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Lexicon Development to Measure Emotions Evoked by Foods: a Review

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Abstract

There is rising research interest in consumers' emotions elicited by foods. To this end, emotion lexicons as part of food-evoked emotion measurement methods have been developed. Though there are various methods and techniques for emotion measurement, verbal self-report on behalf of the consumer has been identified as the most direct means of assessing the experience of emotion. The focus of this review is mapping the development of lexicons of food-evoked emotions, and their implementation in questionnaires to identify gaps and opportunities in research and methodologies currently developed. The emotion lexicon and emotion measurement questionnaires of the last decade have been reviewed, including adaptations, and presented in a systematic way according to approach, method and technique used, and objectives of study. The manuscript is structured in such a way that it can be used both as an in-depth review of the subject and as a tool for new and future users of lexicon applications for the assessment of consumer responses. The categorization presented is useful in emotion lexicon development, product development, and marketing, in food and consumer studies in general. This review provides experts and non-experts

interested in working with emotions with categorizations, available options with their advantages and disadvantages for each step of the process, from developing a food-related emotion lexicon and designing an emotion measurement questionnaire to implementing the tool and analyzing the data.

Keywords: food, lexicon, emotion measurement, emotion questionnaires, consumer

1. INTRODUCTION TO LEXICONS OF FOOD-ELICITED EMOTIONS

Emotions have always been an area of interest for various theoretical and applied scientific fields, such as medicine, philosophy, psychology, linguistics, education. Various definitions of emotion have been proposed according to the field of science or the perspective from which it is studied. An emotion can be broadly defined as a two-step event during which emotion elicitation mechanisms, caused by a "related" or "significant" event, generate immediate emotional responses, namely action tendency, automatic bodily reaction, expression, feeling, and appraisal [1]. These are considered as the five components of emotion. Emotion is considered different from feeling. For example, the emotion of tiredness is generally understood to refer to an unpleasant state and can be used to communicate a feeling of sleepiness, annoyance and misery, or fatigue [2]. Emotion is also considered different from mood. A clear distinction is provided by King and Meiselman: emotions are brief, intense, and focused on a referent (e.g., The comment made him angry), while moods are more enduring, build up gradually, are more diffuse, and are not focused on a referent (e.g., I am happy) [3].

During the past few decades, other fields, like the consumer, food, and marketing industries, have turned to the study of emotion and the application of findings -mainly from psychology- to product development and promotion for better targeted results. Research is aimed at creating emotion lexicons, measuring, and studying emotions within and across languages and cultures, creating conceptual profiles of food products, and identifying consumer groups. An emotion lexicon is a list of emotion words or phrases used to describe emotions. Food-elicited emotion lexicons can be (a) language or culture-specific, containing for example only Italian emotion words [4], (b) cross-linguistic or cross-cultural, containing for example Dutch and Portuguese emotion words [5], (c) general, containing words expressing emotions elicited by food in general

[3], (d) food-specific, containing words expressing emotions elicited by a specific type of food such as coffee [6].

Various emotion measurement methods have been developed: physiological, behavioral, and cognitive, each focusing on a different component of emotion. Physiological measures include electroencephalography (EEG), magnetic resonance imaging (MRI), electrocardiography (ECG), and skin conductance response measurements, used to measure automatic bodily reactions to emotion. Behavioral measures include voice tone, pitch, facial expressions, body expressions and postures measurements, used to measure expression of emotion. Cognitive measures, used to measure feeling, action tendency, and appraisal, expect the participants to self-report on how they process perceived emotions mentally and can be visual, depicting emotions as cartoons [7], pictures [8], or emoji [9]. Cognitive measures can also be verbal, using emotion words [3]. The latter type of emotion measurement, i.e., cognitive verbal self-report, is the focus of this review, as it is linked to the development and use of emotion lexicons.

The number and variety of the existing emotion lexicons and measurement instruments are indicative of the variety in theories and views as regards the number of human emotions, emotion categories, emotion dimensions, the hierarchy of these emotions, their universality, and other aspects of emotion. Verbal report, even with all its failings, is considered the most accurate means of assessing the experience of emotion [10]. Furthermore, self-report questionnaires is the preferred method to access consumers' emotions because data can be collected faster, more easily, and with less expenses than using implicit methods, by requiring no equipment and by engaging multiple participants at the same time [11]. What is more, self-report questionnaires offer many advantages when studying emotions cross-culturally [12]. As Dutton & Lyons (2021)

pinpoints however, it is imperative that researchers pay close attention to characteristics of languages spoken by their participants that may lead them to respond to questions a certain way. Existing food-evoked emotion lexicons consist of terms varying in number and form, and emotion measurement questionnaires come in varying forms. According to the aim of the study and the theoretical assumptions of the researcher, the appropriate method is implemented.

Emotions are experienced, expressed and explained within a specific cultural and linguistic context, as discussed in detail in chapters 3.1 and 5 of this review. The various ways and the degree to which culture and language form and affect food-related emotion expression and measurement is not a point of convergence [5,13–15]. This is especially evident in emotion lexicon development and emotion measurement instruments in cross-linguistic and cross-cultural studies. As food product companies are trying to grow bigger in a global market, is developing universal emotion measures or translating an instrument that works into other languages the best way to measure emotion?

2. FOCUS, AIM, SOURCES, AND METHODS OF REVIEW

The focus of this review is the development of lexicons of food-elicited emotions, and their implementation in consumers' verbal self-reporting questionnaires to identify and measure these emotions. This review covers the trends in emotion lexicon development approaches and methods, and emotion measurement questionnaire design techniques of the last decade, as well as some of their adaptations, and presents them in a systematic way according to the approach, method and technique used and the objectives of study. This categorization will be useful to emotion lexicon developers, product developers, marketers, and other parties that work with consumers. The aim of this review was to identify the various possibilities in how to develop and utilize a lexicon of food-elicited

emotions, to identify key trends, to check the strong and weak points of each, and present them in a critical qualitative, not quantitative, manner.

The sources used to search for candidate studies are: ScienceDirect.com, academia.edu, mendeley.com, scopus.com, online.wiley.com, heal-link.gr, scholar.google.com during the months of October 2020 through March 2021. The papers selected by the authors had to contain the words/phrases: emotion lexicon (development), emotion measurement, questionnaires, emotions, food and had to be published in 2010 and since. The review was decided to depict the last decade and 2010 was the year that the first food-related emotion lexicon and measurement tool was published.

The inclusion criteria were the following:

(a) to be about the food as a whole experience, not about a specific sensory or chemical property of the food under study.

(b) to be original as regards the methods, tools, and techniques applied. We then noticed that there were interesting adaptations of them and decided to include those, too. We did not include straightforward applications of existing tools and methods though.

(c) to have emotion lexicon development as its main aim or the means to other ends. The other ends were a) conceptual profiling of foods, b) emotion measurement, and c) the study of food-elicited emotions.

The search yielded twenty-two (22) original methods and thirty-eight (38) adaptations of these methods that had added value. Other related reviews were consulted. We also checked every reference made in the papers selected. Issues that arose as to the inclusion or exclusion of studies were solved after discussion between the authors, the

criterion always being originality as regards emotion lexicon development and application.

The final list of studies reviewed are presented in Table 1, categorized according to the aim of study and their being an original method or an adaptation. For each emotion lexicon development study/stage of study, specific characteristics are presented. Columns C-G present aspects of emotion lexicon development. Columns H-J present aspects of emotion measurement using the respective lexicon. Columns K and L present the foods and the language under study for each case.

Table 1. Schematic review of food-related emotion lexicon development studies and their methodology features.

3. GENERAL ASPECTS OF EMOTION LEXICON DEVELOPMENT

3.1 Language and Culture, translatability of emotions and emotion words

Cultures are complex sets of shared meanings, values and, corresponding behavior and cultural products. [12]. The same applies to languages and emotions. The construction of emotional meaning is determined by social, cultural, and linguistic factors. The social environment is a major regulator of emotional display and culture is a central factor that mediates emotional experience, conceptualization, and expression. Thus, emotions are culture- and language-specific constructs, fundamentally biocultural in nature [12]. There are both quantitative and qualitative divergences in how different languages lexicalize emotions [16]. On the other hand, emotion words in many different languages appear to refer to the same, or very similar phenomena. And, while there is no consensus about what exactly constitutes a universal level of emotions, there is no denying that this universality exists [16,17]. From a quantitative perspective though, there are

considerable differences among languages as to the number of distinct emotions that are lexicalized in them or the number of emotion words available to express a specific emotion. On these grounds, lexical designations of emotions should be translatable across languages. However, the absence of exact correspondence between words in different languages is one of the fundamental presuppositions in semantic analysis, leading to the conclusion that equivalence of any two emotion words in two different languages is always a matter of degree [17].

