In this case, the factors wine, age and gender and the interactions wine*age and wine*gender were included in the model.

2.4.2. Multivariate analysis: sensory evaluation and emotional data

To summarize the emotional map of the wines and relate it to the sensory descriptors, multivariate methods (Principal Component Analysis (PCA) and cluster analysis) have been carried out on the means of the discriminating emotional variables, using sensory attributes and hedonic response as supplementary variables. The cluster analysis was based on the Euclidean distance among individuals, and the Ward algorithm was used as the agglomerative method.

2.4.3. Emotional map by consumer segments

When differences by gender and/or age were found, an additional analysis was done in order to investigate the latent structure of the data. This included PCA and cluster analysis on the different market segments.

3. RESULTS

3.1. Emotional response in wine: general lexicon capability and relationship with the sensory profile

The emotional response obtained by the EsSense25 lexicon was able to characterize the set of wines and to establish a relationship with the sensory profile. This section demonstrates the ability of the lexicon and the relationship between the consumers' emotional response and the wine sensory properties.

3.1.1. EsSense25 as a lexicon to measure emotional response in wine

Most emotional terms of the modified general emotional lexicon, EsSense25, were able to capture differences ($p\text{-value} < 0.05$) by wines or by consumers' segment (gender and/or age). Only 4 out of 26 did not show any statistical significance: *adventurous*, *free*, *wild* and *worried*.

Among the wines, significant differences in *aggressive, disgusted, good, happy, joyful, mild, and pleasant* were found. Looking at the gender effect, nine emotions were significant: *bored, calm, good natured, joyful, mild, satisfied, secure, tame, and understanding*. The age effect was also significant for 17 emotional descriptors: *active, calm, enthusiastic, good, good natured, guilty, happy, interested, joyful, loving, mild, nostalgic, pleasant, satisfied, understanding, warm and curious* (table 11).

Table 11. P-values of 3-way ANOVA based on consumer data

	Wine	Gender	Age	Wine * Gender	Wine * Age
Hedonic	0.0019	0.5585	0.0146	0.0024	0.9330
Active	0.5509	0.3217	0.0010	0.1009	0.6933
Adventurous	0.2470	0.6174	0.1536	0.2131	0.6862
Aggressive	< 0.0001	0.3333	0.1117	0.9984	0.6990
Bored	0.5714	0.0156	0.9925	0.6143	0.9355
Calm	0.1865	0.0004	0.0016	0.5963	0.6090
Disgusted	0.0472	0.2838	0.8794	0.6147	0.9133
Enthusiastic	0.2884	0.7310	0.0066	0.1817	0.7536
Free	0.0808	0.4767	0.0588	0.5079	0.5687
Good	0.0104	0.1835	0.0054	0.2670	0.5744
Good natured	0.0783	0.0171	0.0027	0.7874	0.9811
Guilty	0.4175	0.3631	0.0009	0.6616	0.9392
Happy	0.0088	0.6352	0.0163	0.4220	0.7872
Interested	0.2434	0.2959	< 0.0001	0.6930	0.9335
Joyful	0.0142	0.6039	0.0012	0.0343	0.3779
Loving	0.2520	0.0531	0.0013	0.3501	0.9019
Mild	< 0.0001	0.0001	0.0004	0.7760	0.6098
Nostalgic	0.8179	0.0646	< 0.0001	0.7470	0.7780
Pleasant	0.0042	0.0550	0.0028	0.1084	0.6251
Satisfied	0.4601	0.0054	0.0002	0.0632	0.9737
Secure	0.6040	0.0050	0.0655	0.4343	0.4377
Tame	0.3188	0.0310	0.1300	0.9894	0.8679
Understanding	0.3990	0.0374	0.0011	0.6585	0.7909
Warm	0.3637	0.0524	0.0006	0.4194	0.3475
Wild	0.1639	0.1181	0.8708	0.5121	0.8701
Worried	0.6095	0.7728	0.0527	0.7545	0.9401
Curious	0.5716	0.2722	0.0015	0.7909	0.9979

In general, EsSense25 was a useful lexicon to measure emotional response in this set of commercial wines, which have very different sensory properties.

3.1.2. Associations between emotional response and sensory profiles of wines

The set of wines studied presented different sensory profiles and also different emotional responses. PCA (figure 10) allows the visualization of the emotional descriptors of wines together with the sensory attributes as supplementary variables.

Figure 10. First factorial plot of the PCA based on emotion data: a) Correlation plot of emotions (sensory descriptive variables are considered to be supplementary variables), b) Projection of wines. Groupings are based on clustering results of the same dataset. See table 1 for wine code description

The first two principal components of the PCA performed on the emotional data accounted for 86.16% of the data variance. It can be observed that the first principal component was related to pleasantness and that the second principal component was related to activation/arousal of emotional terms (figure 10).

Looking at the general relationship between the emotional and the sensory profiles of wines, it was observed that, within the set of wines of this study, emotions like *good*, *happy*, *joyful*, *mild* and *pleasant* were positively associated with attributes such as fruity and floral, and more negative emotions like *aggressive* and *guilty* were associated with attributes related to aged wine. A more detailed correlation analysis (data not shown) associated both negative emotions to vanilla (correlation coefficients of 0.81 and 0.78, respectively), clove (correlation coefficients of 0.92 and 0.89, respectively) and licorice (correlation coefficients of 0.92 and 0.89, respectively).

Although the position in the PCA of acid and *disgusted* was quite close, the correlation coefficient between those attributes in the set of wines was 0.57, meaning that there is not a very strong linear relationship. This could happen due to the opposition to both acid and *disgusted* in white wines 1 and 2 versus red wine 5, which contributes very strongly to the first principal component. In fact, acidity varies from 6.83 for wine 2 to 7.85 for wine 5 (table 10), while *disgusted* ratings vary from 1.92 for wine 1 to 2.65 for wine 5. However, the remaining wines show very little variation in both attributes. Another association between a sensory and an emotional term to consider is that between astringent and *aggressive*. The correlation coefficient between them was 0.95. It is true that astringency is generally associated with young red wines compared to aged red wines, but in the wines tested in this experiment, astringency differences were more guided by the opposition between the white and rosé wines compared to red wines rather than by wine ageing differences.

Clustering of wines based on the emotional variables (figure 10b) was different from the clustering of wines based on the sensory attributes (figure 11).

Figure 11. Projection of wines in the first factorial plot of the PCA based on sensory descriptive data. Groupings are based on clustering results of the same dataset. See table 1 for wine code description

On the one hand, emotional clustering presented white wines (1 and 2) together in one group, rosé wine (3) in another group, Rioja PDO red wines (4 and 5) in the same group, and Ribera del Duero PDO wine (6) alone in another cluster.

On the other hand, sensory clustering separated verdejo white wine (1) into one cluster, while chardonnay white and rosé wines (2 and 3, respectively) were clustered together, red wines 4 and 6 were in another group, and red wine 6 was in another cluster.

3.2. Effect by consumer segment

The next section explains how emotional response elicited by wines varied across consumer segments by gender and age.

3.2.1. Gender effect

A significant effect of gender and the wine*gender interaction was found. In emotions with a significant gender effect, men scored emotions higher than women.

The results showed that there was a difference between men and women when rating emotional descriptors (figures 12a and 13a). This was also demonstrated by a correlation analysis of the means by wines on both genders (results not shown). To summarize, *secure* and *bored* are good examples of this effect: the wines that elicited *bored* emotions for men did not do so for women. Only *mild* (0.947) and *tame* (0.953) had a high correlation between genders.

Figure 12. First factorial plot of the PCA based on emotion data for men. a) Correlation plot of emotions (the hedonic variable is considered a supplementary variable). b) Projection of wines. Groupings are based on clustering results of the same dataset.

See table 1 for wine code description

Figure 13. First factorial plot of the PCA based on emotion data for women. a) Correlation plot of emotions (the hedonic variable is considered a supplementary variable). b) Projection of wines. Groupings are based on clustering results of the same dataset.

See table 1 for wine code description

In the case of interactions like *joyful* (figure 14a) and *hedonic* (figure 14b), wine differences varied by gender; while men did not discriminate their *joyful* score among wines, women reported significantly higher scores for *joyful* when consuming white wines and lower scores when consuming red wines. Similar behavior was observed in hedonic responses.

Figure 14. Consumer gender effect on (a) joyful and (b) hedonic. See table 1 for wine code description

Different PCA and cluster analyses by gender were successfully utilized to show the differences in ratings on elicited emotions between men and women. It can be observed that men (figure 12b) grouped white wine 2 and rosé wine 3 in the same cluster, whereas the other white wine was in a separate group. In the case of red wines, wines 4 and 5 were in the same group while wine 6 was separated. For women (figure 13b), wines 1 and 2 were grouped together, completely differently from men; wines 6 and 4 were clustered in the same group, while wines 3 and 5 were in independent groups.

3.2.2. Age group effect

Statistically significant differences among age groups were found. In general, older adults reported significantly higher scores in the emotional terms. Older adults reported higher significant values for *active, enthusiastic, good natured, joyful, loving, mild, nostalgic, pleasant, satisfied, understanding, warm* and *curious* than the young and middle-aged groups. For the term *interested*, it was observed that the older adults reported higher scores than the younger group, followed by the middle-aged group. Unclear and negative terms, such as *guilty* and *worried*, showed a different behavior pattern; here, older and middle-aged adults were not significantly different from each other but recorded higher ratings on those feelings than young adults.

Making a peer comparison between older adults, middle-aged and young adult groups, it could be seen that different emotions were elicited by wine for each age segment. For example, comparing older and middle-aged adults, older adults evoked significantly higher scores for *happy*, while older adults also recorded significantly higher ratings than young adults for *calm* and *good*.

Figure 15. Emotional profiles of the wine groups by age. a) Young adults. b) Middle-aged adults. c) Older adults. See table 1 for wine code description

As a result of the multivariate analysis by age segment, it was observed (figures 15 a, b y c) that for young adults, wines 1, 2 and 3 evoked higher feelings of *good*, *happy* and *pleasant*; in contrast, wine 5 elicited lower ratings on those emotions. However, older adults were more homogeneous; the most important differences between wines 1, 2 and 3 versus wine 5 were due to the emotion *mild*. While ratings for wines 1, 2 and 3 were close for other age segments, middle-aged adults' ratings for wine 3 were below wines 1 and 2 on positive emotions (see, for example, *good* and *pleasant* in figure 15b). These differences, based on the analysis of means by age segment, were also confirmed by the univariate analysis of some emotions (figure 16).

Figure 16. Consumer age group effect on a) happy, b) pleasant and c) mild. See table 1 for wine code description

Another interesting finding was the significant differences found by age for *guilty* (figure 15). Young adults (<35 years old) felt less *guilty* than middle-aged adults and adults (>35 years old) when consuming any of the wines. This could be linked to an increase in health concerns when the age of consumers increases.

4. DISCUSSION

The present study gathered information using a general lexicon for the influence of sensory properties and consumers' age and gender on the emotional response to wine. Findings showed the effectiveness of EsSense 25 to measure elicited emotions by wine, as well as the relationship between wine sensory attributes and emotional response. Also, gender and age differences in the emotional response towards wines were found; gender and age generated different clusterings of commercial wines.

Regarding the ability of general lexicons to measure emotions triggered by wines, this study showed that most emotional terms within the modified general emotional lexicon, EsSense25, were discriminating among wines, although 4 out of 26 were not discriminating at all: *adventurous*, *free*, *wild* and *worried*. This result is consistent with the research carried out by Silva, Jager, van Bommel, et al. (2016), where wine was associated with low arousal terms such as *calm*, *loving* and *comforted*. Also, Jiang et al. (2017), in their developed lexicon, found *adventurous* to be an insignificant emotion. On the contrary, Danner et al. (2016) found *adventurous* to be a significant emotion for Australian consumers of wine. This discrepancy could be explained by the work of van Zyl & Meiselman (2015), who reported the relevance of culture on emotional language. Cross-cultural differences could affect understanding of the emotional descriptors, even for consumers speaking the same language (van Zyl & Meiselman, 2016).

This is the first work to apply the EsSense25 general lexicon to study the emotional impact of different wines. Silva, Jager, Van Zyl, et al. (2016) compared two methods (Free Elicitation and EsSense Profile®) to study the emotional response towards beverages such as beer, wine and non-alcoholic beer. The authors found a more precise discrimination between beverages when using product-specific lexicons. Generic lexicons have been developed to be applied to a wide variety of products (King & Meiselman, 2010; Nestrud et al., 2016; D. M. H. Thomson & Crocker, 2013), but when looking at a specific product category, their effectiveness is somewhat reduced (Ng et al., 2013a). That is why product-specific emotional lexicons have been developed for some food products such as dark chocolate (Thomson et al., 2010), blackcurrant squashes (Ng et al., 2013), fruit salads (Manzocco et al., 2013), chocolate spreads (Spinelli et al., 2014), coffee (Bhumiratana et al., 2014) and beer (Chaya et al., 2015). Although previous works proposed a lexicon to study the emotional response elicited by wine (Danner et al., 2016; Ferrarini et al., 2010; Jiang et al., 2017; Silva, Jager, van Bommel, et al., 2016), they were created for Australian, Italian, and Dutch and Portuguese wine consumers, respectively. The obtained results are relevant for future works related to the development of a specific lexicon for Spanish wine consumers; specifically, the emotions that were non-effective in terms of discrimination in this context might be discarded. Future lexicons should take into account the term *curious* (added to EsSense 25 in the context of this research) as a discriminating emotion for Spanish consumers of wines.

Another important finding was the clear relationship between sensory descriptors and emotional response: within the set of wines analyzed, consumers associated more positive emotions with white wine attributes and more negative emotions with aged wine attributes. The findings could potentially be useful for product development as a way to increase consumer satisfaction (Laros & Steenkamp, 2005). To elicit specific emotions from products, a consonance among sensory characteristics and emotions must be established (Jager et al., 2014; Mojet et al., 2015; D. Thomson et al., 2010). Ferrarini et al. (2010) highlighted the link between the sensory and emotional characterization of wines as a way to generate different emotional profiles according to the types of wine.

Beyond emotional lexicons and how reported emotions are linked to sensory attributes, this research attempts to uncover the effect of gender and age in wine preferences and evoked emotions. The study conducted by King et al. (2010) demonstrated that women, on average, rated emotion intensities stronger than men, but this pattern depended on the type of product and sometimes it could be reversed. On the contrary, Chaya et al. (2015) showed in their study that beer products elicited higher emotion ratings in men than in women for the emotion categories Classic, Desire, Disappointment, Indifference,

Mildness and Nostalgia; this was reversed for the emotion category Intensity comprising the terms *intense, strong* and *powerful*. In the present study, men scored the terms *bored, calm, good natured, mild, satisfied, secure, tame* and *understanding* significantly higher than women. Some past studies have illustrated the same behavior: men reported stronger positive emotions for comfort foods (Dubé et al., 2005), meals (Edwards et al., 2013) and non-alcoholic wine (Parra et al., 2015) and recalled typical and memorable meals (Piqueras-Fiszman & Jaeger, 2015) at a higher rate than women. However, other works reported a different 'gender role', which was explained by women's tendency to express emotions at a higher level than men (Diener et al., 1985; King et al., 2010; Krings & Gordon, 1998).

A significant wine x gender interaction in hedonic response and the *joyful* emotion has been found, showing similar scores for all wines in men while a clear discrimination among wines is found for women. This finding confirms that products within the same product category elicit different responses for men and women. Although this differentiated behavior has only been found for the terms hedonic and joyful, it would be interesting to confirm if this pattern is reproduced or even widened with the use of a more specific lexicon for wine products and/or a larger consumer sample.

In addition to the effect of gender, an age effect on the emotional response of wines has been found. The results show that emotions are different in each age group. In general, older adults evoked higher scores than middle-aged and young adults in all of the significant emotional terms: *active, calm, enthusiastic, good, good natured, happy, interesting, joyful, loving, mild, nostalgic, pleasant, satisfied, understanding, warm* and *curious*. However, observing the wine clustering profile in each age group, young adults were more extreme and more discriminating among wines, while middle-aged adults presented more similar scores and fewer differences among wines and older adults separated wines by a much lower number of emotions. This result is in agreement with den Uijl, Jager, Zandstra, et al. (2016) and den Uijl, Jager, de Graaf, et al. (2016), who reported that age was an important factor when emotional responses elicited by olfaction were compared. Younger adults reported emotions that varied in pleasantness and activation, whereas older adults' emotions varied only in pleasantness (den Uijl, Jager, de Graaf, et al., 2016; den Uijl, Jager, Zandstra, et al., 2016; Montepare & Dobish, 2014). Looking at the young adults' emotional response, other authors noted that they had a more critical view of foods than that of older adults (Edwards, Hartwell, & Giboreau, 2016). Furthermore, Chaya et al. (2015), Dubé et al. (2005), and Piqueras-Fiszman et al. (2015) showed that older people reported more positive emotions than younger ones in response to beer and comfort foods and recalled typical and memorable meals, respectively. Another interesting finding was the significant differences found by age for *guilty*.

5. CONCLUSION

In conclusion, the commercial wine products tested were clearly different in terms of sensory profile and emotional response. A relationship between sensory properties and emotional response of wines was found.

Interestingly, the emotional responses evoked for different consumers' gender and age segments were clearly different. The wines evoked higher ratings on emotional response for men than for women. However, women were more discriminating among wines than men, according to their emotional response.

A completely different pattern between young adults and older adults was found. Older adults reported higher levels of emotion for wines in general, but young adults discriminated better among wines according to their emotional response. This segmentation could guide the development of new products as a function of the target consumer segment.

The development of an emotional lexicon specific to wine products would contribute to a better understanding of the emotional response. This work could help in the decision regarding which emotions could be (or not be) relevant for a wine emotional lexicon. Also, while the set of wines included in this study covers a wide style of wines, it is not sufficiently representative of wine product variation. Enlarging the wine sample set in order to cover a wider range of sensory properties is advised for future works. The combination of both a wider sensory variation and a wine-specific emotional lexicon could provide additional insights. Finally, other important factors, such as consumption context or other consumer traits (apart from gender and age), are additional research areas that should be explored in future studies.

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STUDY 2

Effect of personality on the emotional response elicited by wines

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Effect of personality on the emotional response elicited by wines

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KEYWORDS

Emotions, Feelings, Wine, Big Five Inventory, Neuroticism, Extraversion

HIGHLIGHTS

- Personality traits influenced hedonic and emotional response elicited by wine samples
- The most discriminating personality dimensions were Neuroticism and Extraversion
- Higher scores on Neuroticism were related with higher scores on negative emotions
- Higher scores on Extraversion were related to higher scores on positive emotions

ABSTRACT

Studies related to the measurement of the emotional response and its relationship with preferences and consumer behavior are gaining relevance in the last years. Some of them have highlighted the influence of individual factors, such as personality, on the evoked emotions. The current study examined the relationship between personality traits and the emotions elicited by different wine samples. Six wines were assessed by 175 consumers in terms of hedonic and emotional response, using 9-point scale and EsSense25 respectively. Consumers were clustered into four personality segments according to their personality traits which were determined using the Big Five Inventory method. Results showed an association between the psychological profile and the elicited emotions. A strong effect of personality on the emotional response elicited by the wine samples was found on 14 emotions. In addition, a significant effect was found for six emotions when studying the sample effect. The main relationships between personality and emotions were found in two consumers' segments: G1 characterized by higher ratings on the Neuroticism dimension, was more related to negative emotions than G4. On the contrary, G4, defined by higher ratings on Extraversion, Agreeableness, and Conscientiousness, was more related to positive emotions than G1. No significant interactions between wine and personality were identified, meaning that the effect of personality did not change significantly across wines. Splitting the consumers' panel depending on their personality profile allowed obtaining a deeper overview and a further understanding of the emotions evoked by wines.

2. INTRODUCTION

Success in product development is related to understanding how consumers act and how their behavior is defined. In the last years, sensory research has been extended towards the study of consumers' insights and some new methods have been proposed to investigate the influence of different factors in the decision-making process (Köster, 2009). Some of these factors are based on psychological concepts, and need to be considered to understand how eating and drinking behavior, and also food choice of consumers, are defined (Köster, 2009).

Mojet (2001) classified these psychological factors in three main groups: i) cognition, emotion, motivation, and decision-making, ii) memory, previous experiences, and learning, and iii) neophobia and personality traits. Emotional response has been one of the most studied psychological factors to understand consumers' food choice and preferences during the past decade (Prescott, 2017). Damasio (2006) reported that unconscious emotions played an important role in the decision-making process. Emotions elicited by odors and flavors are powerful drivers of behavior, key to promote preferences, and also to strengthen memories (Herz, 2005; Prescott, 2017; Sugiyama et al., 2015; Yeomans, Prescott, & Gould, 2009). However, few works have reported information about the influence of individual differences on emotions, which might be relevant in the decision making process (Köster, 2009; Prescott, 2017; Spinelli, 2017). Prescott (2017) pointed out that the expression of emotions could be affected by a wide variety of individual factors such as age, education, culture, socio-economic status, and personality. Up to date, just few works have studied these effects (Mora, Urdaneta, & Chaya, 2018; Torrico et al., 2018). Thus, to study consumer behavior and emotions, the *Fallacy of Uniformity* needs to be considered: *people's behavior differs in degree, but not in essence*. Köster (2009) put in evidence this fallacy arguing that studies which averaged consumers could provide misleading data when the results are based on bimodal or even multi-modal distributions that reflect different underlying behaviors. Personality might be one of these underlying individual factors leading to different behaviors.

In psychology, personality is described as traits which capture "patterns of thinking, feeling, and behaving" (APA, 2018). Authors such as Köster (2009) and Keller & Siegrist (2015), reported that personality could influence people's food choice. Keller et al. (2015) studied the effect of personality in consumers' food choices showing that individuals' personality significantly affected respondents' preferences for different kinds of products such as meat, fruit, vegetables, sweets, and savory foods. Other authors, as Spinelli et al. (2018) Robino et al. (2016), Byrnes & Hayes (2013), Ullrich, Touger-Decker, O'Sullivan-Maillet, & Tepper (2004) and Stone & Pangborn (1990) explored the influence of personality

traits on hedonic response. Spinelli et al. (2018) studied the role of personality on liking and choice of pungent foods, and found a relationship among different personality traits and liking. Personality traits which liked significantly more pungent foods were high sensitivity to reward, low food neophobia, low sensitivity to disgust, and low sensitivity to punishment. Also, Robino et al. (2016) confirmed the relationship among *alexithymia*, intensity perception, and acceptance of the bitter taste using PROP as stimulus. Regarding emotions, Prescott (2017) pointed out that personality traits, such as *granularity* or *alexithymia*, had an impact on the perceived or elicited emotions. Also, Scott, Burgess & Tepper (2019), Samant & Seo (2018), and Herz (2011) found that taste perception, hedonic and emotional responses were affected by the personality traits. Scott et al. (2019) found that the acceptance of pungent spices was highly related to 1) PROP taster status, 2) personality traits such as sensation seeking and food adventurousness, and 3) emotions as wellbeing and disgust.

