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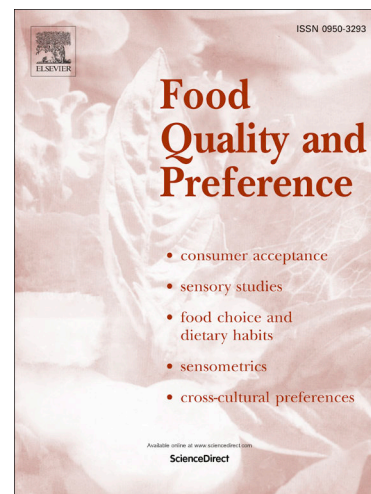
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Research Article

Development of an emoji-based self-report measurement tool to measure emotions elicited by foods in preadolescents

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Abstract

Emoji evolved as an attractive instrument to measure emotions in preadolescents due to their potential to express a wide range of emotions. However, the emotional meaning of emoji can be ambiguous and is often not universal across age groups, which has not been considered when developing emoji questionnaires. Hence, this research aimed to develop an emoji-based self-report measurement tool to measure emotional responses to food products in preadolescents. In total, 5 studies were conducted, and 454 preadolescents (aged 9-13 years) participated to develop the tool. First, preadolescents selected food-related emoji (Study 1, n=96), then they evaluated their dimensional emotional meaning using projective mapping (Study 2, n=162). They then evaluated the linguistic semantic meaning by describing emoji with emotion words (Check-All-That-Apply) (Study 3, n=92) and vice versa (Study 4, n=85). Finally, one-on-one interviews using a modified version of the Repertory Grid Method were conducted to investigate emoji more in depth (Study 5, n=19). The findings resulted in 17 emoji pairs associated with specific linguistic semantic and dimensional (valence, power, and arousal) meanings. Based on this, we developed an emoji-based self-report measurement tool to measure emotions in response to food products with two suggested response formats, the CATA Emoji Pair Questionnaire and the Emoji Pair Rating Scale. Future research will test the discriminative ability of this tool over a wide range of food products. The questionnaire will allow for a better understanding of preadolescents' affective responses to food and could be used in food innovation targeted at preadolescents to promote healthier food behaviors.

Keywords

Emotions; Questionnaire development; Emoji; Valence; Arousal; Power

1. Introduction

1.1. The importance of measuring affective responses to foods in children with appropriate tools

A growing interest in using emoji to measure consumer's product-elicited emotions emerged in the field of sensory and consumer science over the past years. Within the last decade, social media and digital text messaging resulted in a dramatic rise in the number of users making emoji a popular communication tool in today's information exchange. Consequently, emoji are already familiar to many people and particularly with the youngest. Emoji can serve as a measurement of explicit emotions to describe how a product makes one feel when using self-reported questionnaires (Meiselman, 2016). In fact, emoji are supposed to simulate facial expressions that convey specific emotions or other situational meanings (Bai, Dan, Mu, & Yang, 2019). Recently, emoji evolved as an attractive instrument to measure emotions elicited by food. Several studies showed that emoji can help to discriminate between food products, which was particularly effective when liking was not a strong discriminator between them (Ares & Jaeger, 2017; Da Cruz et al., 2021; Gallo, Swaney-Stueve, & Chambers, 2017b; Jaeger, Lee, et al., 2018; Jaeger, Roigard, & Ares, 2018; Schouteten, Verwaeren, Gellynck, & Almlí, 2019). The information given by emoji can help to better understand consumer's food preferences to improve product performance and assist in the development of new products (Carr et al., 2015; Vidal, Ares, Machín, & Jaeger, 2015).

Given the rise of food products targeted at children and the need of healthier food products (European Commission - EU Science Hub, 2020) to combat the global rise of childhood obesity (Wang & Lobstein, 2006), children take an important role in consumer testing today (Laureati et al., 2015). Although children between 4-11 years are already able to perform a range of consumer tests similar to adults, the assessment of children's food preferences requires engaging and age-appropriate methods (Laureati et al., 2015). Pictorial self-report methods were suggested (Desmet, Hekkert, & Jacobs, 2000) as a measurement tool for emotionally responding to products. These methods are used in a variety of demographic populations, including children or populations of different languages. Examples include cartoon characters like PrEmo expressing a variety of emotions by Desmet et al. (2000) or images like the Self-Assessment Manikin (SAM) by Bradley & Lang, 1994; Lang (1980). SAM was used to measure emotions in different eating contexts with 6-14-year-old children (van der Horst, Ferrage, & Rytz, 2014; van der Horst, Mathias, Prieto Patron, & Alliot, 2019). PrEmo has been used with adults to measure emotional responses to foods to discriminate between similar products of the same product category (Gutjar et al., 2015) but to date this has not been explored with children in food research yet. Such methods require preadolescents' familiarization with images/cartoons. With the SAM method, one drawback is that children must be explained the three affective dimensions (valence, arousal, and power) before the approach can be applied. A further risk is that unfamiliar images/cartoons could be misinterpreted when filling out a survey response, thus misdirecting the data interpretation.

Several researchers discovered the advantage of emoji to measure preadolescents' emotions towards food products (Gallo et al., 2017b; Lima, de Alcantara, Martins, Ares, & Deliza, 2019; Schouteten et al., 2019; Schouteten, Verwaeren, Lagast, Gellynck, & De Steur, 2018). Most preadolescents are already familiar with emoji and think they are fun to use when describing

their food experiences, which is a significant prerequisite when developing novel tools where emoji are implemented (Sick, Spinelli, Dinnella, & Monteleone, 2020) because this motivates children to be more actively engaged in sensory and consumer studies. In a focus group conducted by Gallo, Swaney-Stueve, & Chambers (2017) preadolescents stated their preference using emoji over words when describing food-related emotions. Studies using emoji to measure food-elicited emotions already tested a variety of food products such as baby carrots, cheddar cheese, chocolate graham snacks, fresh spinach, lychee gummy candy, orange juice, white bread, white grapes (Gallo et al., 2017b), biscuits (Schouteten et al., 2018) and samples of probiotic fermented milk (Da Cruz et al., 2021).

1.2. Existing emotion measurement tools/questionnaires/scales/methods

Recently, a range of self-report tools using emoji to measure food-related emotions have been developed and tested in adults and children, e.g., Check-All-That-Apply (CATA) with emoji (adults: Ares & Jaeger, 2017; children: Gallo, Delores, Swaney-Stueve, et al., 2017; Schouteten et al., 2019 and 2018), Rate-All-That-Apply (RATA) with emoji (adults: Ares & Jaeger, 2017), EmojiGrid (adults: Toet et al., 2018), and K-state emoji scale (children: Deubler, Swaney-Stueve, Jepsen, & Su-Fern, 2020, adults: Deubler & Swaney-Stueve, 2020). Some of these methods were developed specifically for or adjusted for preadolescents (Deubler et al., 2020; Gallo et al., 2017b; Schouteten et al., 2019, 2018; Sick, Monteleone, Pierguidi, Ares, & Spinelli, 2020; Sick, Spinelli, et al., 2020).

The most common method used is the CATA approach. Here participants are presented a food stimulus and asked to state how this makes them feel by selecting all emoji that apply. This method has the advantage of being intuitive, easy to understand and quick to use. The integration of emoji in a CATA approach was used with preadolescents to measure food-elicited emotions, whereof a large variety of emoji were shown to discriminate between food products (Da Cruz et al., 2021; Gallo et al., 2017b; Schouteten et al., 2019, 2018). The number of included emoji varies widely among studies ranging between 7 and 38 emoji (Da Cruz et al., 2021; Gallo et al., 2017b; Schouteten et al., 2019, 2018; Swaney-Stueve, Jepsen, & Deubler, 2018), while not all the emoji were shown to have a discriminant ability between food products (Da Cruz et al., 2021; Gallo et al., 2017b; Schouteten et al., 2019). One of the reasons for this fact could be that most previous studies started with very heterogenous emoji lists resulting in a large set of emoji that were either not related to food, or not relevant for use with preadolescents. Product-specific emoji lists usually contain less emoji compared to general emoji lists (Schouteten et al., 2019). However, their specificity is restricted to a specific set of food products, which limits their application to a wider range of food categories. This is comparable to general emotion word lexicons (like the EsSense Profile[®]) and product-category specific emotion using words/sentences (e.g., like the EmoSemio questionnaire) to capture emotional profiles in response to food products. Emoji have often been selected based on emoji lists developed for adults (e.g., Lima et al., 2019) but the use and interpretation of emoji can vary between different age groups (Brants, Sharif, & Serebrenik, 2019; Herring & Dainas, 2020) - especially among preadolescents (Sick, Monteleone, et al., 2020). Gallo, Swaney-Stueve, & Chambers (2017) conducted focus groups with 8-11-year-old children to develop an age-appropriate emoji list that can be used to measure food-elicited emotions. In prior research,

we developed an emoji list relevant to describe food experiences in 9-13-year-old children and investigated age- (9-11 vs. 12-13-year-old children) and gender differences (Sick, Spinelli, et al., 2020). Furthermore, we studied the dimensional and semantic meaning of emoji (Sick, Monteleone, et al., 2020) to further reduce the emoji list.

Moreover, the use of rating scales (e.g., RATA format) were shown to provide more information and have higher sensitivity compared to CATA questionnaires in adults. This could further improve the discriminant ability of emoji, especially if food products are very similar in sensory characteristics (Ares & Jaeger, 2017). By using rating scales, it can also be measured how intense emotions are felt towards food products, which can give further insights into product discrimination using emoji.

Ares & Jaeger (2017) compared four different emoji questionnaire formats to describe how consumers would feel eating different seafood products using: a) Check-All-That-Apply (CATA) question on single page with direct emoji selection; b) CATA question on single page (with scroll bar) with adjacent box to click; c) yes/no forced-choice question on single page (with scroll bar); d) Rate-All-That-Apply (RATA) questionnaire on single page (with scroll bar) by clicking an adjacent box to indicate that it applied to the food and then providing a “low”, “medium” or “high” response. The study used a fifth questionnaire format similar to a) but without asking “How would you feel?”. The authors concluded that while either of the tested methodological variants can be used to lead to the similar overall findings, the RATA showed superior performance in terms of frequency of emoji use and sample discrimination. Forced yes/no questions were participants’ least favorite methodological variant. Despite leading to a high frequency of emoji use, sample discrimination was a stable relative to CATA questions.

To our knowledge, the approach to use a rating scale with emoji to measure children’s emotional responses to food products has not been used before but might be beneficial when differences between products are small and difficult to quantify.

1.3. Why is it important to develop a new emoji scale for children?

The development of emoji-based questionnaires is strongly encouraged (Jaeger, Vidal, & Ares, 2021). Supporting reasons for using questionnaires with emoji compared to emotion words are children’s familiarity and shared meanings between cultures through the use of emoji. This is advantageous, especially when there are language barriers in cross-cultural research (Jaeger, Vidal, et al., 2021).

Previous studies often selected emoji without the consideration of how emoji are interpreted by preadolescents regarding their semantic meanings, degree of valence, arousal, and power. Interpretations of some food-related emoji were shown to differ between preadolescents (Sick, Monteleone, et al., 2020) and therefore a thorough preselection of an age-appropriate emoji list is required. For example, emoji such as the *neutral face* 😐 are often considered a neutral anchor point in hedonic scales used with children (Guinard, 2001) and in scales to measure emotional responses (Deubler et al., 2020). However, preadolescents often interpret this emoji as slightly more negative than solely neutral (Sick, Monteleone, et al., 2020). Furthermore, the interpretation of the *face screaming fear* 😱 has a tendency to shift from “surprise” to “fear” from younger to older adult groups (Brants et al., 2019).

By more carefully selecting appropriate emoji used in emoji-emotion-measurement-tools, the discriminative ability of the tool between products could be enhanced, thereby helping researchers to better understand preadolescent's food preferences (Sick, Spinelli, et al., 2020). Furthermore, it is unclear if some emoji are redundant, e.g., express some similar meanings, or are ambiguous, e.g., express different contrasting meanings.

1.4. The aim of the study: the development of an emoji-based self-report measurement tool

The aim of this study was to develop an emoji-based self-report questionnaire for preadolescents consisting of a food-specific emoji list with identified emotional meaning. The purpose is to reduce the ambiguity in the interpretation of the emotions associated with the emoji amongst preadolescents. The questionnaire could be used to study preadolescents' emotions elicited by foods.

The questionnaire was developed based on five studies, which include the selection of emoji evaluated as appropriate by preadolescents to describe food experiences (Study 1), and the exploration of the meaning of emoji resulting from Study 1 by using four different methods; Study 2 investigated the "dimensional" meaning of emoji (in terms of valence, power, and arousal) using the projective mapping technique; Study 3 and 4 explored the linguistic semantic meaning using a CATA questionnaire with emoji described by emotion words (Study 3) and a CATA with emotion words described by emoji (Study 4). Finally, one-on-one interviews were conducted using a modified version of the Repertory Grid Method (Study 5) to investigate emoji more in-depth.

2. Methods

2.1. Overview of the questionnaire development

Several steps were undertaken to develop the emoji-based self-report questionnaire (see Figure 1): First, it was necessary to reduce the list of available emoji obtained from Apple iOS 12.2 (Apple, Inc, Cupertino, CA) accessed through Emojipedia in April 2019 (Emojipedia, 2019). This was an important step due to the large number of emoji (n=2776) at this time. For this reason, only facial emoji were included for further evaluation. Furthermore, facial emoji were assumed to simulate facial expressions and hence, identified as emotions. A researcher preselected all available facial emoji (in this study defined as round and usually yellow facial emoji varying in facial expressions e.g., 😊) and emoji displaying people, animals, objects, food etc. were excluded. Then, preadolescents were asked to select from the preselected list of 92 emoji the ones that they thought were relevant to describe food experiences (Sick, Spinelli, et al., 2020). Next, the emotional meaning of 46 emoji (selected in Study 1) was explored to exclude emoji with similar or ambiguous/unclear meaning by preadolescents (Study 2-4). One-on-one interviews helped to explore the meaning of emoji more in-depth on a selection of 28 emoji (Study 5). Finally, a reduced list of 34 emoji (17 pairs) was obtained that constituted the emoji-based questionnaire.