In cross-cultural studies or when using pre-existing emotion lists compiled in other languages, translation of emotion terms is an issue. Most research utilizes professionals in translations of different languages, and the terms are *back-translated* for confirmation purposes [15]. The terms do not usually exhibit a one-to-one correspondence between different languages. Sometimes the meaning of a word in the source language takes two words to be covered, but it is also possible that the meaning of two words can be covered by just one in the target language. For example, a comparative cross-cultural study of affective terms showed that the dimensional organization of odor-related affective terms in a given culture better explained data variability for that culture than data variability for the other cultures, thus highlighting the importance of culture-specific tools in the investigation of odor-related affect [18].

The process of translation and back-translation was followed by van Zyl & Meiselman (2015) when working with English and Spanish. The English terms were translated from English into Spanish and back-translated. Another approach is to assign translation to bilingual experts [19]. In Thomson & Crocker's study, bilingual psychologists translated the terms from English into idiomatic Italian, French, or German, making additions and deletions as appropriate. A similar approach was followed by Silva et al. (2016), who assigned the translation of Dutch and Portuguese

terms into English native speakers of Dutch and Portuguese, respectively. The resulting translations were then agreed upon by at least 3 authors for each language [5]. An interesting and innovative technique was applied in a cross-cultural study by Hu and Lee (2019). For each English term they chose 2-3 candidate words in Korean and Chinese from dictionaries, and they made a multiple-choice questionnaire to be answered by consumers native speakers of Korean and Chinese. For each English term, the participants could choose either one of these 2-3 terms or "I do not know" or "other". Their approach was justified by the fact that English is taught as the first foreign language in all primary schools in Korea and China as early as the 3rd grade [15].

Language is inextricably linked with culture, the context in which food and food consumption is experienced. Food as a concept is learnt through associated learning, dietary habits are formed by family and social practices, and language provides the medium and the linguistic context in which food-evoked emotions are expressed. Mental frames in general, and the mental frame of food more specifically, vary cross-culturally as do their culture-specific connotations [20]. Current research has shown that the perceived health effects of food products are more important for Asian consumers than Westerners and that Western participants tend to express high arousal emotions when assessing food products while Asian participants express low arousal emotions [21]. These differences lead to the conclusion that emotion lexicons should be developed using linguistic and cultural data from the frame in which they are going to be exploited, and that using pre-existing lists of food-evoked emotions developed in another language should be done with caution.

3.2   Emotion terms collection and identification - sources of terms:

Emotion lexicon development can either be the main objective of a food-related study or a major step towards creating an emotion measurement instrument. Either way, there seem to be certain steps and methods towards the creation of such a list (Fig. 1).
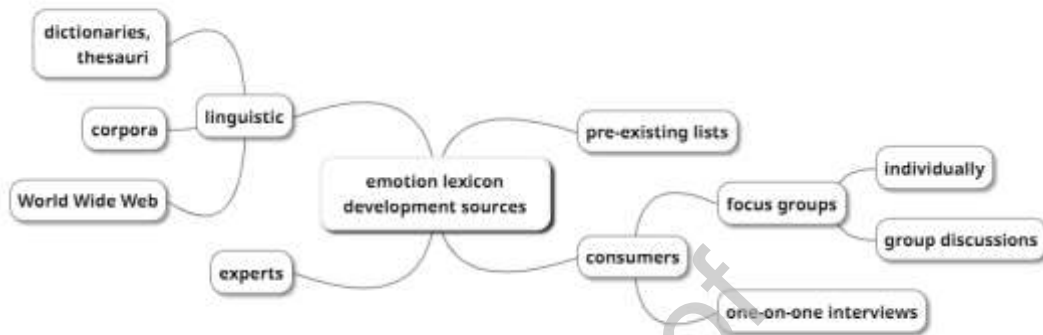

Figure 1. Emotion lexicon development sources.

3.2.1 Using pre-existing lists

Before 2010, food scientists relied on research within the psychology and consumer domains for lists of emotions, as was *the Consumption Emotion Set* [22], for categories and hierarchies of emotions [23–25], as well as for measurement methods and tools, such as the *Profile of Mood States* (POMS), the *Multiple Affect Adjective Check Lists* (MAACL, MAACL-R), the *Emotion and Odor Scales* (LEOS, SEOS, GEOS, UniGEOS).

Since 2010, however, the interest has shifted towards the consumer and food domains, as more and more emotion lexicons are being developed in various languages targeted at specific products and groups of consumers. Within the food science domain the first study in English is that by King and Meiselman, the *EsSense Profile®*, a measurement tool for consumer emotions associated with foods, aimed for commercial usage [3]. The initial list of terms was taken from existing mood and emotion lists compiled by and for psychiatrists and psychologists. Feedback was also provided by consumers. For the

present review this study was taken as a chronological starting point since it was the first study done specifically for foods.

Using pre-existing lists from other countries speaking the same language [e.g., list of terms in Spanish developed in Spain to be used in Mexico [14], or list of terms in English developed in the USA [3] to be used in New Zealand [13,26]] is an option but needs to be confirmed. Using lists developed in other languages after applying valid translation methods can be used when the cultures under study are quite similar to each other [e.g., China and Korea [15]], but the need to run validity checks still exists.

3.2.2 Collecting terms from scratch – applying linguistics methodology

On the other hand, there are studies that have created emotion lexicons from scratch, without using existing term lists. Focus groups of consumers is usually the first step in such a process for term collection. These studies are mainly food category specific and have used consumers' feedback to create the respective lexicon. Consumers are usually asked to taste samples and provide emotional responses to them in free listing tasks, either individually or after group discussions. Beverages, especially, beer and wine, are the foods that have been studied the most in this way [5,27,28].

When developing an emotion lexicon, a variety of sources should be used to achieve maximum validity. Linguistic sources, such as dictionaries, thesauri, and corpora, are especially useful for word disambiguation and synonymity checks. Another linguistic source available thanks to modern technology is the World Wide Web.

Thesauri, dictionaries: Reference works such as thesauri and dictionaries, even though they are not usually the source of terms for an emotion lexicon, serve as a useful tool, for meaning disambiguation, synonymity checks, cluster formation, use

information and so on. These tools are usually used during the term selection process to narrow down the list.

Corpora: A corpus is a finite-size body of machine-readable authentic texts, sampled to be representative of a language or language variety [29]. Corpora can provide word frequencies and linguistic patterns and can be used for qualitative and quantitative analysis. They are not very often used in consumer studies. However, in languages that no emotion lists exist yet, corpora have been used in from scratch lexicon development [30], as they provide synchronous linguistic patterns.

The World Wide Web: The Web, its search engines and lexicon database, has been used as a source of emotion terms in emotion lexicon development from scratch [30]. The Web has some very distinctive features that render it a unique tool for linguistic research:

(a) it is connected and thus it can be examined and used as a single unit.

(b) it contains authentic spontaneous speech.

(c) it contains a new style of speech: written speech with features of oral speech.

(d) it is inclusive and thus all linguistic styles within a language can be found and studied.

(e) it always contains up-to-date language which makes it ideal for synchronic research but also provides data for diachronic research.

(f) it is self-productive because of the wikis, blogs, and forums daily updated and created.

There are however some disadvantages in its use:

(a) its dimensions are unknown and constantly changing.

(b) replicability of results is impossible, because of the use of algorithms.

(c) because of its broad heterogeneity it can be a double-edged sword for a researcher.

According to Sinclair "the World Wide Web is not a corpus, because its dimensions are unknown and constantly changing, and because it has not been designed from a linguistic perspective" [31]. Nevertheless, the number of researchers that are using the Web to create corpora and as a corpus itself has increased lately.

"During the last decade, the amount of content that is published online has increased tremendously, primarily due to the wide adoption and use of online social media (OSM) platforms. The content produced within OSM has the potential to be used for understanding, modeling and predicting human behavior and its effects." [32]. The Web can thus be used mainly not for quantitative but for qualitative research to identify patterns and tendencies.

A distinctive study within the food science field is that by Gmuer et el. (2015), a linguistic-based systematic approach to design a food-associated emotion lexicon in German. Since there was no food-related emotion list in German, a three-step approach was followed to investigate which words are appropriate in the German language for describing emotions associated with food products. The initial list of terms, single-word adjectives only, was accumulated using thesauri, electronic corpora, dictionaries, the Web (Google search, lexicon-database), and the emotion hierarchy by Storm and Storm (1987). The aim was to extract the German emotion terms that were more actively used in everyday situations and met specific syntactic criteria (i.e., co-occurred with the verbs *I feel/I am* within the same sentence). The terms were then evaluated using several linguistic-related criteria to identify the terms that possess potential emotional connotations or describe an overall emotional condition, including evaluative terms, following Storm and Storm's taxonomy. These terms were assembled through

consumer free-listing or free-labelling tasks. An online survey followed in which the final candidate terms were rated for their food relatedness. Thus, the criteria for term selection were (a) emotionality, (b) food-relatedness, (c) being up to date. Being single-word adjectives and following specific syntactic patterns were prerequisites. The terms approved by at least two-thirds of the participants formed the lexicon. The next step of the study was to characterize the emotion terms as positive, negative, or neutral, following the methodology by King and Meiselman (2010), to be able to interpret the food-related emotional experiences assessed with these words and check whether this hedonic asymmetry was true for the German language as well, which was confirmed.

