



Cross-national comparison on the meaning of emoji to describe emotions elicited by foods in preadolescents

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ABSTRACT

Emoji are supposed to simulate facial expressions that convey specific emotions or other situational meanings that are language-independent indicators of emotions with shared meanings between different countries. However, some research demonstrated that the meaning of emoji can differ across countries in adults, but little is known about preadolescents. The aim of Study 1 was to compare the semantic emotional meaning of emoji to describe food experiences between 11 and 13-y.o. Italian (n = 92) and Norwegian (n = 109) preadolescents by asking children to describe 46 emoji with emotion words (n = 31) using the Check-All-That-Apply format. Spearman's correlation on the relative frequencies resulting from the Cochran's Q test and Multiple Factor Analysis (MFA) on the total frequencies of emotion words were applied to compare the emotional meaning between countries. Italian and Norwegian preadolescents were found to describe emoji with overlapping emotional meaning. This allowed the application of an emoji-based self-report questionnaire (CATA Emoji Pair Questionnaire) to measure food-elicited emotions in response to 28 food names of three food categories (fruits, vegetables, desserts/juices) in 148 Norwegian preadolescents (11–13-y.o.) (Study 2). Results showed that emoji pairs discriminated across and within food categories. Emoji pairs were shown to discriminate between food names in the vegetable and dessert/juice category despite similar liking of the products, and to give important additional information helping a better understanding of preadolescents' food preferences.

1. Introduction

Emoji were shown to have a promising potential to be used in sensory- and consumer research to measure food-elicited emotions in preadolescents (Gallo, Swaney-Stueve, & Chambers, 2017; Schouteten, Verwaeren, Gellynck, & Almli, 2019; Sick, Monteleone, Pierguidi, Ares, & Spinelli, 2020). They have the advantage of being language-independent indicators of emotions (Novak, Smailović, Sluban, & Mozetič, 2015) with shared meaning between different cultures as shown with adults (Jaeger, Vidal, & Ares, 2021). This is advantageous, especially, when there are language barriers in cross-national research and where the translation of words is problematic (Jaeger, Vidal, et al., 2021; Schouteten & Meiselman, 2021).

When using emotion word lists with adults, cross-national studies highlighted translation issues (e.g., when the exact translation of a word does not exist and there are nuances of meaning, or it exists but it is not used, see Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014), (Souza Olegario, Estevéz, González-Mohino, Madruga, & Ventanas,

2021a; van Zyl and Meiselman, 2015, 2016), where cross-cultural differences in emotional responses to different product categories were reported. Instead it has been suggested that in adults the interpretation of emoji is not strongly dependent on cultural context (Jaeger, Vidal, et al., 2021). A study investigating the dimensional meanings (pleasure, arousal and dominance) concluded that food-related emoji showed similar results between participants from New Zealand and the UK (Jaeger, Jin, Ryan, & Schouteten, 2021). Some studies investigated emotional responses to foods with adults from different cultures/countries e.g., USA and China (Jaeger, Vidal, Kam, & Ares, 2017), New Zealand and Korea (Jaeger, Lee, et al., 2017), Brazil and Spain (Souza Olegario, Estevéz, González-Mohino, Madruga, & Ventanas, 2021b), yet a direct comparison of semantic emoji meanings between more cultures/countries is lacking in both adults and preadolescents. Unpublished work by Gallo (2016) investigated emotional responses to foods using emotion words and emoji with preadolescents from USA and Ghana and found that emoji and emotion word usage was mostly similar between both countries. For the application of emoji questionnaires in sensory- and

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consumer research, cross-national shared meanings of emoji are a crucial prerequisite to be able to compare emotional profiles in response to foods/beverages between countries, however, little is known about preadolescents.