One of the most popular structures to define personality traits is the “Big Five” or “Five Factors” Model (Goldberg, 1990). This model has five dimensions: Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N). The “Openness to experiences” factor is related to be open or skeptic to novelty, and to the flexibility in emotions and ideas. The “Conscientiousness” dimension refers to aptitude for being organized and hardworking. The “Extraversion” factor is described by the inclination to be sociable and extraverted. The “Agreeableness” dimension is related to traits that define whether an individual is cooperative, and sympathetic. The last factor “Neuroticism” includes aptitudes related to emotional instability.

Many authors such as Letzring & Adamcik (2015) and DeNeve & Cooper (1998) studied the relationship between the Big Five and emotions or affects. Their findings showed that the Extraversion dimension was positively related to positive affect or emotions, and the Neuroticism dimension was positively related to negative affect or emotions. This relationship was investigated also by Larsen & Ketelaar (1991) who concluded that extraverts were more receptive to positive mood induction such as rewards, and neurotics were more receptive to negative mood induction such as punishments. Also, Letzring & Adamcik (2015) examined the relationship of the negative and positive affects with the other Big Five traits, revealing that Agreeableness was negatively related to negative affect or emotions, while Conscientiousness and Openness were positively related to positive affect or emotions. In relation with the study of the personality’s effect on the food elicited emotions, Samant & Seo (2018) provided evidences that the traits Extraversion and Neuroticism affected the emotional responses and contributed to predict overall liking and preferences of basic taste stimuli.

The hypothesis of the present study was that personality had an impact on the emotions elicited by wines. Thus, the main objective on the present study was to find out the relationship between personality traits and emotional responses elicited by different wine samples. Up to date, no studies have been published which provide data related to the effect of the Big Five traits on liking and emotional response elicited by commercial beverages.

3. MATERIALS AND METHODS

3.2. Wines selection

Wines selection (table 12) was based on three different criteria to cover a wide range of sensory properties: 1) type of wine, 2) type of grape and 3) wine ageing. Wines were characterized by a trained panel. The descriptive analysis was previously reported in Mora, Urdaneta, & Chaya (2018).

Table 12. Description of wine samples used in the present study

Code	Type of wine	Grape	Aging	PDO	Alcohol content v/v (%)
1	White	Verdejo	Young (2015)	Rueda	13.5
2	White	Chardonnay	Young (2015)	Navarra	13
3	Rosé	Garnacha	Young (2015)	Navarra	13.5
4	Red	Tempranillo	Reserva (2012)	Rioja	12.5
5	Red	Tempranillo	Reserva (2013)	Rioja	13.5
6	Red	Tempranillo	Reserva (2012)	Ribera del Duero	14

NOTE: see Mora et al. (2018), for sensory description

3.3. Consumer evaluation

A consumer panel of 175 volunteers, 48% men ($n = 84$) and 52% women ($n = 91$), range age from 18 to 70 years old, was recruited to conduct the consumer study. The screening was conducted taking into consideration that participants had to consume wine at least once per month. All tests were conducted in the tasting room of the Universidad Politécnica de Madrid. The room is equipped with individual booths and controlled light and temperature conditions (21°C).

The tasting day, consumers were first asked to fill out a sociodemographic form. Second, they completed the Big Five Inventory questionnaire (BFI) (John & Srivastava, 1999). The BFI is a self-reported questionnaire designed to measure the Big Five dimensions of the personality: Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N). Participants were asked to rate the 44 statements of the BFI (table 13) on a 5-point scale (from 1 = strongly disagree to 5 = strongly agree). A Spanish translated version of the questionnaire was provided by Berkeley Personality Lab (John,

2007). Because the questionnaire was translated into a Latin-American Spanish, a slight modification was done to adapt the questionnaire for Spaniards (back-translation procedure). Cronbach's alpha was used to confirm the internal consistency of the different dimensions.

Table 13. Big Five Inventory items

	Original questionnaire*	Translated questionnaire**
1	Is talkative	Es locuaz, comunicativo
2	Tends to find fault with others	Tiende a ser criticón
3	Does a thorough job	Es minucioso en el trabajo
4	Is depressed, blue	Es depresivo, melancólico
5	Is original, comes up with new ideas	Es original, se le ocurren ideas nuevas
6	Is reserved	Es reservado
7	Is helpful and unselfish with others	Es generoso y ayuda a los demás***
8	Can be somewhat careless	Puede a veces ser algo descuidado
9	Is relaxed, handles stress well	Es calmado, controla bien el estrés
10	Is curious about many different things	Tiene intereses muy diversos***
11	Is full of energy	Está lleno de energía
12	Starts quarrels with others	Inicia disputas con los demás
13	Is a reliable worker	Es un trabajador cumplidor digno de confianza
14	Can be tense	Con frecuencia se pone tenso***
15	Is ingenious, a deep thinker	Es ingenioso, analítico***
16	Generates a lot of enthusiasm	Irradia entusiasmo***
17	Has a forgiving nature	Es indulgente, no le cuesta perdonar***
18	Tends to be disorganized	Tiende a ser desorganizado
19	Worries a lot	Se preocupa mucho por las cosas
20	Has an active imagination	Tiene una imaginación activa
21	Tends to be quiet	Tiende a ser callado
22	Is generally trusting	Es generalmente confiado
23	Tends to be lazy	Tiende a ser perezoso
24	Is emotionally stable, not easily upset	Es emocionalmente estable, difícil de alterar
25	Is inventive	Es inventivo
26	Has an assertive personality	Es asertivo, no teme expresar lo que opina
27	Can be cold and aloof	Es a veces frío y distante
28	Perseveres until the task is finished	Persevera hasta terminar el trabajo
29	Can be moody	Es voluble, de humor cambiante
30	Values artistic, aesthetic experiences	Valora lo artístico, lo estético***
31	Is sometimes shy, inhibited	Es a veces tímido, cohibido
32	Is considerate and kind to almost everyone	Es considerado y amable con casi todo el mundo
33	Does things efficiently	Hace las cosas de manera eficiente
34	Remains calm in tense situations	Mantiene la calma en situaciones difíciles***
35	Prefers work that is routine	Prefiere trabajos que son rutinarios
36	Is outgoing, sociable	Es extrovertido, sociable
37	Is sometimes rude to others	Es a veces maleducado con los demás
38	Makes plans and follows through with them	Hace planes y los lleva a cabo
39	Gets nervous easily	Se pone nervioso con facilidad
40	Likes to reflect, play with ideas	Le gusta reflexionar, jugar con las ideas
41	Has few artistic interests	Tiene pocos intereses artísticos
42	Likes to cooperate with others	Le gusta cooperar con los demás
43	Is easily distracted	Se distrae con facilidad
44	Is sophisticated in art, music, or literature	Tiene conocimientos de arte música o literatura

*Source: John, O. P., & Srivastava, S. (1999) **Source: John, O. P. (2007) ***Back-translated terms to Spaniards consumers

After completing the forms, wine samples (15 ml) were served simultaneously, all of them labelled with three-digit random codes. The first sample was always the same and was used as a warm-up sample to avoid the first position effect (Dorado, Pérez-Hugalde, et al., 2016; Wakeling & MacFie, 1995). The presentation order of the other six wine samples was randomly assigned. After tasting each wine, consumers were asked to rate their liking degree using a 9-point hedonic scale, anchored at: 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. Then, consumers were asked to rate the emotions elicited by the sample, because it has been suggested that rating emotions before liking could bias the hedonic score (King et al., 2013).

For the emotions questionnaire, a Spanish validated version of the EsSense25 (Dorado, Pérez-Hugalde, et al., 2016; Nestrud et al., 2016) was used to study consumers' response. An additional term, "curious", was included because it was reported to be an important emotion elicited by wine (Cuesta et al., 2010). FIZZ software (Biosystemes, Dijon, France) was used to create the questionnaire and collect the data. Emotions were randomized for each consumer, but the same order was always kept for each consumer across the different samples. Each emotion was rated on a 10 cm linear scale anchored at 0.5 cm from the line ends, from "very low" to "very high". Water and breadsticks were provided for palate cleansing between samples, and consumers were asked to wait for a minimum of 1 minute between products to minimize carry-over effects.

3.4. Data Analysis

As described above, BFI questionnaire contained 44 items classified into five different dimensions. Internal consistency of each dimension was verified by means of the Cronbach's alpha (values > 0,8). Means of every dimension were computed for each consumer and a matrix was built: consumers were the "observations" (rows) and the dimensions were the "variables" (columns). Individual consumer ratings on the aggregated BFI dimensions were input to Hierarchical Cluster Analysis (HCA). Consumers were grouped in clusters using Euclidean distance and the Ward's criterion to obtain personality consumers' groups. χ^2 tests were used to verify the independence of the consumers' distribution of personality groups by age and gender. XLSTAT (2018.7 version, New York, USA) (Addinsoft, 2019) was used to conduct the analysis. Significant differences among personality groups were verified by 1-way ANOVA performed on each personality dimension. Personality group was the main factor and consumers'

means of each personality dimension were the dependent variables. Statgraphics (Centurion XVII version, The Plains, VA, USA) was used to conduct the analysis.

To compare the effect of personality on liking and emotional response elicited by wines, 2-way ANOVAs followed by Tukey test were performed for the significant factors. The factors “wine” and “personality group”, and the 2-way interaction “wine*personality group” were included in the 2-way ANOVA models. Statgraphics (Centurion XVII version, The Plains, VA, USA) was used to conduct the analysis.

To summarize the emotional map elicited by the samples, and relate it to the personality dimensions, a Principal Component Analysis (PCA) was carried out using the means of the significantly different emotions identified among consumers’ personality segments. XLSTAT (2018.7 version, New York, USA)(Addinsoft, 2019) was used to conduct the analysis.

4. RESULTS

4.2. Effect of wine samples on the hedonic and emotional response of consumers

The univariate analysis showed that a significant effect of wine was found on the hedonic response ($p < 0.05$). Also, the effect of wine samples in the elicited emotions was significant on 5 of the 26 evaluated emotions: *aggressive*, *happy*, *joyful*, *mild*, and *pleasant* (table 14).

Table 14. p-values of the 2-way ANOVA on hedonic and emotional response

Items	Wine	Personality	Wine* Personality
Hedonic	0,0332*	0,0170*	0,8946
Active	0,6680	0,0360*	0,3665
Adventurous	0,6219	0,0001**	0,7666
Aggressive	<0,0001**	0,3625	0,9557
Bored	0,9258	0,0008**	0,2106
Calm	0,6962	0,3054	0,8143
Disgusted	0,5223	0,0250*	0,7520
Enthusiastic	0,2812	0,0061**	0,7502
Free	0,2129	0,0405*	0,7496
Good	0,0597	0,2294	0,8587
Good natured	0,2342	0,5373	0,9986
Guilty	0,9541	0,2194	0,8862
Happy	0,0403*	0,0006**	0,9679
Interested	0,4164	0,2820	0,5149
Joyful	0,0316*	0,0002**	0,9942
Loving	0,4720	0,0028**	0,9342
Mild	<0,0001**	0,0688	0,8608

*, ** significant $p \leq 0.05$, $p \leq 0.01$ respectively

Table 14. Continuation

Items	Wine	Personality	Wine* Personality
Nostalgic	0,7380	0,9230	0,9547
Pleasant	0,0177*	0,0044**	0,7658
Satisfied	0,5592	0,0008**	0,8522
Secure	0,5907	0,4450	0,4919
Tame	0,2606	0,0153*	0,8176
Understanding	0,4451	0,7114	0,9417
Warm	0,3781	0,0005**	0,8153
Wild	0,3693	0,1468	0,6527
Worried	0,5741	0,0013**	0,9574
Curious	0,3774	0,2434	0,6155

*, ** significant $p \leq 0.05$, $p \leq 0.01$ respectively

4.3. Effect of consumers' personality on the hedonic and emotional response elicited by wines

Consumers were grouped, depending on their personality, using the results of the BFI questionnaire. Hierarchical Cluster Analysis segmented consumers into four clusters: G1 (n=20), G2 (n=70), G3 (n=46), and G4 (n=37) (figure 17).

Figure 17. Dendrogram of the cluster analysis of consumers based on the BFI dimensions

Although ANOVA and Tukey tests revealed that all dimensions were significantly different between consumers' groups (table 15), the main differences on personality were found between two groups: G1,

characterized by rating higher scores in the Neuroticism dimension and lower on Extraversion and Agreeableness, and G4, characterized by rating higher scores on the Extraversion, Agreeableness, and Conscientiousness dimensions and lower on Neuroticism. Clusters 2 and 3 presented in-between characteristics. The Chi square test revealed independence of the personality groups consumers' distribution by age and gender (p-values 0.28 and 0.91 respectively).

Table 15. Results of ANOVA and Tukey test of personality group (G1 to G4) on the dimensions of the Big Five

Dimension	p-value	G1	G2	G3	G4
Extraversion	<0,0001	3,35 a	4,22 b	5,08 c	5,72 d
Agreeableness	<0,0001	4,00 a	5,56 c	5,11 b	6,03 d
Conscientiousness	<0,0001	4,90 ab	5,11 b	4,47 a	5,73 c
Neuroticism	<0,0001	4,46 c	3,42 b	4,24 c	2,98 a
Openness	<0,0001	4,42 a	4,82 ab	5,09 b	5,84 c

Groups not sharing the same letter within the same row (dimension) are significantly different (p-value $\leq$ 0.05)

Figure 18. Effect of the personality group (G1 to G4) on liking. Personality groups not sharing the same letter are significantly different (p-value $\leq$ 0.05)

ANOVA results showed a strong effect of the personality group on liking and on 14 positive and negative emotions: *active, adventurous, bored, disgusted, enthusiastic, free, happy, joyful, loving, pleasant, satisfied, tame, warm* and *worried* (table 14). Regarding to the hedonic response, figure 18 shows that G4 reported higher ratings in liking if compared with G1. Clusters G1 and G4 showed reverse behavior in the elicited emotions: positive emotions such as *active, adventurous, enthusiastic, happy, joyful, loving, satisfied*, and *warm* received higher scores by group 4 (e.g.: Enthusiastic figure 19a), meanwhile

personality group 1 rated with significantly higher scores negative emotions such as *bored*, *worried*, and *disgusted* (e.g.: Bored figure 19b).

Figure 19. Effect of the personality group (G1 to G4) on the emotions enthusiastic (a) and bored (b) elicited by wine samples. Personality groups not sharing the same letter are significantly different (p -value ≤ 0.05)

No statistically significant interactions between wine and personality segments on the hedonic and emotional response were found (table 14). The effect of personality in the emotions elicited by wine did not change significantly across wines. Figure 20 shows an example of the effect of personality on *loving* emotion. Hedonic and emotional response to all wines by the different personality groups of consumers can be found in supplementary materials (Annex II).

Figure 20. Effect of personality group (G1 to G4) on loving emotion evoked by the different wine samples. Personality groups not sharing the same letter are significantly different (p -value ≤ 0.05)

The PCA showed a relationship between the emotions elicited by all wines and the different consumers' personality groups. The first two Principal Components of the PCA explained 97.46% of the data variance.

Figure 21 biplot shows the projection of the personality groups, and the correlation of emotions with the first two principal components (PC1 and PC2). PC1, with higher contributions of G4 (69.7%) and G1 (21.9%), seems to follow a general trend, apparently separating negative (*aggressive, worried, disgusted, bored* and *tame*) from positive (*enthusiastic, adventurous, active, loving, joyful, satisfied, free, pleasant, happy, warm* and *mild*) emotions. It is to note that emotional terms included in the analysis were significantly different across personality groups. G1, characterized by higher ratings on Neuroticism dimension, was located closer to the negative emotions than G4. On the contrary, G1, characterized by having higher ratings on Extraversion, Agreeableness, and Conscientiousness, was positioned closer to the positive emotions. The first dimension (88.61%) was positively correlated with pleasant emotions such as *satisfied* (0.979), *happy* (0.975), *pleasant* (0.953), and *enthusiastic* (0.881), and negatively correlated to unpleasant emotions, such as *disgusted* (-0.991), *worried* (-0.955), *bored* (-0.890) and *aggressive* (-0.921). The second dimension (8.85%) was correlated to the level of engagement/activation of the emotions. It was positively correlated to less engaging/activated emotions such as *tame* (0.571), and negatively correlated to more engaging/activated emotions such as *adventurous* (-0.413).

Figure 21. Principal Component Analysis biplot of personality groups and emotions

5. DISCUSSION

The aim of this research was to investigate the influence of consumers' personality on the emotions elicited by products such as wine. Results showed an association among the psychological profile, the hedonic response, and the elicited emotions.

The present study revealed a personality effect on the hedonic response. Samant & Seo (2018) did not find significant differences between personality clusters, high neuroticism and high extraversion, in the liking of basic taste solutions. Differences between both studies could be due to the nature and complexity of the stimuli. The present study was carried out with commercial wines, with very different profiles on appearance, taste, aroma and aftertaste attributes. Less complex stimuli, such as the basic taste solutions used by Samant & Seo (2018), could be less affected by personality traits. Future studies could confirm the relationship between complexity of the stimuli and personality effect on the hedonic response.

In the same study conducted by Samant & Seo (2019) an effect of personality on emotions elicited by basic taste solutions was found. The present study is the first one conducted with commercial products investigating emotions and personality traits. Results showed that G4 reported higher ratings on positive emotions, while G1 reported higher scores on negative emotions. This response could be related with the Neuroticism and the Extraversion dimensions: Neuroticism was rated higher by G1 and lower by G4, and Extraversion was scored higher by G4 than by G1. These results were consistent with the studies carried out by Ng (2009) and Larsen & Ketelaar (1991), who found that people high in Neuroticism reacted more strongly to negative stimuli than those low in Neuroticism, and those with high Extraversion reacted more strongly to positive stimuli. Ng (2009) also found that individuals high in neuroticism showed a significant decrease on positive emotions in an unpleasant situation. The author pointed out the need to investigate across pleasant situations of differing intensities (from neutral to extremely pleasant), and to confirm the effect of neuroticism personality on positive emotions. He proposed to use a more comprehensive measure, including more emotions (he only used the terms: happiness, relief, satisfaction and pride) which comprised a wider activation range. Also, Letzring & Adamcik (2015), DeNeve & Cooper (1998), and Tellegen (1985) stated that Neuroticism was positively correlated with negative affect and Extraversion was positively correlated with positive affect. Therefore, results of the present study confirmed the previous findings and emphasize the idea that the personality traits Extraversion and Neuroticism have an important influence on the emotional response (either negative or positive feelings).

Although the univariate analysis showed an effect of personality on the elicited emotions, no interactions between wine and personality segments were found. Results of the present study provided a more detailed description of the emotional response elicited by wine than the ones reported by Mora et al. (2018). Segmenting in personality groups allowed detecting another source of variation into the data, providing further and deeper understanding of the evoked emotions. Once it is verified, if this effect is not taken into consideration, the discriminant power of other effects could be decreased. Samant & Seo (2018) reported similar results, these authors found that personality traits related to Extraversion and Neuroticism affected the measurement of emotional responses, and contributed to a better prediction of liking of basic taste stimuli. However, the statistically significant personality effect does not mean causality. More research is needed to investigate the nature of relationship between personality and emotional response.

The Principal Component Analysis of the emotions elicited by wine in the personality groups showed that the projection of the emotions followed the circumplex model of emotions (Larsen & Diener, 1992; Russel, 1980; Watson & Tellegen, 1985), where pleasantness (horizontal axis) and engaging/activation (vertical axis) summarized the multidimensional emotional response. In this research, the term *tame* was located closer to negative emotions, while the term *mild* was closer to positive emotions. The classification of those terms by King & Meiselman (2010) was unclear, and the authors found different results depending on the product category. Results suggested that the classification of those terms might be affected by the personality traits of consumers.

The present study used EsSense25 to study the relationship between the emotional response and the personality. Considering the studied effects, results showed that 16 of the 26 emotions discriminated significantly among samples and personality groups: *active, adventurous, aggressive, bored, disgusted, enthusiastic, free, happy, joyful, loving, mild, pleasant, satisfied, tame, warm* and *worried*. Generic lexicons (King & Meiselman, 2010; Nestrud et al., 2016; D. M. H. Thomson & Crocker, 2013), such as EsSense25, have been developed to measure emotions elicited by the consumption of food products, but not for a specific product category. When studying specific product categories, the effectiveness could be slightly reduced. Up to date, the only work comparing general vs product specific lexicon on wine was the one published by Silva et al. (2016). These authors compared two methods, Free Elicitation and EsSense Profile®, concluding that a better discrimination was achieved in beer, wine, and non-alcoholic beer when using product specific emotional lexicons.

A product specific emotional lexicon should be used in future studies to confirm the association between personality traits and emotional response elicited by wines. The present research used a set of Spanish commercial wines, but more research is needed with a wider variety of wine samples and/or with other product categories to confirm the reported differences on consumers' personality segments.

6. CONCLUSIONS

This research was a starting point for understanding the association between product elicited feelings/emotions and personality. The main conclusion of the present study was that some personality traits (neuroticism and extraversion) could have an effect on the emotional response elicited by wine.

Clustering consumers depending on their personality might improve discrimination power of the analysis of the emotional response elicited by wines. Including this information in consumer studies could provide a deeper and further overview of the emotional response elicited by wine and/or other product categories. In particular, findings of this study should be confirmed with other product categories and/or other emotional lexicons, such as specific lexicons for wines.

BFI has proved to provide an easy way of segmenting consumers, but more research is needed to get a deeper knowledge of the effect of personality on self-reported feelings and to confirm our findings related to the neuroticism vs extraverted dimension. Our results suggested that including the BFI in the screening of consumers could improve the consumers' discrimination in terms of liking and elicited emotional responses. Extraversion and Neuroticism dimensions were the personality traits more closely linked with feelings and emotions, therefore, these dimensions seemed to be the main ones to focus on further affective consumer studies.

7. ACKNOWLEDGEMENTS

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STUDY 3

Improvement of an emotional lexicon for the evaluation of beers

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Improvement of an emotional lexicon for the evaluation of beers

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KEYWORDS

Emotion; Lexicon; Beer; Consumers.

HIGHLIGHTS

- An improved consumer-defined emotional lexicon has been generated and tested.
- Emotional response evoked by beer products has been successfully assessed.
- The improved lexicon is more user-friendly for consumers.

ABSTRACT

Emotional response has been the subject of many studies during the last years. Many studies have shown the importance of using consumers to generate emotional lexicons. Chaya et al. (2015) developed a consumer defined (CD) lexicon to assess emotional response elicited by beer products. Shortly after, van Zyl et al. (2015) presented a procedure to ensure that emotional lists were fully composed by emotions. The present research was developed to improve and test the lexicon developed by Chaya et al. (2015) following the approach proposed by van Zyl et al. (2015). The proposed procedure allowed an easy filtering of terms for the study of emotional response. As a consequence, the test was shorter, clearer, and easier to understand and to complete by consumers. The improved emotional lexicon of beer favored 1) the efficiency of the research in terms of discrimination among samples, 2) the simplicity of use by the consumers.