Using linguistic sources as a starting point has the advantage of accumulating a variety of terms which consumers might not recall during a free-listing task. This is especially useful when creating an emotion list from scratch, without using specific foods as stimuli, in order to develop a comprehensive language-specific emotion lexicon from which to form food-specific lists and tools. Nevertheless, several words in the initial list may not be understood or may be unknown to the consumers. The use of other sources and screening by consumers are needed to capture the real contemporary use of language.

3.2.3   Experts

Experts, other than the main researchers of a study, such as psychologists, linguists, translators, sometimes participate to offer guidance in the lexicon development process without providing the terms themselves, except in the case of the Empathic Food Test [33] (Table 1).

3.2.4   Consumers: focus groups, group discussion, interviews

Consumers have become the main source of data for emotion lexicon development as they simultaneously express the linguistic, cultural, and social aspects under study. In focus groups, in central location tests, online surveys and real consumption settings, consumers of the food product category in question are asked to provide emotion terms as a response to various stimuli. Three distinct types of stimuli are used in food-evoked emotion studies in the early stages of term generation or identification, either individually or in combinations: food pictures, food names, and actual food tasting. The latter is the most frequently used.

A focus group is an interview technique that brings together 6–10 participants and a moderator, in the framework of a structured discussion about a specific topic and is especially important when little is known about the topic. It is a qualitative method that provides deeper insights into beliefs, by encouraging participant interaction socially [34], as is the case in real life when discussing foods and products in general. Focus groups are usually used in the early stages of emotion lexicon development and in food-evoked emotion studies in general for term generation and term identification. This method has been applied in several cross-cultural studies and is gaining importance in consumer behaviour related to food and beverages [5]. Focus groups have proven especially useful for the sensory characterization of products as well.

Most reviewed studies, as depicted in Table 1, have used focus groups of consumers to generate emotion terms in free listing tasks, to identify terms from given lists using CATA (Check-All-That-Apply), rating scales, RATA (Rate-All-That-Apply), best-worst scaling -where participants are presented with the object under investigation with a set of 4 or 5 words and asked to decide which of these words they feel is most and least closely associated with what they are experiencing in response to the object-, to decide on food-appropriateness of terms or to categorize emotion terms in sorting tasks

either individually or after reaching consensus through discussion. The number of participants and the number of groups per study varies widely though (Table 1).

The members of focus groups can either work individually taking notes on their own or work as a group, discussing the topic in question and reaching a consensus. Most focus groups reach a consensus via discussion. If they are working as a group, the moderator is taking notes while the participants are exchanging views. Both techniques, individual and group work, have their benefits and drawbacks. Group work is closer to real-life conditions of consuming and talking about food as a social practice but has the potential danger of forming false tendencies as individuals with less powerful personalities tend to assimilate their opinion to that of the group's. The method of interviewing consumers one-on-one is used as an alternative or in addition to groups and can help shy personalities open up and co-operate more freely but is extremely time consuming. The Repertory Grid Method (RGM) can be used in interviews to collect information on food related perceptions. The RGM is considered an efficient interviewing procedure, able to generate series of attributes used by consumers to discriminate amongst foods. Three stimuli are presented at once to the participants who are asked to describe the similarities and the differences amongst them [35]. Modified versions of the RGM have been developed and used in sensory and emotional characterization of foods [36–38].

In the reviewed studies, there was a case where the participants' views underwent semiotic analysis [38], since linguistic context disambiguates meaning and the use of semiotics allows a deep analysis. The semiotic approach "decomposes" the texts in order to deeply investigate their meaning by identifying the semantic units in the text. The words or expressions referring to similar meaning are grouped together and recognized as belonging to the same "semantic category". Then, the inter-relationships

(e.g., oppositions) between the different semantic categories are investigated. Semiotics has a long tradition in advertising and communication analysis and has developed various approaches to research in marketing; it is currently used to study brands, advertisements and consumer styles and recently it was applied in storytelling and consumer food studies [38].

Segmentation of focus groups participants, i.e. how participants of focus groups are grouped together, can be made on the basis of gender, age, social status and other characteristics according to the aim of study but demographic criteria seem to affect food-evoked emotions less than food consumption habits, ways of dealing with the products and the expectations of their benefits [39]. Therefore, unless the focus of the study demands otherwise, focus groups should be segmented based on food consumption and purchase criteria. Food related studies have shown that consumers of a food category or product create very different emotional profiles from non-consumers.

If the emotion lexicon development process is not food-specific, then demographic criteria can be applied. In the studies reviewed here, research shows that women express emotions at a higher level than men [40], they appear to be more elaborate in their emotion terms production and exhibit greater granularity, i.e., the ability to distinguish between different emotional states in a more fine-grained way. As regards age, as people grow older they more often seek emotionally meaningful goals, food neophobia increases with age, and food type consumption is affected by health issues [41]. These factors need to be taken into account when working with focus groups.

3.3 Developing food- and non- food-specific emotion lexicons

Emotions are by definition stimulus dependent. Thus, studies within the consumer and food domain are usually food specific. It is proven and generally accepted that lexicons should be food category specific to be effective and accurate when used to describe and measure food-evoked emotions. Discussion on the advantages of each method, i.e., using a general food related emotion list versus using a consumer-defined emotion list, is presented in chapter 4 of this review. For example, the Coffee Drinking Experience captured changes in mental state better than the non food-specific lexicon of the EsSense Profile® [42]. Table 1 summarizes the foods studied for developing food specific lexicons. Some examples of foods frequently studied are coffee (3 studies), wine (11 studies), chocolate (12 studies), and beer (15 studies) (Table 1). Other studies focus on food products containing sustainable ingredients, namely Bambara flour [43], products with protected designation of origin, namely apple cider [40], and non-alcoholic beverages, namely non-alcoholic beer [5,44]. There seems to be an intense interest in studying emotions elicited by beverages and comfort foods. This might be due to the fact that people consume beverages, especially alcoholic drinks, and comfort foods, such as chocolate, to make certain feelings duller or more intense. To make negative feelings duller people in some cultures tend to consume beverages [45,46]. On these grounds, beverages are culture-specific[1] and studying them provides insight into the culture under study. Our cultural heritage does not only determine the type of products we are familiar with and learn to like but also the emotional connection that we have with those products. Wine for example is part of everyday life in France, Italy, Spain, and Portugal, where consumers expect it to be part of the meal, while in some other countries wine might be seen as a way of reducing stress [46].

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[1] As culture-specific are defined foods and beverages that are closely linked to culture, because they are traditionally produced, or linked to traditional and religious practices, thus becoming part of a people's identity [100].

There are however food-evoked emotion lexicon development studies that are not food category specific, which either use a variety of food categories as stimuli or no food stimulus at all (Table 1). Some of these aim at developing emotion lexicons, emotion measurement instruments, conceptual profiling instruments, or at studying various aspects of food-elicited emotions, such as well-being [47], socio-economic status [48], emotion classification [19], temporal dynamics of emotions [49], culture and language [13,14], context [50,51], food choice prediction [52–54], health labels [55], health concerns [56], liking [36,44,54,57–59], sensory drivers of emotions [60,61].

3.4   Criteria for term selection

While reviewing emotion lexicon development studies, certain criteria for the selection of emotion terms that form a food-related lexicon immerge (Table 2). These can be summarized in two main categories: universal criteria, applied by most researchers, and optional criteria, applied according to the needs of each study. The decisive factors for term inclusion in an emotion lexicon are that the terms refer to distinct food-evoked emotions (excluding moods, and hedonic terms), currently used by most consumers at a high frequency. There are also some additional inclusion criteria applied by some studies, such as grammatical and syntactic criteria, or how clearly positive or negative the terms are when related to food. Modifications to inclusion criteria can be made due to feedback from participants on unclear, or potentially offensive terms.

universal criteria
to describe emotions [not moods nor evaluative terms]
to describe food-evoked emotions
to be clear in meaning
to be politically correct [not offensive to persons with mental illnesses]
to be up to date
to have a high frequency of use
to be statistically discriminant and not redundant
additional criteria
to be clearly positive or negative in context

| to fulfil grammatical criteria [e.g., be a single-word adjective] |
| to fulfil syntactic criteria [e.g., I feel + adjective] |
| to be in relation to food, not in relation to another person [e.g., envy, pride] |

Table 2. Universally applied and optional criteria, applied in some studies, for term selection during emotion lexicon development.

3.5   Lexicon: word class, form, and number of terms

The list of an emotion lexicon can consist of adjectives only, or nouns only, or adjectives and nouns, or adjectives and phrases, or adjectives, nouns, and phrases (Table 1). This is a decision made by the researchers according to the aim of study and can be affected by consumer responses during the lexicon development process and the language studied.