The Emoji Pair Questionnaire (Fig. 1) has been developed to measure food-elicited emotions in preadolescents (Sick, Monteleone, Dinnella, Pierguidi, & Spinelli, 2022). The questionnaire consists of 17 emoji pairs with identified semantic and dimensional meaning, selected based on an intensive work of preliminary studies conducted with Italian preadolescents to reduce ambiguity in the interpretation. The first aim of the present study is to verify if the semantic emotional meaning of emoji used to describe food experiences in preadolescents differs across countries. For this reason, a Check-All-That-Apply with emoji described by emotion words was replicated with Norwegian preadolescents, which is then compared to previously collected data with Italian preadolescents (Study 1).

The second aim is to measure the emotional responses to familiar foods (belonging to different product categories of vegetables, fruits, and desserts/juices) using the Emoji Pair Questionnaire with Norwegian preadolescents to assess its discriminant ability, face validity and its relationship with acceptability (Study 2). Familiarity has been shown to be positively associated with acceptability and (positive) emotional responses (Jiang, King, & Prinyawiwatkul, 2014). The rationale behind testing the Emoji Pair Questionnaire with familiar food products was to investigate if the instrument could be valid to discriminate product experiences beyond liking.

2. Methods

2.1. Participants

In Study 1, 109 Norwegian preadolescents (mean (M) = 12, standard deviation (SD) = 0.3, 47 % girls) were recruited from three public schools in the Viken area of Southern Norway and 92 Italian preadolescents (M = 12, SD = 0.3, 43 % girls) were recruited from one public school in the Florence area, Italy. In Study 2, 148 Norwegian preadolescents (M = 11, SD = 0.3, 52 % girls) were recruited from three public schools (of which children from two schools overlapped with the ones from Study 1). In general, it was aimed for around 100 children, as a sample of a 60–80 consumers has been shown to be sufficient (when using CATA questionnaires) to get stable sample and descriptor configurations when working with widely different food samples (Ares, Tárrega,

Izquierdo, & Jaeger, 2014). Furthermore, some recruitment criteria for the schools were defined to minimize background variable differences (e.g., socio-demographics): all schools were situated in rural areas and it was aimed for a similar socio-economic status and level of education of the parents, which is recommended when conducting cross-national research (Ares, 2018). However, specific sampling procedures such as random sampling were not considered (Ares, 2018).

Children had to return a consent form signed by themselves and their parents, where they consented to voluntarily participate in the study. 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 protocol of the study was approved by the Norwegian Center for Research Data (NSD) No. 715,734 and the Ethical Committee of the University of Florence, Italy.

2.2. Data collection

Both studies were conducted during school time. The children sat in rows and approximately one meter apart to not disturb each other. Children conducted the test either on tablets or laptops provided by their schools and were all confident in using such devices. The questionnaire was conducted using the web-based software Compusense Cloud (version 20.0.7557.33837, Compusense Inc., Guelph, ON, Canada). The tests of Study 1 and Study 2 lasted approximately 45–60 min per class.

In Study 1, countries differed in the way the researcher was located at the time of the test session. In Italy, the researcher and two assistants were physically present in the classroom, while in Norway, the researcher gave instructions remotely via online conference (this action was undertaken in Norway due to the unexpected COVID-19 pandemic and tightened regulations to prevent the spread of the virus). The teacher's laptop was used to connect the instructor with the school class, enabling the instructor to see and hear the children, while the children could see and hear the instructor at the same time. The instructor led the test session by first sharing a short PowerPoint presentation that was projected in the class's white board to explain the test step-by-step. One to two teachers were present per class throughout the entire test session to facilitate the online setup, but also to ensure a quiet atmosphere in the classroom. In both countries, children were allowed to ask questions during the instructions and the test session by rising their hand and addressing their question either directly to the instructor or through the teacher.