[Please insert Figure 1 around here]

2.2. Participants

A total of 454 children (9-13-years-old) that attended primary and secondary school classes in schools based in the Florence area in Italy participated in the studies. An overview of the participating children for each study can be found in Table 1. Only children who returned a signed consent form from their parents and who agreed to voluntarily participate in the study by signing their own consent form could participate. For the quantitative Studies 1-4 we aimed to include around 80-100 children to reach an adequate level for analyzing the data based on indications for CATA and projective mapping tests (Valentin, Chollet, Lelièvre, & Abdi, 2012). For the qualitative, one-on-one interviews (Study 5) we aimed to include around 20-25 interviews as suggested by Spinelli & Monteleone(2018). Furthermore, for the interviews we decided to include only secondary school children (12-13-y.o.) due to their increased developmental ability to express emotions with words compared to younger children. There were no other exclusion criteria set. Recruitment criteria and data treatment were planned in accordance with the General Data Protection Regulation (GDPR) 2016/679 and the principles of the Declaration of Helsinki. The protocols of all studies were approved by the Ethical Committee of the University of Florence, Italy.

[Please insert Table 1 around here]

2.3. Procedures

Studies 1-4 took place in the regular classrooms of the schools. Data was collected in one school class at a time taking approximately one hour in the morning. Studies 1-4 were conducted on tablets (Acer Iconia One 10, Android 7.0) using the web-based software Compusense Cloud (Compusense, Inc., Guelph, Ontario, Canada). Examples of the experimental set-ups for each study can be found in Figure 2a-d. Children sat in their normal seating order, either in rows or in groups of 2-6 seats. They were asked to place their tablets flat on the table to prevent any peers from seeing and thereby copying any responses. Additionally, questionnaires were randomized for each child. In Study 5, children were interviewed on a one-on-one basis and therefore the set-up of the participating school class differed from the previous studies. Interviews took place in a room in the school separated from the regular classroom to ensure a quiet environment. The detailed procedures for each study are described in the following sections.

A school class was only allowed to participate in one of the studies. One instructor (researcher in sensory and consumer science) briefed the children about the questionnaire and procedure of the test before each testing session and made sure all children were confident in how to use the tablets, if necessary. Two to four assistants were available to ensure the protocol-based procedure and helped distribute the tablets and assisted in answering questions if they arose. The teacher was present during the session to ensure that children were less distracted and felt more at ease. The risk that the teacher impacted the results was eliminated as the teacher was

strongly advised not to help children with the questionnaire and was not involved in the activity of the study. At the end of each study (except Study 5), children were asked about some background information about emoji usage using the Emoji Usage Questionnaire (EUQ) (Sick, Spinelli, et al., 2020) including the domains “Familiarity”, “Frequency of usage”, “Social use”, “Motivation”, “Valence” of emoji and “Enjoyment” in using emoji.

2.3.1. Study 1: Selection of food-related emoji

For the development of a novel emoji tool to measure food elicited emotions in preadolescents, we conducted a prior study (Sick, Spinelli, et al., 2020) with the aim to explore the appropriateness of emoji to describe preadolescents’ emotions elicited by foods as recalled in relation to different evoked eating contexts. Children were asked which foods they had eaten in seven specific eating contexts (most liked food, most disliked food, breakfast, dinner, snack, Birthday, and novel food). Using the CATA method, they then selected from a list of 92 facial emoji the emoji that described how each of those foods made them feel. Forty-six emoji resulted as appropriate to describe emotions in different eating contexts. Results showed that children used mainly positive emoji except when expressing their “most disliked food”. Age and gender differences were also shown to influence emoji selection. Girls and 9-11-year-old children selected some emoji more frequently across eating contexts but also within contexts. Procedures and results of Study 1 are described in detail in Sick, Spinelli, et al. (2020) and will not be further described here.

2.3.2. Study 2: Projective mapping

The study aimed to explore the dimensional meaning of 46 emoji (resulting from Study 1) used to describe food experiences. Children were asked to map emoji according to similarities and differences in their emotional meaning using the projective mapping technique on a white rectangular mapping area (140 x 90 mm). Emoji were presented in a random order for each child, but children could freely choose in which sequence to place the emoji on the mapping area. Children were asked to place emoji with very similar emotional meaning close to each other and emoji with very different meaning far from each other. Children were explicitly instructed to think about using these emoji to describe food experiences and to pay attention to the emotional meaning of emoji and not to how they look graphically. Figure 2b) shows the set-up of the questionnaire. For details of the procedure see Sick, Monteleone, et al. (2020).

2.3.3. Study 3: Emoji described by emotion words (CATA)

The study aimed to explore the linguistic semantic emotional meaning of 46 emoji (resulting from Study 1) to describe preadolescents’ food experiences. The meaning of 46 emoji was explored by linking emoji with emotion words using a CATA format. Emoji and emotion word presentation order was randomized. Thirty emotion words were selected by reviewing literature on emotions elicited by foods (Jaeger, Lee, et al., 2019; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014), but also general literature on emotions (Yik, Russell, & Steiger, 2011) to include a wide range of emotion words differing in levels of valence and arousal (energetic, enthusiastic, amused, cheerful, happy, satisfied, cuddled, gratified, confident, at ease, reassured, relaxed, calm, serene, carefree, indifferent, quiet, bored, sad, melancholic, unhappy, dissatisfied, disappointed, guilty, annoyed, disgusted, angry, worried, surprised and curious).

Children were asked to choose all emotion words that describe the emotional meaning of emoji, but children had to select at least one emotion word per emoji (the closest one in terms of meaning). In case children were not satisfied with the list, they had the option to specify their own emotion words in an open-ended response format. Figure 2c) shows the set-up of the questionnaire. For details of the procedure see Sick, Monteleone, et al. (2020).










2.3.4. Study 4: Emotions described by emoji (CATA)

Similar to Study 3, the aim was to explore the semantic emotional meaning of the selected 46 emoji from Study 1. The study procedure was organized similarly to Study 3, but instead of describing emoji using emotion words, children were asked to describe emotion words using emoji. This inverted procedure was used to recheck the linkage between emoji and emotion words from Study 3. Children did not have the possibility to add other emoji than the ones already presented in the list. Emotion words (n=30) were presented one at a time in two blocks of emotion words (2x15), presented in a balanced order across children. A refreshment break was given between the two blocks, where children were asked to solve a fun riddle.

The following instructions appeared on the screen: *“We are interested in the meaning of several emoji used to describe food experiences. You will be asked to evaluate 30 emotion words in total but split into two sessions, so you will have a short break in between the two sessions. First, you will see on your screen an emotion word and a list of 46 emoji. You will be asked to select all the emoji that seem suitable for you to describe the given emotion word. You have to choose at least one emoji for each emotion word, which best represents its meaning. You can also choose several emoji if you think they suit. There are no right or wrong answers. If you have any questions during the test, raise your hand and we will come to you.”*. Figure 2d) shows the set-up of the questionnaire.

[Please insert Figure 2 around here]

2.3.5. Study 5: One-on-one interviews

The aim of the one-on-one interviews was to explore the semantic meaning of emoji more in-depth and to check if the used emotion words overlap with emotion words from Study 3 and 4. For the interviews, the emoji list of 46 food-related emoji was reduced to a shorter list of 28 emoji due to children’s limited attention span and to decrease the risk of boredom effects during the interviews. Emoji that were described by emotion words selected by $\geq 40\%$ of children qualified to be included in the interviews. Eight emoji (, , , , , ,  and ) were excluded directly and not used in the final questionnaire. Either they had a very ambiguous semantic meaning (based on Study 3 and 4) or if the meaning of emoji was quite similar with another emoji. We also included the emoji in the interviews that had a more complex meaning. The emoji *drooling face*  was selected by less than 40% but included as it could be a relevant emoji when describing food experiences based on previous studies (Jaeger, Lee, et al., 2018).

One-on-one interviews were conducted by asking children about the emotional meaning of 28 emoji using a modified version of the Repertory Grid Method (EmoSemio approach, Spinelli et al., 2014). The resulting list included 16 positive emoji, 11 negative emoji and 1 emoji (*face with open mouth* 😬) with both positive and negative meaning, which was the only emoji included in both emoji groups (positive and negative). Classification was based on results of the projective mapping data (Study 2, see also Sick, Monteleone, et al., 2020). Emoji were printed on 4x4 cm paper cards. The interviews were held by four Italian native speaking researchers working in sensory- and consumer research. Each child was interviewed about a group of positive emoji and a group of negative emoji on separate days to avoid mental overstrain. Half of the children started with the positive block and half with the negative one. The interviews took place in a quiet classroom at the school and a desk with two chairs set up: one for the child and one the interviewer (Figure 3). Each interview took approximately 15-20 minutes. The children's responses were noted on a response scheme and the interviews were audio recorded with a smartphone. The interviewers ensured the protocol-based procedure and assisted in case of questions. Depending on if children started with the positive or negative emoji group, they were asked to give examples of foods they liked or disliked, respectively, to trigger emotions elicited by food experiences. The interview structure for the positive emoji group with 17 emoji was as follows:

- 1) Children were asked to think about and provide examples of their favorite foods and other foods they like (even if they are not their favorites). The interviewer recorded the responses.
- 2) The children were then asked to select an emoji from the list in front of them to describe how these foods make them feel. They were asked to rank the emoji cards to describe their indicated foods from the most liked to less appreciated but still liked foods (Figure 4a). The interviewer noted the order of emoji for each child and divided the emoji into triads (Triads 1-5 + one remaining pair: emoji 1,2,3/ 4,5,6/ 7,8,9/ 10,11 /12,13,14/ 15,16,17) to facilitate a structured conversation about emoji with the children.

The interviewer focused on one triad at a time, starting from the cards 1,2,3 (Figure 4b); the emoji cards of the triads not used at that moment were moved to the side of the desk to help the child focus only on the triad object of the interview. The interviewer's instructions for one triad were: *"The emoji you put on the first position (1), what does it express differently compared to the other two (always thinking you're using them to describe your experience of food)?"* [Child's answer] *"The emoji you put on the third position (3)/in the middle (2), what does it express differently compared to the other two (always thinking you're using them to describe your experience of food)?"*. This was repeated for all the triads and the remaining emoji pair. The same procedure was repeated for the negative emoji group with 12 emoji (Triads 1-4), in this case asking for examples or disliked (including the most disliked) foods.

[Please insert Figure 3 around here]

[Please insert Figure 4 around here]

2.4. Data analysis

2.4.1. The Emoji Usage Questionnaire (EUQ)

Data of the EUQ from Studies 1-4 were merged and analyzed by calculating frequencies (%) of the total sample and separated by gender (boys vs. girls) and school level (elementary vs. secondary school). Gender and school level effects on Familiarity, Frequency of usage, Valence and Enjoyment were tested by using Kruskal-Wallis One-Way Analysis of Variance by ranks. Chi-squared test was applied to test differences in the distributions of the responses by gender and school level for each item of the other domains.

2.4.2. Study 3 and 4: Emoji described by emotion words and emotion words described by emoji (CATA)

Data were analyzed using Cochran's Q test with Sheskin as a post-hoc test to identify the semantic meaning of emoji/words described by emotion words/emoji. Frequency tables (emoji as columns x emotion word as rows or the opposite, depending on the study) were generated and correspondence analysis (CA) was applied. Emotion words selected by $\geq 40\%$ of children for each emoji were considered as important emotion words to describe a specific emoji. For the open-ended responses in Study 3, additional words were grouped based on their meaning and all emotion words $\geq 10\%$ were considered as a further emotional meaning for a specific emoji.

2.4.3. Consensus of Studies 2-4 and clustering of similar emoji groups

Hierarchical Multiple Factor Analysis (HMFA) was conducted on Study 2 (projective mapping), Study 3 (emoji described by emotion words) and Study 4 (emotion words described by emoji). A first MFA was conducted on Study 2 as standard procedure to analyze projective mapping data, while a second MFA was conducted to compare the results of the first MFA (study 2) with Study 3 and 4. Emoji ($n=46$) were in rows and each study was treated as a table in columns; frequency tables were used for the two CATA questionnaires, while the coordinates of each emoji for each child were used in Study 2. The resulting partial coordinates map was used to compare the consensus of dimensional and semantic emoji meanings between studies.

Next, emoji groups differing in their emotional meaning were identified. An Agglomerative Hierarchical Cluster analysis (AHC) on the emoji coordinates (dimensions 1-3) resulting from the HMFA was conducted by using the dissimilarity measure Euclidean distance and Ward's method. Three dimensions, that accounted for 54.03 % of the variance, were selected based on the scree plot inspection. First, automatic truncation resulting into two clusters followed by forced truncation into smaller clusters (up to 7) were used to identify emoji groups with more specific emotional meaning.

2.4.4. Study 5: One-on-one interviews

Interviews were analyzed through manual semiotic text analysis (Spinelli et al., 2017). Coding based on semantic meaning was applied by two researchers separately. A third researcher checked the analysis and the coding. Emotion phrases with a similar meaning were grouped into one group (e.g., "felice", "felicissimo", "molto felice" were grouped into "felice") and

translated into English by a researcher to the aim of this manuscript. The frequencies (%) of emotion constructs for each emoji were calculated. Emotion words (constructs) that were used by $\geq 10\%$ of the participants were considered to describe the emotional meaning of a specific emoji.

The level of significance for all the analyses was set at $p \leq 0.05$. Statistical analyses were performed using XLSTAT (version 2018.7, Addinsoft, New York, NY, USA), except for HMFA that was conducted using RStudio (version 1.1.456, 2018, RStudio, Inc., Boston, MA, USA) and the package FactoMineR (Lê, Josse, & Husson, 2008; R Core Team, 2016).