An emotion lexicon can consist of terms only, or clusters of emotions (emotion categories) formed either by applying statistics, researchers, and participants, or by statistics and researchers, or by statistics only, or by participants only. There is also an emotion lexicon presenting its terms in pairs of opposites, another presenting each term with a sentence clarifying the emotion, and another one presenting each term with a description (definition) and an example (Table 1). The latter follows sensory attribute list guidelines.

Emotion lexicons appear in either the form of lists of terms or sets of emotion categories/clusters with or without super-ordinate/representative terms. Clustering of emotion terms can be done by participants of a study or by statistics. If the process is done by the participants, a sorting task is usually used (participants may also be asked to choose the representative emotion term for each emotion category) and hierarchical clustering is then applied to form the final categories. This process is preferrable when developing a non-food-specific lexicon. Emotion categories can also be formed by

applying cluster analysis to the responses of participants to an emotion measurement questionnaire consisting of separate terms. This process is usually preferred when developing a food-specific emotion lexicon. These statistical methods of forming clusters of emotions make the process quick, easy, objective, and reproducible. Clusters of emotions are especially practical when the emotion lexicon is going to be used for emotion measurement purposes, as this form provides a concise and semantically clearer set of terms, making the process quicker and easier for the participant. According to Eaton et al. (2019) both forms of the lexicon -one with clusters and one with separate terms- are consistent in their discriminating ability and one should prefer the shorter form (with clusters) for product comparisons [62]. Shorter lexicons could be more sensitive to first position effect though [63].

As regards the number of terms in the reviewed studies, an emotion lexicon can consist of 9-66 terms with a median of 26. Consumer-defined lexicons tend to consist of fewer terms. The number of terms depends on the aim of study. For instance, when the focus of the study is cultural comparison or conceptual profiling of a food category then more terms seem to be necessary to capture habits, beliefs, conceptualizations, associations (in the studies currently reviewed 66-86 terms) (Table 1).

3.6 Dimensions of emotion often depicted in food-related lexicons: valence and arousal

3.6.1 Valence (also called pleasantness): positive and negative terms

An emotion is a valenced affective reaction to perceptions of situations [22]. This definition of emotion highlights how important it is to include the valence dimension when studying emotions. The valence dimension can be conceived as an axis with pleasure and displeasure, or attractiveness and averseness at its ends. It is an emotional

value associated with an event, object, or situation [2]. Valence is depicted in the distinction of terms as positive and negative.

In psychiatry and psychology, most emotion lists refer to five or six basic emotions, namely love, joy, anger, sadness, fear, and perhaps surprise [24]. They contain mostly negative emotions probably because the focus is on dealing with mental illnesses. In the food studies reviewed here, positive emotions seem to outnumber the negative ones [3,6,33,37,38,55,64–66], since food consumption is thought to be a generally pleasurable experience for healthy humans. This phenomenon is called "hedonic asymmetry" and suggests that people prefer positive rather than negative words to describe food experiences, because healthy people tend to like eating and tasting food, and because food products are formulated to be appealing and liked by consumers [65].

When developing an emotion lexicon, researchers sometimes choose to include a balanced amount of positive and negative terms, while others choose to include mostly positive terms in accordance with the "hedonic asymmetry hypothesis". There are also terms that are both positive and negative or neither positive nor negative and are thus characterized as unclear, neutral, or unclassified as regards their valence. These neutral terms should not be considered lacking information and thus be left out of emotion lexicons. Neutrality of emotion is a state on its own. Neutral terms show a lack of positive or negative appraisal, and a lack of arousal. Depending on the food/ beverage product type, neutrality of emotion may or may not be desired. It should be noted that the terms are not labelled when presented to the participants. The labels positive, negative, and neutral are used when setting up the study and when analyzing the data.

Most emotion lexicon development studies use existing lists of positive and negative terms to classify their terms. There is also a method that provides classification of

emotion terms implicitly. Participants are asked to think of their most and their least favourite foods and characterize them using emotion terms. This way, the researchers get a list of positive terms, i.e., emotion words that describe the most favourite foods, and a list of negative terms, i.e., emotion words that describe the least favourite foods [3,48]. In emotion measurement questionnaires, the overall liking question can help distinguish between positive and negative terms, even without characterizing the terms one by one.

3.6.2 Arousal (also called engagement): activation and deactivation

Arousal or engagement is another key dimension of emotion that can be conceived as an axis with felt activation and deactivation at its ends or high to low energy feelings. It is related to interoceptive sensitivity [2]. Interoception is a broad term that refers to perception internal to the body's surface, and incorporates sensations from the visceral organs (e.g., heart, lungs, stomach) along with autonomic, hormonal, and even immunological signals. Since emotional experience incorporates physiological and visceral changes, there has also been some speculation regarding how interoceptive sensations contribute to the processing of emotions [67]. According to research, emotions with the same valence (e.g., anger, fear, sadness, shame) produce a similar influence on judgments and choices [23]. That is why arousal can add a lot of information and understanding when studying emotions. For example, anger and sadness are emotions of the same valence but very different affect (arousal). Both emotions express that someone feels wronged in some way but sad people become inactive and withdrawn while angry people become more energized to fight [23].

The two main dimensions of emotion, valence and arousal, need to be taken into consideration when developing emotion lexicons. Evolutionary reasons have made us

want to minimize experience of negative emotions and maximize experience of positive emotions [19] and food consumption is in general a positive experience for healthy individuals. The decision as to whether a balanced lexicon is needed or not depends on the aim of the study. If the focus of a study is a new food product, a variety of terms both positive and negative are needed to capture food acceptability and food-evoked emotions. The arousal dimension of emotions might be of special interest when studying beverages, as the reviewed studies here show, or when studying functionality[2] of foods and mealtimes. For example, people consume main meals to get energy; snacks and desserts are considered a reward; dinner is consumed for pleasure; breakfast is consumed out of habit [41]. However, research has shown that sub-categories of products have different emotional associations in different cultures, especially beverages. As a result, it could be concluded that what is pleasant and what is not is culture- and food-specific and should be studied within context [13–15,68].

4.   EMOTION MEASUREMENT – QUESTIONNAIRE DESIGN

Lexicons of food-elicited emotions are usually developed to be used for emotion measurement. Decisions taken during the lexicon development process affect the emotion measurements that result from the tool.

One of the first decisions to make is whether the length of the lexicon list can be used as compiled during the emotion terms generation and collection process or needs reducing. In general, when working on a new food product, or working in a language whose waters are unchartered, or when the aim is to explore the concept of a food category, then the full version of the lexicon should be used. However, there are cases when a reduced version of the lexicon is preferrable to make the process quicker, easier

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[2] The functions that people ascribe to specific foods and mealtimes expressing their expectations and motives for consumption.

for the participant, and more focused. This reduced version can either be non-food-specific, as is EsSense25 [66], or it could be food-specific.

4.1 Clusters versus terms

The use of clusters or emotion categories instead of terms is a good choice especially in reduced lexicon forms and in cross-cultural studies (Table 3). As regards cross-cultural studies, it is linguistically and semantically preferrable to translate emotion categories instead of individual terms, because as already explained absolute linguistic, semantic, and pragmatic equivalence for individual words across languages is a rare phenomenon.

In Mora et al. (2019), following the procedure of van Zyl and 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, as stated by the authors. In the context of the shorter list, overlapping meanings were less frequent and the terms became more differentiated, even though they may be less precise. Thus, an unintended benefit of the shorter list was that there seemed to be more agreement on how the words were interpreted. The words in the shorter list had a more distinct meaning, because there are simply fewer words of similar meaning in the shortened list [66]. This was due to the fact that emotion terms were easier to deal with not only because they were fewer, but also because their meaning was clearer to the participants. Word sense disambiguation is done within context, i.e., people understand the meaning of words in relation and in contrast to the words that "surround" them. 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 [69].

This leads to the conclusion that linguistic context -more specifically using clusters of emotions for emotion measurement- disambiguates meaning. The meaning of each word is clearer when the word is presented as part of a group. This is obvious in sorting task procedures where words may move between factors indicating that there is either disagreement among the participants about what the words mean, or agreement but the meaning changes depending on the specific set of words being used [66]. As a result, the participants still have the terms that form the cluster available in order to grasp the emotion category concept but rate the category as a whole.

As regards emotion measurement, when comparing the differences among mean emotion ratings for the same words between questionnaires (meaning EsSense Profile® and EsSense25), there appears to be a tendency for the ratings to be greater when using EsSense25. One potential explanation for this is halo-dumping, a response bias that occurs when individuals are given a limited number of response alternatives with which to describe or rate a product [70]. In such situations, when the questionnaire respondents experience emotions for which appropriate words are not available on the list, they choose emotion words that do appear on the list and are close to the desired meaning resulting in higher ratings, thus "dumping" values to the available responses [66].

aim of study	stimuli		lexicon list		response format		
	food pictures /names	tasting blind/ unbranded	clusters	terms	CATA	rating scales	RATA
food-specific lexicon	+	+	+	+	+	+	+
non-food-specific lexicon	+		+	+	+		+
cross-cultural study	+	+	+		+	+	+

to distinguish within food category		+		+		+	+
to distinguish across food categories	+		+		+		+
to develop emotion lexicons	+	+					
to develop emotion measurement instruments		+					
to develop conceptual profiling instruments	+						
to study various aspects of food-elicited emotions	+	+					

Table 3. Available and recommended [indicated with +] options regarding food-related stimuli, the form of the emotion lexicon list, and the response format questionnaire, according to the aim of study.