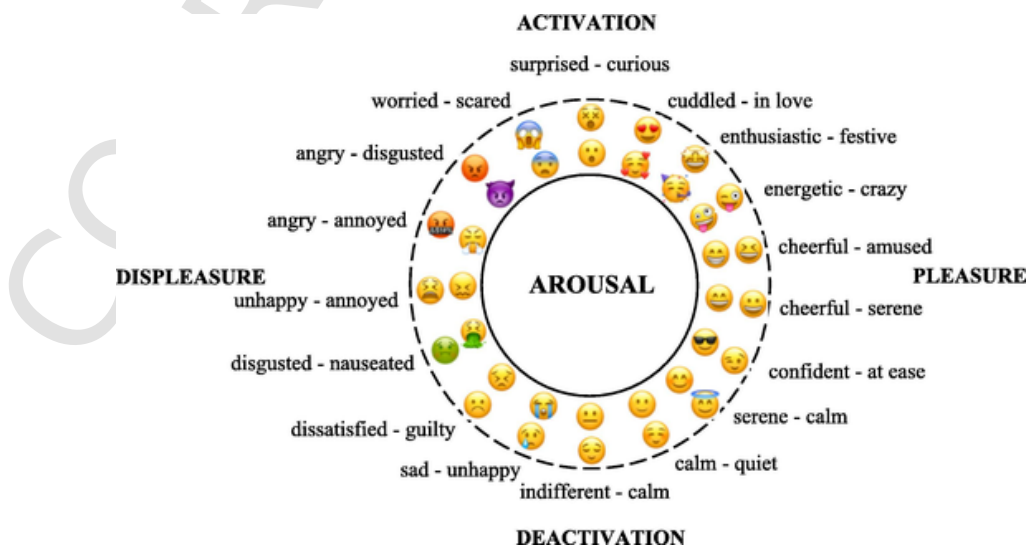


Fig. 1. Emoji pair questionnaire (presented as a emoji circumplex) showing 17 emoji pairs with two representative emotion words based on similar semantic meanings and levels of valence (pleasure vs displeasure) and arousal (activation vs deactivation) (developed by Sick et al., 2022).

2.3. Study 1: Cross-national comparison of the meaning of emoji between Italian and Norwegian preadolescents

2.3.1. Selection of emoji and emotion words

Emoji ($n = 46$) and emotion words ($n = 30$) were used from a previous study on the semantic meaning (CATA emoji described by emotion words) with Italian preadolescents (Sick et al., 2020). Emotion words were translated from Italian to English and then from English to Norwegian and checked for correct translation individually by one bilingual (Norwegian and English) and one trilingual (Norwegian, English, and Italian) sensory science researcher of the research institute Nofima in Ås, Norway. The emotion word “afraid” was added to the emotion word list in the Norwegian study because it was found that Italian children frequently used “afraid” in the additional comments to describe e.g., *face screaming in fear* 😱 (Sick et al., 2020). The final emotion word list with translations used in each country can be found in the [Supplementary Materials Table S1](#). Emoji were retrieved from Apple iOS 12.2 (Apple, Inc, Cupertino, CA) accessed through Emojipedia (Emojipedia, 2019).

2.3.2. Procedure

Procedures followed the protocol of the study (CATA with emoji described by emotion words) conducted with Italian preadolescents (Sick et al., 2020). One emoji was presented at a time and children were asked to select all emotion words they found appropriate to express the meaning of each of the emoji. Emoji were presented in two blocks of emoji (2x23 emoji) for each child to give a refreshing break. Emoji were randomized within each block and the presentation order of the two blocks was balanced across children. The order of emotion words was balanced for each emoji. In case children could not find a fitting emotion word to describe the presented emoji or they felt that some words were missing, they had the possibility to specify their own emotion word(s) in an open-ended response format. As soon as they finished, children were offered a riddle that helped to keep the quiet atmosphere in the class. Before the test day, the teacher went through the definitions of the emotion words to ensure all children had the same interpretation. If children wanted to reassure themselves about the meaning of a specific emotion word, they could do so by viewing the definition that was available in the questionnaire. Additionally, children were asked about gender and age and to answer some questions about emoji usage (Emoji Usage Questionnaire - EUQ), which included the following domains: Familiarity, Frequency of usage, Social use, Motivation, Valence and Enjoyment in using emoji (Sick et al., 2020).