3. Results

The following sections report the results of the emoji usage questionnaire and describe step-by-step how emoji were reduced to the final emoji pair list to be used in the emoji-based self-report questionnaire.

3.1. The emoji usage questionnaire (EUQ)

Children ($n=435$) participating in Studies 1-4 were found to be regular users (71%) of emoji using them either “every day” (54%) or “a few times a week” (30%), (Supplementary Materials Table S1). Children declared to send emoji most frequently to friends (85%), parents (57%) and relatives (56%) and mainly use positive emoji (69%) in their communication. Children’s enjoyment in using emoji was either “a lot” (64%) or “fairly” (29%).

Gender differences were found in the Motivation domain, where boys responded more than girls that emoji “are fun” (62%, $p=0.036$, compared to 52%) and that they “save time when sending messages” (26%, $p=0.022$, compared to 17%). Girls (74%) were found to use more positive emoji compared to boys (64%) ($p=0.023$).

Differences between school levels were found across several domains. Older children attending secondary school level (10-13-y.o.) were more familiar with emoji and used them more frequently ($p < 0.0001$, respectively) compared to younger children attending elementary school (9-10-y.o.). In terms of Social use, older children send more emoji to friends ($p < 0.0001$), siblings ($p=0.004$) and parents ($p=0.003$) compared to younger children. Younger children were motivated to use emoji because “they are fun” which corresponds with the overall Enjoyment domain, where younger children (75%) responded that they enjoy emoji “a lot” more than older children (58%) ($p=0.001$). However, more older children (60%) think that emoji “make the text messages more understandable” compared to younger children (34%, $p < 0.0001$).

3.2. Consensus of Studies 2-4 and clustering of similar emoji groups

A HMFA on Studies 2-4 was conducted, which provides the consensus representation of the three studies. The superimposed representation of the partial clouds shows that the three tasks gave quite similar results in terms of emotional meaning of emoji. The studies show a better discrimination of negative emoji than positive emoji.

The high agreement between studies enabled the AHC analysis to be based on the shared emoji coordinates (dimensions 1-3) resulting from the HMFA. The AHC analysis helped to cluster into positive (n=25) and negative (n=21) emoji. For a more detailed interpretation of emoji, hierarchical cluster results with 4-7 clusters were evaluated, which enabled to build several emoji clusters differing in their emotional meaning beyond valence (Figure 5). A satisfying clustering of emoji differing in their emotional meaning was found at the truncation level of 7 clusters.

[Please insert Figure 5 around here]

Each of the 7 clusters included between 4-8 emoji. Cluster 1-4 can be described as positive and cluster 5-7 as negative (see Table 2). Cluster 1 consisted of four emoji with laughing/smiling emoji (e.g., 😄), Cluster 2 consisted of emoji showing their tongue (e.g., 😜) as well as excited and celebrating emoji (e.g., 🥳). In general, cluster 3 resulted in emoji with lower activation level (e.g., 😊 and 😎) compared to emoji of cluster 1 and 2. Cluster 4 consists of emoji with hearts (e.g., 🥰) and some “content” emoji with closed eyes (e.g., 😌). Cluster 5 consisted of a group of angry faces (e.g., 😡), Cluster 6 consisted of mainly sad emoji (e.g., 😞), while cluster 7 consisted of a more diverse group of negative emoji with neutral (e.g., 😐), nauseated (e.g., 🤢) and surprised (e.g., 😲) emotional expressions. Within-class variance is relatively low for some clusters (e.g., C1 and C2) while it is much larger for other clusters (e.g., C5-7). This indicates that while emoji in cluster 1 have a very similar meaning, emoji in cluster 7 are more heterogeneous (see 3.3). Between-classes variance is 4.048, indicating that despite the higher within class variance in some cases, the difference between the clusters is higher. The AHC helped to generally cluster emoji groups with similar emotional meaning based on Studies 2-4, but we also looked at each study separately to further explore the emotional meaning (in respect to their dimensional and semantic meaning) more in detail. This enabled further characterization of emoji across and within each cluster and will be described in the following sections.

[Please insert Table 2 around here]

3.3. Study 3 and 4: The semantic meaning of emoji using the CATA format

In Study 3 (emoji described by emotion words), emoji were described by 11.7 words on average, and more emotion words were selected for positive emoji than for negative emoji (14.3 and 8.7, respectively). In Study 4, emotion words were described by 3.1 emoji on average, with “indifferent” and “curious” described by the lowest number of emoji (1.4 and 1.5, respectively) and “happy” and “cheerful” described by the highest number of emoji (7.3 and 5.7, respectively). On average, the number of selected emoji was higher for positive emotion words than for negative emotion words (3.6 and 2.5, respectively).

Results of Study 3 and 4 were congruent in linking emoji and emotions words of several emoji. A summary of emoji described by emotion words (Study 3) and emotion words described by

emoji (Study 4) evaluated by $\geq 40\%$ of children can be found in Table 3. More detailed results of the contingency tables (%) (Supplementary Materials Table S2 and S3) and correspondence analysis of emoji described by emotion words (Study 3, Supplementary Materials Figure S1a) and emotion words described by emoji (Study 4, Supplementary Materials Figure S1b) can be found in the Supplementary Materials.

Nineteen emoji in Study 4 overlapped with the emotional meaning of Study 3, but emoji of Study 4 were linked with less emotion words in general. Aligning with results of Study 3, the interpretation of the meaning of negative emoji was clearer compared to the one of positive emoji as more differentiation was found. The emoji *hot face* 🥵, *exploding head* 🤯 and *drooling face* 🤤 were found to have a more ambiguous meaning in both studies.

The linkages between emoji and emotion words (emoji/emotion words selected by $\geq 40\%$ of children) for both studies are described for each emoji cluster in the following paragraph.

Emoji in cluster 1 (😊, 😊, 😄, 😁) were described as “happy”, “cheerful”, “serene”, “amused”, “enthusiastic”. Emoji in cluster 2 (😄, 😁, 😊, 😋, 😂, 😜, 😝, 😞) were described as “happy”, “amused”, “energetic”, “enthusiastic”, “serene” and differs from cluster 1 as emoji were generally described by the emotion words “energetic” and “enthusiastic” referring to a meaning of higher activation. In addition, the emoji 🥳 was described as “festive” (22%). Emoji in cluster 3 (😊, 😊, 😄, 😇, 😊, 😋, 😊, 😎) were described with emotion words of lower activation level compared to cluster 1 and 2. Emotional meanings of this group included “calm”, “quiet”, “happy”, “serene”, “cheerful”, “confident”, “satisfied” and “at ease”. Several emoji in this cluster were described with additional words: the *money-mouth face* 😊 was described as “rich” (26%), the *face savoring food* 😋 as “gluttonous” (14%) and “hungry” (10%), the emoji 😇 as “I am good/ I feel like an angel” (11%) and the *smiling face with sunglasses* 😎 as “feeling cool” (11%).

Emoji in cluster 4 (😍, 😘, 😘, 😊, 😊, 😊) were described as “happy”, “cuddled”, “serene”, “calm” and “quiet”, which are also emoji indicating emotions lower in activation and “cheerful” indicating an emotion higher in activation. One group consisted of emoji with hearts (😍, 😘 and 😘) described also as “in love” as mentioned in the additional comments (63%, 35% and 17%, respectively). One emoji was described differently in the two studies; in Study 3, *relieved face* 😌 was described as “serene” (52%) and “calm” (44%), while in Study 4 it was used to describe mostly the word “quiet” (40%). Furthermore, the study indicates that “calm” and “quiet”, which are both words indicating pleasant deactivation, could have indifferent meanings for preadolescents. Compared to all other positive emoji, this emoji was the only one not associated with “happy”. Cluster 5 (😞, 😠, 😡, 😡, 😡) was the emoji group with most distinct emotional meaning sharing the meaning “angry” of which some of them (😞, 😡, 😡) were also described as “annoyed”. Emoji in cluster 6 (😞, 😞, 😞, 😞, 😞, 😞, 😞) were described mostly as “unhappy” and “sad”, but further words included “disappointed”, “dissatisfied”, “worried”, “surprised”, “disgusted”, “annoyed”, “guilty” and “melancholic”.

The emoji expressing “sadness” with larger agreement were *crying face* 😭 and *loudly crying face* 😱 (75% and 87%, respectively).

Emoji in cluster 6 (😐, 😬, 🤢, 😞, 😫, 🤔, 😟, 🤯) were described as “indifferent”, “bored”, “disgusted”, “surprised”, “worried” and “curious”. The *neutral face* 😐 was described as “bored” (47%) in Study 4 but in Study 3 children this link was weak (13%). A distinct group included the *nauseated face* 🤢 and *face vomiting* 🤮 that were mainly described as “disgusted” (87% and 84%, respectively). In the additional comments the *nauseated face* 🤢 was described as “urge to vomit/nauseated” (12%) and *face vomiting* 🤮 as “feeling sick” (12%). The *face with cross-out eyes* 😵 was also described as “dead/deceased” (26%) and the *face screaming in fear* 😱 as “scared/frightened” (21%).

3.4. Study 5: The semantic meaning of emoji by using one-on-one interviews

A selection of emoji for each emoji cluster (2-6 emoji per cluster) was used for a more in depth-analysis in the one-on-one interviews. Prior to the interviews, eight emoji were excluded to limit the emoji list due to children’s limited attention span in the interviews. For negative emoji, we were less restrictive in the exclusion criteria as there were fewer negative emoji than positive. When there was a set of emoji that were very similar in their meaning (e.g., 😄 and 😁 both described as “happy”, “cheerful”, “amused”, “energetic”), we considered the emoji with the more complex meaning (😄). In other cases, we excluded the emoji that had the lower percentage of an emotion word that was specific for similar emoji (e.g., 😘 was excluded because it showed a lower percentage (17%) of “in love” compared to 😍 (63%) and 😘 (35%). Other emoji either showed a very ambiguous meaning or were not associated with any emotion word in Study 3 and 4 and were excluded directly (e.g., 🤔 and 😞).

Reported emotion word constructs for each emoji mentioned by $\geq 10\%$ of children were summarized in Table 3. The word “happy” was associated with all positive emoji except for the *face with open mouth* 😱. Some positive emoji were only described as “happy” (😊 and 😘), while some were described with additional emotion words that are described below.

In accordance with Study 3 and 4, emoji in cluster 1 (😄, 😁, 😂, 😃) were mainly described as very “happy”. One child described the emoji 😄 in response to a food as “*I liked the dish very much and [the emoji] is very happy and smiling, it communicates that it was very good*”. Children described the *grinning squinting face* 😄 very similar to the other emoji of cluster 1 (“happy”), e.g., “I am happy that today I eat this food.”, which suggests that this emoji is more similar to emoji of cluster 1 than cluster 2.

The emoji star-struck 🤩 was described as “content” and “wow (surprised)/impressed” (“*It is a food that when my dad prepares it for me, I have to eat it before the others. It’s fixed in my mind, that it is a food that makes me happy*”). The *partying face* 🥳 was described as “happy” in a festive context (e.g., “*A dish that when you party, you can’t wait to eat it.*”, “[it makes me think to] *a party, such as when I eat the New Year’s aperitivo.*” or “*I am very, very happy when I eat good things for Birthday*”), which corresponds to “festive” mentioned in the additional comments of Study 3.

Emoji that have been previously defined as cluster 3 (😊, 😊, 😇, 😌, 😎) were generally described as indicating emotions characterized by lower activation level in line with the results of Study 3 and 4. For example, the *slightly smiling face* 😊 was described as “less happy” compared to most other positive emoji (e.g., “*When they call me for dinner and there are meatballs: I do not want to go to eat even if I am hungry (I am forced to go). It makes me feel happy, but less happy, because I will have meatballs for dinner*”), but also lower in arousal “*I am happy, but calm, not excited at the sight of food.*”). The *smiling face with halo* 😇 was defined as “happy” but also as “feeling like an angel”, which was mentioned in the additional comments of Study 3. One child mentioned using the emoji in the context of eating a rarely eaten but good food, which differs from other foods: “*Good but not like the others: I like the dish, I eat it but not many times*”.

The *smiling face with hearts* 🥰 was described as indicating “happy”, but also as expressing a feeling of being “in love” (e.g., “*You are in love with food*”), which corresponds with the additional comments of Study 3.

The *face with open mouth* 😮 was described as indicating both positive (e.g., “*I am surprised because it is something that is not usually eaten: something new in a positive sense.*”) and negative surprise in both interviews (positive and negative emoji group), however with a more negative tendency (e.g., “*Surprised by what I have to eat, in a negative sense.*”). The emoji 🤯 was described as “surprised”, but in contrast to the *face with open mouth* 😮 it was associated exclusively with negative surprise and was associated with other negative emotions like “it makes me feel bad”, “afraid” and “worried”. A child described the emoji as “*I'm surprised to find it [the food] on my plate: they know I don't like it. The surprise is negative*”.

The *neutral face* 😐 was described as “indifferent” (e.g., it is used for foods that are tasting neither good nor bad) “*half and a half: I feel that it is not good, but it is not so bad either. It makes me feel good because there is worse than this*”).

A group of emoji (e.g., 😞, 😓 and 😡) - all present in cluster 6 - were described as mainly “sad” emoji, which corresponds with the semantic studies. It appeared that the emoji 😞 was described as “less sad” (“*sad, a little less, sorry*”) compared to 😓, which a child described as “very sad”. In addition to “sad”, the emoji 😓 was described by words such as “confined/I find it unfair” and “I want to complain”.

The interpretation was less clear for the emoji 😬 described by a wider range of words e.g., “uncomfortable”, “annoyed”, “sad”, “anxious”, “I don't want it”, “worried”, “amazed/perplexed” and “disgusted”, whereas in Study 3 and 4 it was only described as “worried” (53% and 41%, respectively).