4.2 Language as context in emotion measurement

People use the same emotion words in very different ways to communicate their feelings [2]. That is why, including linguistic context helps in determining the meaning of a word, thus reducing ambiguity. For example, using full sentences, it was possible to specify the emotion for a better understanding by respondents [38]. The semiotic analysis of interviews showed that "relax" was used by respondents with two meanings. For this reason, the questionnaire included two different sentences where a context helped to clarify the meaning of the emotion to be evaluated: "It is an antistress: it calms me, soothes me, reassures me" referred to a situation where the product acted as an active agent, able to inspire a passage from a negative state of uneasiness and agitation (a stressful state) to a positive mood characterized by more serenity. The emotion described with this sentence was different from that described in the sentence "It makes me feel relaxed", which referred to an emotional state of relaxation and did not necessarily imply a passage from a negative to a positive state. This leads to the conclusion that semiotic analysis and term disambiguation using linguistic context is not to be skipped.

4.3 Ordering of terms

The terms of an emotion lexicon, when presented to survey participants for emotion measurement, can either be in alphabetical order, or in random order (Table 1).

Ordering of terms in emotion measurement tools alphabetically is thought to make the task cognitively easier and thus quicker for the respondent than working with terms in random order, without affecting the results [71]. However, this is not probably true for all response formats. The CATA format seems to be slightly more sensitive to the order of the emotion terms (alphabetical vs. random) [71]. When using clusters of emotions terms, this predicament is overcome. Emotion categories are always presented in random order with subordinate terms sometimes presented alphabetically within each cluster.

4.4   What is measured? What are the participants expressing?

Sources of food emotions include sensory attributes (e.g., amusing, surprising taste or texture), experienced (e.g., relief, stimulation, dissatisfaction) and anticipated consequences (e.g., health effects, fear of obesity), individual meaning (personal/cultural) (e.g., this reminds me of sb), and actions of associated agents (e.g., contempt towards meat eaters…) [65]. Food and drink consumption is not only a physical experience that involves smell, taste and appearance, thus determining the subjective bodily state, but also -and mainly- a cognitive and affective experience" [4].

Whether emotion measurement is food-specific or not, taking place under blind conditions or not, it provides deep insights into personal and cultural conceptualizations, associations, expectations, habits, and past experiences. The aim of study is what guides the use of specific stimuli (Table 3). Food names and food pictures are preferred when studying emotions based on memory and past experiences. Food names create an emotional response that is consistent across time [72] and may elicit

memories of an emotional experience with the food, whereas actual consumption of that food may not evoke this idealized experience [73]. Strangely enough the role of memory is almost always neglected in food-related consumer research, although it is probably much more important than the first impression experiences that are commonly investigated, as memory gives rise to more intense emotions than actual sensory contact with food. The emotions, evoked by remembering a product, are essential in the expectations that guide repurchase decisions. What is remembered is what influences our later food choice decisions [39]. An interesting finding is that feelings of discontent seem to grow over time and positive feelings seem to wear off with repeated exposure [39]. Using food names or pictures to elicit emotions is a quick, easy, and economical method, allowing for the use of online questionnaires and the participation of more people. Food tasting should be preferred when interested in specific food products, not in the respective food category. Furthermore, research has shown that by providing elaborate description of the tasted product results in more intense positive emotions and less intense negative emotions, as this technique seems to bring expectations and sensory/emotional experience to convergence [74].

Meal functionality – the functions that people ascribe to specific mealtimes, e.g., energizing, or relaxing – seems to be another concept that provides a deeper understanding of food consumption motives. Thomson, Crocker, and Marketo (2010) recently discussed this topic and emphasized the use of conceptualizations, such as 'will refresh me,' 'will make me happy,' and 'will annoy me,' to understand consumer behaviour [75]. These conceptualizations seem to be inevitably connected to food experience, since we react not only to the product itself but also to the associations that we assign to that product [41].

4.5 Stimuli selection for emotion measurement

By measuring food-evoked emotions we gain insight into the consumers' personal and cultural habits, into their expectations, into how they conceptualize and associate specific foods and beverages, into how they visualize their own selves and make choices accordingly, into how emotions are expressed through Language as a coding system and through specific languages, and so on. According to the aim of the study, various stimuli can be used to elicit emotions (Table 3). Most of the studies that were included in our review (47 studies) used actual food tasting (blind-unbranded, branded). The rest used food names (9 studies) (e.g., bread) informed food tasting (6 studies) (e.g., bread with Bambara flour), food pictures (showing food under study) (3 studies), and food videos (showing food under study being consumed) (2 studies) (Table 1).

Actual food tasting is used as the main food-specific stimulus (48 studies). The tasting is done under blind/unbranded conditions (when the participant has no information regarding the contents, ingredients, brand, packaging etc of the food product being tested) except when the use of packaging, name, origin, ingredients etc. are being assessed. Even in blind testing conditions though, cultural conceptualizations and personal past experiences are present. The sensory information is perceived, processed, and reacted to, based on both intrinsic and extrinsic features of the tasted food. Intrinsic features are more closely associated with emotions, than extrinsic features which tend to have more abstract and functional associations [36]. It has also been noted that absence of attributes rather than presence evokes greater consumer discriminating emotions [76].

Testing emotions under informed conditions is especially interesting. Participants are given information on the ingredients, origin, (alleged or real) health benefits etc. of the food or beverage about which they are asked to express emotions. Under such conditions, there seems to be a halo effect over actual sensory perception. Knowledge

of food nutrient content, even if false, can alter emotions towards food [43,77], increase consumers' hedonic evaluation and purchase intention, as well as vary the perception of different sensory attributes [40]. The effect on emotions of knowing more about the product can be better identified by measuring emotions before tasting or under blind conditions and after tasting or getting the relevant information. Such processes can be very useful when studying novel products, such as functional foods, or products with sustainable ingredients, and their findings can be applied to branding, packaging design, marketing, restaurant menu writing, health campaigns etc.

4.6   Time of emotion measurement when tasting is involved

The usual process in most emotion measurement studies is to ask for the consumers' emotions after having tasted the foods under study. However, there are other choices for specific reasons. For example, especially when measuring beverage-evoked emotions, and comfort foods, before and after measurement seems to be the most preferred choice. Participants' mood before tasting an alcoholic beverage has been found to strongly influence the emotions evoked [45,50]. There is also the Temporal Dominance of Emotions model which measures emotions while tasting, using a multi-sip approach. And finally, there is the whole experience evaluation which takes place after tasting but the question refers to the entire consumption/emotional experience (Table 3).

The time of measuring the emotions is a parameter that can affect the results. If the measurement is done only after tasting, then there is no way to check to what extent the emotions can be attributed to the food itself and to what extent to expectations either met or not. A solution to this can be measuring emotions both before and after tasting, or measuring emotions during the whole process of tasting, applying the Temporal Dominance Model.

4.7   Context and setting of emotion measurement

Emotion lexicon development and emotion measurement is usually a lab or Central Location process in order to have as much control over the process as possible, following procedure guidelines for sensory testing which is often combined. However, emotions are by definition context-relevant, and cues external to sensory attributes drive different emotions [51,53], so lads and central locations are probably not the best choice of venue to measure emotions related to food consumption. Frequency of emotional terms and intensity of response seem to be much higher when the dimensions of location, social setting, and time have been included. More surprisingly, the differences in emotional responses attributed to the samples seem to be smaller compared to the differences due to the different test conditions, and/or the test settings [78]. This agrees with observations made by Silva et al. (2014) when studying the emotional and functional conceptualizations of beer consumers with the typical predefined scenario approach where researchers usually specify the social settings, the location, or the time in which the product is consumed. Linguistic context, as well as physical and social setting, are important parameters of food consumption and thus of emotion elicitation [79,80].

The use of a written scenario to accompany emotion questionnaires, the use of video as a stimulus [45,56], the use of real-like, real, or virtual-reality environments in food-evoked emotion measurements seem to be the new trends, in an effort to recreate a setting as close to real food-consumption as possible (Table 1). Food and drink consumption is a social event, even when done individually at home, and if we want to be as close to the real thing as possible then real, or real-like, settings need to be used. Recent studies taking place in real restaurants, bars, cafeterias, or recreating these environments using virtual reality set the trend. The use of video, or of a written

scenario that sets the scene for tasting, can make the experience as complete as possible within the lab environment and is less costly (Table 3). One should however bear in mind that there can be lesser product discrimination for emotions, but better repeatability of results, and a higher relation between emotions and liking in real and immersive environments than in a lab [81].