2.4. Study 2: Testing the discriminant ability of emotions in response to food names

2.4.1. Selection of food names

Twenty-eight food items were selected to represent the sensory variety in the categories of fruits ($n = 10$, apple, clementine, grapes, grapefruit, kiwi, orange, pineapple, raspberry, strawberry, watermelon), vegetables ($n = 10$, arugula, broccoli, carrot, corn, green beans, iceberg salad, peas, spinach, squash, tomato), and desserts/juices ($n = 8$, dark chocolate, fruit yogurt, grapefruit juice, milk chocolate, natural yogurt, orange juice, strawberry sorbet, vanilla ice cream). The products were selected among healthier (vegetables, fruits) and less healthy categories (desserts/juices) to include familiar (and some less familiar) options in both countries (Norway and Italy) based on previous studies (Dinnella et al. 2016, Monteleone et al. 2017, Laureati et al. 2018) considering products commonly consumed in Europe by preadolescents.

2.4.2. Procedure

The 28 food names were presented one at a time by first asking about how familiar the food items were to them (5-point categorical scale; 1 = I do not know it, 2 = I know it but have never tasted it,

3 = I have tasted it but rarely eat it, 4 = I occasionally eat it, 5 = I regularly eat it) (Tuorila, Lähteenmäki, Pohjalainen, & Lotti, 2001). If children were familiar to the food item (by responding to one of the anchor points between 3 and 5 of the familiarity scale), they were asked about how much they like the food item using a 7-point hedonic scale (1 = dislike very much, 2 = dislike moderately, 3 = dislike slightly, 4 = neither like nor dislike, 5 = like slightly, 6 = like moderately, 7 = like very much). A verbal (not smiley) scale was used as previous studies showed that this scale could be reliably used with this age-group (Schouteten et al., 2019; Schouteten, Verwaeren, Lagast, Gellynck, & De Steur, 2018, see also Guinard, 2001, Laureati et al., 2015). Then they were asked how this product made them feel by selecting all emoji pairs ($n = 17$) that apply (CATA Emoji Pair Questionnaire by Sick et al., 2022). Food names were randomized following a 4x Williams Design (4 Latin Squares).

2.5. Data analysis

2.5.1. Study 1: Cross-national comparison of the meaning of emoji between Italian and Norwegian preadolescents

Data from the EUQ were analyzed by computing frequencies (%) of responses for each country. Differences between countries (Norway vs Italy) for Familiarity, Frequency of usage, Valence and Enjoyment were tested by using Kruskal-Wallis One-Way Analysis of Variance by ranks. Chi-square test was applied to test differences in the distributions of the responses between countries for each item of the other domains.

The data from the emoji list were analyzed using standard procedures for CATA approach (Meyners, Castura, & Carr, 2013). Cochran's Q test with Sheskin as a post-hoc test was conducted to establish the meaning of emoji from the CATA questionnaire.

Frequency tables (emoji $\times$ CATA word combinations) were created. Emotion words selected by $\geq 40\%$ of children for each emoji were considered as important emotion words to describe a specific emoji. To evaluate gender differences in Italian and Norwegian preadolescents, correspondence analysis (CA) was applied on boys and girls separately (within-gender approach). RV coefficients were calculated based on the coordinates of the products on the CA, and then compared between countries. For the open-ended responses, additional words were grouped by their meaning and all emotion word constructs $\geq 10\%$ were considered as a further emotional meaning for a specific emoji.

Two statistical analyses were used to compare the emotional meaning between countries:

1) Cochran's Q test with Sheskin as post-hoc test was applied on the binary data (0/1) for each emotion word (emoji $\times$ subjects) separately for each country. Relative frequencies for each emotion word by emoji were extracted. For each emotion word (Italy and Norway), Spearman's correlation was applied to compare the frequency of use across the emoji between countries.