1. INTRODUCTION

The study of consumer emotional response elicited by food products has increased during the last years. Many methods have been developed to study emotions evoked by food and beverages. EsSense Profile™ (King & Meiselman, 2010) was the first emotional lexicon developed to measure emotions related to food products consumption and illustrated a methodological advance in consumer testing. Although this emotional lexicon was recommended to determine the emotions elicited by food products, authors also recommended to adapt this lexicon to the food category. Since EsSense Profile™ was published, several methods to measure emotional response have been developed and improved. For example, Ng, Chaya, & Hort (2013a) highlighted in their study the importance of a consumer defined lexicon as compared with EsSense Profile™. The authors showed that a consumer defined lexicon was a list of positive and negative emotions more specific to the product category than the EsSense Profile™. Spinelli, Masi, Dinnella, Zoboli, & Monteleone (2014) used a list of full sentences for the study of cacao and hazelnuts spreads, instead of a list of specific emotional terms. This method, called EmoSemio, resulted in reduced ambiguity and improved understanding by the consumers.

Regarding the study of emotional response to beer products, different authors have used diverse lexicons and methods to analyze the emotions elicited by beers. Chaya et al. (2015) developed, using consumers' focus groups methodology, the first published beer specific lexicon for the Spanish population and grouped a lexicon of 44 single terms into 12 emotional categories. Using the same approach, Eaton (2015) established an English version for British beer consumers. Ng et al. (2013a) had previously developed an emotional lexicon for black currant squashes using direct-one-to-one interviews with individual consumers. The focus groups methodology proved to be more efficient than the method developed by Ng et al. (2013a), but the effort needed to generate consumer defined lexicons was still considerable. Silva, Jager, van Bommel, et al. (2016) also developed consumer led lexicons for beer Dutch and Portuguese consumers by means of focus groups. Cardello et al. (2016) and Jaeger et al. (2017) successfully applied a variant of the 12-point emotion circumplex method of Yik, Russell, & Steiger (2011) in an attempt to reduce the time/effort to capture emotions related to beer.

In addition to the works mentioned above, other authors have developed consumer defined emotional lexicons for specific product categories, such as chocolate spreads (Spinelli et al., 2014), coffee (Bhumiratana et al., 2014), and wine (Danner et al., 2016; Silva, Jager, van Bommel, et al., 2016). Van Zyl (2016) provides a detailed list of lexicons applied in beverages in tables 19.3a to 19.3d.

In general, emotional lexicons are difficult to generate, they have to be understandable and clear to consumers, and relevant to the product category (Gmuer et al., 2015). One of the clues is to ensure that the terms generated by the consumers are true feelings. Van Zyl & Meiselman (2015) proposed some basic rules for a procedure for the development of consumer defined emotion lists. The authors proposed checking that the terms generated by the consumers are found on the lists of Laros & Steenkamp (2005) and Clore, Ortony, & Foss (1987). However, to date no references can be found using the procedure proposed by van Zyl & Meiselman (2015) as a guide to ensure the suitability of the emotional terms generated by consumers.

This study aimed to improve and test the Spanish consumer beer lexicon developed by Chaya et al. (2015), following the procedure proposed by van Zyl & Meiselman (2015).

2. MATERIALS AND METHODS

2.1. *Improvement of the emotional lexicon*

This research is based on a previous study presented by Chaya et al. (2015). The approach is summarized in figure 22.

2.1.1. Samples

For the present study, samples and sample preparation were the same as reported in Chaya et al. (2015) (Table 16). Two samples were 'control' commercial beer samples, one of which was a commercial non-alcoholic beer. The other eight samples were based upon the control samples and were each manipulated in a single sensory property. Several sensory properties were chosen to represent key characteristic properties of beer (e.g. bitterness, hoppiness, etc.) whilst others reflected off-flavors and/or hypothesized drivers of emotional response (e.g. isoamyl acetate, dimethyl sulfide (DMS)). The commercial beers were modified using ethanol (Merck Chemicals Ltd, UK), dextrose (Myprotein, UK), specific flavor capsules (Cara Technology, UK), or controlled decarbonation. All 10 samples had been evaluated by the University of Nottingham's trained expert beer panel who had rated each sample for the 8 sensory properties of interest (data not shown).

Figure 22. Step by step approach for developing the beer consumer defined lexicon

The assessments revealed significant differences between the spiked and control samples, indicating that the samples differed in their sensory properties. From these results, it was anticipated that subjects in subsequent studies would perceive the differences in relevant sensory properties across samples. Samples were prepared by adding the relevant materials to samples and 10 ml decanted into transparent closed screw cap universal containers 2–4 h before assessment by consumers. This was with the exception of the Low CO₂ samples which was decarbonated by leaving open and refrigerated (4 ± 1 C) for 3 h before re-sealing. Low CO₂ samples were then decanted just prior to consumer assessment. Products were presented blind (labelled with three-digit random codes) at 4 ± 1 C. Unsalted crackers (Carrefour, Spain) and mineral water (Fuente Liviana, Spain) were provided as palate cleansers.

Table 16. Samples and treatments used

Sample	Treatment
1 Control	Commercial lager
2 Hoppy	0.75 mg kettle hop extract (AROXA TM)/litre commercial lager
3 Light struck	0.3 µg 3-methyl-2-butene-1-thiol (AROXA TM)/litre commercial lager
4 Isoamyl acetate	10.5 mg isoamyl acetate (AROXA TM)/litre commercial lager
5 DMS	0.9 mg dimethyl sulfide (AROXA TM)/litre commercial lager
6 Bitter	25 mg iso-α-acids (AROXA TM)/litre commercial lager
7 Sweet	25 g dextrose/litre commercial lager
8 Low CO ₂	Commercial lager decarbonated to ~1.6 units
9 Non-alcohol control	Commercial non-alcohol lager
10 High alcohol	96% ethanol added to commercial non-alcohol lager (8% ABV)

2.1.2. Procedure to improve the lexicon and terms grouping

The initial list of the emotional terms generated by the focus groups in Chaya et al. (2015) (table 17) was checked and verified following the method of van Zyl & Meiselman (2015). It was compared with the emotional lists published by Clore et al. (1987) and Laros & Steenkamp (2005) containing 564 and 50 terms respectively. The initial terms not included in those lists were discarded.

After the terms were verified on the emotional list, beer samples were evaluated by a panel of 17 subjects. The subjects tasted the beer samples and rated each evoked emotional term. A warm-up sample (the same as control) was tasted and rated to minimize first position effect (Dorado, Pérez-Hugalde, et al., 2016). Then, 10 beer samples were served in random order according to a Balanced Incomplete Block design. Rating was done on a 15 cm continuous line scale anchored at 1.5 cm from the line ends from 'very low' to 'very high'. To minimize bias, emotion terms were presented in a randomized order for each consumer.

A Hierarchical Cluster Analysis was applied on the average ratings for each emotional term of the 10 beer samples (Chaya et al., 2015) to group similar emotions into categories according to the consumers' assessment of the beer samples. Terms were grouped using Euclidean distance and the Ward's criterion of aggregation (XLSTAT Version 2009.6.03, Addinsoft, USA).

Table 17. Original emotion lexicon proposed by Chaya et al. (2015) in Spanish and English

Spanish		English	
Suave	Ligero/suave/flojo	Mildness	Mild
Indiferencia	Aburrido/ Indiferente	Indifference	Bored/ indifferent
Placer	Agradable/amigoso/ Apetecible/placentero/ Positivo/relajado/ tranquilo/ fresco/ satisfecho/conforme	Pleasure	Nice/friendly/ appetized/ agreeable/ positive/relaxed/ fresh/pleasant/ satisfied
Clásico	Auténtico/esperado/ clásico/natural/ normal/tradicional	Classic	Authentic/ classic/natural/ normal/ traditional
Diversión	Alegre/contento/animado chispeante/divertido curioso/festivo /	Fun	Happy/lively/ curious/festive/ enjoyment
Deseo	Deseoso/ansioso	Desire	Eager

Table 17. Continuation

Spanish		English	
Disgusto/ Negatividad	Asqueado/disgustado/ contrariado/ desagradable/ desmotivado/ engañado/ indeseable/ mal/negativo/ reacio/rechazo/ Repulsion	Disgust/ Negative feelings	Disgusted/ annoyed/ unpleasant/ unmotivated/ cheated/bad/ objectionable/ negative/ repulsed/ shocked
Desilusión	Desilusionado/ extrañado desencantado/inesperado Sorprendido negativamente/ raro/ atípico/inapetente	Disillusionment	Disillusioned/ disenchanted/ unusual lacking in appetite
Decepción	Decepcionado/ incómodo/ Inatifecho	Disappointment	Disappointed/ uncomfortable/ dissatisfied
Intensidad	Fuerte/potente/ Intenso	Intensity	Strong/ powerful/ intense
Nostalgia	Nostalgico	Nostalgia	Nostalgic
Entusiasmo	entusiasmado/ Emocionado	Excitement	Excited

2.2. Test of the improved lexicon

2.2.1. Subjects

A panel of 83 Spanish beer consumers (aged 18-60), who consumed beer at least once a week, participated in the tests of the new lexicon. Each consumer rated their liking and their emotional response to the 10 beer samples.

2.2.2. Testing procedure

To test the improved lexicon, the warm-up sample and the beer samples were served, randomizing the 10 samples according to a Balanced Incomplete Block design. After tasting each sample, consumers were first asked to rate the overall liking on a 9-point scale. Then, they had to read all of the terms associated with each emotion category, and to rate the intensity of their feelings on a 15 cm linear scale, anchored at 0.5 cm from the line ends from “very low” to “very high”. To minimize bias, the order of emotion categories was randomized for each consumer.

2.2.3. Consumer data analysis

Responses to the emotional terms were input to mixed ANOVA using beer samples as a fixed effect and consumer as a random effect. Post-hoc tests for sample effect were conducted using Tukey's HSD (Statgraphics Centurion XVII version).

Principal Components Analysis (correlation matrix) was performed on the average ratings of each emotion category to explore relationships between emotion categories and beer samples (XLSTAT 2014.6.05 version). Liking was used as supplementary (non- active) variable in the analysis.

3. RESULTS Y DISCUSSION

3.1. Improved lexicon

From the 44 terms of the emotional lexicon used in Chaya et al. (2015), a list of 28 words was kept, as shown in table 18.

The terms not included in Clore et al. (1987) and Laros & Steenkamp (2005) and hence excluded from the lexicon of Chaya et al. (2015) were: *Agreeable, Appetized, Authentic, Classic, Disenchanted, Fresh, Intense, Lacking in appetite, Natural, Negative, Nice, Normal, Objectionable, Repulsed, Traditional, Unpleasant and Unusual.*

Table 18. Modified emotion lexicon in Spanish and English

Spanish		English	
Ligereza	Ligero/suave/flojo	Mildness	Mild
Indiferencia	Aburrido/ Indiferente	Indifference	Bored/ indifferent
Placer	Amistoso/ Placentero/positivo/ tranquilo/relajado/ satisfecho	pleasure	Friendly/ pleasant/ positive/ relaxed/ satisfied
Diversión	Alegre/contento/ Chispeante/animado/ Curioso/divertido/ festivo	Fun	Happy/lively/ curious/ festive/ enjoyment
Deseo	Deseoso	Desire	Eager
Disgusto	Asqueado/disgustado, Contrariado/ Mal	Disgust	Disgusted/ annoyed/ bad

Table 18. Continuation

Spanish		English	
Decepción	Decepcionado/	Disappointment	Disappointed/
	Incómodo/		uncomfortable/
	Desmotivado/		unmotivated/
	Engañado/ inesperado/		cheated/
	Sorprendido/ negativamente		shocked
Insatisfacción	Desilusionado/ insatisfecho	Dissatisfaction	Disillusioned/ dissatisfied
Entusiasmo	Emocionado	Excitement	Excited
Nostalgia	Nostálgico	Nostalgia	Nostalgic
Vigor	Fuerte/potente	Vigour	Strong/ powerful

The cluster analysis of mean ratings of the remaining emotional terms resulted in 11 clusters. These clusters were reviewed with the aim of avoiding confusion and ambiguities, and therefore some words or categories were modified. For example, INTENSITY category (table 17), with which consumers had some problems in the previous lexicon, was renamed VIGOUR (table 18). The final clusters were: VIGOUR, MILDNESS, DISSATISFACTION, INDIFFERENCE, EXCITEMENT, PLEASURE, NOSTALGIA, FUN, DISSAPOINTMENT, DESIRE and DISGUST.

The initial Chaya et al. (2015) lexicon underwent several changes:

- CLASSIC cluster, consisting of terms *Authentic, Classic, Natural, Normal* and *Traditional*, was discarded.
- Clusters generated with the new data led to the movement of some emotions from one category to another: *Cheated, Shocked* and *Unmotivated* moved into the new cluster DISAPPOINTMENT.
- The group named DISILLUSIONMENT was changed into DISSATISFACTION, which included the emotional terms *Disillusioned* and *Dissatisfied*.

3.2. Discrimination power of the improved lexicon

Univariate analysis showed that all emotion categories discriminated between samples. Post hoc analyses identified different groupings for each emotion category among beers (table 19).

Figure 23. Principal Component Analysis of beer samples by emotion categories a) Correlation between the emotion categories and the first two Principal Components (liking is included as supplementary -non active- variable). b) Samples projection on the first factorial plot

Post Hoc analyses allowed identifying the link between emotional categories and sensory properties of beer samples (table 19). Control, Light Struck, and Isoamyl Acetate beer samples elicited higher ratings on DESIRE, EXCITEMENT, FUN, NOSTALGIA, and PLEASURE than the Hoppy sample, which evoked lower scorings in these emotional categories. On the contrary, the Hoppy sample elicited significant higher scores than the Control and Light Struck samples on unpleasant emotion categories: DISSATISFACTION, DISAPPOINTMENT, and DISGUST. PCA confirmed the results of univariate analysis. As seen in figure 23a, PC1 (74.16%) was strongly correlated to the pleasant emotions categories and liking, and negatively correlated to unpleasant emotion categories. Position (figure 23b) of Control, Isoamyl Acetate, and Light Struck samples was associated to DESIRE, EXCITEMENT, FUN, NOSTALGIA and PLEASURE, while Hoppy was projected close to DISSATISFACTION, DISAPPOINTMENT, and DISGUST.

As seen in table 19, the Low CO₂ sample elicited significantly higher intensities on the MILD category; the High Alcohol sample produced the contrary effect on that category. VIGOUR ratings were significantly higher on High Alcohol sample, and significantly lower on Sweet sample. MILDNESS and VIGOUR were emotional categories related to engagement, but their correlation to PC2 was opposite: positive and negative respectively. PC2 explained 17.46% of data variability (figure 23a). Low CO₂ and Sweet samples were associated with unengagement or low activation. The high Alcohol sample was associated to VIGOUR and related to high activation (figure 23b).

Finally, Sweet, Low CO₂, and High Alcohol samples evoked significantly higher ratings on INDIFFERENCE, while Light Struck evoked lower ratings on that emotion category (table 19). INDIFFERENCE showed a relatively slight linear correlation to unpleasant emotions (0.645 DISSATISFACTION; 0.638 DISAPPOINTMENT; 0.575 DISGUST) while it was not correlated to MILD (0.072) or VIGOUR (0.231). However, it was important for the discrimination by the univariate analysis of Light Struck sample on the one hand, *versus* Sweet, Low CO₂, and High Alcohol samples on the other hand (table 19). These results revealed the importance of using emotional lexicons better than the models based on the circumplex model of emotions (pleasure/displeasure; high/low activation) as the ones used by Cardello et al. (2016) and Jaeger et al. (2017). In fact, INDIFFERENCE was independent of the pleasantness and engagement axes, building its own third dimension. This result shows an important contribution of the consumer defined lexicons.

Table 19. Means scores and p-values for the 11 emotion categories and liking across 10 samples

Category	Sample																P-value				
	Control		Hoppy		Light struck		Isoamyl acetate		DMS		Bitter		Sweet		Low CO2			Non-alcohol control		High alcohol	
Vigour	4.33	abc	4.38	abc	5.22	cd	4.27	abc	5.07	cd	5.29	cd	3.81	a	3.98	ab	5.01	bcd	5.60	d	<0.001
Mildness	5.48	bc	4.41	ab	4.70	ab	4.97	abc	4.83	abc	4.40	ab	5.60	bc	6.03	c	4.68	ab	4.06	a	<0.001
Dissatisfaction	3.78	a	5.60	d	3.43	a	3.95	ab	4.28	abc	4.10	ab	4.01	ab	4.26	abc	5.18	bcd	5.46	cd	<0.001
Indifference	4.05	ab	4.37	ab	3.26	a	4.00	ab	4.03	ab	4.22	ab	4.31	ab	4.50	b	4.18	ab	4.54	b	0.0315
Excitement	4.92	cd	3.36	a	5.33	d	4.75	cd	4.46	abcd	4.49	abcd	4.63	bcd	4.32	abcd	3.94	abc	3.60	ab	<0.001
Pleasure	5.40	c	3.31	a	5.35	c	4.98	bc	4.67	bc	4.83	bc	4.82	bc	5.03	bc	3.81	ab	3.78	ab	<0.001
Nostalgia	3.52	b	2.50	a	3.59	b	3.48	b	3.19	ab	3.06	ab	3.35	ab	2.96	ab	3.38	ab	2.96	ab	0.0044
Fun	5.14	c	3.46	a	5.64	c	5.00	c	4.62	bc	4.72	bc	4.67	bc	4.58	bc	3.80	ab	3.85	ab	<0.001
Disappointment	3.62	a	5.96	c	3.32	a	3.94	ab	4.13	ab	3.85	ab	4.39	ab	4.19	ab	4.95	bc	5.09	bc	<0.001
Desire	4.80	cd	3.26	a	5.14	d	4.50	bcd	4.17	abcd	4.24	abcd	4.34	abcd	4.32	abcd	3.71	abc	3.40	ab	<0.001
Disgust	3.41	a	5.79	c	3.31	a	3.76	ab	4.20	ab	3.91	ab	3.94	ab	3.75	ab	4.87	bc	5.82	c	<0.001
Liking	5.57	cd	3.60	a	5.82	d	5.05	bcd	4.90	bc	5.16	bcd	5.19	bcd	5.06	bcd	4.35	ab	3.96	a	<0.001

Different letters within the same row indicate different post-hoc groupings by Tukey's HSD ($p < 0.05$).

In summary, as compared to the previous version by Chaya et al. (2015), the importance of the category INDIFFERENCE has been emphasized. As a result of the proposed lexicon improvement, the relative position of samples was different. We hypothesize that the reduction of the number of categories and the replacement of the category name INTENSITY by VIGOUR could be related to this improvement.

To conclude, the improved proposed lexicon has been tested with unbalanced beer samples, spiked with different flavors, which made them suitable for eliciting different emotional responses. The previous version of the lexicon was also applied to commercial beer products (Chaya et al., 2015), where 5 out of 12 categories were discriminant among commercial beers and helped to explain the differences in hedonic response (unpublished results). According to these previous findings, the improved lexicon would also be suitable for explaining the differences in evoked feelings during consumption of commercial beers.

4. CONCLUSION

Following the procedure of van Zyl & Meiselman (2015) allowed for an easy filtering of terms for the study of the emotional response. As a consequence, the test was shorter, clearer, and easier to understand and to complete by consumers. The interpretation of the emotional map obtained after the improvement of the lexicon was clearer than the one obtained from the complete-non reduced lexicon. The new emotional lexicon of beer improved 1) the efficiency of the research in terms of discrimination among samples, 2) the simplicity of use by the consumers.

Using both univariate and multivariate statistical analysis complemented each other in the understanding of emotional response to beer products.

Caution should be taken concerning the representativeness of consumers' sample. Although the method has improved the initial lexicon, the number of respondents in this study is relatively low and more research is needed to guarantee the generation of sufficiently robust data.

Future research is needed to test the improved lexicon in commercial beers. The real benefit would be to understand how this emotion lexicon can be used to differentiate between commercially available beers and whether it can give an insight about consumers' liking/disliking reasons.

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CHAPTER 4. GENERAL DISCUSSION

1. MAIN FINDINGS

The main objective of this thesis was to acquire a deeper insight on the methods to measure the emotional response elicited by wine and beer in Spanish consumers. With this aim in mind, chapter 3 and Annex I include the studies carried out to achieve the specific objectives. This section aims to summarize the main results of the thesis and to integrate them in a general discussion.

It is important to mention that the studies developed in this thesis were mainly focused in two research areas. The first one, aiming at studying the relationship of emotions and preferences with the intrinsic characteristics of the product, and also the biological and psychological factors which might influence consumers' response. The second one focused on the improvement and development of methodologies to measure consumers' emotional response elicited by beer and wine consumption. Chapter 3, which includes the study 1 entitled "Emotional response to wine: sensory properties, age and gender as drivers of consumers' preferences", and the study 2 entitled "Effect of personality on the emotional response elicited by wines", are included in the first research area. On the other hand, the study 3 entitled "Improvement of an emotional lexicon for the evaluation of beers", and Annex I, with the study 4: "Comparison of methods to develop an emotional lexicon of wine: Conventional vs Rapid-method approach" belong to the second research area.

Studies 1 and 2 were conducted with the aim of understanding the effects of product characteristics on the emotions elicited by wine consumption, and the different consumers' segments depending on people characteristics. In addition, study 1 added knowledge about the emotions evoked in Spanish consumers during wine consumption, and therefore about the emotional terms suitable for measuring the emotional response. The terms identified during this study, were the starting point for the development of a specific wine lexicon for Spaniards, which is included in the second research area.

A summary of the developed studies, specific aims, findings, and their contribution to the two research areas, are shown in Table 20.

Table 20. Outline of the main findings of the thesis

RESEARCH AREA 1: To study the relationship of emotions and preferences with intrinsic product characteristics factors, and biological and psychological consumers' factors		
STUDY 1 (CHAPTER 3)	Emotional response to wine: sensory properties, age and gender as drivers of consumers' preferences <i>Food quality and preference</i> 2018; 66, 19-28	
	Aim	To explain the relationship between emotional response and the sensory traits of wine products, and to understand the effect of gender and age in evoked emotions by wine.
	Findings	<ul style="list-style-type: none"> ✓ Most of the emotional terms of Essence 25 were suitable to measure the emotional response elicited by wine consumption for Spanish consumers. ✓ There was a relationship between sensory descriptors and emotional response. Spanish consumers associated positive emotions with fruity and floral aroma attributes, and negative emotions with aged wine attributes such as vanilla, clove and licorice. ✓ Consumers' gender influenced the emotional response. The wines evoked higher ratings on emotional response for men than for women. However, women were more discriminating among wines than men, according to their emotional response. ✓ Consumers' age has an effect on the elicited emotions evoked by the wine consumption. Older adults reported higher emotions ratings in general, but young adults discriminated better among wines when studying their emotional response.
STUDY 2 (CHAPTER 3)	Effect of personality on the emotional response elicited by wines <i>Food Quality and Preference</i> 2019; 76, 39-46	
	Aim	To find out the relationship between personality traits and the consumer response elicited by different wines.
	Findings	<ul style="list-style-type: none"> ✓ A relationship between personality traits and hedonic response was found. ✓ There was a connection between personality traits and the emotional response elicited by wine. The main relationships between personality and emotions were found in two consumers' segments: G1 characterized by higher ratings on the Neuroticism dimension, was more related to negative emotions than G4. On the contrary, G4, defined by higher ratings on Extraversion, Agreeableness, and Conscientiousness, was more related to positive emotions than G1. ✓ The BFI (Big Five Inventory) was a suitable test to characterize consumers in the context of a sensory consumer test.
RESEARCH AREA 2: To improve and develop methodologies to measure the emotional response elicited by beer and wine consumption for Spanish consumers		
STUDY 3 (CHAPTER 3)	Improvement of an emotional lexicon for the evaluation of beers <i>Food quality and preference</i> 2019; 71, 158-162	
	Aim	To improve a consumer-led emotional lexicon of beer through a methodology to reduce the number of emotional terms.
	Findings	<ul style="list-style-type: none"> ✓ The application of the procedure proposed by van Zyl & Meiselman (2015) was a suitable method to filter terms. ✓ The emotional map generated with the results of the improved lexicon was clearer than the one obtained from the complete-non reduced lexicon. ✓ The improved emotional lexicon of beer increased the efficiency of the research in terms of discrimination among samples, and the simplicity of use by consumers.
STUDY 4 (ANNEX I)	Comparison of methods to develop an emotional lexicon of wine: Conventional vs rapid-method approach <i>Submitted for publication</i>	
	Aim	To test the suitability of a rapid method application such as sorting task, for the emotional lexicons' development, using a wine emotional lexicon as a case study.
	Findings	<ul style="list-style-type: none"> ✓ The use of rapid methodologies such as sorting task was suitable for the development of a wine emotional lexicon. ✓ The methodology developed using sorting task was faster than the procedure mainly proposed in the literature. Also, the rapid-method approach consumed fewer resources. ✓ The lexicon developed by the rapid-method approach had the same discrimination capacity than the lexicon developed using the procedure mainly proposed in the literature.