The clearest meaning was shown for the emoji *enraged face* 😡 and *face with steam from nose* 🤬, which were both described as mainly “angry” and 🤬 as a bit less angry than 😡 corresponding with Study 3 and 4 e.g., “*Similar to the emoji 😡 but less angry, [feeling] anger towards whoever cooked the dish.*”

[Please insert Table 3 around here]

3.5. The development of the final emoji-based self-report questionnaire

Emoji expressing similar linguistic semantic and dimensional (based on Studies 2-5) were grouped in pairs of two. This was done to facilitate the interpretation by the respondents following previous work in the emotion field (Porcherot et al., 2010). After the interviews (Study 5), further 4 emoji (😊, 😟, 😊, 😊) were excluded either because they showed very similar emotional meaning to other emoji pairs (😊, 😟), or the meaning was still unclear (😊, 😊). The final emoji list resulted in 17 emoji pairs (n = 34 emoji) that were associated with specific emotion words (see Table 4). For simplification and readability, the set of emotion words for each emoji pair were reduced to two representative words (see Table 4), which will be used in the results and discussion.

Each emoji pair resulted in different levels of valence (pleasure vs. displeasure), arousal (activation vs. deactivation) (see Figure 5a) and power (dominance/control/strength vs. submissiveness/lack of control/weakness) (see Figure 5b). For example, the emoji pairs 😍😘 and 😄😂, associated respectively with “cuddled – in love” and “enthusiastic – festive” are positive and high in arousal in contrast to 😌😊 and 😊😊 (associated respectively with “calm – quiet” and “serene – calm”) that are positive and low in arousal. Among the negative emoji pairs, 😱😨 (“worried – scared”) and 😡😈 (“angry – disgusted”) are high in arousal, whereas 😞😞 (“sad – unhappy”) and 😞😞 (“dissatisfied – guilty”) are low in arousal. When considering the power dimension, the positive emoji pairs 😊😎 (“confident – at ease”) and 😄😜 (“energetic – crazy”) are high in power opposing 😍😘 (“cuddled – in love”) and 😌😊 (“calm – quiet”) that are low in power. The negative emoji pairs 😡😈 (“angry – disgusted”) and 😡😡 (“angry – annoyed”) are high in power, while 😱😨 (“surprised, worried, scared/frightened, makes me feel bad, afraid”) and 😞😞 (“sad – unhappy”) low in power. The AHC helped to pre-classify emoji with the most similar semantic and dimensional meaning. However, there were four emoji pairs (😊😊, 😊😊, 😊😊 and 😱😨) that were grouped even though they did not appear in the same cluster because the additional comments of Study 3 and the interviews clarified that in fact, they share aspects of their meaning. Additionally, the Euclidean distances resulting from the AHC of the grouped emoji pairs 😊😊, 😊😊 and 😱😨 were rather small (0.70, 1.08, and 0.60, respectively), apart from the emoji pair 😊😊 (Euclidean distance 2.8), which were grouped because they were both very low in arousal and positive and negative in valence. Furthermore, each emoji pair shares at least part of their semantic meaning (see Table 4), based on the studies that explored the link between words and emoji (Study 3-5). It was possible to establish a distinct emotional meaning for each emoji pair, even though some emotion words overlap with emotion words from other emoji pairs.

[Please insert Table 4 around here]

[Please insert Figure 5 around here]

The circumplex was used here to facilitate the interpretation of the selected emoji, but the emoji pairs can be presented using different response formats and layout in a randomized order as it has been shown that circumplex and list formats (using CATA) obtained similar results using emotion words (Jaeger, Roigard, & Chheang, 2021).

Emoji pairs can be presented as a simple CATA Emoji Pair Questionnaire (Figure 6a) or by using the emoji pairs in combination with a rating scale (Figure 6b). One of the advantages of using a rating scale is that the discriminant ability of emoji groups could be increased for food products with very similar sensory properties/acceptability.

The “CATA Emoji Pair Questionnaire” works like the CATA questionnaires with emoji that have been already used by preadolescents to measure emotions elicited by foods (e.g., Gallo, Delores, Swaney-Stueve, Chambers, & Delores (2017) and Schouteten et al. (2019, 2018)) however, instead of selecting single emoji, children are asked to select a group of emoji. Children are asked to check-all-emoji-that-apply to describe how they feel in response to a food item. “*How does the food make you feel? Choose as many emoji pairs as possible. If only one emoji from the group fits, select the group anyway.*” Children are asked to select at least one of the emoji pairs.

In the “Emoji Pair Rating Scale”, each emoji pair is rated on a 5-point categorical rating scale (King & Meiselman, 2010) ranging from 1= *Does not fit at all* to 5= *Fits very well*. The idea is to ask children to taste one sample at a time and answer the Emoji Pair Rating Scale for each sample tasted: “*How does this food make you feel? Look at the emoji pairs. For each group, indicate how much the emoji (one of the two or both) match the feeling you get from tasting the food sample.*”

[Please insert Figure 6 around here]

4. Discussion

We developed an emoji-based self-report questionnaire for preadolescents consisting of a food-specific emoji list with identified emotional meaning. Five studies were conducted, which include the selection of emoji evaluated as appropriate by preadolescents to describe food experiences (Study 1) and the exploration of the dimensional and semantic meaning of emoji resulting from Study 1 by using four different methods (Studies 2-5). These studies (projective mapping, CATA with emoji, CATA with words, and interviews) were analyzed together to determine which emoji may be used to best express emotions in preadolescents. The reported studies contributed to a new understanding of the meaning of food-related emoji in preadolescents and reduced the list of the final selection of emoji used for the self-report

questionnaire. The questionnaire can now be used as a quantitative tool to study preadolescents' emotions elicited by foods.

4.1. Original aspects of the emoji-based self-report questionnaire

Emoji expressing similar semantic and dimensional meanings (based on valence, power, and arousal dimensions of selected emotion words and the projective mapping task) were grouped in pairs of two, which has not been done previously. We argue that the grouping of the two emoji with the most similar meaning allows us to best identify the overall meaning of the emoji pair. A similar approach was conducted by Chrea et al. (2009) in the Geneva Emotion and Odor Scale (GEOS), where emotion terms were merged into groups and reduced to a set of representative emotion terms to describe the subjective emotions induced by odors. Their motivation was to reduce the set of terms to a smaller set of summary scales and to gain insight into the structure of emotions elicited by odors derived from affective and qualitative assessments. Jaeger, Roigard, Jin, Xia, et al. (2019) applied a similar method by assembling a questionnaire with 12 axes spanning the dimensions of pleasure and arousal, and their combinations. Each of the axes is presented by a pair of emotion words (e.g., happy/satisfied, energetic/excited, unhappy/dissatisfied). Including synonymous words that could be advantageous in key product characteristics, which may not have been selected by some consumers or because they previously could not make sense of/relate to them. Similarly, in our approach, retaining emoji with wide overlapping meaning, has the advantage of including two occurrences of emoji that may be used alternatively for different children to express a similar emotional meaning. Furthermore, two emoji may have a similar meaning but be perceived as suitable in different contexts (e.g., *star-struck* 🤩 and *partying face* 🥳) (Sick, Spinelli, et al., 2020). For example, in the interviews children mentioned that *star-struck* 🤩 is appropriate to use in a context of positive surprise and impressing context when someone prepares a food that he/she really likes but is unexpected, while *partying face* 🥳 is more appropriate to describe foods in festive contexts like parties, Birthday, New Year's Eve. In this way we offer a novel approach to measure children's food-elicited emotions with emoji.

The developed emoji list is a general list that can be applied to a wide range of food products compared to a product-specific list. General emotion lists usually contain more items than product-specific lists, which could lead to increased fatigue and boredom among children. However, the final emoji list was condensed to 17 emoji pairs being an adequate number of items as also highlighted by Schouteten et al. (2019), where 7-12-year-old children mentioned that an emoji list should not include more than 25 items.

The advantage of the emoji list is that its preselection not only considers emoji varying in valence (positive, neutral, and negative) (Gallo et al., 2017b; Lima et al., 2019; Schouteten et al., 2019; Swaney-Stueve et al., 2018), but also offers emoji differing in degrees of arousal and power. The emoji list developed by Gallo, Swaney-Stueve, Chambers, et al. (2017) contains a variety of 28 facial emoji including mostly emoji of lower activation level (except for the *grinning face* 😄 and *smiling face with heart-shaped eyes* 😍). Based on our research we were able to expand the emoji list to emoji with higher activation levels and emoji varying in power. In contrast, Schouteten et al. (2018) used a list with 33 emoji with preadolescents originally derived from Jaeger, Vidal, et al. (2017) that included around 10 emoji (out of 15 positive

emoji) of higher activation level. As the range of emoji of low and high activation level can vary between other emoji lists to a considerable extent, we aimed for a more balanced distribution of emoji of low/ high level of activation and power. This has never been considered before when developing food-specific emoji lists for preadolescents but could be a benefit by facilitating the interpretation of the results.

The standardized emoji list developed by Gallo, Swaney-Stueve, Chambers, et al. (2017), which was also used by Schouteten et al. (2019), includes 18 overlapping emoji (😄, 😊, 😞, 🤔, 😡, 😏, 😭, 😠, 😘, 😬, 😇, 😊, 😊, 😊, 😊, 😊, 😊) that were also included in our emoji list. One notable difference is that the newly developed Emoji Pair Questionnaire consists of 16 further emoji relevant for preadolescents to describe food experiences with established emotional meaning (😍, 😄, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁, 😁) and 😞 (Sick, Monteleone, et al., 2020; Sick, Spinelli, et al., 2020). Our research showed that the emoji list developed by Gallo, Swaney-Stueve, Chambers, et al. (2017) contains emoji with similar emotional meaning that were paired in our questionnaire (e.g., 😞 with 😞, 🤔 with 😞 and 😊 with 😏), reducing the number of options (in a CATA format) to avoid mental overstrain in children. Some emotions relevant to describe food experiences were not included in prior emoji lists for preadolescents. “Disgust” (represented here by *nauseated face* 🤢 and *face vomiting* 🤮) is an important emotion in food choice (Fallon & Rozin, 1983) as it is one of the emotions involved in preadolescents’ food rejection (De Moura, 2007; Sick, Højer, & Olsen, 2019). Other emoji unique to the Emoji Pair Questionnaire are *star-struck* 🤩 and *partying face* 🥳 that are very positive, highly activated emotions that can be used e.g., in a festive eating context. Furthermore, we included rather newly developed emoji (e.g., *star-struck* 🤩) that were not yet present in former emoji lists (like Gallo, Delores, Swaney-Stueve, et al., 2017; Schouteten et al., 2019) for preadolescents. Some of these emoji look very similar to emoji used in the list by Gallo, Swaney-Stueve, Chambers, et al. (2017) e.g., 😊 vs. 😊/😊, 😞 vs. 😞, 😞 vs. 😞. Differences in emoji expressions are due to updated Unicode versions (here Apple iOS 12.2 vs. earlier Apple iOS versions) but deviations in emotional meanings seem to be rather small in this case. Future research may be needed to determine if different iOS versions may affect preadolescents’ interpretation of food-related emoji.

Lastly, the Emoji Pair Questionnaire has the advantage that it was specifically developed with and for preadolescents ranging between 9-13 years, which included the selection of relevant emoji relevant to describe food experiences and the identification of their meaning to develop the questionnaire. This has been the first study that based the development of an age-appropriate emoji list on the semantic and dimensional meaning of emoji by a specific age group (9-13-year-old).

We suggest that when measuring preadolescents’ food-elicited emotions, the emoji pairs can be applied either using a CATA format or using a rating scale, particularly when sensory variations among products are reduced. The circular valence × arousal circumplex-inspired emotion questionnaire layout was found to be of no particular benefit (nor hindrance) in adults using words (Jaeger, Roigard, & Chheang, 2021) and for this reason this format is not the first choice.

The main characteristics of the Emoji Pair Questionnaire compared to previously developed questionnaires/lists/scale are summarized in Table 5.

[Please insert Table 5 around here]

4.2. The semantic structure of emoji according to preadolescents

Prior studies aiming at developing a food-specific emoji list asked children which emoji they found appropriate for describing how they felt in response to different food products (Gallo et al., 2017a; Schouteten et al., 2019). The approach to identify the semantic structure of emoji in detail to describe food experiences has not been applied before with preadolescents. The present study extends previous research by asking children not only which emoji they found appropriate to describe how a food product makes them feel (Study 1, see Sick, Spinelli, et al. (2020), but also how they interpret emoji when describing their experiences (Studies 3-5). Several emotional meanings of emoji aligned with research findings based on adults (Jaeger, Roigard, Jin, Vidal, & Ares, 2019) but some minor differences were shown as well. For example, in their research, *grinning face* 😄 was associated mainly with “happy” (99%) and “excited” (11%), while in our study it was associated with “happy” (66%), “serene” (54%), “cheerful” (50%) and “amused” (41%). The *smiling face with sunglasses* 😎 was associated mainly with “be/act cool” (63%), “happy” (23%), “relaxed/calm” (21%), while in our study it was also associated with “confident” (50%), “satisfied” (44%), “at ease” (44%) and “feeling cool” (11%). The *winking face* 😉 was linked with “wink” (30%) and “flirty/sexy” (20%), which may not be appropriate in the case of preadolescents (in our study interpreted as “happy” (49%), “cheerful” (40%) and “confident” (40%)). The *angry face* 😡 was also interpreted as “crazy/mad” (30%), which was only interpreted as “angry” (91%) and annoyed (53%) in our findings. These differences support the importance of developing age-specific emoji lists for preadolescents to avoid ambiguity in the interpretation and following use of emoji in such self-report questionnaires.