4.8 Response formats and statistical analysis per response format for lexicon development and emotion measurement

When developing an emotion lexicon and measuring emotions using self-report verbal questionnaires, various response formats may be used according to the task at hand and the decisions taken as regards methodology, namely free-listing, CATA, rating scales, rating lines, and RATA (Table 1).

Most of the reviewed studies have opted for rating scales in their ballots (21 studies), which seems to work well for the participant alongside the rating scale used for liking measurement. Most rating scales consist of 5 points (17 studies), and there are versions of 7 (1 study) and 9 points (3 studies). Rating scales demand an intensity rating for every term, even if it the emotion is not experienced at all (e.g., satisfied: 1 =not at all – 2=slightly – 3=moderately – 4=very – 5=extremely). Next in popularity comes the CATA format where the participants just check the emotions they experience, regardless of intensity. There is also the option to use rating lines instead of scales which seems to be popular with ballots consisting of clusters/categories of emotions (11 studies). The final option is the RATA, a combination of CATA and rating scales, where the participants provide ratings of intensity for the terms that they experience only. The RATA method has been modified to contain a "not-at-all" option which makes it even more similar to the rating scales. In Table 3, the response format options are presented as recommendations according to the aim of study.

Many of the reviewed studies have used the EsSense Profile® in either its original form for emotion measurement using rating scales or in the CATA version, which is very popular as well, depending on the aim of study.

Free listing of terms: Asking the participants to provide their own terms in a free-listing task, including triadic elicitation [i.e., say in what way two samples are similar but different from the third in terms of the emotional response they evoke [62]], or to talk about their emotions during a focus group discussion or a one-on-one interview, results in a list of terms that are food-appropriate or food-specific. The terms to be kept are determined by their frequency of citation, by counting the number of participants who mentioned the term. The cut-off point is not a point of convergence. Some researchers use the emotion terms mentioned by the 50% of the participants and above, others use the 20% threshold. It probably depends on how long the list needs to be and to what extent these terms express distinguishable emotions, after grouping synonyms.

CATA: Using a pre-defined list of terms and asking the participants to check-all-that-apply, usually allowing for the addition of any extra terms that do not appear in the list, is a response format that is quick and cognitively easy for the participant, and quick and easy for statistical analysis by the researcher. It can be used to narrow down the terms of a long list so as to keep the food-appropriate emotions or to create a food-specific emotional profile. Providing the terms from which to choose is helpful to the participants, as some people find it hard to pinpoint and accurately express their exact feelings. When answering CATA questions most consumers might not select all the terms that apply, but simply select those that are the most important to them for the task at hand. The drawback of this format, while compiling a lexicon, is that it may seed terms that would not come up in a free-listing task.

While measuring emotions, frequency of citation is calculated by counting the number of participants who selected the term. This format has the drawback of not discriminating between highly intense emotions and emotions only slightly experienced. This drawback can be overcome by using a modified CATA where each term can be endorsed by one to three checks, depending on the appropriateness or the intensity of the emotion experienced, thus providing a certain degree of discrimination [19]. One could then decide to keep the terms endorsed with two or three checks only, to avoid casual endorsement. The CATA format also seems to be affected by the order in which the terms are presented, which means that random ordering across participants should be preferred, but the same order by participant should be used to keep the task cognitively easy [26]. This format allows discrimination across food categories. For statistical analysis of CATA data one can apply the Cochran's Q test to check frequency of selection per emotion term and pairwise comparisons between terms. The use of ANOVA has also been proposed and checked but there are limitations acknowledged and further research needs to be done on that [82].

Rating scales and rating lines: Rating scales and rating lines can be used as the step following CATA in the lexicon development process, in order to create a food-specific profile using a relatively short pre-defined list but are especially used in emotion measurement questionnaires as they discriminate well both across and within food categories. Such a format demands the participant to attend to all terms equally and is thus more time consuming and cognitively harder than the CATA format, but ratings yield more detailed information as regards the experienced emotions. Demographic information, such as gender and cultural background, should be taken into account when using ratings, because of the variations in expressing intensity of emotion. Rating lines are probably more discriminating than rating scales but may be confusing to

participants due to their relativity and the lack of specific intensity markers. Statistical analysis of these formats is done via ANOVA or MANOVA, to identify significantly discriminating factors.

RATA: The rate-all-that-apply format seems to combine the advantages of the CATA format and of the rating scales, i.e., it is quick and discriminating. That is because frequency of use of the terms correlates with intensity ratings [83,84]. Consumers are expected to only select the most applicable attributes in CATA questions, so they only check an attribute if its intensity exceeds a certain (subject-specific) threshold, whereas in RATA questions consumers are expected to provide a more detailed characterization of the samples by selecting a larger number of attributes and additionally indicating their intensity [85]. There is also an interesting variation, a modified RATA where participants are asked to rate all terms using a rating method, where 0 reflects not feeling the emotion at all [15,57].

Results from a RATA questionnaire can be analysed in two ways: RATA as CATA and RATA as scores, giving a 0 score to the attributes that are not endorsed. It has been noted that using a RATA ballot and treating the data as CATA is likely to be disadvantageous to sample discrimination. All-in-all, however, no clear superiority of one methodology over the other has been observed.

4.9 Emotions and overall liking as inter-complementary measurements and the position of overall liking/acceptability question in emotion questionnaire

Emotions and liking, or else hedonic, ratings are inter-complementary. That is why emotion lexicons in emotion measurement tools are usually accompanied by an overall liking or overall acceptability question, in order to gain deeper insight into consumers'

preferences, as liking ratings express which sensory and emotional attributes are desirable and which are not for the food under study. Emotion profiles can differentiate between products of the same acceptability and liking. Emotion responses may even be a decisive factor for consuming or buying a food product, even more decisive than sensory liking and price [72]. Research on food products has shown that liking, expressed through hedonic tests, cannot predict food choice and purchase on its own [3,86]. What is more, liking cannot always differentiate between a consumer's attitude towards a food product before and after tasting it (especially beverages) but emotions can give such a differentiation [44]. On the other hand, emotions alone cannot provide us with a full food profile as hedonic ratings help explain the choice of emotion terms. This happens because certain emotions can be considered desirable in some food cases or in some cultures but undesirable in others, and hedonic ratings clarify emotions that are neither positive nor negative or both positive and negative depending on context. For example, the emotion of *guilt*, needs the liking factor to be correctly understood. Actually, in Dalenberg et al. the strongest predictive strength was achieved by the combination of evoked emotions and liking [52], and according to Beyts et al. emotions are more discriminating than hedonic liking alone [87].

An overall acceptability or overall liking question is added to most emotion measurement tools, usually to be answered on a 9-pt scale (1-dislike extremely, 5-neither like nor dislike, 9-like extremely) and usually precedes the emotions questions. The rating scale format seems more sensitive to the position of the emotion terms relative to the overall acceptance question [71]. Information provided by this hedonic liking question adds information to emotions, especially in cross-cultural studies where some emotions may be experienced but undesirable. For example, in a study Asian participants were found to have positive attitudes toward a healthier variety of foods

compared to that of Western participants [88]. In another study, the conclusion was that although chocolate is highly liked, actual consumption of chocolate varies between consumers and heavily depends on many more factors than merely liking [52]. In a cross-cultural study between Westerners and Asians to develop emotion lexicons for chocolate types, Westerners felt a little naughty and guilty at a high frequency when consuming chocolate, which were characterized as unclassified emotions, while Asians had only clearly positive emotions and these specific emotions were not in the final lexicon. Westerners were also found to feel mainly elegant when consuming dark chocolate, while Asians felt mainly healthy [21]. In another study, sweeteners high in liking have been associated with neutral to positive terms, while sweeteners low in liking, and neither liked nor disliked have been uniquely associated with negative terms [59]. These studies emphasize the fact that emotion terms and liking on their own tell only half the story.

Beverages, even if equally liked by consumers within a specific group (i.e., who have the same age, gender, or frequency of consumption), can have very different emotional profiles. In a study, consumers grouped according to their frequency of consumption as "heavy", "medium", and "light" users, who liked light and dark roast coffee samples equally, expressed different emotions towards each sample: positive-high energy emotions were generated when drinking one type of coffee (active, boosted, energetic, rested, and empowering), while positive-low energy feelings were felt when drinking another type of coffee (comfortable, pleasant, warm) or a third one (relaxed, curious) [6]. In a study comparing beer, wine, and non-alcoholic beer, consumers distinctively expressed feeling free when drinking beer, calm and loving when drinking wine, but safe, responsible, rational, and conscious when drinking non-alcoholic beer [5].

4.10 Creating consumer-led emotion and sensory lexicons, linking emotions and sensory attributes

Sensory perception, usually through the sense of taste, is a source of emotions, and there are quite a few studies (9 reviewed here) that combine data from sensory and emotion measurements to gain deeper insights into consumers' preferences [36,54,55,58,60,61,68,75,89]. Linking emotional attributes with sensory attributes, such as amusing, surprising etc., can provide deeper insights into consumers' preferences and is necessary during the product development process (Table 1). There are ready-made models to make this link with specific advantages each:

EmoSemio / Global Profile [38,90,91]: The EmoSemio, by providing sentences along with emotion terms, can be clearer for the participants as to the meaning of the terms. It has also proven discriminating and good at creating product-specific profiles. Its extension, the Global Profile, is the most complete emotion measurement tool, including liking, sensory characterization, emotions, emotional and functional conceptualizations, and context. It thus measures the experience as a whole, which makes it ideal for creating complete food profiles.