1.1. Emotions and food choice factors

Emotions are a powerful driver of preference and has an important role in the decision-making process (Damasio, 2006). Up to date there, is not much information about the factors that have an impact on the emotional response elicited by wine. This thesis has studied the relationship among the intrinsic characteristics of the product (e.g.: wine sensory properties), the biological factors (e.g.: such as consumers' gender and age), and the psychological factors (e.g.: personality traits) with the emotions elicited by wine consumption.

1.1.1. Wine sensory properties and emotions

Ferrarini et al. (2010) highlighted the importance of studying the link between the sensory characteristics and emotional response to wine consumption. They specified that the emotional and sensory characterization of wines could be useful to profile different product categories; this profiling could be of great use to target different consumer segments which are interested in feeling different emotions when consuming wine.

In a global study conducted by Ashton, Bellis, Davies, Hughes, & Winstock (2017), authors showed that emotions such as *tired* and *relaxed* were associated with red wines, whereas white wines evoked no strong emotional response. Because culture has a huge impact on the emotions elicited by food consumption, it would be recommendable to study the sensory/emotional profiles of the different types of wines taking into consideration the cultural factor. For example, in a qualitative study developed by Silva, Jager, van Bommel, et al. (2016), authors found that for Dutch and Portuguese consumers, wine evoked emotions of low arousal and positive valence such as *calmness*, *loving* and *relaxed*.

Ristic et al. (2019) developed an online survey to study how 9 wine descriptors aromas influenced emotions elicited by consumers from Australia, United Kingdom and United States of America. Results from the whole dataset of the three countries showed which emotions were elicited by the different aromas: chocolate, strawberry and passionfruit aromas elicited positive emotions, lemon and mint aromas evoked high arousal emotions, confectionary aroma elicited positive and neutral emotions, barnyard aroma evoked negative emotions, rose aroma triggered positive and low arousal emotions, and pepper aroma evoked positive, high arousal and negative emotions. The lexicon was in English and all participants were native English speakers, but from different cultures (Australia, UK and USA), therefore some differences were found on the emotions elicited by the nine aroma descriptors. A good agreement between countries was found in the emotions evoked by lemon, rose, mint, and barnyard aromas. However, chocolate, strawberry, passionfruit and confectionary aromas evoked low arousal emotions in USA and UK, but not in AU consumers. Passionfruit aroma elicited loving

emotions for USA consumers, and the same aroma evoked high arousal emotions in UK consumers. Pepper evoked low arousal emotions in AU and UK, but not in USA consumers.

Jiang et al. (2017) reported, in a study conducted with Australian consumers, that the floral aroma of wines elicited *optimistic, happy, passionate, relaxed, contented* and *warm* emotions, while wines with green aroma elicited emotions such as *irritated, tense, unfulfilled*, and *sad*.

The results presented in study 1 of the present thesis contribute to delineate the sensory/emotional profile for Spanish consumers. Fruity and floral wine aromas elicited positive emotions, while aged wine attributes such as vanilla, clove and licorice, evoked negative emotions.

1.1.2. Biological factors and emotions: gender and age

Prescott (2017) pointed out that individual differences contribute to the variation of consumers' emotional response. Biological factors such as gender and age have been studied to understand their effect on the emotions evoked by wine.

King, Meiselman and Carr (2010) demonstrated that women, on average, gave emotion ratings higher than men. However, these authors also pointed out that this behavior is food category dependent and could be reversed. An example of reverse behavior is also found in different studies across literature: Dubé et al. (2005) showed that men reported stronger positive emotions for comfort foods than women; Edwards et al. (2013) reported the same behavior for meals; and Piqueras-Fiszman & Jaeger (2015) presented the same pattern when studying recalled typical and memorable meals.

A similar pattern has been reported when reviewing beverages literature: men reported higher emotions than women. Parra et al. (2015) studied the emotional status of the consumer when tasting an alcohol-free red wine powder drink. Results showed that, although males and females selected a similar frequency of emotional terms, males had more citations of positive terms than females. Chaya et al. (2015) showed that beers elicited higher emotional ratings in men for the Classic, Desire, Disappointment, Indifference, Mildness and Nostalgia emotional categories, but for Intensity, women reported higher ratings than men. In the aforementioned study conducted by Ristic et al. (2019) males expressed significantly higher ratings on intense positive emotions than females.

In the results obtained in the study 1 of the present thesis, a similar behavior was found: men scored the terms *bored, calm, good natured, mild, satisfied, secure, tame*, and *understanding* significantly higher than women. However, a significant wine*gender interaction was found in *joyful*, showing similar scores for all wines in men, while women reported scorings which allowed a clear discrimination among wines. Thus, although men reported general higher ratings on the emotional

response elicited by wines, they gave similar scores to all different samples. On the other side, women's emotional response allowed a higher discrimination among samples.

Literature also shows that age factor is important on studying the emotions elicited by foods. Den Uijl et al. (2016) and den Uijl et al. (2016) reported that age was an important factor when comparing the emotional responses elicited by olfaction. Results of both studies showed that younger adults reported emotions that varied in pleasantness and activation, whereas older adults' emotions varied only in pleasantness. The study conducted by Edwards, Hartwell, & Giboreau (2016) reported that, in general, young adults had a more critical view of foods than older adults. Finally, various studies developed with comfort foods, beers, and recalled typical and memorable meals, showed that older people reported more positive emotions than younger ones (Chaya et al., 2015; Dubé et al., 2005; Piqueras-Fiszman & Jaeger, 2015). These findings were in the same line with the results obtained in the study 1 of the present thesis: emotions evoked by wine consumption were different for each age group. In general, older adults gave higher scores than middle-aged and young adults in all of the significant emotional terms: *active, calm, enthusiastic, good, good natured, happy, interesting, joyful, loving, mild, nostalgic, pleasant, satisfied, understanding, warm, and curious*. However, young adults were more extreme and more discriminating among wines, middle-aged adults presented similar scores and fewer differences among wines, and older adults discriminated among wines by a lower number of emotions.

1.1.3. Psychological factors and emotions: personality

Considering that consumer personality is one individual factor that could affect the emotional response to food products, one of the aims of the present thesis was to find out the relationship between personality traits and the emotional responses elicited by different wines.

Results of study 2 revealed that when consumers were grouped into 4 clusters according to their personality, the consumer cluster with higher scores on Extraversion reported higher ratings on positive emotions, while the consumer cluster defined for reporting higher scores on Neuroticism reported higher scores on negative emotions. These results were in line with the published researches in the psychological field by Letzring & Adamcik (2015), DeNeve & Cooper (1998), and Tellegen (1985). They pointed out the relationship between "sensory traits" and "the affect", defending the fact that the personality trait Neuroticism was positively correlated with negative affect, whereas the personality trait Extraversion was positively correlated with positive affect. Similarly, Samant & Seo (2019), in their study with basic taste solutions, reported that personality traits related to Extraversion and Neuroticism affected the measurement of emotional responses,

and contributed to a better prediction of liking. The study 2 was the first published study to report the effect of personality traits in the consumers' response elicited by commercial products.

1.2. Improvement and development of methodologies to measure emotional response

Verbal self-reported measures, such as the ones recorded by using questionnaires, are the most used tools to measure the emotional response elicited by food products. These methodologies have been characterized as being easier to use and cheaper (Spinelli & Monteleone, 2018). Although there are various specific lexicons suitable for measuring the emotional response to beers (Chaya et al., 2015; Eaton, 2015; Yik et al., 2011) and wines (Danner et al., 2016; Ferrarini et al., 2010; Silva, Jager, van Bommel, et al., 2016), emotional questionnaires should only be used for the culture in which they have been developed. This thesis focused in improving the existing methodologies to develop a specific lexicon to study the emotional response elicited by the consumption of wines in Spanish consumers.

1.2.1. General emotion list as a starting point

The first step to develop a specific emotional lexicon for wine was done in study 1. Although generic lexicons could be used in a wide variety of products, reporting valuable information about the assessed samples, specific lexicons are more suitable to detect slight differences among products (Ng et al., 2013a). This was also demonstrated in a study developed by Silva, Jager, Van Zyl, et al. (2016). The authors compared two methods (Free Elicitation and EsSense Profile®) to study the emotional response towards beverages such as beer, wine and non-alcoholic beer. Results showed a more precise discrimination between beverages when using product-specific lexicons.

During study 1, EsSense25 was used as a first step to select discriminating terms for the measurement of the emotional response evoked by wines in Spanish consumers. Twenty-two out of the 26 terms analyzed were discriminant to measure the emotional response evoked by wines. The 4 non-discriminating terms were *adventurous*, *free*, *wild* and *worried*. In general, emotions associated with high activation seemed not to be elicited by wine consumption for Spaniards. Similar results were found in the research carried out by Silva, Jager, van Bommel, et al. (2016) where wine was related with low activation emotional terms, such as *calm* and *loving* for Portuguese and Dutch consumers. Other authors have found a relationship between high activation of emotional terms and wine. For example, Ferrarini et al. (2010) found *euphoric* being significant to Italian consumers, and Danner et al. (2016) found *adventurous* being significant to Australian consumers. This confirmed, as reported by Van Zyl et al. (2015), that there might be a cultural effect in the emotions elicited by a food product, and, in particular, by wine.

1.2.2. Application of methodologies to remove non-emotional terms

Some authors have been discussing about the issues to be considered when measuring the emotional response using lists of emotion (Herbert L. Meiselman, 2017; Prescott, 2017; Spinelli, 2017). Prescott (2017) established that researches have to consider some semantic issues; he suggested being aware of the emotional nature of the terms used in the lexicon. Van Zyl & Meiselman (2015) were the first to publish an easy procedure to remove non-emotional terms by checking published emotions lists. The words compiled from a previous stage were checked to verify if the terms were included in the lists of Laros and Steenkamp (2005) and Clore et al. (1987). Study 3 applied this methodology to remove non-emotional terms in an attempt to improve a published consumer-led emotional lexicon for beers. Seventeen non-emotional terms were removed from the previous published lists (Chaya et al., 2015). This change had an effect in the resulting number of emotional categories after the cluster analysis. The resulting list was shorter, clearer, and easier to understand and to complete by consumers; in addition, the emotional map obtained from the PCA was clearer and easier to interpret than the one obtained by using the previous lexicon of Chaya et al. (2015).

1.2.3. Application of a rapid method to generate emotional lexicons

Different authors have been interested in providing additional steps or methodologies to shorten the procedure for developing emotional lexicons. Chaya et al. (2015), in their development of an emotional lexicon for beer, proposed to use focus groups to generate emotional terms associated with the beer consumption as an alternative to the personal interviews used by Ng et al. (2013a) and Spinelli et al. (2014). Also, Gunaratne et al. (2019) proposed conducting online surveys as a fast-screening method to remove irrelevant terms in an attempt to simplify emotional lexicon development. Study 4 of the present thesis (Annex I), currently submitted for publication, showed that the application of Sorting Task (Chollet et al., 2014) reduced the time invested in the clustering of terms into categories, using a semantic approach in which consumers joined emotions and feelings with similar meaning for them in the context of wine consumption.

The use of Sorting Task helped not only to reduce the time invested during lexicon development, it also helped to diminish the questionnaire length, and therefore the time invested by the consumer during the measurement of the emotional response. Some authors have considered the length of emotional questionnaires as an important factor during the development of emotional lexicons and have proposed some final steps to shorten them. Ferrarini et al. (2010) introduced a final step to reduce the list from 23 into 16 emotional terms, when developing a lexicon to measure the emotional response elicited by wines with Italian consumers. Silva et al. (2018) proposed an initial step, before measuring the temporal dominance of emotions elicited by wine, to select the 10 main terms from a previous list generated in a qualitative study (Silva, Jager, van Bommel, et al., 2016). Danner et al.

(2016) proposed a final phase in the development of the Australian Wine Evoked Emotions Lexicon (AWEEL) to reduce the 16 emotional categories, collected during the focus group sessions, into 16 representative emotions of each emotional category. However, other authors have applied specific methodologies to reduce the length by grouping emotions into categories, or to diminish the difficulty of the task using methods such as the 12-point emotion circumplex structure. Yik, Russell, & Steiger (2011) developed a 12-point emotion circumplex structure to measure the core affect, which shows the feelings resulting from moods and emotions. Chaya et al. (2015) applied Hierarchical Cluster Analysis to group emotional terms with similar ratings into emotional categories. The effectiveness of this approach was analyzed by Eaton et al. (2019).

The research presented in this thesis compared a lexicon developed using the approach proposed by Chaya et al. (2015), Hierarchical Cluster Analysis (lexicon I), vs a lexicon developed using Sorting task (lexicon II). Lexicon II, which was developed after grouping the emotions using the Sorting Task approach, had 15 emotional categories, whereas lexicon I, which was developed after grouping the emotions by sensory consumer tests, resulted in 13 emotional categories. Both lexicons had an acceptable length to ease the task for the consumers. It is to note that results found a sample effect for 10 of the 13 emotional categories in lexicon I, while lexicon II discriminated the wines in all 15 categories. In addition, the same wine groups and projections were found in the observation plots of both lexicons, with a high RV coefficient (0.985) between maps. Thus, it was proven that both methods were appropriate in discriminating wine emotional responses, and therefore the Rapid Method was proposed as a more efficient methodology to group emotions.

2. CONCLUSIONS

The mains conclusions derived from the different studies conducted within this thesis are the following:

- The sensory properties of the product, gender, age, and personality of the consumer had an impact on the emotional response evoked by the consumption of wine.
- A relationship between sensory properties of wines and the elicited emotional response was found. Spanish consumers associated more positive emotions with fruity and floral aroma attributes, and more negative emotions with aged wine attributes such as vanilla, clove and licorice.
- Consumers' gender and age had an influence on the emotional response evoked by wines. Men's ratings were higher than women were, but women discriminated samples better than men did. Also, older adults reported higher ratings of emotions for wines, but young adults' results helped a better discrimination of samples.
- A relationship between personality traits and hedonic response evoked by wines was found. Consumers who reported higher ratings on the Neuroticism dimension were prone to perceive negative emotions; on the contrary, consumers characterized by reporting higher ratings on Extraversion, Agreeableness, and Conscientiousness, also reported higher ratings on positive emotions.
- The methodological contributions of this thesis were useful steps to improve the beer lexicon and to develop a wine emotional lexicon, both for Spanish consumers.
- The use of a generic emotional lexicon was an accurate first step to determine which emotions could be elicited by different wines. Most of the emotional terms of Essence 25 were useful for discriminating commercial wines.
- The application of the procedure proposed by van Zyl & Meiselman (2015) was a suitable method of filtering terms. The application of this methodology over a beer specific lexicon increased the efficiency of the task for getting a good discrimination among samples and to ease consumers' use of the lexicon.
- The use of rapid methodologies such as Sorting Task was suitable for the development of a wine emotional lexicon. This methodology was faster and fewer resources were consumed if compared with a lexicon developed using the procedure mainly proposed in the literature, having the same discrimination capacity.

3. FUTURE RESEARCH LINES

This thesis aimed at studying the emotions elicited by some food products from a holistic approach. The relationship among aspects such as sensory properties, gender, age, and personality, have been included in the research, to obtain a complete understanding of emotions and their influence on the decision-making process. Futures works could focus on other food choice aspects, increasing the knowledge into a wider approach of the emotional response.

To measure emotions elicited by the consumption of low alcoholic beverages, and to predict consumers' preferences and choices, studies should be conducted in a specific context to reflect real consumption settings. Future studies should include specific backgrounds aligned with the usual consumption contexts and habits of the selected population. Some of the interesting contexts to study alcoholic beverages (e.g.: wine and beer) might consider the comparison of the inclusion of social options (friends, family or alone), and also the comparison of different environments (fine dining restaurants, daily restaurant, at home or countryside). Also, new technologies such as virtual reality could be used to determine the effect of immersive virtual reality vs real life in the emotional response evoked by different wines or beers, with the aim at evaluating if the virtual reality is a suitable method to predict the emotional response of the consumer.

Some of the most important aspects to consider when studying emotions, and which have highlighted during the present thesis, belong to the individual differences research (Prescott, 2017; Spinelli, 2017). During decades, sensory researches have considered that consumer response is uniform across different studies. This bias is known as the *Fallacy of Uniformity*, which stated that people's behavior differs in degree, but not in essence (Köster, 2009). However, consumers' response is far from this; a wide variety of factors which lead to different behaviors could provide misleading data. Prescott (2017) pointed out that the expression of emotions could be affected by an extensive range of individual factors such as age, education, culture, socio-economic status, and/or personality. This thesis addressed personality, gender, and age as sources of variation in the emotional response, but futures studies should be conducted to investigate other individual aspects. For example, the effect of the oral physiology and saliva compounds might be compared across individuals to measure the impact of physiological differences in the elicitation of emotions and therefore in the consumer preferences. Another individual factor that should be deeper investigated is culture. Cross-cultural studies should be conducted to investigate the effect of the drinking culture in the emotional response of consumers.

A different but important topic to consider in the measurement of the emotional response elicited by food products, is the unknown link between the unconsciousness emotional components (e.g.:

bodily reactions, face expressions), with the consciousness emotional components (e.g.: feelings). Future studies could focus on this link with the study of the emotional response through the inclusion of explicit and implicit methodologies to measure emotions elicited by foods and beverages

Last but not least, emotions are complex processes triggered by specific stimulus. Having the knowledge of which sensory properties are key factors to elicit a positive emotional response, future studies could include the study of different wine packaging designs to get a perfect match between the emotions elicited by the packaging, and the emotions elicited by the consumption of the beverage.

REFERENCES

- Addinsoft. (2019). XLSTAT statistical and data analysis solution. Long Island, NY, USA. Retrieved from <https://www.xlstat.com>
- American Psychological Association (APA). (2018). Personality. Retrieved November 2, 2018, from <https://www.apa.org/topics/personality/>
- Arnold, M. B. (1960). *Emotion and personality*. New York: Columbia University Press.
- Ashton, K., Bellis, M. A., Davies, A. R., Hughes, K., & Winstock, A. (2017). Do emotions related to alcohol consumption differ by alcohol type? An international cross-sectional survey of emotions associated with alcohol consumption and influence on drink choice in different settings. *BMJ Open*, 7(10), e016089. <https://doi.org/10.1136/bmjopen-2017-016089>
- Barrena, R., & Sanchez, M. (2009). Connecting product attributes with emotional benefits: analysis of a Mediterranean product across consumer age segments. *British Food Journal*, 111(2), 120–137. <https://doi.org/https://doi.org/10.1108/00070700910931959>
- Beyts, C., Chaya, C., Dehrmann, F., James, S., Smart, K., & Hort, J. (2017). A comparison of self-reported emotional and implicit responses to aromas in beer. *Food Quality and Preference*, 59, 68–80. <https://doi.org/10.1016/J.FOODQUAL.2017.02.006>
- Bhumiratana, N., Adhikari, K., & Chambers, E. (2014). The development of an emotion lexicon for the coffee drinking experience. *Food Research International*, 61, 83–92. <https://doi.org/http://doi.org/10.1016/j.foodres.2014.03.008>
- Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(1), 49–59. [https://doi.org/10.1016/0005-7916\(94\)90063-9](https://doi.org/10.1016/0005-7916(94)90063-9)
- Britton, J., Frey, L., Hopp, J., Korb, P., Koubeissi, M., Lievens, W., ... St. Louis, E. (2016). *Electroencephalography (EEG): An introductory text and atlas of normal and abnormal findings in adults, children, and infants*. Chicago: American Epilepsy Society. <https://doi.org/10.5698/978-0-9979756-0-4>
- Byrnes, N. K., & Hayes, J. E. (2013). Personality factors predict spicy food liking and intake. *Food Quality and Preference*, 28(1), 213–221. <https://doi.org/10.1016/J.FOODQUAL.2012.09.008>
- Calvo-Porral, C., Ruiz-Vega, A., & Lévy-Mangin, J.-P. (2019). The Influence of Consumer Involvement in Wine Consumption-Elicited Emotions. *Journal of International Food & Agribusiness Marketing*, 31(2), 128–149. <https://doi.org/10.1080/08974438.2018.1482587>
- Campbell, G., & Guibert, N. (2006). Old World strategies against New World competition in a globalising wine industry. *British Food Journal*, 108(4), 233–242. <https://doi.org/http://dx.doi.org/10.1108/00070700610657092>
- Cardello, A. V., Meiselman, H. L., Schutz, H. G., Craig, C., Given, Z., Leshner, L. L., & Eicher, S. (2012). Measuring emotional responses to foods and food names using questionnaires. *Food Quality and Preference*, 24(2), 243–250. <https://doi.org/10.1016/J.FOODQUAL.2011.12.002>
- Cardello, A. V., Pineau, B., Paisley, A. G., Roigard, C. M., Chheang, S. L., Guo, L. F., ... Jaeger, S. R. (2016). Cognitive and emotional differentiators for beer: An exploratory study focusing on “uniqueness.” *Food Quality and Preference*, 54, 23–38. <https://doi.org/http://doi.org/10.1016/j.foodqual.2016.07.001>