Results showed that emoji ranged from having distinct meanings, a small set of related meanings to heterogeneous meanings, which conforms with previous research findings (Bai et al., 2019; Jaeger, Roigard, et al., 2019). In general, negative emoji were shown to have more distinct meanings compared to positive emoji, which is in line with previous research (Jaeger & Ares, 2017). For some emoji, a very high agreement among children in linking emoji and emotions words was found, which was especially true for angry emoji (e.g., *enraged face* 😡, 79-95% in Studies 3-5), disgusted emoji (e.g., *nauseated face* 🤢, 79% in Studies 3 and 87% in Study 4) and sad emoji (e.g., *loudly crying face* 😭, 53-86% in Studies 3-5). Emotions such as anger and sadness are frequent emotions in everyday life and this contributes to explaining this result (Scherer, Wrانik, Sangsue, Tran, & Scherer, 2004). A further explanation could be that anger (Butler, Meloy-Miller, Seedall, & Dicus, 2018) and especially disgust (Rozin & Fallon, 1987) (both high in arousal) serve as “protective” emotions against incidences that could be potentially dangerous (e.g., consumption of poisonous food, threat etc.). Hence, these

instances of emotions could be learnt from an early age and be more memorable when needed. Most positive emoji were described by the word “happy”. Jaeger, Roigard, et al. (2019) reported that “happy” also occurred in several positive emoji of which some overlap with our findings. “Happy” may be a very familiar word for children to describe general positive feelings (positive valence), which is learnt from early age and may be predominant for individuals that have a lower emotional granularity (defined as the inability to make finer distinctions between emotions, Barrett, 2016). This may be especially true for children as their language/vocabulary is not yet as developed as the ones of adults. Positive emoji were also described by more words in general, which could be explained either by some ambiguity in the meaning of some emoji or that the use of positive emoji is more context dependent (Wijeratne, Balasuriya, Sheth, & Doran, 2016). We may also hypothesize that emoji expressing a basic emotion (e.g., disgusted, sad, angry, happy; Ekman, 1992) are more easily associated with a facial expression, represented in a stereotypical and exaggerated way in emoji. This may explain why these words are more easily associated with some emoji. On the other hand, we observed a pervasiveness of the word “happy” (or “content”, a synonym in Italian), that was associated with almost all the emoji expressing a positive meaning. This may suggest that there is a variation in positive emotions that is not fully expressed by specific words or faces (Barrett, 2006).

Some emoji were excluded from the final emoji list due to the lack of agreement on the meaning among children. This is an important aspect as it enables the Emoji Pair Questionnaire to gain in effectiveness and rigor.

Gallo, Swaney-Stueve, & Chambers (2017) suggested some emotion words as relevant and appropriate for 8-11-year-old children to describe their emotions in response to food. The words “cheerful”, “disgusted” and “cool” were also found to be relevant in our study, however, this was not the case for “amazed”, “confused”, “excited”, “nervous”, “powerful”, “safe”, “thankful”, “tired”, “upset”, and “weird”. It should also be considered that the two studies were conducted in different languages (American English, in Gallo, Swaney-Stueve, & Chambers, (2017) and Italian, in our case) and this may contribute to explain these differences.

4.3. Emoji and words: not always a straightforward link

Moreover, we observed a large variability in children’s selection of words/emoji based on individual differences in ticking styles when selecting emoji using the CATA format and a variability in the strength of association when emoji are described by words or vice versa. In a recent study it was shown that children differ in ticking styles when using the CATA task (Galler, Næs, Almli, & Varela, 2020). Some children could be more likely to tick only a few attributes per sample, increasing their number of ticked attributes per sample over the test, while some children tick a steadier number of attributes in general. We might hypothesize that the number of selected attributes could be influenced by the emotional granularity of the person describing the emotion. For example, people lower in emotional granularity often use more global terms when expressing emotions and use some terms (e.g., “sad” and “angry”) interchangeably to describe a general unpleasant feeling (Barrett, 2006). Children who added extra words to describe emoji (Study 3) could be higher in emotional granularity as they make finer distinctions between the meaning of emotion words.

The task to link emotion words with emoji and vice versa resulted in overlapping emotional meanings. However, when children described emotion words with emoji (Study 4), in some cases children had difficulties to describe words with emoji. We suspect that for children it is easier to describe emoji with emotion words than vice versa. In Study 4, there were emotion words that never reached the selection threshold of $\geq 40\%$. Using emoji in text communication is a learned/ acquired language, which requires the understanding of the appropriate usage of such icons. In contrast, the mother tongue acts as the meta language and therefore it is easier to describe another acquired language (in this case, emoji) with the metalanguage (emotion words).

4.4. Practical implications of the emoji-based self-report questionnaire

The use of the emoji-based self-report questionnaire offers a wide application especially in product development and/or sensory testing in research aimed at preadolescent children. Measuring emotions in response to food products can give additional insights that go beyond hedonic measurement thereby improving common procedures of sensory- and consumer research (Meiselman, 2016; Spinelli & Monteleone, 2018). The tool can be used to develop healthier and tastier food products for children, which is urgently needed given the steep rise of childhood obesity and related diseases (Wang & Lobstein, 2006; WHO, 2020). The Emoji Pair Questionnaire is a general list that can help to understand children's affective responses to foods. It can be applied to a wide range of food products across food categories but also within food categories. The use of different response formats (e.g., CATA and rating scale) allows flexibility to the food products investigated and can be adapted in terms of difficulty level depending on the children's cognitive development.

Children were not only found to be very familiar with emoji, but they also stated as the main motivations for the application that emoji are fun to use and that they express something they normally cannot be described in words. Following, using emoji could be more intuitive for children leading to improved understanding of their food preferences and enhance their engagement in sensory- and consumer tests.

It is important to mention that when applying the emoji-based self-report questionnaires with children, rigorous and appropriate instructions to children on how to fill in the questionnaire are required to avoid any misunderstandings (e.g., how to deal with the interpretation of an emoji pair when they express different meanings for a child).

As for all the self-report measures, this questionnaire relies on the ability of the individuals to report their subjective experience. For this reason, it is possible that the questionnaire will be easier to use for older preadolescents; however, the questionnaire was developed based on studies conducted with children aged 9-13 so the risk is mitigated.

Finally, for the application of the developed Emoji Pair Questionnaire in other cultures/countries, cross-cultural shared meanings of emoji are a crucial prerequisite. In fact, there is fair evidence that humans can attribute emotions to facial and body expressions and that these have stability across cultures to some degree (Ekman, 1992b; Elfенbein & Ambady, 2002). However, potential issues to apply the questionnaire in other cultures/countries could be that emoji may be interpreted differently due to differences e.g., in emoji usage, familiarity and context of use. Some research demonstrated that emoji meanings can differ across countries in adults (Barbieri, Kruszewski, Ronzano, & Saggion, 2016; Lu et al., 2016), but little

is known about preadolescents. Following, it is necessary to explore the meaning of emoji and, if necessary, adjust the Emoji Pair Questionnaire to other cultures/countries in preadolescents.

4.5. Conclusions and future research

The findings resulted in 17 emoji pairs associated with specific semantic and dimensional (valence, power, and arousal) meanings. Based on this, we developed an emoji-based self-report measurement tool to measure emotions in response to food products with two suggested response formats, the CATA Emoji Pair Questionnaire and the Emoji Pair Rating Scale. Future research will test the discriminant ability of this questionnaire in these two formats over a wide range of food products. The questionnaire will allow better understanding of affective responses to food and could be used in food innovation targeted to preadolescents to promote healthier food behaviors. Furthermore, further studies should test the persistence of the same semantic structure here described across different languages and cultures.

CRedit author statement

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Declarations of conflicts

The authors declare that there is no conflict of interest regarding publication of this paper.

References

- Ares, G., & Jaeger, S. R. (2017). A comparison of five methodological variants of emoji questionnaires for measuring product elicited emotional associations: An application with seafood among Chinese consumers. *Food Research International*, *99*, 216–228. <https://doi.org/10.1016/j.foodres.2017.04.028>
- Bai, Q., Dan, Q., Mu, Z., & Yang, M. (2019). A Systematic Review of Emoji: Current Research and Future Perspectives. *Frontiers in Psychology*, *10*(2221). <https://doi.org/10.3389/fpsyg.2019.02221>
- Barbieri, F., Kruszewski, G., Ronzano, F., & Saggion, H. (2016). How Cosmopolitan Are Emojis?: Exploring Emojis Usage and Meaning over Different Languages with Distributional Semantics. In *Proceedings of the 24th ACM international conference on Multimedia* (pp. 531–535). New York, NY, USA: ACM. <https://doi.org/10.1145/2964284.2967278>
- Barrett, L. F. (2006). Valence is a basic building block of emotional life. *Journal of Research in Personality*, *40*(1), 35–55. <https://doi.org/10.1016/j.jrp.2005.08.006>
- Barrett, L. F. (2016). Navigating the Science of Emotion. In H. L. Meiselman (Ed.), *Emotion Measurement* (pp. 31–63). Elsevier. <https://doi.org/10.1016/B978-0-08-100508-8.00002-3>
- Brants, W., Sharif, B., & Serebrenik, A. (2019). Assessing the Meaning of Emojis for Emotional Awareness - A Pilot Study. In *Companion Proceedings of The 2019 World Wide Web Conference* (pp. 419–423). New York, NY, USA: ACM. <https://doi.org/10.1145/3308560.3316550>
- Butler, M. H., Meloy-Miller, K. C., Seedall, R. B., & Dicus, J. L. (2018). Anger Can Help: A Transactional Model and Three Pathways of the Experience and Expression of Anger. *Family Process*, *57*(3), 817–835. <https://doi.org/10.1111/famp.12311>
- Carr, J., Decreton, L., Qin, W., Rojas, B., Rossochacki, T., & Yang, Y. wen. (2015). Social media in product development. *Food Quality and Preference*, *40*(PB), 354–364. <https://doi.org/10.1016/j.foodqual.2014.04.001>
- Chrea, C., Grandjean, D., Delplanque, S., Cayeux, I., Le Calvé, 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/10.1093/chemse/bjn052>
- Da Cruz, M. F., Rocha, R. S., Silva, R., Freitas, M. Q., Pimentel, T. C., Esmerino, E. A., ... Maia, L. C. (2021). Probiotic fermented milks: Children's emotional responses using a product-specific emoji list. *Food Research International*, *143*, 110269. <https://doi.org/10.1016/j.foodres.2021.110269>
- De Moura, S. L. (2007). Determinants of food rejection amongst school children. *Appetite*, *49*(3), 716–719. <https://doi.org/10.1016/j.appet.2007.08.006>
- Desmet, P. M. A., Hekkert, P., & Jacobs, J. J. (2000). When a car makes you smile: Development and application of an instrument to measure product emotions. *Advances in Consumer Research*, *27*(2000), 111–117. Retrieved from <http://static.studiolab.io.tudelft.nl/gems/desmet/papersmile.pdf>
- Deubler, G., Swaney-Stueve, M., Jepsen, T., & Su-Fern, B. P. (2020). The K-State emoji scale. *Journal of Sensory Studies*, *35*(1), 1–9. <https://doi.org/10.1111/joss.12545>
- Deubler, G., & Swaney-Stueve, M. (2020). The K-State emoji scale, a cross-cultural validation with adults. *Journal of Sensory Studies*, *35*(4), e12573. <https://doi.org/10.1111/joss.12573>
- Ekman, P. (1992a). An argument for basic emotions. *Cognition and Emotion*, *6*(3–4), 169–200. <https://doi.org/10.1080/02699939208411068>
- Ekman, P. (1992b). Facial Expressions of Emotion: New Findings, New Questions.

- Psychological Science*, 3(1), 34–38. <https://doi.org/10.1111/j.1467-9280.1992.tb00253.x>
- Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: a meta-analysis. *Psychological Bulletin*, 128(2), 203–235. <https://doi.org/10.1037/0033-2909.128.2.203>
- Emojipedia. (2019). Apple Emoji List. Retrieved April 4, 2019, from <https://emojipedia.org/apple/>
- European Commission - EU Science Hub. (2020). Food and non-alcoholic beverage marketing to children and adolescents. Retrieved June 16, 2020, from <https://ec.europa.eu/jrc/en/health-knowledge-gateway/promotion-prevention/other-policies/marketing>
- Fallon, A. E., & Rozin, P. (1983). The Psychological Bases Of Food Rejections By Humans. *Ecology of Food and Nutrition*, 13(1), 15–26. <https://doi.org/10.1080/03670244.1983.9990728>
- Galler, M., Næs, T., L. Almli, V., & Varela, P. (2020). How children approach a CATA test influences the outcome. Insights on ticking styles from two case studies with 6–9-year old children. *Food Quality and Preference*, 86, 104009. <https://doi.org/10.1016/j.foodqual.2020.104009>
- Gallo, K. E., Swaney-Stueve, M., & Chambers, D. H. (2017a). A focus group approach to understanding food-related emotions with children using words and emojis. *Journal of Sensory Studies*, 32(3), 1–10. <https://doi.org/10.1111/joss.12264>
- Gallo, K. E., Swaney-Stueve, M., & Chambers, D. H. (2017b). Comparing visual food images versus actual food when measuring emotional response of children. *Journal of Sensory Studies*, 32(3), e12267. <https://doi.org/10.1111/joss.12267>
- Guinard, J. X. (2001). Sensory and consumer testing with children. *Trends in Food Science and Technology*, 11(8), 273–283. [https://doi.org/10.1016/S0924-2244\(01\)00015-2](https://doi.org/10.1016/S0924-2244(01)00015-2)
- 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(P2), 216–223. <https://doi.org/10.1016/j.foodres.2014.12.022>
- Herring, S. C., & Dainas, A. R. (2020). Gender and Age Influences on Interpretation of Emoji Functions. *ACM Transactions on Social Computing*, 3(2), 1–26. <https://doi.org/10.1145/3375629>
- Jaeger, S. R., & Ares, G. G. (2017). Dominant meanings of facial emoji: Insights from Chinese consumers and comparison with meanings from internet resources. *Food Quality and Preference*, 62(March), 275–283. <https://doi.org/10.1016/j.foodqual.2017.04.009>
- Jaeger, S. R., Lee, P. Y., Xia, Y. X., Chheang, S. L., Roigard, C. M., & Ares, G. (2019). Using the emotion circumplex to uncover sensory drivers of emotional associations to products: six case studies. *Food Quality and Preference*, 77, 89–101. <https://doi.org/10.1016/j.foodqual.2019.04.009>
- Jaeger, S. R., Lee, S. M., Kim, K. O., Chheang, S. L., Roigard, C. M., & Ares, G. (2018). CATA and RATA questions for product-focused emotion research: Five case studies using emoji questionnaires. *Food Quality and Preference*, 68(January), 342–348. <https://doi.org/10.1016/j.foodqual.2018.04.001>
- Jaeger, S. R., Roigard, C. M., & Ares, G. (2018). Measuring consumers' product associations with emoji and emotion word questionnaires: case studies with tasted foods and written stimuli. *Food Research International*, 111, 732–747. <https://doi.org/10.1016/J.FOODRES.2018.04.010>
- Jaeger, S. R., Roigard, C. M., & Chheang, S. L. (2021). The valence × arousal circumplex-inspired emotion questionnaire (CEQ): Effect of response format and question layout. *Food Quality and Preference*, 90, 104172.