The Temporal Dominance of Emotions Model [49,58,92]: This model is analogous to the Temporal Dominance of Sensations and the Temporal Dominance of Liking and is often combined with them. It studies emotions as they evolve during the tasting process instead of measuring them as static events after tasting. The participants evaluate the dominant emotion since its onset through to its peak and its dissipation. This approach is far closer to the real eating/drinking process, and it adds an extra layer of information when liking, emotions, and emotion intensities cannot discriminate between foods. This method can be very insightful for beverages and comfort foods, where the "flow" of emotions can indeed be the factor that determines purchase and preference.

EmoSensory® Wheel [55,93,94]: The wheel response format, where participants can choose the emotions they want by using CATA or RATA. This format can be used to easily link sensory and emotional attributes, and because of its electronic format it can easily be made product specific.

The Emotional Circumplex Model [61,68]: This model distinguishes well among foods but cannot be used for emotional profiling as the participants choose only one pair of emotions, capturing valence and arousal. It can be used when locating the emotional domain instead of specific emotions is enough. This model makes linkages between emotional and sensory terms easy, and its response format allows for less dispersion of data than others.

4.11 Demographic data matters

One should keep in mind certain trends, such as that female consumers and Westerners rate emotions more intensely than male consumers and Asians, or that men tend to report higher positive emotions for comfort foods than women [40]. Another example can be found in the emotion of *guilt*. If the reason of guilt is the amount of calorie intake from a type of food, then it could be explained as guilty pleasure and be considered a desirable attribute. If the reason of guilt is the high price paid for a food type considered a luxury, then it would be an undesirable attribute. Income is another factor that can affect emotional responses. For example, low-income consumers tend to express negative emotions (e.g., disappointed, anguish, annoyed, sad, rejection, disgusted) towards beer and wine probably because these beverages can cause social and family problems due to drinking issues, while middle-income consumers tend to express positive emotions (e.g., loving, good-humoured, fun, sharing, friendship) towards beer and wine [95]. There are other studies that deal with different aspects of demographics, but they did not fulfil the inclusion criteria for this review.

5. CONCLUSIONS AND FUTURE PERSPECTIVES

When compiling emotion lexicons, it is important to take both culture and language into consideration and to bear in mind that an emotion lexicon developed in one country for a specific product type is not necessarily suitable in another country or for a different product. Emotion lexicons should be developed using linguistic and cultural data from the frame in which they are going to be exploited. Using pre-existing lists of food-evoked emotions developed in another language should be done while paying attention to certain parameters. On the other hand, from a practical point of view, the process of generating emotion lists for each country is both time consuming and expensive. For this reason, pan-global questionnaires implemented locally in local languages have been proposed. The need to have quick, easy, inexpensive, universal instruments within the global market and international companies' landscape is evident and rational. In Fig. 2, the words that appear the most frequently in emotion lexicons reviewed in this article are presented in size according to their frequency of appearance. They could be used as a starting point in creating pan-global emotion measurement tools.

Figure 2. Food-evoked emotion words that appear in EsSense Profile®, EsSense25, EmoSemio, Empathic Food Test, and Global Profile. The larger the font, the more frequent the word.

The most important participant in the emotion lexicon development process is consumers. Personal and cultural conceptualizations, associations, expectations, habits, and past experiences with foods form consumers' emotions and preferences. Thus, a hybrid approach for lexicon development is recommended, one that combines published lists and consumer input, at first applying CATA for term identification and then rating scales or RATA for emotion measurement.

A combination of pre-existing lists and product specific consumer-defined lists in lexicon development may provide a more comprehensive strategy, so as not to miss important discriminating terms [37].

In languages less studied, time consuming but thorough linguistic methods should be the first step to identify food-appropriate non-food-specific emotion terms. New

linguistic sources available thanks to technology, such as the World Wide Web, Information Technology tools, and social media, should be exploited for term collection and for qualitative analysis of food-elicited emotions.

The use of clusters or emotion categories instead of individual terms is a good choice especially in reduced lexicon forms and in cross-cultural studies, when comparing emotion categories is better than comparing specific emotion words, and term to term translation should be avoided. It would, therefore, be a good idea for an emotion lexicon to have two versions for researchers to choose from, a full version and a short one.

In emotion measurement, especially of alcoholic beverages and comfort foods, a measurement of the participants' mood before or during the entire tasting process should be taken to trace the emotional alterations and gain better insight since consumption of these types of food are specifically targeted at altering our emotional state.

Researchers should be aware of the fact that creating high expectations to participants when performing informed testing may be risky as these expectations may not be met and may result in decreased satisfaction. Nevertheless, informed conditions can be used when studying cultural aspects of food acceptability and attitudes to specific food attributes. These conditions could also give great insight into target group discrimination.

In emotion measurement, opting for a response format should be done according to the task at hand. To discriminate between quite different food categories, one can choose CATA with the option to add terms that are not on the list. To discriminate products within the same food category, rating scales would be the format to choose. The

modified RATA with a scale of 0-5 (0 not feeling the emotion at all) is a good alternative if keeping the task quick and easy is an important factor.

Liking ratings, linking sensory and emotional attributes and also taking into account demographic information such as income can provide even deeper insights into consumers' preferences.

Food-elicited emotions and the respective emotion lexicons could be used outside the food science and consumer studies field, in Natural Language Processing for opinion mining in food talk social media and reviews of restaurants, recipes etc. on the Web.

Studying food-elicited emotions is more important than ever now that people are becoming more and more conscious of what they purchase and what they consume. They are mindful eaters, have high expectations, and health and wellness are a big issue [86,93,96]. Functionality of foods and meals is a key concept as well [41,79]. The reviewed studies, having emotion lexicon development as the main focus, were conducted with healthy participants. As a result, health issues such as obesity, diabetes, anorexia nervosa etc. have not been addressed here. However, this is a point where emotion measurement could be applied to provide helpful data.

To be as close to the real food consumption experience as possible, then settings such as restaurants, bars, cafeterias, or virtual environments recreating these settings set the trend. Another option, less costly, is the use of video, or of a written scenario that sets the scene for tasting. As an extension of this, emotion measurements should be taken at the time of actual purchase or consumption, via the use of interactive electronic devices, for the outcome to depict reality.

An alternative to self-report verbal questionnaires for emotion measurement is the use of emoji instead of terms [97]. This approach has its advantages and drawbacks, among their advantages being enhanced ecological validity, familiarity and cross-culturally shared meanings, and among their disadvantages emoji meanings/interpretations, appropriateness for older consumers and ability to represent emotional arousal (activation to deactivation) [98]. Comparing emoji to emotion words in food studies there was greater agreement on which words best describe the samples than on which emoji. Emoji was also found to discriminate better among lesser liked samples, since there is greater diversity in meanings of negative emoji [97]. The choice for either emotion words or emoji might depend on the stimuli and presentation mode under study although the age of the participants should be considered but there is no clear direction on whether words or emoji generate more discriminative differences in product testing [99]. Since emoji is a fun and easy way to express emotion requiring little cognitive effort and linguistic ability, they could be the way to go when the participants are children or young adults, much accustomed to using them in text messaging and on social media, as well as in cross-cultural studies when developing an emotion lexicon from scratch or translating existing lists is not an available or the right option. As Schouteten and Meiselman (2021) put it, we probably do not need to make a choice between either emotion words or emoji; it might be interesting to include both.

From a linguist's and a lexicographer's perspective, the process of developing and applying emotion lexicons in general and more specifically in the domain of food is enticing for various reasons. On the one hand, a linguist or a lexicographer can offer their expertise in every step of the emotion lexicon development process: as regards possible sources of terms for lexicon development from scratch, collection of data techniques, for example by making use of electronic lexicography and Natural

Language Processing tools, highlighting aspects of the relationship between language and culture, working on the translatability of emotions and emotion words in cross-cultural studies, providing insight into how to work with clusters of emotions or with the valence and arousal dimensions of emotions based on frame semantics, conceptual linguistics, and sensory linguistics, providing guidelines as to how to use linguistic context to make emotion terms clearer to consumers/ research participants, helping explain results in the light of "language within context".

On the other hand, concepts about food, eating habits, and relative emotional associations are depicted in linguistic constructs, such as metaphors, and research regarding emotions in the food domain can offer a wealth of data and great insight that can -and should- be depicted in dictionary definitions and examples, or provided as pragmatic information about the usage of a word or expression. Also, making use of demographic data about the frequency of use and the way of usage of emotion terms as related to foods can enrich dictionary entries, too.