- Carver, C. S., Sutton, S. K., & Scheier, M. F. (2000). Action, Emotion, and Personality: Emerging Conceptual Integration. *Personality and Social Psychology Bulletin*, 26(6), 741–751. <https://doi.org/10.1177/0146167200268008>
- Chaya, C., Eaton, C., Hewson, L., Vázquez, R. F., Fernández-Ruiz, V., Smart, K. A., & Hort, J. (2015). Developing a reduced consumer-led lexicon to measure emotional response to beer. *Food Quality and Preference*, 45, 100–112. <https://doi.org/http://doi.org/10.1016/j.foodqual.2015.06.003>
- Chollet, S., Valentin, D., & Abdi, H. (2014). Free Sorting Task. In *Novel Techniques in Sensory Characterization and Consumer Profiling* (pp. 207–227). Boca Raton, Florida: CRC Press.
- Chrea, C., Grandjean, D., Delplanque, S., Cayeux, I., Le Calve, B., Aymard, L., ... Scherer, K. R. (2009). Mapping the semantic space for the subjective experience of emotional responses to odors. *Chemical Senses*, 34(1), 49–62. <https://doi.org/https://doi.org/10.1093/chemse/bjn052>
- Churchill, A., & Behan, J. (2010). Comparison of methods used to study consumer emotions associated with fragrance. *Food Quality and Preference*, 21(8), 1108–1113. <https://doi.org/10.1016/J.FOODQUAL.2010.07.006>
- Clore, G. L., Ortony, A., & Foss, M. A. (1987). The psychological foundations of the affective lexicon. *Journal of Personality and Social Psychology*, 53(4), 751–766. <https://doi.org/10.1037/0022-3514.53.4.751>
- Coppin, G., & Sander, D. (2016). Theoretical Approaches to Emotion and Its Measurement. In *Emotion Measurement* (pp. 3–30). Elsevier. <https://doi.org/10.1016/B978-0-08-100508-8.00001-1>
- Cuesta, D., Chaya, C., & Pérez, F. J. (2010). *Estudio de la respuesta emocional del consumidor español de vino*. Universidad del País Vasco (UPV-EHU), Vitoria, País Vasco.
- Dael, N., Mortillaro, M., & Scherer, K. R. (2012). Emotion expression in body action and posture. *Emotion*, 12(5), 1085–1101. <https://doi.org/10.1037/a0025737>
- Damasio, A. R. (2004). Emotions and Feelings. In A. S. R. Manstead, N. Frijda, & A. Fischer (Eds.), *Feelings and Emotions: The Amsterdam Symposium* (Cambridge, pp. 49–57). Cambridge.
- Damasio, A. R. (2006). *Descartes' error: emotion, reason and the human brain*. Vintage.
- Danner, L., Johnson, T. E., Ristic, R., Meiselman, H. L., & Bastian, S. E. P. (2017). “I like the sound of that!” Wine descriptions influence consumers’ expectations, liking, emotions and willingness to pay for Australian white wines. *Food Research International*, 99(Part 1), 263–274. <https://doi.org/10.1016/J.FOODRES.2017.05.019>
- Danner, L., Ristic, R., Johnson, T. E., Meiselman, H. L., Hoek, A. C., Jeffery, D. W., & Bastian, S. E. P. (2016). Context and wine quality effects on consumers’ mood, emotions, liking and willingness to pay for Australian Shiraz wines. *Food Research International*, 89, 254–265. <https://doi.org/http://doi.org/10.1016/j.foodres.2016.08.006>
- Darwin, C., & Ekman, P. (1872). *The expression of the emotions in man and animals*. Oxford University Press.
- den Uijl, L. C., Jager, G., de Graaf, C., Meiselman, H. L., & Kremer, S. (2016). Emotion, olfaction, and age: A comparison of self-reported food-evoked emotion profiles of younger adults, older normosmic adults, and older hyposmic adults. *Food Quality and Preference*, 48(Part A), 199–

209. <https://doi.org/http://dx.doi.org/10.1016/j.foodqual.2015.09.011>
- den Uijl, L. C., Jager, G., Zandstra, E. H., de Graaf, C., & Kremer, S. (2016). Self-reported food-evoked emotions of younger adults, older normosmic adults, and older hyposmic adults as measured using the PrEmo2 tool and the Affect Grid. *Food Quality and Preference*, 51, 109–117. <https://doi.org/http://doi.org/10.1016/j.foodqual.2016.03.002>
- DeNeve, K. M., & Cooper, H. (1998). The happy personality: A meta-analysis of 137 personality traits and subjective well-being. *Psychological Bulletin*, 124(2), 197–229. <https://doi.org/10.1037/0033-2909.124.2.197>
- Desmet, P. (2003). Measuring Emotion: Development and Application of an Instrument to Measure Emotional Responses to Products. In M. Blythe, K. Overbeeke, A. Monk, & P. Wright (Eds.), *Funology. Human-Computer Interaction Series, vol 3*. (pp. 111–123). Dordrecht: Springer. https://doi.org/10.1007/1-4020-2967-5_12
- Diener, E., Sandvik, E., & Larsen, R. J. (1985). Age and sex effects for emotional intensity. *Developmental Psychology*, 21(3), 542–546. <https://doi.org/https://doi.org/10.1037/0012-1649.21.3.542>
- Donadini, G., Fumi, M. D., Kordialik-Bogacka, E., Maggi, L., Lambri, M., & Sckokai, P. (2016). Consumer interest in specialty beers in three European markets. *Food Research International*, 85, 301–314. <https://doi.org/10.1016/J.FOODRES.2016.04.029>
- Dorado, R., Pérez-Hugalde, C., Picard, A., & Chaya, C. (2016). Influence of first position effect on emotional response. *Food Quality and Preference*, 49, 189–196. <https://doi.org/10.1016/j.foodqual.2015.12.009>
- Dorado, R., Chaya, C., Tarrega, A., & Hort, J. (2016). The impact of using a written scenario when measuring emotional response to beer. *Food Quality and Preference*, 50, 38–47. <https://doi.org/10.1016/j.foodqual.2016.01.004>
- Dubé, L., LeBel, J. L., & Lu, J. (2005). Affect asymmetry and comfort food consumption. *Physiology & Behavior*, 86(4), 559–567. <https://doi.org/http://doi.org/10.1016/j.physbeh.2005.08.023>
- Eaton, C. (2015). Developing an effective approach to measure emotional response to the sensory properties of beer.
- Eaton, C., Chaya, C., Smart, K. A., & Hort, J. (2019). Comparing a full and reduced version of a consumer-led lexicon to measure emotional response to beer. *Journal of Sensory Studies*, 34(2), e12481. <https://doi.org/10.1111/joss.12481>
- Edwards, J. S. A., Hartwell, H. J., & Brown, L. (2013). The relationship between emotions, food consumption and meal acceptability when eating out of the home. *Food Quality and Preference*, 30(1), 22–32. <https://doi.org/http://doi.org/10.1016/j.foodqual.2013.04.004>
- Edwards, J. S. A., Hartwell, H. J., & Giboreau, A. (2016). 15 - Emotions Studied in Context: The Role of the Eating Environment. In Herbert L Meiselman (Ed.), *Emotion Measurement* (pp. 377–403). Woodhead Publishing. <https://doi.org/http://dx.doi.org/10.1016/B978-0-08-100508-8.00015-1>
- Ekman, P., & Friesen, W. (1967). Head and body cues in the judgment of emotion: A reformulation. *Perceptual and Motor Skills*, 24(3), 711–724. <https://doi.org/doi:10.2466/pms.1967.24.3.711>

- Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, 17(2), 124–129. <https://doi.org/10.1037/h0030377>
- Elliot, A. J., Eder, A. B., & Harmon-Jones, E. (2013). Approach–Avoidance Motivation and Emotion: Convergence and Divergence. *Emotion Review*, 5(3), 308–311. <https://doi.org/10.1177/1754073913477517>
- Etcoff, N. L., & Magee, J. J. (1992). Categorical perception of facial expressions. *Cognition*, 44(3), 227–240. [https://doi.org/10.1016/0010-0277\(92\)90002-Y](https://doi.org/10.1016/0010-0277(92)90002-Y)
- Ferdenzi, C., Delplanque, S., Barbosa, P., Court, K., Guinard, J.-X., Guo, T., ... Grandjean, D. (2013). Affective semantic space of scents. Towards a universal scale to measure self-reported odor-related feelings. *Food Quality and Preference*, 30(2), 128–138. <https://doi.org/10.1016/J.FOODQUAL.2013.04.010>
- Ferdenzi, C., Schirmer, A., Roberts, S. C., Delplanque, S., Porcherot, C., Cayeux, I., ... Grandjean, D. (2011). Affective dimensions of odor perception: A comparison between Swiss, British, and Singaporean populations. *Emotion*, 11(5), 1168–1181. <https://doi.org/10.1037/a0022853>
- Ferrarini, R., Carbognin, C., Casarotti, E. M., Nicolis, E., Nencini, A., & Meneghini, A. M. (2010). The emotional response to wine consumption. *Food Quality and Preference*, 21(7), 720–725. <https://doi.org/http://doi.org/10.1016/j.foodqual.2010.06.004>
- Field, M., Caren, R., Fernie, G., & De Houwer, J. (2011). Alcohol approach tendencies in heavy drinkers: Comparison of effects in a relevant stimulus-response compatibility task and an approach/avoidance Simon task. *Psychology of Addictive Behaviors*, 25(4), 697–701. <https://doi.org/10.1037/a0023285>
- Francis, I. L., & Williamson, P. O. (2015). Application of consumer sensory science in wine research. *Australian Journal of Grape and Wine Research*, 21(S1), 554–567. <https://doi.org/10.1111/ajgw.12169>
- Frøst, M. B., & Noble, A. C. (2002). Preliminary study of the effect of knowledge and sensory expertise on liking for red wines. *American Journal of Enology and Viticulture*, 53(4), 275–284.
- García-Milon, A., Martínez-Ruiz, M. P., Olarte-Pascual, C., & Pelegrín-Borondo, J. (2019). Does the product test really make a difference? Evidence from the launch of a new wine. *Food Quality and Preference*, 71, 422–430. <https://doi.org/10.1016/J.FOODQUAL.2018.08.007>
- Gmuer, A., Nuessli Guth, J., Runte, M., & Siegrist, M. (2015). From emotion to language: Application of a systematic, linguistic-based approach to design a food-associated emotion lexicon. *Food Quality and Preference*, 40, 77–86. <https://doi.org/10.1016/j.foodqual.2014.09.001>
- Goldberg, L. R. (1990). An alternative “description of personality”: The Big-Five factor structure. *Journal of Personality and Social Psychology*, 59(6), 1216–1229. <https://doi.org/10.1037/0022-3514.59.6.1216>
- Gonzalez Viejo, C., Fuentes, S., Torrico, D. D., Godbole, A., & Dunshea, F. R. (2019). Chemical characterization of aromas in beer and their effect on consumers liking. *Food Chemistry*, 293, 479–485. <https://doi.org/10.1016/J.FOODCHEM.2019.04.114>
- Gunaratne, T. M., Gonzalez Viejo, C., Fuentes, S., Torrico, D. D., Gunaratne, N. M., Ashman, H., & Dunshea, F. R. (2019). Development of emotion lexicons to describe chocolate using the Check-All-That-Apply (CATA) methodology across Asian and Western groups. *Food Research*

- International*, 115, 526–534. <https://doi.org/10.1016/J.FOODRES.2018.10.001>
- Gutjar, S., de Graaf, C., Kooijman, V., de Wijk, R. A., Nys, A., ter Horst, G. J., & Jager, G. (2015). The role of emotions in food choice and liking. *Food Research International*, 76(Part 2), 216–223. <https://doi.org/10.1016/J.FOODRES.2014.12.022>
- Gutjar, S., De Graaf, C., Kooijman, V., Mensink, M., De Wijk, R., & Jager, G. (2013). Emotional responses to unlabelled and labelled food products. *Appetite*, 71, 476. <https://doi.org/http://dx.doi.org/10.1016/j.appet.2013.06.029>
- Herz, R. (2005). Odor-associative Learning and Emotion: Effects on Perception and Behavior. *Chemical Senses*, 30(Supplement 1), i250–i251. <https://doi.org/10.1093/chemse/bjh209>
- Herz, R. (2011). PROP taste sensitivity is related to visceral but not moral disgust. *Chemosensory Perception*, 4(3), 72–79. <https://doi.org/10.1007/s12078-011-9089-1>
- Hu, X., & Lee, J. (2019). Emotions elicited while drinking coffee: A cross-cultural comparison between Korean and Chinese consumers. *Food Quality and Preference*, 76, 160–168. <https://doi.org/10.1016/j.foodqual.2018.08.020>
- ISO. (2014). EN ISO 8586. Sensory analysis — General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors. Asociación Española de Normalización y Certificación (AENOR).
- Jaeger, S. R., Cardello, A. V., Chheang, S. L., Beresford, M. K., Hedderley, D. I., & Pineau, B. (2017). Holistic and consumer-centric assessment of beer: A multi-measurement approach. *Food Research International*, 99, 287–297. <https://doi.org/10.1016/J.FOODRES.2017.05.004>
- Jaeger, S. R., Cardello, A. V., Jin, D., Hunter, D. C., Roigard, C. M., & Hedderley, D. I. (2017). Product uniqueness: Further exploration and application of a consumer-based methodology. *Food Quality and Preference*, 60, 59–71. <https://doi.org/10.1016/J.FOODQUAL.2017.03.013>
- Jaeger, S. R., Xia, Y., Le Blond, M., Beresford, M. K., Hedderley, D. I., & Cardello, A. V. (2019). Supplementing hedonic and sensory consumer research on beer with cognitive and emotional measures, and additional insights via consumer segmentation. *Food Quality and Preference*, 73, 117–134. <https://doi.org/10.1016/J.FOODQUAL.2018.11.015>
- Jager, G., Schlich, P., Tijssen, I., Yao, J., Visalli, M., De Graaf, C., & Stieger, M. (2014). Temporal dominance of emotions: Measuring dynamics of food-related emotions during consumption. *Food Quality and Preference*, 37, 87–99. <https://doi.org/http://doi.org/10.1016/j.foodqual.2014.04.010>
- Jarlier, S., Grandjean, D., Delplanque, S., N'Diaye, K., Cayeux, I., Velazco, M. I., ... Scherer, K. R. (2011). Thermal Analysis of Facial Muscles Contractions. *IEEE Transactions on Affective Computing*, 2(1), 2–9. <https://doi.org/10.1109/T-AFFC.2011.3>
- Jellinek, G. (1964). Introduction to and critical review of modern methods of sensory analysis (odour, taste and flavour evaluation) with special emphasis on descriptive sensory analysis (flavour profile method). *Journal of Nutrition and Dietetics*, 1, 219–260.
- Jiang, W., Niimi, J., Ristic, R., & Bastian, S. E. P. (2017). Effects of Immersive Context and Wine Flavor on Consumer Wine Flavor Perception and Elicited Emotions. *American Journal of Enology and Viticulture*, 68, 1–10. <https://doi.org/10.5344/ajev.2016.16056>

- John, O. P. (2007). Berkeley Personality Lab. Retrieved November 9, 2018, from <https://www.ocf.berkeley.edu/~johnlab/index.htm>
- John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of Personality: Theory and Research*, 2(1999), 102–138.
- Kaneda, H., Kojima, H., & Watari, J. (2011). Novel Psychological and Neurophysiological Significance of Beer Aromas. Part I: Measurement of Changes in Human Emotions during the Smelling of Hop and Ester Aromas Using a Measurement System for Brainwaves. *Journal of the American Society of Brewing Chemists*, 69(2), 67–74. <https://doi.org/10.1094/ASBCJ-2011-0328-01>
- Keller, C., & Siegrist, M. (2015). Does personality influence eating styles and food choices? Direct and indirect effects. *Appetite*, 84, 128–138. <https://doi.org/10.1016/j.appet.2014.10.003>
- Kemp, S. E., Hollowood, T., & Hort, J. (2011). *Sensory evaluation: a practical handbook*. John Wiley & Sons.
- King, S. C., & Meiselman, H. L. (2010). Development of a method to measure consumer emotions associated with foods. *Food Quality and Preference*, 21(2), 168–177. <https://doi.org/http://doi.org/10.1016/j.foodqual.2009.02.005>
- King, S. C., Meiselman, H. L., & Carr, B. T. (2010). Measuring emotions associated with foods in consumer testing. *Food Quality and Preference*, 21(8), 1114–1116. <https://doi.org/http://doi.org/10.1016/j.foodqual.2010.08.004>
- King, S. C., Meiselman, H. L., & Thomas Carr, B. (2013). Measuring emotions associated with foods: Important elements of questionnaire and test design. *Food Quality and Preference*, 28(1), 8–16. <https://doi.org/http://dx.doi.org/10.1016/j.foodqual.2012.08.007>
- Köster, E. P. (2009). Diversity in the determinants of food choice: A psychological perspective. *Food Quality and Preference*, 20(2), 70–82. <https://doi.org/https://doi.org/10.1016/j.foodqual.2007.11.002>
- Köster, & Mojet, J. (2018). Complexity of Consumer Perception: Thoughts on Pre–Product Launch Research. In *Methods in Consumer Research, Volume 1* (pp. 23–45). Woodhead Publishing. <https://doi.org/10.1016/B978-0-08-102089-0.00002-9>
- Kragel, P. A., & LaBar, K. S. (2016). Decoding the Nature of Emotion in the Brain. *Trends in Cognitive Sciences*, 20(6), 444–455. <https://doi.org/10.1016/J.TICS.2016.03.011>
- Kring, A. M., & Gordon, A. H. (1998). Sex differences in emotion: expression, experience, and physiology. *Journal of Personality and Social Psychology*, 74(3), 686–703. <https://doi.org/http://dx.doi.org/10.1037/0022-3514.74.3.686>
- Lagast, S., Gellynck, X., Schouteten, J. J., De Herdt, V., & De Steur, H. (2017). Consumers' emotions elicited by food: A systematic review of explicit and implicit methods. *Trends in Food Science & Technology*, 69, 172–189. <https://doi.org/10.1016/J.TIFS.2017.09.006>
- Lapatki, B. ., Stegeman, D. ., & Jonas, I. . (2003). A surface EMG electrode for the simultaneous observation of multiple facial muscles. *Journal of Neuroscience Methods*, 123(2), 117–128. [https://doi.org/10.1016/S0165-0270\(02\)00323-0](https://doi.org/10.1016/S0165-0270(02)00323-0)
- Laros, F. J. M., & Steenkamp, J.-B. E. M. (2005). Emotions in consumer behavior: a hierarchical approach. *Journal of Business Research*, 58(10), 1437–1445.

- <https://doi.org/http://doi.org/10.1016/j.jbusres.2003.09.013>
- Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. *Review of Personality and Social Psychology*, 13, 25–59.
- Larsen, R. J., & Ketelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology*, 61(1), 132. <https://doi.org/https://doi.org/10.1037//0022-3514.61.1.132>
- Lattey, K. A., Bramley, B. R., & Francis, I. L. (2010). Consumer acceptability, sensory properties and expert quality judgements of Australian Cabernet Sauvignon and Shiraz wines. *Australian Journal of Grape and Wine Research*, 16(1), 189–202. <https://doi.org/10.1111/j.1755-0238.2009.00069.x>
- Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: principles and practices*. Springer Science & Business Media.
- Lazarus, R., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.
- Letzring, T. D., & Adamcik, L. A. (2015). Personality traits and affective states: Relationships with and without affect induction. *Personality and Individual Differences*, 75, 114–120. <https://doi.org/10.1016/j.paid.2014.11.011>
- Lund, C. M., Thompson, M. K., Benkwitz, F., Wohler, M. W., Triggs, C. M., Gardner, R., ... Nicolau, L. (2009). New Zealand Sauvignon blanc Distinct Flavor Characteristics: Sensory, Chemical, and Consumer Aspects. *American Journal of Enology and Viticulture*, 60(1), 1–12.
- Manzocco, L., Rumignani, A., & Lagazio, C. (2013). Emotional response to fruit salads with different visual quality. *Food Quality and Preference*, 28(1), 17–22. <https://doi.org/http://doi.org/10.1016/j.foodqual.2012.08.014>
- Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion: A review. *Cognition & Emotion*, 23(2), 209–237. <https://doi.org/10.1080/02699930802204677>
- McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States (POMS)*. San Diego: Educational and Industrial Testing Service.
- Meiselman, H.L., Johnson, J. L., Reeve, W., & Crouch, J. E. (2000). Demonstrations of the influence of the eating environment on food acceptance. *Appetite*, 35(3), 231–237. <https://doi.org/10.1006/APPE.2000.0360>
- Meiselman, H. L. (2013). The future in sensory/consumer research:evolving to a better science. *Food Quality and Preference*, 27(2), 208–214. <https://doi.org/10.1016/J.FOODQUAL.2012.03.002>
- Meiselman, H. L. (2017). Emotion measurement: Theoretically pure or practical? *Food Quality and Preference*, 62, 374–375. <https://doi.org/10.1016/j.foodqual.2017.05.011>
- Meiselman, H. L. (2015). A review of the current state of emotion research in product development. *Food, Emotions and Food Choice*, 76, Part 2, 192–199. <https://doi.org/https://doi.org/10.1016/j.foodres.2015.04.015>
- Melo, L., Colin, J., Delahunty, C., Forde, C., & Cox, D. N. (2010). Lifetime wine drinking, changing attitudes and associations with current wine consumption: A pilot study indicating how

- experience may drive current behaviour. *Eighth Pangborn Sensory Science Symposium - Wine Special Issue*, 21(7), 784–790. <https://doi.org/https://doi.org/10.1016/j.foodqual.2010.07.012>
- Mojet, J. (2001). No Title. *Internal Report Wageningen University and Research Center, Wageningen, The Netherlands*.
- Mojet, J., Dürrschmid, K., Danner, L., Jöchl, M., Heiniö, R.-L., Holthuysen, N., & Köster, E. (2015). Are implicit emotion measurements evoked by food unrelated to liking? *Food Research International*, 76, 224–232. <https://doi.org/10.1016/j.foodres.2015.06.031>
- Montepare, J. M., & Dobish, H. (2014). Younger and older adults' beliefs about the experience and expression of emotions across the life span. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 69(6), 892–896. <https://doi.org/https://doi.org/10.1093/geronb/gbt073>
- Mora, M., Urdaneta, E., & Chaya, C. (2018). Emotional response to wine: Sensory properties, age and gender as drivers of consumers' preferences. *Food Quality and Preference*, 66, 19–28. <https://doi.org/10.1016/j.foodqual.2017.12.015>
- Nelson, M. (2005). *The barbarian's beverage*. Abingdon, UK: Taylor & Francis. <https://doi.org/10.4324/9780203309124>
- Nestrud, M. A., Meiselman, H. L., King, S. C., Leshner, L. L., & Cardello, A. V. (2016). Development of EsSense25, a shorter version of the EsSense Profile®. *Food Quality and Preference*, 48, Part A, 107–117. <https://doi.org/http://dx.doi.org/10.1016/j.foodqual.2015.08.005>
- Ng, M., Chaya, C., & Hort, J. (2013a). Beyond liking: Comparing the measurement of emotional response using EsSense Profile and consumer defined check-all-that-apply methodologies. *Food Quality and Preference*, 28(1), 193–205. <https://doi.org/http://doi.org/10.1016/j.foodqual.2012.08.012>
- Ng, M., Chaya, C., & Hort, J. (2013b). The influence of sensory and packaging cues on both liking and emotional, abstract and functional conceptualisations. *Food Quality and Preference*, 29(2), 146–156. <https://doi.org/10.1016/J.FOODQUAL.2013.03.006>
- Ng, M., & Hort, J. (2015). Insights into measuring emotional response in sensory and consumer research. In J. Delarue, J. Ben Lawlor, & M. Rogeaux (Eds.), *Rapid Sensory Profiling Techniques* (pp. 71–90). Elsevier. <https://doi.org/10.1533/9781782422587.1.71>
- Ng, W. (2009). Clarifying the relation between neuroticism and positive emotions. *Personality and Individual Differences*, 47(1), 69–72. <https://doi.org/https://doi-org.ezproxy.mondragon.edu:4443/10.1016/j.paid.2009.01.049>
- Niimi, J., Danner, L., Li, L., Bossan, H., & Bastian, S. E. P. (2017). Wine consumers' subjective responses to wine mouthfeel and understanding of wine body. *Food Research International*, 99(Part 1), 115–122. <https://doi.org/10.1016/J.FOODRES.2017.05.015>
- Nijman, M., James, S., Dehrmann, F., Smart, K., Ford, R., & Hort, J. (2019). The effect of consumption context on consumer hedonics, emotional response and beer choice. *Food Quality and Preference*, 74, 59–71. <https://doi.org/10.1016/J.FOODQUAL.2019.01.011>
- Noble, A. C., Arnold, R. A., Buechsenstein, J., Leach, E. J., Schmidt, J. O., & Stern, P. M. (1987). Modification of a Standardized System of Wine Aroma Terminology. *American Journal of Enology and Viticulture*, 38(2), 143–146.