- <https://doi.org/10.1016/j.foodqual.2020.104172>
- Jaeger, S. R., Roigard, C. M., Jin, D., Vidal, L., & Ares, G. (2019). Valence, arousal and sentiment meanings of 33 facial emoji: Insights for the use of emoji in consumer research. *Food Research International*, *119*, 895–907.
<https://doi.org/10.1016/j.foodres.2018.10.074>
- Jaeger, S. R., Roigard, C. M., Jin, D., Xia, Y. X., Zhong, F., & Hedderley, D. I. (2020). A single-response emotion word questionnaire for measuring product-related emotional associations inspired by a circumplex model of core affect: Method characterisation with an applied focus. *Food Quality and Preference*, *83*, 103805.
<https://doi.org/10.1016/j.foodqual.2019.103805>
- Jaeger, S. R., Vidal, L., & Ares, G. (2021). Should emoji replace emotion words in questionnaire-based food-related consumer research? *Food Quality and Preference*, *92*, 104121. <https://doi.org/10.1016/J.FOODQUAL.2020.104121>
- Jaeger, S. R., Vidal, L., Kam, K., & Ares, G. (2017). Can emoji be used as a direct method to measure emotional associations to food names? Preliminary investigations with consumers in USA and China. *Food Quality and Preference*, *56*, 38–48.
<https://doi.org/10.1016/j.foodqual.2016.09.005>
- 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/10.1016/j.foodqual.2009.02.005>
- Laureati, M., Pagliarini, E., Gallina Toschi, T., Monteleone, E., Toschi, T. G., Monteleone, E., ... Monteleone, E. (2015). Research challenges and methods to study food preferences in school-aged children: A review of the last 15 years. *Food Quality and Preference*, *46*, 92–102. <https://doi.org/10.1016/j.foodqual.2015.07.010>
- Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: An R package for multivariate analysis. *Journal of Statistical Software*, *25*(1), 1–18. <https://doi.org/10.18637/jss.v025.i01>
- Lima, M., de Alcantara, M., Martins, I. B. A., Ares, G., & Deliza, R. (2019). Can front-of-pack nutrition labeling influence children's emotional associations with unhealthy food products? An experiment using emoji. *Food Research International*, *120*, 217–225.
<https://doi.org/10.1016/j.foodres.2019.02.027>
- Lu, X., Ai, W., Liu, X., Li, Q., Wang, N., Huang, G., & Mei, Q. (2016). Learning from the ubiquitous language: An empirical analysis of emoji usage of smartphone users. In *UbiComp 2016* (pp. 770–780). Heidelberg, Germany: ACM Press.
<https://doi.org/10.1145/2971648.2971724>
- Meiselman, H. L. (2016). *Emotion Measurement*. (H. L. Meiselman, Ed.). Elsevier.
<https://doi.org/10.1016/C2014-0-03427-2>
- Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., 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>
- R Core Team. (2016). R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing.
- Rozin, P., & Fallon, A. E. (1987). A Perspective on Disgust. *Psychological Review*, *94*(1), 23–41. <https://doi.org/10.1037/0033-295X.94.1.23>
- Scherer, K. R., Wranik, T., Sangsue, J., Tran, V., & Scherer, U. (2004). Emotions in everyday life: probability of occurrence, risk factors, appraisal and reaction patterns. *Social Science Information*, *43*(4), 499–570. <https://doi.org/10.1177/0539018404047701>
- Schouteten, J. J., Verwaeren, J., Gellynck, X., & Almlı, V. L. (2019). Comparing a standardized to a product-specific emoji list for evaluating food products by children. *Food Quality and Preference*, *72*(June 2018), 86–97.

- <https://doi.org/10.1016/j.foodqual.2018.09.007>
- Schouteten, J. J., Verwaeren, J., Lagast, S., Gellynck, X., & De Steur, H. (2018). Emoji as a tool for measuring children's emotions when tasting food. *Food Quality and Preference*, 68, 322–331. <https://doi.org/10.1016/j.foodqual.2018.03.005>
- Sick, J., Højer, R., & Olsen, A. (2019). Children's self-reported reasons for accepting and rejecting foods. *Nutrients*, 11(10), 2455. <https://doi.org/10.3390/nu11102455>
- Sick, J., Monteleone, E., Pierguidi, L., Ares, G., & Spinelli, S. (2020). The Meaning of Emoji to Describe Food Experiences in Pre-Adolescents. *Foods*, 9(9), 1307. <https://doi.org/10.3390/foods9091307>
- Sick, J., Spinelli, S., Dinnella, C., & Monteleone, E. (2020). Children's selection of emojis to express food-elicited emotions in varied eating contexts. *Food Quality and Preference*, 85, 103953. <https://doi.org/10.1016/j.foodqual.2020.103953>
- Spinelli, S., Dinnella, C., Masi, C., Zoboli, G. P., Prescott, J., & Monteleone, E. (2017). Investigating preferred coffee consumption contexts using open-ended questions. *Food Quality and Preference*, 61, 63–73. <https://doi.org/10.1016/j.foodqual.2017.05.003>
- 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 *Methods in Consumer Research, Volume 1: New Approaches to Classic Methods* (pp. 261–296). Woodhead Publishing. <https://doi.org/10.1016/B978-0-08-102089-0.00011-X>
- Swaney-Stueve, M., Jepsen, T., & Deubler, G. (2018). The emoji scale: A facial scale for the 21st century. *Food Quality and Preference*, 68(March), 183–190. <https://doi.org/10.1016/j.foodqual.2018.03.002>
- Toet, A., Kaneko, D., Ushiana, S., Hoving, S., Kruijff, I. de, Brouwer, A. M., ... van Erp, J. B. F. (2018). EmojiGrid: A 2D pictorial scale for the assessment of food elicited emotions. *Frontiers in Psychology*, 9(NOV), 2396. <https://doi.org/10.3389/fpsyg.2018.02396>
- Valentin, D., Chollet, S., Lelièvre, M., & Abdi, H. (2012). Quick and dirty but still pretty good: A review of new descriptive methods in food science. *International Journal of Food Science and Technology*, 47(8), 1563–1578. <https://doi.org/10.1111/j.1365-2621.2012.03022.x>
- van der Horst, K., Ferrage, A., & Rytz, A. (2014). Involving children in meal preparation. Effects on food intake. *Appetite*, 79, 18–24. <https://doi.org/10.1016/J.APPET.2014.03.030>
- van der Horst, K., Mathias, K. C., Prieto Patron, A., & Alliot, X. (2019). Art on a Plate: A Pilot Evaluation of an International Initiative Designed to Promote Consumption of Fruits and Vegetables by Children. *Journal of Nutrition Education and Behavior*, 51(8), 919-925.e1. <https://doi.org/10.1016/J.JNEB.2019.03.009>
- Vidal, L., Ares, G., Machín, L., & Jaeger, S. R. (2015). Using Twitter data for food-related consumer research: A case study on “what people say when tweeting about different eating situations.” *Food Quality and Preference*, 45, 58–69. <https://doi.org/10.1016/j.foodqual.2015.05.006>
- Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, 1(1), 11–25. <https://doi.org/10.1080/17477160600586747>
- WHO. (2020). Noncommunicable diseases: Childhood overweight and obesity. Retrieved November 26, 2020, from <https://www.who.int/news-room/q-a-detail/noncommunicable-diseases-childhood-overweight-and-obesity>

- Wijeratne, S., Balasuriya, L., Sheth, A., & Doran, D. (2016). EmojiNet: Building a Machine Readable Sense Inventory for Emoji. In *8th International Conference on Social Informatics (SocInfo 2016)* (pp. 527–541). https://doi.org/10.1007/978-3-319-47880-7_33
- 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/10.1037/a0023980>

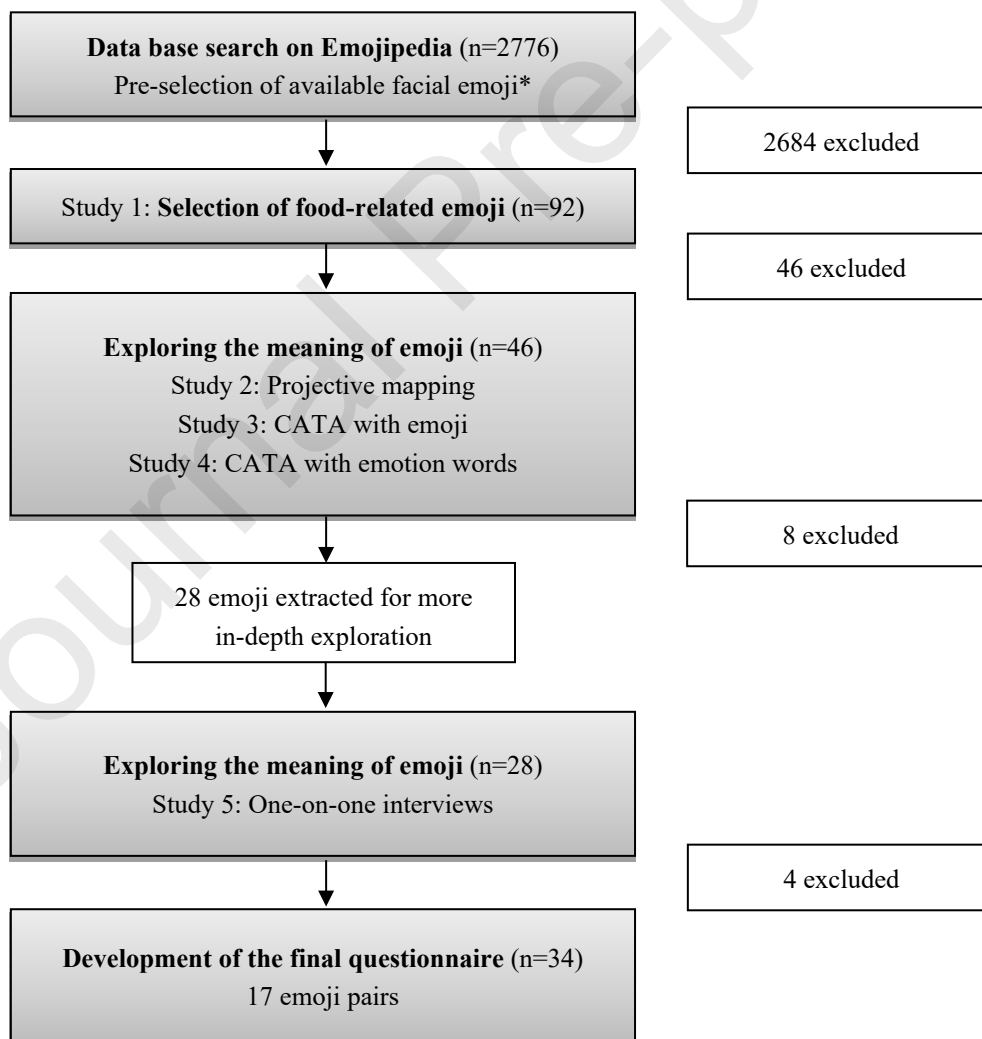


Figure 1. Flow-chart of the experiments to reduce the number of emoji and to explore their meaning to develop the final questionnaire; Study 1 based on Sick, Spinelli, et al. (2020), Study 2 and 3 based on Sick, Monteleone,

et al. (2020); n=number of emoji included for each study; * in the current study, facial emoji were defined as round and usually yellow facial emoji varying in facial expressions.