To conclude, there is an opportunity of a rich and fruitful give-and-take between food science and linguistics / lexicography, beneficial for all parties concerned.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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A	B	C		D	E	F	G	H	I	J	K	L	M
		term sources											
aim of study		other than consumers	focus groups	stimulus for term elicitation	lexicon list	word class of terms	ordering of terms	questionnaire response format	stimulus for emotion measurement	context/setting of measurement [other than lab/Central ...]	foods	language	references
emotion lexicon development	original	p, e	CATA	n	16 t	a	r	5pt	n	lc	wine	Italian	Ferrarini et al. (2010)
		ls	fl	t	12 c	a, p	r	150mm	t		beer	Spanish	Chaya et al. (2015)
		ls	fl, d	n, t	43 t, 9 c	a	r	150mm	t		beer	Spanish English	Eaton (2015)
		ls			49 t	a	r				x	German	Gmuer et al. (2015)
		p	fl, st, d, rl	t	15 c	a, n	r	10cm	t	lc	wine	Spanish	Mora, Dupas de Matos et el. (2020)
	adaptation	p			33 t + e	a, n, p	r	CATA	n, t	ws	milk, water, red wine, chocolate, muesli bars, popcorn	English Mandarin	Jaeger, Roigard et al. (2018)
		p	fl, CATA	n, t	64 t	a, n, p			n, t		chocolate	English	Gunaratne et al. (2019)
		p, ls	fl, d	t	43 t, 9 c	a, n	r	150mm	t		beer	English	Eaton et al. (2019)
		p		t	11 c	a, n	r	15cm	t		beer	Spanish	Mora et al. (2019)
conceptual profiling	original		fl, bws	t	24 t	a					chocolate	English	Thomson et al. (2010)
			fl, d	p, t	25 t	a					beer, wine	Dutch Portuguese	Silva et al. (2016)
		p			16 t	a, n	r	CATA	t		cashew nuts, peanuts, chocolate, fruit, processed tomatoes	English Italian	Jaeger, Spinelli et al. (2018)
		p	i	t	27 t	n		7pt		real	processed tomatoes	Italian	Spinelli, Dinnella et al. (2019)
	adaptation	p	fl	t	34 t, 38 t, 50 t	a, n, p		CATA	t		blackcurrant squash	English	Ng et al. (2013b)
		p			24 t, 12 c	a, n		CATA [choose 1 only]	t		salted snacks, potato chips, yogurt, cheese, snack bars, fruit	English	Jaeger et al. (2019)
emotion measurement	original	p	fl, CATA	n, t	39 t	a	a	5pt	n, t		among & within product categories	English	King & Meiselman (2010)
		p	fl	t	36 t	a, n, p	a, r	CATA, 5pt	t		blackcurrant squash	English	Ng et al. (2013a)
		p	fl, i, CATA	t	23 t+s	a, p	r	5pt	t	lc	chocolate and hazelnut spreads	English	Spinelli et al. (2014)
		p	fl, d	t	44 t	a, p	a	5pt	t	real	coffee	English	Bhumiratana et al. (2014)
		p	fl, CATA		14 17 t	a, n, p	a	RATA	t	real	cola, chocolate, crisps, burgers, vanilla pudding [blind, informed]	Dutch	Schouteten et al. (2015a)

abbreviations per column:

C: p = pre-existing list of terms, e = experts, ls = linguistic sources, fl = free listing, d = discussion, st = sorting task, rl = rating lines, rs = rating scales, bws = best-worst scaling, i = interviews, fcp = free choice profiling

D, I: n = food names, p = food pictures, t = tasting, lc = linguistic context

E: t = terms, c = clusters / categories, e = example, s = sentence, d = definition

F: a = adjectives, n = nouns, p = phrases

G: a = alphabetical, r = random

H: pt = point scales, mm=millimeters (line), cm=centimeters (line)

		p, e	fcp	t	12 t	a, p	r	5pt	t		milk, water, bread, sugar	German	Geier et al. (2016)
	adaptation	p	st		25 t	a	a	5pt	n, t		various un/branded	English	Nestrud et al. (2016)
		p	rs	n	39 t	a	a	5pt	n, t		comfort foods	English	Cardello et al. (2012)
		p			13 t	a, n, p	a	RATA	t	lc	cheese	Dutch	Schouteten et al. (2015b)
		p			19 t	a, n	a	CATA, RATA	t		chocolate, yogurt	Dutch	Schouteten et al. (2017)
		p			39 t / 44 t	a	a	5pt	t	real	coffee	English	Kanjanakorn & Lee (2017)
		p	RATA	lc	10 t	a	r	RATA	t	real	wine	Portuguese	Silva et al. (2018)
		p			39 t	a	r	CATA	t		white wine, honey, peanuts, chocolate, cheese crackers, white bread, cashew nuts	English	Jaeger, Swaney-Stueve et al. (2018)
		p			25 t	a	a	5pt	t		sweet & savoury snacks with Bambara flour	English	Yang et al. (2020)
		p			25 t	a	a	10cm	t		apple cider	Spanish	Mora, Elzo-Aizarna et al. (2020)
study food-elicited emotions	original	p			18 pairs of opposites	a, n, p		5pt	t		dairy products, non-dairy milk substitutes, vegetables, bakery products	German	Geier et al. (2012)
		p, e	mod. CATA		12 c	a, p	r				x	English French German Italian	Thomson & Crocker (2013)
		p	CATA	t	10 t + d + e	a	r	temp. CATA	t		chocolate	English	Jager et al. (2014)
		p	st		15 t	a		9pt			mealtimes	Dutch	den Uijl et al (2014)
		p, e	st, d	n	66 t	n		3pt †			beverages, beer	English Spanish	van Zyl & Meiselman (2015)
		p	d, rs, fl	t	19 t	a	a	9pt	t	real	wine	English	Danner et al. (2016)
		e	fl		17 c	a, n, p					x	Brazilian	Fonseca et al. (2019)
	adaptation	p			39 t	a	a	5pt	t		breakfast drinks	Dutch	Dalenberg et al. (2014)
		p	fl, bws	n, p	33 t	a, n, p	a	CATA	p		chocolate, soup, pizza, beer/wine, steak, yogurt	Spanish	Sosa et al. (2015)
		p			43 t	a	a	CATA	t		artificial & natural sweeteners in tea	English	Leitch et al. (2015)
		p			39 t	a	a	5pt	t	real-like	breakfast drinks & dessert products	English Dutch	Gutjar et al. (2015)
		p	CATA		20 t	a	a	5pt	n, p, lc		chicken eggs	English	Wardy et al. (2015)
		p	fl	t	10 c	a, n	r	line + CATA	t	ws	beer	English	Dorado, Chaya et al. (2016)
		p			38 t / 12 c	a, n, p		5pt, 15cm	t		chocolate, beer	Spanish	Dorado, Pérez-Hugalde et al. (2016)
		p			66 t	a		3pt †	n		beverages, beer	English Spanish Portuguese	van Zyl & Meiselman (2016)
		p			19 t	a	a	9pt	t	lc	wine	English	Danner et al. (2017)
		p			10 c	a, n, p	a	line	t		beer	English	Beyts et al. (2017)
		p			42 t	a	a	CATA	t	videos	breakfast meal	English	Walsh et al. (2017)

linguistic context, ws = written scenario, VR = Virtual Reality

general

p			25 t	a	r	100mm	t		beer	Dutch	Silva et al. (2017)
p			26 t	a	r	10cm	t		wine	Spanish	Mora et al. (2018)
p		t	53 Ch / 29 Kor	a, p	r	mod. RATA	t		coffee	Chinese Korean	Hu & Lee (2019)
p			39 ESP/ 9 EmoS / 24 GP				t		cashew nuts, chocolate [ESP], canned tomatoes [EmoS], potato crisps [GP]	English Italian	Spinelli, Monteleone et al. (2019)
p			25 t	a	a	5pt	t		vegetable juice products	English	Samant & Seo (2019)
p		t	10 t	a		temp. CATA	t		beer	Dutch	Silva et al. (2019)
p			10 t	a		CATA	p, t		various	English	Torrico et al. (2019)
p			11 t	a	r	CATA	t	real, VR, VR-360°	beer	Italian	Sinesio et al. (2019)
p			11 t	a	r	CATA	t	real, real-like, VR-360° video, VR-3D modelling + 360° photos	beer	Italian	Worch et al. (2020)
p			33 t	a	r	CATA	t	real, VR	wine	English	Torrico et al. (2020)
p			60 t	a		5pt	t	videos	beer	English	Desira et al. (2020)
p			25 t	a		mod. RATA	t	real, VR	tea break snacks	English	Low et al. (2021)

abbreviations:CATA=Check-All-That-Apply, RATA=Rate-All-That-Apply, mod. =modified, temp.=temporal, Ch = Chinese, Kor = Korean, ESP = EsSense Profile®, EmoS = EmoSemio, GP = Global Profile
†1:makes me feel more like that, 2:makes me feel less like that, 3:not applicable

Table 1. Schematic review of food-related emotion lexicon development studies and their methodology features.