- Parra, D. R., Galmarini, M., Chirife, J., & Zamora, M. C. (2015). Influence of information, gender and emotional status for detecting small differences in the acceptance of a new healthy beverage. *Food Research International*, 76, 269–276. <https://doi.org/http://doi.org/10.1016/j.foodres.2014.12.021>
- Piqueras-Fiszman, B., & Jaeger, S. R. (2015). Emotions associated to mealtimes: Memorable meals and typical evening meals. *Food Research International*, 76, 243–252. <https://doi.org/10.1016/j.foodres.2014.12.004>
- Porcherot, C., Delplanque, S., Ferdenzi, C., Gaudreau, N., & Cayeux, I. (2016). Emotions of Odors and Personal and Home Care Products. In Herbert L. Meiselman (Ed.), *Emotion Measurement* (pp. 427–454). Woodhead Publishing. <https://doi.org/10.1016/B978-0-08-100508-8.00017-5>
- Porcherot, C., Delplanque, S., Raviot-Derrien, S., Calvé, B. Le, Chrea, C., Gaudreau, N., & Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference*, 21(8), 938–947. <https://doi.org/10.1016/J.FOODQUAL.2010.03.012>
- Prescott, J. (2017). Some considerations in the measurement of emotions in sensory and consumer research. *Food Quality and Preference*, 62, 360–368. <https://doi.org/https://doi.org/10.1016/j.foodqual.2017.04.005>
- Quigley, K. S., Lindquist, K. A., & Barrett, L. F. (2014). Inducing and measuring emotion and affect: Tips, tricks, and secrets. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 220–252). New York: Cambridge University Press.
- Ristic, R., Danner, L., Johnson, T. E., Meiselman, H. L., Hoek, A. C., Jiranek, V., & Bastian, S. E. P. (2019). Wine-related aromas for different seasons and occasions: Hedonic and emotional responses of wine consumers from Australia, UK and USA. *Food Quality and Preference*, 71, 250–260. <https://doi.org/10.1016/J.FOODQUAL.2018.07.011>
- Robino, A., Mezzavilla, M., Pirastu, N., La Bianca, M., Gasparini, P., Carlino, D., & Tepper, B. J. (2016). Understanding the role of personality and alexithymia in food preferences and PROP taste perception. *Physiology & Behavior*, 157, 72–78. <https://doi.org/10.1016/J.PHYSBEH.2016.01.022>
- Russel, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 1161–1178. <https://doi.org/https://doi.org/10.1037/h0077714>
- Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, 76(5), 805–819. <https://doi.org/10.1037/0022-3514.76.5.805>
- Samant, S. S., & Seo, H.-S. (2019). Personality traits affect the influences of intensity perception and emotional responses on hedonic rating and preference rank toward basic taste solutions. *Journal of Neuroscience Research*, 97(3), 276–291. <https://doi.org/10.1002/jnr.24321>
- Sander, D. (2013). Models of emotion: The affective neuroscience approach. In J. Armony & P. Vuilleumier (Eds.), *The Cambridge handbook of human affective neuroscience* (p. 667). Cambridge: Cambridge University Press.
- Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information*, 44(4), 695–729. <https://doi.org/10.1177/0539018405058216>

- Schmelzle, A., Lindemann, B., & Methner, F. J. (2013). Sensory descriptive analysis and consumer acceptance of non-alcoholic beer. *Brewing Science*, 66, 9–10.
- Scott, N. O., Burgess, B., & Tepper, B. J. (2019). Perception and liking of soups flavored with chipotle chili and ginger extracts: Effects of PROP taster status, personality traits and emotions. *Food Quality and Preference*, 73, 192–201. <https://doi.org/10.1016/J.FOODQUAL.2018.11.009>
- Silva A. P. (2017). *A flavour of emotions. Sensory & emotional profiling of wine, beer and non-alcoholic beer*. Wageningen University, Wageningen, The Netherlands. <https://doi.org/http://dx.doi.org/10.18174/412275>
- Silva, A. P., Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., ... 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. <https://doi.org/10.1016/j.foodqual.2015.11.007>
- Silva A. P., Figueiredo, I., Hogg, T., & Sottomayor, M. (2014). Young adults and wine consumption a qualitative application of the theory of planned behavior. *British Food Journal*, 116(5), 832–848. <https://doi.org/https://doi.org/10.1108/bfj-05-2012-0114>
- Silva A. P., 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. <https://doi.org/https://doi.org/10.1080/10408398.2014.969396>
- Silva A. P., Jager, G., Van Zyl, H., Voss, H., Pintado, M., Hogg, T., & de Graaf, C. (2016). Comparing two methods to measure emotions elicited by beer, wine and non-alcoholic beer. *Appetite*, 101, 236. <https://doi.org/http://dx.doi.org/10.1016/j.appet.2016.02.133> "
- Silva A. P., 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. <https://doi.org/https://doi-org/10.1016/j.foodqual.2016.08.008>
- Silva A. P., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C., Pintado, M., & Jager, G. (2018). Temporal dominance of sensations, emotions, and temporal liking measured in a bar for two similar wines using a multi-sip approach. *Journal of Sensory Studies*, 33(5), e12459. <https://doi.org/10.1111/joss.12459>
- Silva, A. P., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C., Pintado, M., & Jager, G. (2019). Effect of adding hop aroma in beer analysed by temporal dominance of sensations and emotions coupled with temporal liking. *Food Quality and Preference*, 75, 54–63. <https://doi.org/10.1016/J.FOODQUAL.2019.02.001>
- Smith, D. E., & Mitry, D. J. (2007). Cultural convergence: consumer behavioral changes in the European wine market. *Journal of Wine Research*, 18(2), 107–112. <https://doi.org/http://dx.doi.org/10.1080/09571260701660870>
- Spinelli, S. (2017). Implications of the science of emotion for applied research: Comments on Prescott (2017). *Food Quality and Preference*, 62, 369–371. <https://doi.org/10.1016/j.foodqual.2017.05.013>
- Spinelli, S., De Toffoli, A., Dinnella, C., Laureati, M., Pagliarini, E., Bendini, A., ... Monteleone, E. (2018). Personality traits and gender influence liking and choice of food pungency. *Food Quality and*

- Preference*, 66, 113–126. <https://doi.org/10.1016/J.FOODQUAL.2018.01.014>
- Spinelli, S., Masi, C., Dinnella, C., Zoboli, G. P., & Monteleone, E. (2014). How does it make you feel? A new approach to measuring emotions in food product experience. *Food Quality and Preference*, 37, 109–122. <https://doi.org/10.1016/j.foodqual.2013.11.009>
- Spinelli, S., & Monteleone, E. (2018). Emotional Responses to Products. In G. Ares & P. Varela (Eds.), *Methods in Consumer Research, Volume 1* (pp. 261–296). Woodhead Publishing. <https://doi.org/10.1016/B978-0-08-102089-0.00011-X>
- Stone, L. J., & Pangborn†, R. M. (1990). Preferences and intake measures of salt and sugar, and their relation to personality traits. *Appetite*, 15(1), 63–79. [https://doi.org/10.1016/0195-6663\(90\)90100-M](https://doi.org/10.1016/0195-6663(90)90100-M)
- Sugiyama, H., Oshida, A., Thueneman, P., Littell, S., Katayama, A., Kashiwagi, M., ... Herz, R. S. (2015). Proustian Products are Preferred: The Relationship Between Odor-Evoked Memory and Product Evaluation. *Chemosensory Perception*, 8(1), 1–10. <https://doi.org/10.1007/s12078-015-9182-y>
- Talavera, M., & Chambers IV, E. (2017). Using sensory sciences help products succeed. *British Food Journal*, 119(10), 2130–2144. <https://doi.org/10.1108/BFJ-10-2016-0486>
- Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In *Anxiety and the anxiety disorders*. (pp. 681–706). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.
- Thomson, D. (2010). Going beyond liking: measuring emotional and conceptual profiles to make better new products. In *Consumer-Driven Innovation in Food and Personal Care Products* (pp. 219–274). Woodhead Publishing. <https://doi.org/10.1533/9781845699970.2.219>
- Thomson, D., Crocker, C., & Marketo, C. (2010). Linking sensory characteristics to emotions: An example using dark chocolate. *Food Quality and Preference*, 21(8), 1117–1125. <https://doi.org/http://doi.org/10.1016/j.foodqual.2010.04.011>
- Thomson, D. M. H., & Crocker, C. (2013). A data-driven classification of feelings. *Food Quality and Preference*, 27(2), 137–152. <https://doi.org/10.1016/j.foodqual.2012.09.002>
- Torrico, D. D., Fuentes, S., Gonzalez Viejo, C., Ashman, H., Gunaratne, N. M., Gunaratne, T. M., & Dunshea, F. R. (2018). Images and chocolate stimuli affect physiological and affective responses of consumers: A cross-cultural study. *Food Quality and Preference*, 65, 60–71. <https://doi.org/10.1016/j.foodqual.2017.11.010>
- Ullrich, N. V., Touger-Decker, R., O’Sullivan-Maillet, J., & Tepper, B. J. (2004). PROP taster status and self-perceived food adventurousness influence food preferences. *Journal of the American Dietetic Association*, 104(4), 543–549. <https://doi.org/10.1016/J.JADA.2004.01.011>
- Van den Stock, J., Righart, R., & de Gelder, B. (2007). Body expressions influence recognition of emotions in the face and voice. *Emotion*, 7(3), 487–494. <https://doi.org/10.1037/1528-3542.7.3.487>
- van Zyl, H. (2016). Emotion in Beverages. In Herbert L Meiselman (Ed.), *Emotion Measurement* (pp. 473–499). Elsevier. <https://doi.org/10.1016/B978-0-08-100508-8.00019-9>
- van Zyl, H., & Meiselman, H. L. (2015). The roles of culture and language in designing emotion lists: Comparing the same language in different English and Spanish speaking countries. *Food Quality*

- and Preference, 41, 201–213. <https://doi.org/10.1016/j.foodqual.2014.12.003>
- van Zyl, H., & Meiselman, H. L. (2016). An update on the roles of culture and language in designing emotion lists: English, Spanish and Portuguese. *Food Quality and Preference*, 51, 72–76. <https://doi.org/10.1016/j.foodqual.2016.02.019>
- Wakeling, I. N., & MacFie, H. J. H. (1995). Designing consumer trials balanced for first and higher orders of carry-over effect when only a subset of k samples from t may be tested. *Food Quality and Preference*, 6(4), 299–308. [https://doi.org/10.1016/0950-3293\(95\)00032-1](https://doi.org/10.1016/0950-3293(95)00032-1)
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037/0022-3514.54.6.1063>
- Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, 98(2), 219–235. <https://doi.org/10.1037/0033-2909.98.2.219>
- Yang, Q., Dorado, R., Chaya, C., & Hort, J. (2018). The impact of PROP and thermal taster status on the emotional response to beer. *Food Quality and Preference*, 68, 420–430. <https://doi.org/10.1016/J.FOODQUAL.2018.03.001>
- Yeomans, M. R., Prescott, J., & Gould, N. J. (2009). Acquired hedonic and sensory characteristics of odours: Influence of sweet liker and propylthiouracil taster status. *Quarterly Journal of Experimental Psychology*, 62(8), 1648–1664. <https://doi.org/10.1080/17470210802557793>
- Yik, M., Russell, J. A., & Steiger, J. H. (2011). A 12-point circumplex structure of core affect. *Emotion*, 11(4), 705–731. <https://doi.org/http://dx.doi.org/10.1037/a0023980>
- Zuckerman, M., & Lubin, B. (1985). *Manual for the Revised Multiple Affect Adjective Check List*. San Diego: Educational and Industrial Testing Service.

ANNEX I

STUDY 4

Comparison of methods to develop an emotional lexicon of wine:

Conventional vs Rapid-method approach

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Submitted

Comparison of methods to develop an emotional lexicon of wine: Conventional vs Rapid-method approach

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KEYWORDS

Emotions, Lexicon, Wine, Sensory, Sorting Task, Rapid method

HIGHLIGHTS

- Conventional vs rapid-method for wine emotional lexicon were compared.
- Sorting Task was suitable to classify emotions by consumers.
- Both emotional lexicons provided similar emotional maps of wines.
- Rapid-method approach saved time and resources.

ABSTRACT

The development of emotional lexicons can be seen as a time- and resource-consuming activity. Several rapid methods (e.g.: Sorting Task) have been developed for time-restricted studies, but the suitability of these methodologies has not been proven for emotional studies.

The aim of the present research was to test the suitability of a rapid method, as it is the Sorting Task, for emotional lexicon development. For this purpose, two different approaches (conventional vs rapid-method) were compared.

222 consumers participated in the lexicon development procedure. A common phase of generation and filtering of the terms was carried out for the development of both lexicons. Then, two approaches were used, one applying the procedures proposed in the literature (conventional), and the other by applying Sorting Task (rapid-method). Lexicon I was obtained using the conventional approach: 13 categories were detected after the Hierarchical Cluster Analysis. Lexicon II was developed using the rapid-method approach: 15 categories were detected after grouping the emotional terms through Sorting Task. To validate both lexicons, consumer studies (n=185) were conducted using a set of seven commercial wines.

Results showed that both methods were helpful in discriminating emotional responses. Lexicon I reported a wine effect for 10 of the 13 emotional categories, while the lexicon II discriminated the samples in all 15 categories. Multifactorial analysis was conducted to compare the emotional maps generated by both lexicons, showing a high agreement between configurations (RV=0.985). Both methods provided similar maps of wines, but Lexicon II was more efficient in terms of time and resources during the lexicon development.

1. INTRODUCTION

The study of the emotional response triggered by foods has gained attention in scientific literature because it is a useful tool to differentiate and to improve the product position in the marketplace (Cardello et al., 2016; Danner et al., 2016; Ferrarini et al., 2010; van Zyl, 2016). In recent years, many authors have developed emotional lexicons to measure the emotional response elicited by the consumption of different food products (e.g., Bhumiratana, Adhikari, & Chambers, 2014; Danner et al., 2016; Ferrarini et al., 2010; Gmuer, Guth, Runte, & Siegrist, 2015; Hu & Lee, 2018; King & Meiselman, 2010; Manzocco, Rumignani, & Lagazio, 2013; Mora, Giussani, Pagliarini, & Chaya, 2019; Silva et al., 2016; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014; Thomson & Crocker, 2013; van Zyl & Meiselman, 2015).

Although there is a wide variety of emotional lexicons in the literature, several authors have showed a better description of emotional responses when a specific lexicon for the product category is applied (Ng, Chaya, & Hort, 2013; Silva et al., 2016). To choose the correct method to measure emotions triggered by foods, some issues should be considered: 1) the potential of the method to capture differences, 2) the culture, and 3) the length of the questionnaire. The ability to detect differences among products will be conditioned by the specificity of the lexicon. Even though generic emotional lexicons (King & Meiselman, 2010; Spinelli et al., 2014; Thomson & Crocker, 2013) could be used to measure the emotional response of any food category, the development of specific lexicons could be more suitable to capture more subtle different feelings or emotions among samples within a certain product category (Ng et al., 2013; Silva et al., 2016; van Zyl, 2016). Culture might affect the use, the dimension, the meaning of emotional terms, and also the consumers' familiarity to the product (van Zyl & Meiselman, 2015, 2016). Emotional lexicons should only be used by consumers of the culture for which it was designed. The length of the questionnaire will affect the time/effort required by the consumer to complete the task of reporting the emotions elicited by a product (Cardello et al., 2016; van Zyl, 2016). Some authors have used different procedures or methodologies to reduce the length and the difficulty of the task. For example, Chaya et al. (2015) applied Hierarchical Cluster Analysis to group terms with similar ratings into emotional categories, and to reduce the length of the questionnaire. The effectiveness of this approach was analyzed by Eaton et al. (2019). Yik, Russell, & Steiger (2011) developed a 12-point emotion circumplex structure to measure the core affect, which shows the feelings resulting from moods and emotions. Considering all these factors, when the emotional response elicited by foods is assessed, specific "shorter/easier" questionnaires or methods belonging to the consumers' culture must be applied.

It is important to consider that the development of emotional lexicons is a time- and resource-consuming activity. The "conventional" method to generate emotional lexicons is conducted after

four different steps: 1) term generation, 2) reduction of terms by removing synonyms and irrelevant terms, 3) grouping of terms into categories to reduce the length of the questionnaire (optional step), and 4) validation of the lexicon. For the first step (term generation), three principal approaches have been reported in the literature, depending on the source of the emotional terms: a) consumer-led approaches, where consumers generate the emotional terms (Bhumiratana et al., 2014; Chaya et al., 2015; Ng et al., 2013; Silva et al., 2016), b) linguistic-based approaches, where specialists or researchers present an existing list of emotions from the literature (Ferrarini et al., 2010; Gmuer et al., 2015; King & Meiselman, 2010), and c) a combination of the two previous methods, where consumers generate the emotional terms with the support of terms from the bibliography (Danner et al., 2016; Manzocco et al., 2013; van Zyl & Meiselman, 2015). Once the terms have been generated, the synonyms should be removed from the list, and a panel of consumers has to check the relevance of the emotional words for the studied product. Then, in some cases, additional consumer tests are carried out to rate the elicited emotions by several products with different sensory properties using the emotional terms previously developed. Hierarchical Cluster Analysis is used to group the different emotions into emotional categories; this step may need to be supervised by the research team (Chaya et al., 2015; Mora et al., 2019). Finally, the resulting lexicon has to be validated to confirm its ability to measure the emotional response evoked by the specific product. Therefore, the current procedure defined in the literature is time-consuming and expensive, because of the many steps needed and the necessity of using a large number of consumers and samples to draw conclusions.

Rapid methods are novel methodologies that have gained popularity in recent years being reliable options when quick information is needed. The application of these methods can provide a quick output about consumers' perception and preferences (Varela & Ares, 2014). Sorting Task is a methodology designed to collect the global degree of similarity among samples; in this method, assessors or consumers classify different stimuli together based on their perceived similarities (Chollet, Valentin, & Abdi, 2014). This methodology is a holistic procedure based on the cognitive process of categorization in which a routine process used in everyday life does not need a quantitative response. Considering that Sorting Task is a useful tool for grouping samples regarding their similarities and differences, it could be applied to generate an emotional lexicon, shortening the length of the procedure. The application of this method might help reduce the number of steps of the lexicon development procedure.

Therefore, the aim of the present research was to test the suitability of a rapid-method, like Sorting Task, for emotional lexicon development, specifically wine emotional lexicons. For this purpose, two different approaches, conventional (time consuming) vs rapid-method, were applied to wine matrices and compared.

2. MATERIAL AND METHODS

2.1. Samples

In order to have as much sensory variation as possible, seven different commercial wines of different wine styles (red, rosé, white, sparkling white, sparkling rosé, sweet and semi-sweet wines) were selected for this study. Descriptive sensory analysis was conducted by a trained panel. ANOVA followed by a Post hoc test Tukey HSD was carried out to ensure diversity of the sensory properties for all the wines. Details of the samples used in the study are reported in Table 1.

Table 1. P-values and mean scores of the sensory descriptors of wine samples.

Sensory attributes	1 Red wine (2012)	2 Sparkling rosé wine (2017)	3 Rosé wine (2017)	4 Sparkling white wine (2017)	5 Red wine (2014)	6 Semi-sweet white wine (2017)	7 Red wine (2017)	p-value
Flowers	0.906 c	2.719 bc	2.356 bc	3.800 ab	0.381 c	5.438 a	1.983 bc	< 0.0001
Violet	1.719 a	1.275 a	1.944 a	0.931 a	0.912 a	1.044 a	2.375 a	0.1402
Clove	1.563 ab	0.156 b	0.769 ab	0.381 b	1.406 ab	0.244 b	2.096 a	0.0002
Pepper	1.163 ab	0.169 b	0.275 b	0.200 b	2.319 a	0.138 b	2.179 a	< 0.0001
Licorice	0.631 a	0.550 a	0.575 a	0.844 a	0.256 a	0.675 a	0.821 a	0.8315
Lemon	0.150 a	0.475 a	0.425 a	1.331 a	0.119 a	1.113 a	0.550 a	0.0377
Blackberry	2.569 a	1.150 abc	0.450 bc	0.281 c	2.019 ab	0.169 c	0.800 bc	< 0.0001
Raspberry	1.800 a	1.338 a	1.694 a	0.187 a	1.944 a	0.406 a	1.829 a	0.0238
Strawberry	1.200 ab	1.638 ab	2.256 a	0.425 b	0.969 ab	0.681 ab	2.092 a	0.0049
Blueberry	1.981 a	0.956 a	1.144 a	0.300 a	1.463 a	0.275 a	1.642 a	0.1217
Peach	0.163 a	0.888 a	0.869 a	1.256 a	0.212 a	1.063 a	0.654 a	0.1617
Apple	0.150 c	0.487 bc	0.731 bc	2.275 a	0.106 c	1.794 ab	0.742 bc	< 0.0001
Pineapple	0.081 c	0.631 bc	0.494 c	2.844 a	0.119 c	2.119 ab	0.512 c	< 0.0001
Banana	0.475 a	1.088 a	0.425 a	1.263 a	0.106 a	1.050 a	0.742 a	0.2239
Tea	0.563 a	0.263 a	0.219 a	0.100 a	0.438 a	0.113 a	0.608 a	0.2105
Nut	0.600 a	0.119 a	0.625 a	0.425 a	0.425 a	0.144 a	0.663 a	0.6015
Vanilla	1.706 a	1.138 a	0.950 a	1.363 a	1.150 a	1.100 a	2.179 a	0.4149
Coffee	0.344 a	0.888 a	0.244 a	0.100 a	0.994 a	0.100 a	0.338 a	0.0663
Butter	0.988 a	0.506 a	0.319 a	0.738 a	0.181 a	0.388 a	0.417 a	0.3828
Mushroom	0.613 ab	0.150 b	0.219 ab	0.100 b	0.994 a	0.313 ab	0.325 ab	0.0209
Acidity	4.794 a	1.194 c	4.438 a	4.519 a	3.513 ab	1.756 bc	5.483 a	< 0.0001
Sweetness	0.706 b	4.994 a	1.513 b	1.638 b	0.575 b	5.494 a	1.279 b	< 0.0001
Astringency	4.681 a	0.750 b	1.750 b	1.844 b	5.813 a	1.281 b	4.275 a	< 0.0001
Carbonation	0.956 b	2.475 ab	0.906 b	4.675 a	1.125 b	1.088 b	0.421 b	< 0.0001

Different letters within the same row indicate different post-hoc groupings by Tukey's HSD ($p \leq 0.05$).