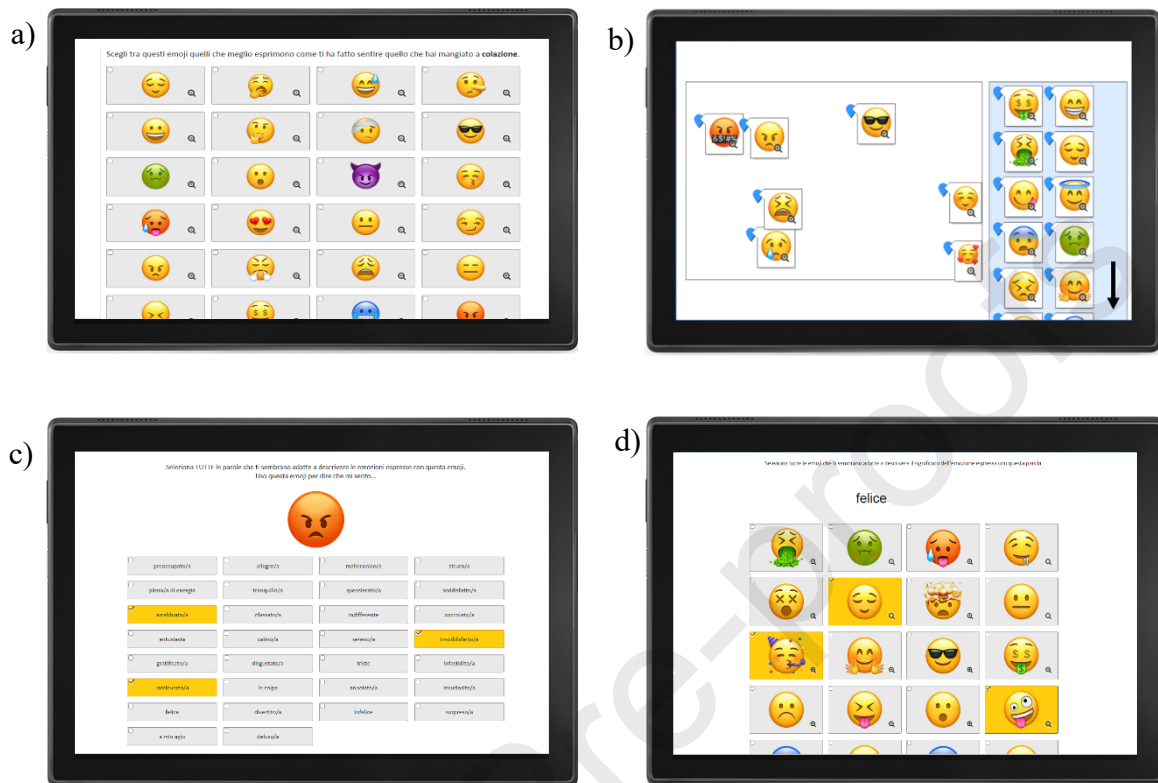


Figure 2. Experimental set-up of Study 1-4; a) Study 1: Selection of emoji to describe food experiences b) Study 2: Projective mapping 3) Study 3: CATA with emoji described by emotion words and 4) Study 4: CATA with emotion words described by emoji; images are derived from screenshots of the original test created through the software Compusense.



Figure 3. Experimental set-up of the interviews with one instructor (left) and the child being interviewed (right).

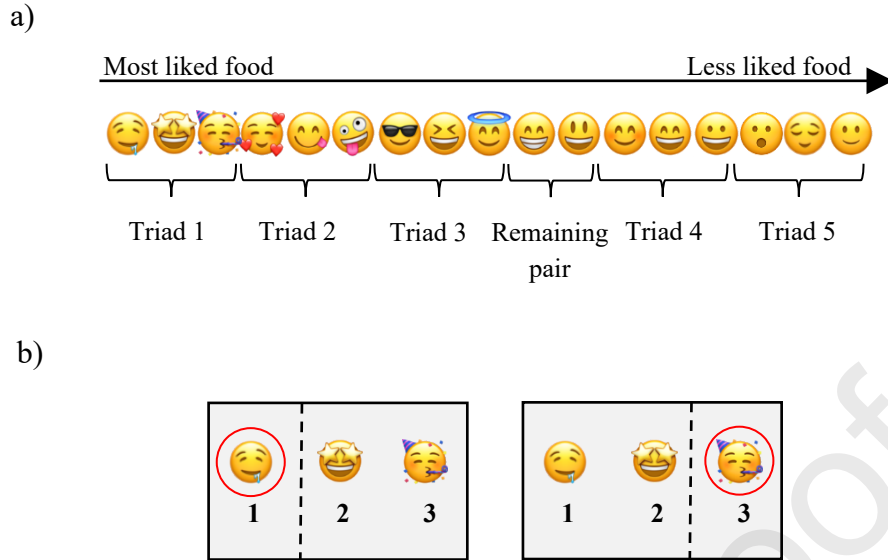


Figure 4. Experimental design of the one-on-one interviews using a modified version of the Repertory Grid Method (RGM) (EmoSemia approach, Spinelli et al., 2014) showing an example of the procedure of the positive emoji group. a) Emoji ranked to describe from the most liked to the ones less liked food (among liked foods); b) Example of Triad 1 to ask to the child about similarities and differences in emotional meaning between emoji.

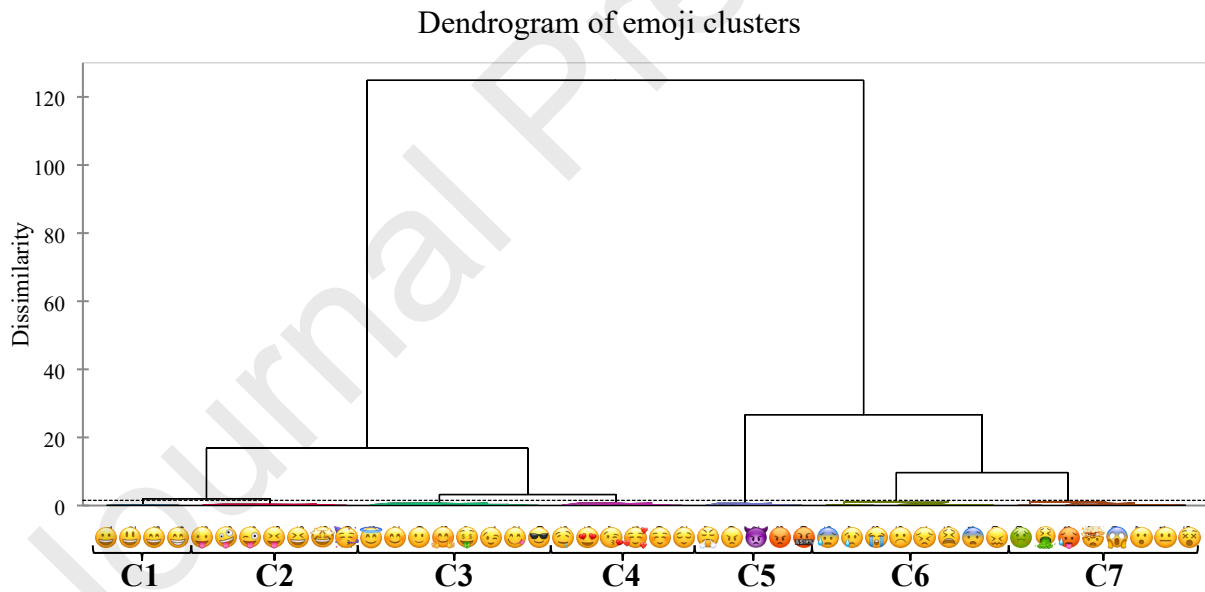
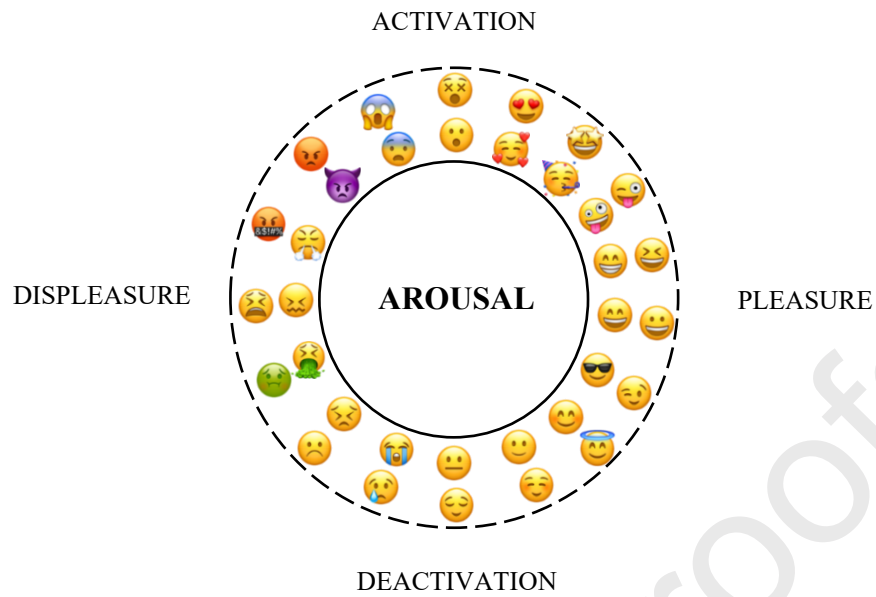


Figure 5. Dendrogram resulting from the Agglomerative hierarchical cluster analysis (AHC) on dimensions 1-3 of the Hierarchical multifactorial cluster analysis (HMFA) showing 7 emoji clusters.

a)



b)

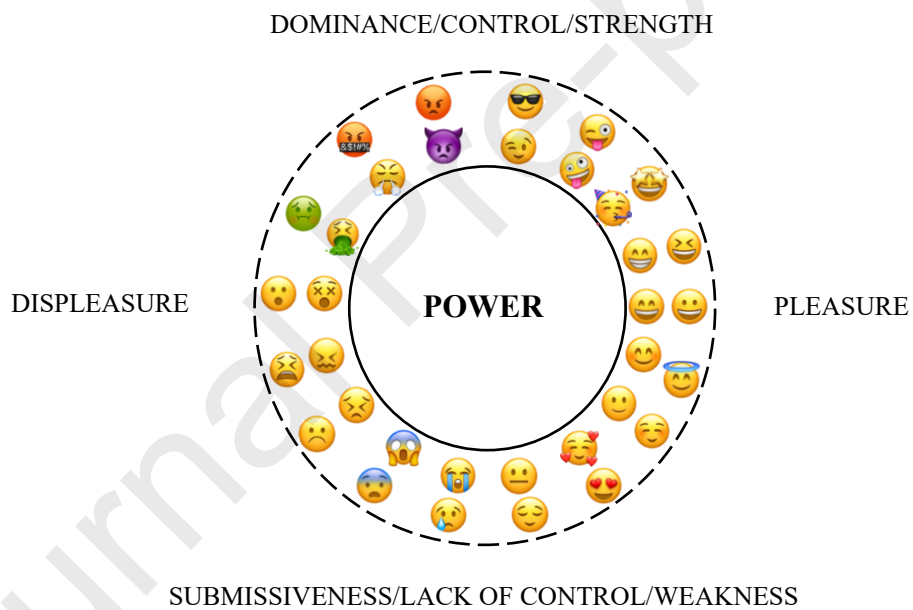


Figure 5. Emoji circumplex showing 17 emoji pairs based on similar meanings and levels of a) valence (pleasure vs. displeasure) and arousal (activation vs. deactivation) and b) valence (pleasure vs. displeasure) and power (dominance/control/strength vs. submissiveness/lack of control/weakness).

a)

b)

Figure 6. Examples of the emoji-group self-report questionnaires a) CATA emoji pair questionnaire with 17 emoji pairs and b) emoji pair rating scale with an example of 3 emoji pairs with a categorical 5-point ranging from 1 = Does not fit at all to 5 = Fits very well. Both screenshots of the questionnaires were derived from the web-based software Compusense Inc.

Table 1. Overview of Studies 1-5 including the number (% in brackets) of participating children and age range (total and divided by gender), school level and number of emoji included in each study.

	Study	Parameter	Total	Girls	Boys	School level	Emoji
Study 1	Emoji selection	n (%) age range	96 (100) 9-13	41 (43) 9-13	55 (57) 9-13	primary and secondary	92
Study 2	Projective mapping	n (%) age range	162 (100) 9-13	87 (54) 9-13	75 (46) 9-13	primary and secondary	46

Study 3	CATA emoji	n (%) age range	92 (100) 11-13	52 (57) 11-13	40 (43) 12-13	secondary	46
Study 4	CATA emotion words	n (%) age range	85 (100) 9-13	46 (54) 9-12	39 (46) 9-13	primary and secondary	46
Study 5	One-on-one interviews	n (%) age range	19 (100) 12-13	9 (47) 12-13	10 (53) 12-13	secondary	28

Table 2. Emoji clusters resulting from the Agglomerative hierarchical cluster analysis (AHC) with truncation into 7 clusters (C1-7), number of emoji and within-class variance per cluster.

	C1	C2	C3	C4	C5	C6	C7
Number of emoji	4	7	8	6	5	8	8
Within-class variance	0.035	0.113	0.194	0.192	0.213	0.216	0.321
	😊 😄 😁 😂	😄 😁 😂 😃 😆 😜 😝	😊 😄 😁 😇 😃 😆 😜 😝 😎	😍 😘 😗 😙 😚	😞 😡 😠 😤 😈	😞 😡 😠 😢 😭 😣 😥 😦	😐 😬 😇 😞 😡 😠 😢 😭 😣 😥 😦 😧

Table 3. Summary table showing cluster groups and semantic meanings (Studies 3-5) of 46 emoji used to describe food experiences in preadolescents. For Study 3 (emoji described by emotion words) and Study 4 (emotion words described by emoji) attributes selected by $\geq 40\%$ of children are displayed, but children's additional emotion words from the open-end response were displayed when selected by $\geq 10\%$ of children (underlined); n=number of children participating in each study. For Study 5, emotion word constructs mentioned by $\geq 10\%$ of children are displayed; * indicates that these emoji were not included in the interviews; whether emoji were included in the final questionnaire was indicated in the last column.