Numbers in bold mean $p \leq 0.05$.

2.2. Consumer-led lexicon development

A total of 222 consumers participated in the lexicon development procedure. Different steps were followed to develop both emotional lexicons (lexicons I and II). The procedures are described in Figure

1.

Figure 1. Flow chart of the lexicon development by both approaches

The initial steps related to the generation, filtering, and reduction of terms were common for both lexicons (n=161).

2.2.1. Procedure for generating terms

Nine focus groups were employed to generate the emotions related to wine consumption. 99 participants (aged from 20 to 85 years old), who consumed wine at least once a month took part in this part of the study.

Each focus group session was divided into three parts following the procedure of Chaya et al. (2015). In the first part, a short explanation of the objective of the focus group was presented. The participants were then instructed about the differences between emotions and mood. During the second part, to stimulate emotion elicitation, a warm up exercise was conducted using different pictures and prompt cards (Ng, Chaya, & Hort 2013). Participants were indicated to look at each picture and individually answer the question “how do you feel after looking at this picture?” Once all

the consumers were ready, a discussion took place to collect all the elicited emotions. During the third part of the focus groups, consumers repeated the same process as the second part, but using different wines instead of pictures/cards. Each consumer received a triad of samples (10 ml each) randomly assigned from the set of wines (see Table 1); the participant was instructed to taste them and to also describe how they felt when drinking each sample in a written questionnaire. To avoid carry-over effects, consumers were asked to take a minimum of a one-minute break between wines. In addition, each participant received unsalted crackers and mineral water as palate cleansers. Later, emotions and feelings were discussed and collected in an initial list of terms, being the kick off for the lexicon development.

2.2.2. Filtering and reduction of terms

The initial list of the emotional terms was checked and verified to remove synonyms and terms which were not considered emotions or feelings by the research team. The list was checked following the method of van Zyl & Meiselman (2015) in which each term was compared with the emotional lists published by Clore, Ortony, & Foss (1987) and Laros & Steenkamp (2005) containing 564 and 50 terms, respectively. The terms generated in the focus group sessions that were not included in the reported lists were removed.

To reduce the number of emotional terms included in the filtered list, two different procedures to determine their relevance were also conducted: a relevance test (RT) and a grouping of irrelevant terms (GIT). To do so, two consumer panels were recruited. All of them had to consume wine at least once a week. For the RT, 30 consumers were asked to rate each emotional term according to the question: "In your opinion, are the following terms relevant in describing how do you feel when consuming wine?". A 10cm linear scale, anchored from "absolutely irrelevant" to "absolutely relevant", was used for the rating. Terms with a mean 'relevance' score less than 33 % were considered as not relevant and were excluded from the lexicon. For the GIT, 32 consumers received the list of emotions and were asked to remove all the terms that they considered irrelevant when consuming wine. The terms which were rejected by ≥ 30 % of the consumers were removed from the lexicon list.

2.2.3. Grouping of terms into emotion categories

2.2.3.1. Conventional approach

Using the approach of Chaya et al. (2015), the seven wines (Table 1) were evaluated by a panel of 33 consumers. Participants tasted each wine sample and rated each evoked emotional term from the list obtained after the filtering and reduction task. A warm-up sample was used to minimize the first position effect (Dorado, Pérez-Hugalde, Picard, & Chaya, 2016). Wines were served in random order

according to a Complete Balanced Block design. Rating was conducted using a 10-cm continuous line scale anchored from 'very low' to 'very high' using Compusense® Cloud software (Compusense Inc., Guelph, Ontario, Canada). To minimize bias, the emotions were presented in a randomized order for each consumer.

A Hierarchical Cluster Analysis (HCA) was conducted with the average ratings of each emotional term to group similar emotions into categories. Terms were grouped using Euclidean distance and the Ward's criterion of aggregation. Once emotions were grouped into categories, the research team used triangulation to propose a category name for each group. Final emotional categories and their names were supervised by a psychologist from the University of the Basque Country (UPV/EHU). Internal consistency of each category was verified by the Cronbach's alpha coefficient.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

2.2.3.2. Rapid-method approach

To study the possibility of simplifying the development of an emotional lexicon, a new grouping procedure was investigated. The new procedure, based on the rapid method named Sorting Task (Chollet et al., 2014), used a semantic approach to cluster emotions and feelings into categories. 28 wine consumers participated in this task. Each consumer was asked to group the emotions or feelings from the filtered and reduced list using the criteria of joining emotions with similar meaning for them. For this purpose, consumers were asked to think in a wine consumption context. Participants were free to propose as many groups as they considered necessary. The distances between emotions obtained from consumer classifications were analyzed by Multidimensional Scaling (MDS). The MDS treated proximities as Euclidean distances showing an Eigen-decomposition for an n-dimensional representation space. To determine the correct number of dimensions needed to obtain a true representation of data, stress should be low, and the Shepard diagram should be as linear as possible (Addinsoft, 2019).

Once the dimensions' configuration was determined, HCA was performed to group similar emotions into categories. Dimensions were grouped using Euclidean distance and the Ward's criterion of aggregation. In the same manner as in the conventional procedure, categories were named using the information collected in the focus groups, thanks to the psychologist assessment. Also, the Cronbach's alpha coefficient was used to ensure that the resulting categories had internal consistency.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

2.3. Testing of lexicons

2.3.1. Consumers

185 consumers (51% males, mean age of 51 years old) participated in the testing procedure. The consumer's panel was randomly split into two groups to test lexicon I (conventional approach) or lexicon II (rapid-method approach).

2.3.2. Testing procedure

Seven wine samples were presented to the consumers (Table 1) in random order using a Complete Balanced Block design. After tasting each wine, the consumers were first asked to rate the overall liking on a 9-point scale. Then, they had to read all the terms associated with each emotion category and rate the intensity of their feelings on a 10-cm linear scale, anchored from 'very low' to 'very high'. Data collection was done using Compusense® Cloud software (Compusense Inc., Guelph, Ontario, Canada). To minimize bias, the order of the emotion categories was randomized for each consumer. Also, a warm-up sample was introduced into the experimental design (Dorado et al., 2016; Wakeling & MacFie, 1995) to avoid the first position effect.

2.3.3. Data analysis

Responses to each emotional category were inputted in ANOVA tests such as dependent variables and using "wine" as a factor. Post-hoc tests for "sample" effect were conducted using Tukey's HSD.

Principal Component Analysis (PCA) was performed on the average ratings of each emotional category to explore the relationships between emotional categories and wines. Liking was used as a supplementary (non-active) variable in the analysis.

HCA was carried out using the averages of each emotional category per wine. The cluster analysis was based on the Euclidean distance, and the Ward algorithm was used as the agglomerative method.

To determine the relationship among the emotional categories, the wines, and the two lexicons, a Multiple Factor Analysis (MFA) was conducted with the mean ratings of each emotion category. Again, liking was used as a supplementary variable. The RV coefficient was also calculated to compare the emotional maps of wines obtained with both lexicons.

All statistical analyses were done using XLSTAT (XLSTAT Version 2018.7, USA) (Addinsoft, 2019).

3. RESULTS

3.1. Consumer-led lexicon development

The lexicon development was a complex process composed of many steps. Figure 1 shows a flow chart of the process and reports the evolution of the number of terms at each stage of the development of the lexicons.

3.3.1. Common steps of the consumer-led lexicon: generation, filtering and reduction of terms

During the first step of the lexicon generation, during the focus group sessions, a total of 127 emotional terms were collected (Table 2). The 127 terms were compared with the emotional lists reported by Clore, Ortony, & Foss (1987) and Laros & Steenkamp (2005). After the comparison, the list composed of 85 terms (Table 1). Then, two analyses were conducted to ensure that the remaining terms were relevant to the study of the emotional response elicited by wine consumption: i) RT, and ii) GIT. The relevance test caused a reduction of 11 terms, and the grouping of irrelevant terms reduced the list by 25 emotions. The results of these steps provided a final list of 49 emotions and feelings related to the wine consumption experience (Table 2).

Table 2. Terms generated in the common process before clustering (terms translated into English are in *italics*).

English	Spanish	English	Spanish	English	Spanish
<i>Overwhelmed</i>	Abrumado**	<i>Difficult</i>	Difícil*	<i>Obligation</i>	Obligación*
<i>Bored</i>	Aburrido***	<i>Displeased</i>	Disgustado	<i>Leisured</i>	Ocioso*
<i>Accelerated</i>	Acelerado*	<i>Fun</i>	Divertido	<i>Hate</i>	Odio**
<i>Welcome</i>	Acogido***	<i>Gentle</i>	Dulzura**	<i>Lazy</i>	Pereza***
<i>Wonder</i>	Admirado***	<i>Excited</i>	Emocionado-entusiasmado	<i>Heavy</i>	Pesado*
<i>Affectionate</i>	Afectuoso	<i>Energetic</i>	Enérgico	<i>Pleasure</i>	Placer
<i>Lucky</i>	Afortunado	<i>Jealous</i>	Envidioso**	<i>Fullness</i>	Plenitud*
<i>Burdened</i>	Agobiado***	<i>Hopeful</i>	Esperanzado***	<i>Positive</i>	Positivo*
<i>Nice</i>	Agradable*	<i>Spiritual</i>	Espiritual*	<i>Powerful</i>	Potente***
<i>Grateful</i>	Agradecido***	<i>Stable</i>	Estable*	<i>Worried</i>	Preocupado**
<i>Cheerful</i>	Alegre	<i>Euphoric</i>	Eufórico	<i>Beloved</i>	Querido***
<i>Bitter</i>	Amargado***	<i>Excited</i>	Excitado	<i>Rage</i>	Rabioso**
<i>Friendly</i>	Amigable	<i>Expectation</i>	Expectación***	<i>Rancid</i>	Rancio*
<i>Loving</i>	Amoroso	<i>Estrange</i>	Extrañado*	<i>Weird</i>	Raro
<i>Distressed</i>	Angustiado**	<i>Familiar</i>	Familiar*	<i>Rejection</i>	Rechazo*
<i>Joyful</i>	Animado	<i>Annoyed</i>	Fastidiado***	<i>Comforting</i>	Reconfortante*
<i>Anxious</i>	Ansioso-deseoso	<i>Happy</i>	Feliz	<i>Refreshed</i>	Refrescado
<i>Yearning</i>	Añoranza	<i>Playful</i>	Fiestero	<i>Relaxed</i>	Relajado
<i>Distressed</i>	Apenado***	<i>Cool</i>	Fresco*	<i>Repulsion</i>	Repulsión*
<i>Disgusted</i>	Asqueado	<i>Frustrated</i>	Frustrado***	<i>Sentimental</i>	Romántico
<i>Attraction</i>	Atracción**	<i>Strong</i>	Fuerte	<i>Rustic</i>	Rustico*
<i>Aversion</i>	Aversión***	<i>Weariness</i>	Hastío*	<i>Satisfied</i>	Satisfecho

Table 2. Continuation

<i>Good</i>	Bien	<i>Homelike</i>	Hogareño*	<i>Saturated</i>	Saturado*
<i>Warm</i>	Cálido	<i>Excited</i>	Ilusionado	<i>Safe</i>	Seguro
<i>Calm</i>	Calmado	<i>Doubt</i>	Incertidumbre***	<i>Sensitive</i>	Sensible
<i>Tired</i>	Cansado***	<i>Uncomfortable</i>	Incomodo*	<i>Serenity</i>	Sereno
<i>Warm</i>	Cariñoso	<i>Indifference</i>	Indiferencia	<i>Serious</i>	Serio***
<i>Closeness</i>	Cercanía*	<i>Unexpected</i>	Inesperado*	<i>Sociable</i>	Sociable*
<i>Sparkler</i>	Chisposo*	<i>Restless</i>	Inquieto***	<i>Alone</i>	Soledad***
<i>Pleased</i>	Complacido	<i>Unsatisfied</i>	Insatisfecho*	<i>Sleepy</i>	Somnoliento/ Adormilado
<i>Common</i>	Común*	<i>Intense</i>	Intenso*	<i>Negatively surprised</i>	Sorprendido negativamente
<i>Comfortable</i>	Confortado	<i>Uneasy</i>	Intranquilo**	<i>Positively surprised</i>	Sorprendido positivamente
<i>Confused</i>	Confuso	<i>Humorous</i>	Jocoso*	<i>Relaxed</i>	Sosegado***
<i>Glad</i>	Contento	<i>Young</i>	Joven*	<i>Fear</i>	Temor**
<i>Curious</i>	Curiosidad	<i>Free</i>	Libertad*	<i>Tense</i>	Tenso***
<i>Corny</i>	Cursi*	<i>Light</i>	Ligero*	<i>Tender</i>	Tierno***
<i>Disappointment</i>	Decepcionado	<i>Wrong</i>	Mal*	<i>Quiet</i>	Tranquilo
<i>Displeased</i>	Desagradado	<i>Melancholy</i>	Melancólico	<i>Sadness</i>	Tristeza
<i>Discouraged</i>	Desanimado***	<i>Monotonous</i>	Monótono*	<i>Summer</i>	Veraniego*
<i>Discontent</i>	Descontento	<i>Motivated</i>	Motivado*	<i>Old</i>	Viejo*
<i>Desirous</i>	Deseo*	<i>Negative</i>	Negativo*	<i>Vulnerable</i>	Vulnerable**
<i>Disinterested</i>	Desinterés*	<i>Nervous</i>	Nervioso***		
<i>Carefree</i>	Despreocupado	<i>Nostalgic</i>	Nostálgico		

Terms removed in the filtering process (*), relevance test (**), and in the grouping of irrelevant terms (***).

3.3.2. Grouping of terms: Conventional approach

The HCA analysis grouped the emotions into 15 emotional categories. The assessment of a psychologist improved the categorization by slightly modifying the clusters (reducing the categories). It is important to note that modifications were done in the original language of the terms (Spanish). Terms and translation are presented in Table 2. For example, the cluster composed of “Displeased” and “Weird” had a very low Cronbach’s alpha. Based on the similarities with other groups, these terms were joined with the cluster CONFUSED, obtaining a final Cronbach’s alpha cluster value of 0.926. Similarly, the cluster composed of “Pleased”, “Quiet”, “Relaxed” and “Refreshed” were included in the CALM cluster, obtaining a final Cronbach’s alpha value of 0.909. Finally, the cluster DISPLEASED, initially composed of “Disgusted”, “Displeased”, “Strong” and “Sleepy” was modified moving the last two terms into other categories. “Strong” was included in the category EUPHORIC, and “Sleepy” was added to the INDIFFERENCE cluster. Both groups increased their Cronbach’s alpha value after including the aforementioned items. After these modifications, the final lexicon I resulted in 13 emotional categories (Table 3).

Table 3. Lexicon I and II categories

LEXICON I			LEXICON II		
Categories	Terms	Cronbach's alpha	Categories	Terms	Cronbach's alpha
YEARNING <i>Añoranza</i>	Cálido/Añoranza/ Melancólico	0.815	SLEEPY <i>Adormilado</i>	Adormilado	-
CALM <i>Calma</i>	Sensible/Calmado/Sereno /Complacido/Tranquilo/ Relajado/Refrescado	0.909	AFFECTIONATE <i>Afectuoso</i>	Afectuoso/Amoroso/ Cálido/Cariñoso/ Romántico	0.943
WARM <i>Cariñoso</i>	Romántico/Cariñoso/ Satisfecho/Bien/Amoroso	0.948	LUCKY <i>Afortunado</i>	Afortunado/Agradecido/ Confortado	0.923
CONFUSED <i>Confuso</i>	Sorprendido negativamente/Confuso/ Descontento/ Desagradado/Raro	0.926	JOYFUL <i>Alegre</i>	Alegre/Contento/Feliz/ Ilusionado	0.962
GLAD <i>Contento</i>	Contento/Divertido/ Fiestero/Ilusionado/ Amigable	0.955	CHEERFUL <i>Animado</i>	Amigable/Animado/Bien	0.935
DESIROUS <i>Deseoso</i>	Ansioso- deseoso	-	CURIOUS <i>Curiosidad</i>	Curiosidad	-
DISPLEASED <i>Disgustado</i>	Asqueado/Disgustado	0.862	DESIROUS <i>Deseoso</i>	Ansioso- deseoso/ Emocionado- entusiasmado/Excitado/ Placer/Sorprendido positivamente	0.914
EXCITED <i>Entusiasmado</i>	Emocionado- entusiasmado/Alegre/ Curiosidad	0.919	DISPLEASED <i>Disgustado</i>	Asqueado/Confuso/ Desagradado/ Descontento/Disgustado/ Indiferencia/raro/ Sorprendido negativamente	0.938
EUPHORIC <i>Eufórico</i>	Animado/Eufórico/ Enérgico/Excitado/Fuerte	0.863	FUN <i>Divertido</i>	Divertido/Enérgico/ Eufórico/Fiestero/Fuerte	0.862
HAPPY <i>Feliz</i>	Feliz/Sorprendido positivamente/Afectuoso/ Afortunado/Feliz/ Agradecido/Placer/ Confortado/	0.965	NOSTALGIC <i>Nostálgico</i>	Añoranza/Melancólico/ Nostálgico	0.886
INDIFFERENCE <i>Indiferencia</i>	Indiferencia/Adormilado	0.602	REFRESHED <i>Refrescado</i>	Refrescado	-
SAFE <i>Seguro</i>	Despreocupado/Seguro	0.589	RELAXED <i>Relajado</i>	Calmado/Despreocupado/ Relajado/Sereno/ Tranquilo	0.872
SADNESS <i>Tristeza</i>	Nostálgico/Tristeza	0.495	SATISFIED <i>Satisfecho</i>	Complacido/Satisfecho/ Seguro	0.876
			SENSITIVE <i>Sensible</i>	Sensible	-
			SADNESS <i>Tristeza</i>	Tristeza	-

3.3.3. Grouping of terms: Rapid-method approach

Using the sorting proximity matrix, different 16-dimensional representation spaces were calculated by MDS. A final number of 16 dimensions were chosen, because the stress value of the 16 dimensions (0.043) was the weakest, and a Shepard diagram was the most linear compared to other dimensions.

Dimensions were inputted in an HCA resulting in 14 clusters of emotions. The internal consistency of each dimension was calculated, and the dimensions with lowest Cronbach's alpha values were adjusted. The cluster composed of the emotions "Curious", "Strong", and "Refreshed" was modified splitting the group into three. "Refreshed" and "Curious" represented two single categories, and "Strong" was included in the FUN category. Finally, lexicon II had 15 emotional categories (Table 3). The resulting categories presented a good internal consistency measured by Cronbach's alpha values.

3.2. Testing of lexicons

Once the lexicons were defined, their ability for wine discrimination was assessed.

3.2.1. Lexicon I

ANOVA tests showed that 11 of the 13 categories of lexicon I (YEARNING, WARM, CONFUSED, GLAD, DESIROUS, DISPLEASED, EXCITED, EUPHORIC, HAPPY, INDIFFERENCE, and SAFE) were significantly different among samples. Post hoc analyses identified different wine groups for each emotional category (Table 4).

Table 4. P-values and mean scores for the two lexicons' emotional categories and liking across the seven wines.

	Categories	p-value	1	2	3	4	5	6	7
LEXICON I	Liking	< 0.0001	5.107 b	6.123 a	4.539 b	5.391 ab	5.009 b	6.096 a	4.704 b
	YEARNING	0.0009	3.279 abc	3.742 ab	2.369 c	2.633 bc	3.807 a	3.406 abc	3.113 abc
	CALM	0.1636	4.079 a	4.497 a	3.431 a	3.959 a	4.014 a	4.147 a	3.540 a
	WARM	< 0.0001	3.409 b	4.852 a	2.999 b	3.626 ab	3.776 ab	4.668 a	3.040 b
	CONFUSED	0.0270	3.513 a	2.289 b	3.175 ab	2.859 ab	2.964 ab	2.317 ab	3.083 ab
	GLAD	< 0.0001	4.059 abc	5.233 a	3.149 c	4.387 abc	3.831 bc	4.981 ab	3.517 c
	DESIROUS	0.0001	3.643 ab	4.665 a	3.019 b	3.844 ab	3.523 ab	4.517 a	3.026 b
	DISPLEASED	0.0013	3.192 a	1.767 b	2.981 a	2.506 ab	2.973 a	2.020 ab	2.885 ab
	EXCITED	< 0.0001	3.889 ab	4.866 a	3.141 b	3.972 ab	3.890 ab	4.947 a	3.457 b
	EUPHORIC	0.0007	3.945 ab	4.595 a	3.030 b	4.027 ab	3.700 ab	4.402 a	3.133 b
	HAPPY	< 0.0001	3.842 b	5.304 a	3.136 b	4.135 ab	3.921 b	5.188 a	3.437 b
	INDIFFERENCE	0.0010	2.942 ab	2.247 b	3.808 a	3.187 ab	2.570 b	2.679 b	3.355 ab
	SAFE	0.0392	4.563 a	4.398 a	3.636 a	4.204 a	4.421 a	4.734 a	3.550 a
	SADNESS	0.1307	3.006 a	2.060 a	2.341 a	2.242 a	2.620 a	2.330 a	2.683 a
LEXICON II	Liking	< 0.0001	5.522 ab	6.046 a	4.004 d	5.442 ab	4.912 bc	6.209 a	4.553 cd
	SLEEPY	0.0192	2.755 ab	2.024 b	2.705 ab	2.533 ab	2.943 ab	2.233 ab	3.081 a
	AFFECTIONATE	< 0.0001	4.042 bc	5.406 a	3.066 c	3.988 bc	3.570 c	5.148 ab	3.290 c
	LUCKY	< 0.0001	4.075 ab	4.828 a	2.874 c	3.970 abc	3.801 abc	4.799 a	3.228 bc
	JOYFUL	< 0.0001	4.231 bcd	5.531 a	3.314 d	4.706 abc	3.761 cd	5.001 ab	3.326 d
	CHEERFUL	< 0.0001	4.473 ab	5.406 a	3.271 c	4.719 ab	3.827 bc	5.170 a	3.624 bc
	CURIOUS	< 0.0001	3.995 abc	5.140 a	3.154 c	4.007 abc	3.518 c	4.712 ab	3.587 bc
	DESIROUS	< 0.0001	3.944 abc	4.918 a	2.776 d	4.146 ab	3.702 bcd	4.412 ab	2.992 cd
	DISPLEASED	0.0002	2.676 abc	2.043 bc	3.143 a	2.620 abc	3.137 ab	1.855 c	3.278 a
	FUN	< 0.0001	3.843 bc	5.128 a	3.121 c	4.445 ab	3.662 bc	4.627 ab	3.059 c
	NOSTALGIC	0.0415	3.375 ab	2.948 ab	2.560 b	3.110 ab	3.729 a	3.115 ab	3.557 ab
	REFRESHED	< 0.0001	2.795 b	5.326 a	3.225 b	4.836 a	2.624 b	4.660 a	2.843 b
	RELAXED	< 0.0001	4.025 bc	5.145 a	3.252 c	4.090 abc	4.121 abc	4.837 ab	3.764 bc
	SATISFIED	< 0.0001	4.587 ab	5.346 a	2.938 c	4.219 ab	4.296 ab	5.234 a	3.551 bc
	SENSITIVE	< 0.0001	3.425 bc	4.497 a	2.902 c	3.765 abc	3.516 abc	4.217 ab	3.210 bc
	SADNESS	0.0005	2.594 a	1.607 b	2.771 a	1.982 ab	2.676 a	1.935 ab	2.636 a

Different letters within the same row indicate different post-hoc groupings by Tukey's HSD ($p \leq 0.05$).