Cluster	Study 3 (n=92): CATA emoji described by emotion words	Study 4 (n=85): CATA emotion words described by emoji	Study 5 (n=19): One-on-one interviews	Final question naire
😊 1	happy (66%), serene (54%), cheerful (50%), amused (41%)	happy (58%), cheerful (47%)	happy (63%)	yes
😄 1	happy (78%), cheerful (55%), serene (44%), enthusiastic (40%)	happy (61%), cheerful (41%)	happy (47%), content (11%), excited (11%)	no
😁 1	happy (75%), cheerful (71%), serene (55%), amused (45%)	happy (57%)	happy (84%), indifferent (11%)	yes
😂 1	happy (70%), cheerful (64%), amused (60%), serene (45%), enthusiastic (42%)	happy (65%), cheerful (46%)	happy (63%), relaxed (11%), quiet (indifferent in a positive way (11%), content (11%), smiling (11%), normal (11%)	yes
😃 2	happy (66%), cheerful (64%), amused (47%), enthusiastic (40%)	happy (44%)	happy (74%), content (11%)	yes

😊	2	happy (64%), energetic (54%), cheerful (49%), enthusiastic (48%), amused (42%)	-	happy (53%), content (16%), “wow” (surprised/impressed) (11%)	yes
😄	2	happy (58%), amused (53%), cheerful (42%)	-	*	no
😄	2	happy (59%), cheerful (59%), amused (51%), energetic (41%)	-	*	yes
😄	2	happy (60%), cheerful (58%), energetic (57%), amused (53%), crazy (23%)	amused (40%)	happy (37%), crazy (32%), amused (11%), makes me feel good (11%)	yes
😄	2	happy (63%), cheerful (57%), amused (52%), energetic (41%)	-	*	no
😄	2	happy (70%), cheerful (70%), energetic (52%), enthusiastic (49%), amused (49%), festive (22%)	-	happy (63%), suitable for a party (47%), suitable for a special occasion (11%), content (11%)	yes
😊	3	happy (61%), serene (49%)	happy (44%), quiet (40%)	happy (less) (47%), sad (21%), I make do with it (16%), forced (16%), indifferent (16%), calm (11%)	yes
😊	3	happy (49%), cheerful (40%), confident (40%)	-	*	yes
😊	3	happy (64%), cheerful (52%), serene (47%), calm (44%)	-	happy (less) (37%), makes me feel good (21%), content (11%), ashamed (11%)	yes
😊	3	serene (60%), happy (55%), quiet (50%), calm (47%), cheerful (44%), <u>I am good/ I feel like an angel</u> (11%)	-	happy (26%), I feel like an angel (16%), makes me feel special/important (16%), makes me feel good (11%), keeps myself from doing things (11%), new/mysterious (11%), calm (11%)	yes
😊	3	happy (59%), cheerful (51%), <u>gluttonous</u> (14%), <u>hungry</u> (10%)	-	gluttonous (42%), makes me feel good (21%), happy (11%)	no
😋	3	happy (51%), satisfied (46%), cheerful (42%), <u>rich</u> (26%)	-	*	no
😊	3	happy (54%), serene (50%), cheerful (48%)	-	*	no
😎	3	confident (50%), happy (49%), satisfied (44%), at ease (44%), <u>feeling cool</u> (11%)	-	happy (26%), proud (26%), makes me feel good (21%), beautiful (16%), superior (11%), lucky (11%), enjoyment (11%)	yes
😘	4	happy (61%), cuddled (58%), serene (44%), cheerful (42%), <u>in love</u> (35%)	cuddled (71%)	happy (26%)	yes
😍	4	happy (59%), <u>in love</u> (63%)	-	*	yes
😘	4	happy (46%), <u>in love</u> (17%)	-	*	no
😊	4	happy (46%), calm (40%)	-	*	yes

😊	4	serene (52%), calm (44%)	quiet (40%)	happy (21%), makes me feel superior (11%), makes me feel good (11%), forced (11%), proud (11%), indifferent (11%)	yes
😓	4	-	-	I like it (58%), mouth watering (32%), well (16%), gluttonous (11%), happy (11%)	no
😡	5	angry (74%), annoyed (50%)		angry (74%), forced (21%)	yes
😡	5	angry (95%)	angry (79%)	angry (84%), disgusted (11%)	yes
😡	5	angry (84%), annoyed (47%)	-	*	no
😡	5	angry (91%), annoyed (53%)	angry (77%)	*	yes
😡	5	angry (86%)	angry (57%)	*	yes
😞	6	sad (69%), unhappy (54%), disappointed (51%), dissatisfied (46%)	unhappy (42%), dissatisfied (41%)	sad (42%), does not make me feel good (16%)	yes
😟	6	worried (57%), surprised (42%)	-	*	yes
😟	6	worried (53%)	worried (41%)	uncomfortable (26%), annoyed (11%), sad (11%), anxious (11%), I don't want it (11%), worried (11%), amazed/perplexed (11%), disgusted (11%)	no
😞	6	sad (75%), unhappy (61%), disappointed (47%)	sad (46%)	sad (53%), suffering (16%), indifferent (negative) (16%)	yes
😞	6	sad (86%), unhappy (66%)	sad (69%)	sad (53%), I want to cry (16%)	yes
😞	6	unhappy (46%), sad (44%), disgusted (44%), annoyed (40%)	-	*	yes
😞	6	sad (52%), unhappy (49%), guilty (47%), disappointed (46%)	-	*	yes
😞	6	unhappy (55%), sad (48%), melancholic (40%), disappointed (40%), guilty (40%)	-	sad (32%), forced/ I find it unfair (26%), I want to complain (16%), desperate (11%), I want to cry (11%), I am satisfied/feeling pleased (11%)	yes
😐	7	indifferent (58%)	indifferent (59%), bored (47%)	indifferent (42%), satisfied (11%), content (11%)	yes
🤢	7	disgusted (87%), <u>urge to vomit/nauseated</u> (12%)	disgusted (79%)	nauseated (58%), disgusted (32%), feeling sick (26%), makes me feel bad (21%)	yes
🤢	7	disgusted (84%), <u>feeling sick</u> (12%)	disgusted (75%)	*	yes
😓	7	<u>tired</u> (27%), <u>feeling hot</u> (20%)	-	*	no
😲	7	surprised (40%), worried (40%), <u>dead/deceased</u> (26%)	-	*	yes
😞	7	-	-	*	no



	7	surprised (73%)	curious (46%), surprised (42%)	positive group: surprised (negative) (47%), surprised (positive) (32%), surprised (positive and negative) (16%) negative group: surprised (negative) (58%), surprised (positive) (11%), surprised (positive and negative) (11%)	yes
	7	surprised (58%), worried (48%), scared/frightened (22%)	-	surprised (negative) (53%), makes me feel bad (16%), afraid (11%), worried (11%)	yes

Table 4. Semantic meaning of emoji pairs sharing overlapping emotional meaning; for simplification and readability, the set of emotion words for each emoji pair were reduced to two representative emotion words; ¹ = emotion words from CATA questionnaires (Study 3 and 4) selected by $\geq 40\%$ of children, ² = additional emotion words from open-ended responses (Study 3) selected by $\geq 10\%$ of children, ³ = emotion word constructs from one-on-one interviews (Study 5) selected by $\geq 10\%$ of children.

















Emoji pair	Representative emotion words	Full semantic meaning (Studies 3-5)
	cuddled – in love	happy ¹ , cuddled ¹ , serene ¹ , cheerful ¹ , in love ²
	enthusiastic – festive	happy ¹ , cheerful ¹ , energetic ¹ , enthusiastic ¹ , amused ¹ , festive ² , suitable for a party ³ , content ³ , suitable for a special occasion ³ , “wow” (surprised/impressed) ³
	energetic – crazy	happy ¹ , cheerful ¹ , energetic ¹ , amused ¹ , crazy ² , makes me feel good ³
	cheerful – amused	happy ¹ , cheerful ¹ , amused ¹ , enthusiastic ¹ , serene ¹ , relaxed ³ , quiet (indifferent in a positive way) ³ , content ³ , smiling ³ , normal ³
	cheerful – serene	happy ¹ , cheerful ¹ , serene ¹ , amused ¹ , indifferent ³
	serene – calm	happy ¹ , serene ¹ , cheerful ¹ , calm ¹ , quiet ¹ , I am good/ I feel like an angel ² , makes me feel good ³ , makes me feel special/important ³ , keeps myself from doing things ³ , new/mysterious ³ , calm ³ , content ³ , ashamed ³
	confident – at ease	happy ¹ , confident ¹ , at ease ¹ , satisfied ¹ , cheerful ¹ , feeling cool ² , proud ³ , makes me feel good ³ , beautiful ³ , superior ³ , lucky ³ , enjoyment ³
	calm – quiet	happy ¹ , serene ¹ , calm ¹ , quiet ¹ , sad ³ , I make do with it ³ , forced ³ , indifferent ³ , calm ³
	indifferent – calm	indifferent ¹ , serene ¹ , calm ¹ , makes me feel superior ³ , makes me feel good ³ , forced ³ , proud ³ , indifferent ³ , satisfied ³ , content ³
	sad – unhappy	sad ¹ , unhappy ¹ , disappointed ¹ , suffering ³ , indifferent (negative) ³ , I want to cry ³
	dissatisfied – guilty	sad ¹ , unhappy ¹ , disappointed ¹ , dissatisfied ¹ , guilty ¹ , does not make me feel good ³
	unhappy – annoyed	unhappy ¹ , sad ¹ , disgusted ¹ , melancholic ¹ , annoyed ¹ , guilty ¹ , forced/ I find it unfair ³ , I want to complain ³ , desperate ³ , I want to cry ³ , I am satisfied/feeling pleased ³
	disgusted – nauseated	disgusted ¹ , urge to vomit/nauseated, feeling sick ² , makes me feel bad ³
	angry – annoyed	angry ¹ , annoyed ¹ , forced ³
	angry – disgusted	angry ¹ , disgusted ³
	worried – scared	surprised ¹ , worried ¹ , scared/frightened ² , makes me feel bad ³ , afraid ³
	surprised – curious	surprised ¹ , worried ¹ , dead/deceased ² , curious ³

Table 5. Characteristics of the emoji pair questionnaire (highlighted in grey) and of previously developed emoji questionnaires/lists/scales: reference, age group, preselection of emoji, number of emoji used in the final version (and Apple iOS version), questionnaire format, dimensions considered in the questionnaire and if the questionnaire was standardized or product-specific are reported; quest. = questionnaire, y.o. = year-old.

Reference	Age group	Preselection of emoji	Emoji (n)	Quest. format	Dimensions	Standardized /product-specific quest.
(Current paper)	9-13-y.o.	9-13-y.o. children evaluating emoji appropriate to describe food experiences (Study 1, Sick, Spinelli et al., 2020) using CATA, projective mapping and Repertory Grid Method-based interviews (Study 2-5)	34 facial emoji (17 emoji pairs) Apple iOS 12.2	Emoji pairs evaluated with CATA or a rating scale (5-point scale)	Valence (8 positive, 1 neutral, 8 negative emoji pairs), Power (9 higher dominance, 8 lower dominance emoji pairs), Arousal (9 higher activated, 8 less activated emoji pairs)	Standardized
Gallo, Swaney-Stueve et al. (2017)	7-11-y.o.	Preselection by researcher, then focus groups with 8-11-y.o. children to identify food-related emoji (Gallo, Swaney-Stueve et al., 2017)	38 facial emoji in food image study 28 facial emoji in served food study Apple iOS 8.3	CATA	Valence (17 positive, 4 neutral emoji, 17 negative)	Standardized
Swaney-Stueve et al. (2018)	8-11-y.o.	Focus groups with 8-11-y.o. children to identify food-related emoji (Gallo, Swaney-Stueve et al., 2017)	7 facial emoji Apple iOS 8.3	Linear scale	Valence (3 positive, 1 neutral, 3 negative emoji)	Standardized
Schouteten et al. (2018)	11-13-y.o.	Emoji derived from previous research based on adults by analyzing tweets of four eating situations. (Jaeger, Vidal, et al., 2017)	33 facial emoji Apple iOS 9	CATA	Valence (15 positive, 2 neutral, 16 negative emoji)	Standardized
Schouteten et al. (2019)	8-11-y.o.	Focus groups with 8-11-y.o. children to identify food-related emoji (Gallo, Swaney-Stueve et al., 2017)	38 facial emoji Apple iOS 8.3	CATA	Valence (17 positive, 4 neutral emoji, 17 negative emoji)	Standardized
Schouteten et al. (2019)	8-11-y.o.	Two-step procedure: emoji were retrieved from prior research studies with 8-11-y.o. children (focus groups: Gallo, Swaney-Stueve, et al., 2017) and adults (Jaeger, Lee, et al., 2017). Then, 7-12-y.o. children indicated the applicability of these emoji for a range of biscuits (Schouteten et al., 2018) and thereafter researchers made the final selection.	20 emoji (15 facial and 5 non-facial emoji) Apple iOS 8.3	CATA	Valence (15 positive, 3 negative, 2 neutral emoji)	Product-specific (speculoos biscuits)
Lima et al. (2019)	6-12-y.o.	Emoji were selected (by researcher) from an emoji list (n=30) developed for adults (Jaeger, Lee, & Ares, 2018). The study included 16 of the 30 emoji but the selection procedure was not described in detail.	16 facial emoji Apple iOS 6.0	CATA	Valence (7 positive, 1 neutral, 8 negative emoji)	Standardized

da Cruz et al. (2021)	Preselection based on children that were presented with a list of 33 emoji (based on adults that were ranked as the most used emoji related to food in Twitter, Jaeger & Ares, 2017) and asked to select all emoji that they felt described their emotional experience during consumption of the fermented milk products using CATA.	15 facial emoji EmojiOne 2021	CATA	Valence (9 positive, 1 neutral, 5 negative emoji)	Product-specific (fermented milk products)
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Declarations of conflicts

The authors declare that there is no conflict of interest regarding publication of this paper.

CRedit author statement

Conceptualization: J.S., S.S., and E.M., Methodology: J.S., S.S., and E.M., Validation, Formal analysis: J.S., Investigation: J.S., S.S., L.P. and C.D., Data Curation: J.S., S.S., C.D., and L.P., Writing – Original Draft: J.S., and S.S., Writing – Review & Editing: S.S., C.D., L.P., and E.M., Visualization: J.S., Supervision: S.S., and E.M., Project administration: S.S., and E.M., Funding acquisition: E.M. All authors have read and agreed to the published version of the manuscript.

Highlights

- An emoji-based self-report questionnaire for preadolescents with a food-specific emoji list was developed
- Seventeen emoji pairs were associated with specific semantic and dimensional (valence, power, and arousal) meanings
- Two suggested response formats are suggested: CATA questionnaire or rating scale

- The questionnaire can be used to study preadolescents' emotions elicited by foods
- It offers a wide application especially in product development and/or sensory testing targeted at preadolescents

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