Numbers in bold mean $p \leq 0.05$.

The first two Principal Components of the Principal Component Analysis (PCA) explained 92.68% of the data variance (Figure 2a). PC1 was positively correlated with CALM (0.928), WARM (0.988), GLAD (0.976), DESIROUS (0.985), EXCITED (0.986), EUPHORIC (0.960) and HAPPY (0.992) categories, whereas categories CONFUSED (-0.838), DISPLEASED (-0.867) and INDIFFERENCE (-0.881) were negatively correlated. PC2 was positively correlated with the SADNESS (0.818) category.

Figure 2b was helpful in the interpretation of the grouping of wines by HCA. Wines 6 and 2 were grouped together and related positively with the PC1. Wines 7 and 3 were in the same cluster and negatively related with PC1. On the contrary, the groups of wines 1 and 5, and wine 4, were positively and negatively related to PC2 respectively.

Figure 2. First factorial plot of the PCA based on the emotional response to wines from the lexicon I. (a) Correlation plot of emotions (b) Projection of wines. Groupings are based on clustering results of the same data set.

3.2.2. Lexicon II

ANOVA test showed that all emotional categories of lexicon II were significantly different among wines. Post hoc analyses identified different wine groupings for each emotional category (Table 4).

The first two Principal Components of the PCA explained 96.03% of the data variance (Figure 3a). The horizontal axis was positively correlated with AFFECTIONATE (0.984), LUCKY (0.960), JOYFUL (0.990), CHEERFUL (0.983), CURIOUS (0.976), DESIROUS (0.967), FUN (0.982), RELAXED (0.951), SATISFIED

(0.922) and SENSITIVE (0.980). It was negatively correlated with SLEEPY (-0.910), DISPLEASED (-0.954) and SADNESS (-0.949). The vertical axis was positively correlated with the emotional category NOSTALGIC (0.965).

The HCA of wines resulting from lexicon II, provided a similar configuration to the one obtained from lexicon I (Figure 3b). Wines 6 and 2 (one group) were positively related with PC1, whereas wines 7 and 3 (another group) were negatively related with this axis. Likewise, wines 1 and 5 (one group) were positively associated to PC2, whereas wine 4 was negatively associated with this axis.

Figure 3. First factorial plot of the PCA based on the emotional response to wines from the lexicon II. (a) Correlation plot of emotions (b) Projection of wines. Groupings are based on clustering results of the same data set.

3.3. Comparison of lexicon

Comparing the univariate analysis results from lexicons I and II, both lexicons were suitable in discriminating wine emotional responses. Lexicon I had a wine effect for 10 of the 13 emotional categories, while lexicon II discriminated wines in all 15 categories.

To study the relationship between the emotional maps of both lexicons, a MFA was conducted and a very similar configuration of the wines was obtained, having a RV coefficient of 0.985. This result was reinforced by the observation plots of lexicons I and II (Figure 2b and Figure 3b, respectively) where the samples were plotted similarly, and also by the HCA results. The major differences between both lexicons were in PC2: in lexicon I, PC2 was mainly driven by SADNESS, and in lexicon II by NOSTALGIC.

4. DISCUSSION

The main objective of the present study was to evaluate if the Sorting Task methodology was a suitable procedure to develop a consumer-led emotional lexicon of wine. Results showed that the application of Sorting Task could be useful in the lexicon development procedure for emotions, reducing steps and resulting in a less time-consuming approach. Also, it was proven that both approaches were similar in discriminating emotional responses elicited by different types of wines.

RT and GIT were suitable procedures for removing irrelevant emotions or feelings from the list of terms obtained from the focus groups. Ferrarini et al. (2010) used a 5-point scale to remove irrelevant terms where 1 meant “the adjective is not at all suitable for describing the emotional experience of the wine” and 5 “the adjective is very suitable for describing the emotional experience of the wine”. Similarly, Chaya et al. (2015) used a linear scale to rate the relevance of terms to measure the emotional response to beer. However, Bhumiratana et al. (2014) and Gunaratne et al. (2019) applied Check-All-That-Apply (CATA) methodology to eliminate unrelated emotions. Our study shows that GIT is a suitable method to remove irrelevant terms. Future studies might introduce GIT as part of the Sorting Task to reduce the length of the lexicon development. Authors recommend requiring the consumers to group irrelevant terms for the measurement of the emotional response of the product at the beginning of the task.

Sorting Task was applied in the present study as a method to group emotions and reduce the questionnaire length. Lexicon II, which was developed after grouping the emotions using the Sorting Task approach, had 15 emotional categories, whereas lexicon I, which was developed after grouping the emotions by sensory consumer tests, resulted in 13 emotional categories. Both lexicons had an acceptable length to ease the task for the consumers. Other authors have considered the length of emotional questionnaires as an important factor during the development of emotional lexicons and have proposed some procedures to shorten them. Ferrarini et al. (2010) introduced a final step to reduce the list from 23 into 16 emotional terms, when developing a lexicon to measure the emotional response elicited by wines with Italian consumers. Silva et al. (2018) proposed an initial step, before measuring the temporal dominance of emotions elicited by wine, to select the 10 main terms from a previous list generated in a qualitative study (Silva et al., 2016). Danner (2016) proposed a final phase in the development of the Australian Wine Evoked Emotions Lexicon (AWEEL) to reduce the 16 emotional categories collected during the focus group sessions, into 16 representative emotions of each emotional category.

The present study showed that Sorting Task (Chollet et al., 2014) could reduce the time invested in lexicon development, using a semantic approach to cluster emotions and feelings into categories. In

this sense, other authors have proposed different methods to reduce the effort when developing emotional lexicons. For example, Chaya et al. (2015) proposed using focus groups as an alternative to the personal interviews used in Ng et al. (2013) and Spinelli et al. (2014) to reduce time during lexicon development. Also, Gunaratne et al. (2019) proposed conducting online surveys as a fast-screening method to develop simplified emotional lexicons.

Results from the present study found a sample effect for 10 of the 13 emotional categories in lexicon I, while lexicon II discriminated the wines in all 15 categories. In addition, the same wine groups and projections were found in the observation plots of both lexicons, with a high RV coefficient between maps. Thus, it was proven that both methods were appropriate in discriminating wine emotional responses.

According to the emotions' disposition in the first factorial plot of the PCA, the horizontal axis (PC1) was associated to pleasure/displeasure emotions in both lexicons. Similar results were reported by Mora, Urdaneta, & Chaya, (2018) and were consistent with the first dimension of the circumplex model of emotions (Larsen & Diener, 1992; Russel, 1980; Watson & Tellegen, 1985). However, the vertical axis of the present study (PC2) did not follow this theoretical model which was previously related to activation/arousal. Apparently, results from this research showed that the emotions associated with low or high activation were more related to the pleasure axis.

5. CONCLUSIONS

The main conclusion of the present study is that the use of rapid methodologies such as Sorting Task was suitable for the development of a wine emotional lexicon. This methodology was faster and fewer resources were consumed, having the same discrimination capacity as a lexicon developed using the procedure mainly proposed in the literature.

The application of this rapid method could be useful in the development of emotional lexicons, saving time and resources, without compromising the discrimination ability of the lexicon. Future studies could apply the proposed methodology to generate emotional lexicons for other products and cultures.

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7. REFERENCES

- Addinsoft. (2019). XLSTAT statistical and data analysis solution. Long Island, NY, USA. Retrieved from <https://www.xlstat.com>
- Bhumiratana, N., Adhikari, K., & Chambers, E. (2014). The development of an emotion lexicon for the coffee drinking experience. *Food Research International*, 61, 83–92.
<https://doi.org/http://doi.org/10.1016/j.foodres.2014.03.008>
- Cardello, A. V., Pineau, B., Paisley, A. G., Roigard, C. M., Chheang, S. L., Guo, L. F., ... Jaeger, S. R. (2016). Cognitive and emotional differentiators for beer: An exploratory study focusing on “uniqueness.” *Food Quality and Preference*, 54, 23–38.
<https://doi.org/http://doi.org/10.1016/j.foodqual.2016.07.001>
- Chaya, C., Eaton, C., Hewson, L., Vázquez, R. F., Fernández-Ruiz, V., Smart, K. A., & Hort, J. (2015). Developing a reduced consumer-led lexicon to measure emotional response to beer. *Food Quality and Preference*, 45, 100–112. <https://doi.org/http://doi.org/10.1016/j.foodqual.2015.06.003>
- Chollet, S., Valentin, D., & Abdi, H. (2014). Free Sorting Task. In *Novel Techniques in Sensory Characterization and Consumer Profiling* (pp. 207–227). Boca Raton, Florida: CRC Press.
- Clore, G. L., Ortony, A., & Foss, M. A. (1987). The psychological foundations of the affective lexicon. *Journal of Personality and Social Psychology*, 53(4), 751.
- Danner, L., Ristic, R., Johnson, T. E., Meiselman, H. L., Hoek, A. C., Jeffery, D. W., & Bastian, S. E. P. (2016). Context and wine quality effects on consumers’ mood, emotions, liking and willingness to pay for Australian Shiraz wines. *Food Research International*, 89, 254–265.
<https://doi.org/http://doi.org/10.1016/j.foodres.2016.08.006>
- Dorado, R., Pérez-Hugalde, C., Picard, A., & Chaya, C. (2016). Influence of first position effect on emotional response. *Food Quality and Preference*, 49, 189–196.
<https://doi.org/https://doi.org/10.1016/j.foodqual.2015.12.009>
- Eaton, C., Chaya, C., Smart, K. A., & Hort, J. (2019). Comparing a full and reduced version of a consumer-led lexicon to measure emotional response to beer. *Journal of Sensory Studies*, 34(2), e12481. <https://doi.org/10.1111/joss.12481>
- Ferrarini, R., Carbognin, C., Casarotti, E. M., Nicolis, E., Nencini, A., & Meneghini, A. M. (2010). The emotional response to wine consumption. *Food Quality and Preference*, 21(7), 720–725.
<https://doi.org/http://doi.org/10.1016/j.foodqual.2010.06.004>

- Gmuer, A., Guth, J. N., Runte, M., & Siegrist, M. (2015). From emotion to language: Application of a systematic, linguistic-based approach to design a food-associated emotion lexicon. *Food Quality and Preference*, 40, 77–86.
- Gunaratne, T. M., Gonzalez Viejo, C., Fuentes, S., Torrico, D. D., Gunaratne, N. M., Ashman, H., & Dunshea, F. R. (2019). Development of emotion lexicons to describe chocolate using the Check-All-That-Applies (CATA) methodology across Asian and Western groups. *Food Research International*, 115, 526–534. <https://doi.org/10.1016/j.foodres.2018.10.001>
- Hu, X., & Lee, J. (2018, August 29). Emotions elicited while drinking coffee: A cross-cultural comparison between Korean and Chinese consumers. *Food Quality and Preference*. <https://doi.org/10.1016/j.foodqual.2018.08.020>
- King, S. C., & Meiselman, H. L. (2010). Development of a method to measure consumer emotions associated with foods. *Food Quality and Preference*, 21(2), 168–177. <https://doi.org/http://doi.org/10.1016/j.foodqual.2009.02.005>
- Laros, F. J. M., & Steenkamp, J.-B. E. M. (2005). Emotions in consumer behavior: a hierarchical approach. *Journal of Business Research*, 58(10), 1437–1445.
- Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. *Review of Personality and Social Psychology*, 13, 25–59.
- Manzocco, L., Rumignani, A., & Lagazio, C. (2013). Emotional response to fruit salads with different visual quality. *Food Quality and Preference*, 28(1), 17–22. <https://doi.org/http://doi.org/10.1016/j.foodqual.2012.08.014>
- Mora, M., Giussani, B., Pagliarini, E., & Chaya, C. (2019). Improvement of an emotional lexicon for the evaluation of beers. *Food Quality and Preference*, 71. <https://doi.org/10.1016/j.foodqual.2018.06.007>
- Mora, M., Urdaneta, E., & Chaya, C. (2018). Emotional response to wine: Sensory properties, age and gender as drivers of consumers' preferences. *Food Quality and Preference*, 66. <https://doi.org/10.1016/j.foodqual.2017.12.015>
- Ng, M., Chaya, C., & Hort, J. (2013). Beyond liking: Comparing the measurement of emotional response using EsSense Profile and consumer defined check-all-that-apply methodologies. *Food Quality and Preference*, 28(1), 193–205. <https://doi.org/http://doi.org/10.1016/j.foodqual.2012.08.012>

- Russel, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 1161–1178. <https://doi.org/https://doi.org/10.1037/h0077714>
- Silva, A P, Jager, G., Van Zyl, H., Voss, H., Pintado, M., Hogg, T., & de Graaf, C. (2016). Comparing two methods to measure emotions elicited by beer, wine and non-alcoholic beer. *Appetite*, 101, 236. <https://doi.org/http://dx.doi.org/10.1016/j.appet.2016.02.133> "
- Silva, Ana P., Voss, H.-P., van Zyl, H., Hogg, T., de Graaf, C., Pintado, M., & Jager, G. (2018). Temporal dominance of sensations, emotions, and temporal liking measured in a bar for two similar wines using a multi-sip approach. *Journal of Sensory Studies*, 33(5), e12459. <https://doi.org/10.1111/joss.12459>
- Silva, Ana Patricia, Jager, G., van Bommel, R., van Zyl, H., Voss, H.-P., Hogg, T., ... 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. <https://doi.org/https://doi.org/10.1016/j.foodqual.2015.11.007>
- Spinelli, S., Masi, C., Dinnella, C., Zoboli, G. P., & Monteleone, E. (2014). How does it make you feel? A new approach to measuring emotions in food product experience. *Food Quality and Preference*, 37, 109–122. <https://doi.org/http://doi.org/10.1016/j.foodqual.2013.11.009>
- Thomson, D. M. H., & Crocker, C. (2013). A data-driven classification of feelings. *Food Quality and Preference*, 27(2), 137–152. <https://doi.org/http://doi.org/10.1016/j.foodqual.2012.09.002>
- van Zyl, H. (2016). 19 - Emotion in Beverages. In H. L. Meiselman (Ed.), *Emotion Measurement* (pp. 473–499). Woodhead Publishing. <https://doi.org/https://doi.org/10.1016/B978-0-08-100508-8.00019-9>
- van Zyl, H., & Meiselman, H. L. (2015). The roles of culture and language in designing emotion lists: Comparing the same language in different English and Spanish speaking countries. *Food Quality and Preference*, 41, 201–213. <https://doi.org/https://doi.org/10.1016/j.foodqual.2014.12.003>
- van Zyl, H., & Meiselman, H. L. (2016). An update on the roles of culture and language in designing emotion lists: English, Spanish and Portuguese. *Food Quality and Preference*, 51, 72–76. <https://doi.org/http://doi.org/10.1016/j.foodqual.2016.02.019>
- Varela, P., & Ares, G. (2014). *Novel techniques in sensory characterization and consumer profiling*. Boca Raton, Florida: CRC Press.

Wakeling, I. N., & MacFie, H. J. H. (1995). Designing consumer trials balanced for first and higher orders of carry-over effect when only a subset of k samples from t may be tested. *Food Quality and Preference*, 6(4), 299–308. [https://doi.org/https://doi.org/10.1016/0950-3293\(95\)00032-1](https://doi.org/https://doi.org/10.1016/0950-3293(95)00032-1)

Watson, D., & Tellegen, A. (1985). *Toward a consensual structure of mood*. *Psychological Bulletin*, 98, 219–235.

Yik, M., Russell, J. A., & Steiger, J. H. (2011). A 12-point circumplex structure of core affect. *Emotion*, 11(4), 705–731. <https://doi.org/http://dx.doi.org/10.1037/a0023980>

ANNEX II

Supplementary tables and figures belonging to the paper “Effect of personality on the emotional response elicited by wines”

Supplemental Table 1. Means of hedonic response and emotions elicited by wines on different groups of consumers. (*,** indicate significant effect of personality and wine, respectively)

Wine	1				2				3				4				5				6			
Personality	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4	G1	G2	G3	G4
Hedonic***	6,15	6,40	5,98	6,53	6,00	5,94	6,22	6,61	5,30	5,82	5,85	5,86	5,55	5,70	5,30	6,46	6,00	5,57	5,40	5,73	5,40	5,74	5,48	6,33
Active*	4,41	4,96	5,32	5,10	4,57	4,64	5,04	6,16	4,31	4,73	4,67	5,36	4,47	5,07	4,33	5,54	4,73	5,03	4,72	4,25	4,57	5,25	5,06	5,39
Adventurous*	4,26	4,59	4,65	5,08	3,78	4,21	4,35	5,63	3,64	4,15	4,32	4,59	3,19	4,70	4,00	5,05	4,03	4,64	3,79	4,53	3,37	4,84	4,41	4,98
Aggressive**	1,92	2,50	2,97	2,58	3,00	2,70	2,43	2,22	2,55	2,42	2,56	2,36	3,06	3,75	3,52	2,92	3,74	3,73	3,53	3,44	4,15	3,65	3,59	3,09
Bored*	3,60	2,44	2,97	2,57	3,00	3,18	2,32	2,30	3,24	3,23	2,99	2,41	3,97	3,03	2,88	2,16	3,34	3,18	2,36	2,92	3,78	2,60	3,54	1,81
Calm	4,03	4,76	3,98	4,55	4,32	5,03	4,40	4,51	4,41	4,66	4,39	4,56	5,12	4,07	3,98	4,29	4,80	4,16	4,00	3,36	4,55	4,19	4,09	4,38
Disgusted*	2,33	1,60	2,45	1,82	3,11	2,44	2,32	2,22	2,13	2,54	2,40	1,83	2,65	2,53	2,53	1,77	2,31	2,77	2,39	2,29	2,82	2,76	2,57	1,67
Enthusiastic*	4,12	5,35	5,05	5,29	4,61	4,75	4,78	5,74	3,70	4,99	4,73	4,91	3,49	4,69	4,47	5,51	4,67	4,53	4,20	4,29	4,59	4,83	4,84	5,30
Free*	5,27	5,28	5,70	5,59	4,77	5,05	4,83	6,05	4,59	4,84	4,90	5,62	4,46	4,78	4,28	5,34	5,62	4,75	4,32	4,49	4,28	4,96	4,84	5,68
Good	5,53	5,58	5,53	5,85	5,33	5,38	5,00	5,99	5,33	5,85	5,04	5,21	4,81	4,79	4,88	5,84	5,26	4,51	4,51	4,73	4,39	5,02	5,08	5,34
Good natured	4,44	5,24	4,61	5,15	4,96	4,95	4,50	4,95	4,33	4,47	4,36	4,45	3,90	4,18	4,23	4,11	4,39	4,11	3,77	4,07	4,50	5,40	4,58	4,22
Guilty	2,16	2,10	2,90	2,34	3,07	2,55	2,49	1,95	2,31	2,27	2,53	2,09	2,74	2,65	2,45	2,21	2,36	2,85	2,30	2,32	3,00	2,57	2,48	2,05
Happy***	5,27	5,50	5,57	6,10	4,90	5,26	5,34	6,46	5,13	5,20	4,76	5,66	4,89	4,93	4,83	6,14	4,87	4,62	4,57	4,71	5,22	5,22	4,87	6,03
Interested	5,34	4,57	5,07	4,89	4,09	4,56	4,33	5,57	4,28	4,40	4,30	4,54	4,58	4,84	4,40	4,45	5,04	4,16	4,00	4,34	3,80	4,93	4,58	5,57
Joyful***	5,59	5,70	5,32	6,13	5,08	5,30	5,08	6,48	4,76	5,73	5,28	5,89	4,76	5,10	4,81	6,22	4,65	4,78	4,39	5,04	4,61	5,21	4,71	5,65
Loving*	3,99	4,61	4,47	5,26	4,23	4,49	4,66	5,71	4,20	4,82	4,50	5,06	4,47	4,00	3,95	5,20	4,28	4,25	3,94	4,59	3,54	4,67	4,22	4,56
Mild**	4,82	5,11	4,72	5,03	4,39	5,07	4,80	5,47	4,57	4,86	4,51	4,99	4,78	4,00	3,57	4,45	3,90	3,57	3,72	3,67	3,53	3,62	3,45	4,94
Nostalgic	4,43	3,53	3,43	3,26	3,53	3,77	3,50	3,50	3,12	3,36	3,26	3,62	4,14	3,50	3,64	4,03	4,05	3,54	3,67	3,47	3,13	3,70	3,82	3,83
Pleasant***	5,43	5,92	5,48	6,14	5,41	5,49	5,48	6,41	4,88	5,34	5,37	6,02	5,73	4,66	4,97	6,21	5,21	4,48	4,93	4,87	4,52	5,09	4,86	5,56
Satisfied*	5,63	5,23	5,28	5,84	4,89	5,19	5,23	6,21	4,60	4,96	4,83	5,83	4,37	4,94	4,96	6,17	5,64	4,65	4,84	4,95	4,30	5,06	5,19	5,89
Secure	5,16	5,13	4,85	4,90	4,71	4,80	4,28	5,28	4,11	4,47	4,59	5,18	5,86	4,50	4,60	5,93	5,19	5,41	4,62	4,57	4,35	4,97	5,57	5,34
Tame*	2,62	2,45	3,00	2,57	3,38	2,61	2,80	2,88	3,56	2,83	3,37	2,56	3,83	3,05	2,96	2,17	2,28	2,23	2,82	2,49	3,63	2,23	2,74	2,49
Understanding	4,81	4,73	4,79	4,30	4,77	4,44	4,28	4,71	4,60	4,34	4,45	4,93	4,23	4,08	4,40	4,43	4,70	4,23	3,67	3,98	4,01	4,34	4,25	4,78
Warm*	4,24	4,55	4,75	5,54	4,51	4,62	4,73	5,65	4,55	4,49	4,82	5,16	4,50	4,02	4,32	6,71	4,25	3,99	4,15	4,46	3,91	4,52	4,13	5,04
Wild	3,16	3,72	3,47	3,78	3,38	3,31	3,32	4,06	2,81	3,05	3,59	3,44	3,80	4,06	3,49	4,26	3,43	3,86	3,46	3,15	2,87	4,41	3,40	3,91
Worried*	2,53	2,47	2,62	2,15	2,67	2,82	2,52	1,92	2,58	2,51	2,23	2,29	3,16	2,81	3,25	1,94	2,61	2,93	2,89	2,08	2,77	2,87	3,24	2,10
Curious	5,42	4,73	4,99	5,16	4,60	4,77	4,81	5,13	3,98	4,70	4,85	4,80	3,99	4,71	4,74	5,23	4,79	4,55	4,45	3,99	3,79	4,99	4,70	5,74

Supplemental Figure 1. Means plot of hedonic response and emotions elicited by wines 1 to 6 on different groups of consumers. (*, ** indicate significant effect at $p \leq 0.10$ and $p \leq 0.05$, respectively)