2) Multiple Factor Analysis (MFA) was computed to compare the total frequencies of emotion words (columns) between countries (two blocks: Norway vs Italy) for emoji (rows). The RV coefficient was calculated to compare the plots by country (Norway vs Italy).

2.5.2. Study 2: Testing the discriminant ability of emotions in response to food names

Familiarity and liking were evaluated across all food names using One-way ANOVA with Tukey's HSD test as post-hoc test. Spearman correlation coefficient test on the raw data was conducted to investigate the relationship between familiarity and liking across foods.

Emotional responses to food names were analyzed for each food category separately. As only familiar food names were evaluated for liking and emotions, food names that were evaluated by the same children were extracted: this was undertaken to include as many children as possible (around 100 children) that evaluated most food names within each food category. Cochran's Q test with Sheskin as post-hoc test was

conducted on the emoji pairs, and frequency tables (food names $\times$ emoji pairs) were created. Similar statistical procedures were conducted to analyze emotional responses to foods in preadolescents (Gallo et al., 2017; Schouteten et al., 2019). Only emoji pairs with selection frequencies $\geq 10\%$ by children were retained. A One-way ANOVA model was applied to test the effect of product (food names) on liking, followed by a Tukey's HSD test as post-hoc test.

For both studies, the level of significance for all the analyses was set at $p \leq 0.05$. Statistical analyses were performed using XLSTAT (version 2021.2.1, Addinsoft, New York, NY, USA).

3. Results

3.1. Study 1: Cross-national comparison of the semantic meaning of emoji between Italian and Norwegian preadolescents

Italian and Norwegian children mostly overlapped in their usage of emoji (EUQ), but some differences between countries were found (see [Supplementary Material Table S2](#)). Italian preadolescents were more familiar with emoji ($p < 0.0001$) and stated to use emoji more frequently ($p < 0.0001$) compared to Norwegian preadolescents. In the Motivation domain, Italian preadolescents stated more than the Norwegian ones that “emoji make text messages more understandable” ($p = 0.023$), “emoji highlight a part of the message” ($p = 0.006$) and that “emoji express something that normally can't be described in words e.g., how one feels” ($p < 0.0001$). Italian preadolescents showed a higher enjoyment compared to Norwegian children ($p < 0.0001$), but Norwegian preadolescents stated that in general they use more positive emoji ($p = 0.018$).

Twenty-eight ($p < 0.0001$) out of 30 emotion words were positively correlated between Italy and Norway (range of correlation: 0.542–0.928). The two emotion words “indifferent” ($p = 0.439$) and “quiet” ($p = 0.297$) were not correlated between countries ([Table 1](#)). The contingency table (%) of emoji described by emotion words evaluated by Norwegian preadolescents can be found in the [Supplementary Materials S3](#) and a summary table comparing the semantic meanings between countries (selected $\geq 40\%$ of children with additional comments) can be found in the [Supplementary Materials S4](#).

Also, the MFA shows a high correlation along the first and second dimension (accounting for 65.19 % of total variance) between Italian and Norwegian preadolescents. The first dimension (accounting for 48.96 % of variance) divides emotion words into positive (left side) and negative (right side) emotion words, while the second dimension (accounting for 16.23 % of variance) could be interpreted as power (high

power on the upper side vs low power lower side of the map) ([Fig. 2](#)). For example, in the literature “angry” and “annoyed” are described as high in power, opposing emotions “worried”, “sad” and “guilty”, which are low in power (Fontaine & Scherer, 2013). The emotion words “indifferent”, “curious”, “surprised”, “quiet”, “cuddled”, “energetic”, “dissatisfied” and “disappointed” do not seem to be well described.

Negative emoji were better discriminated along the second dimension (interpreted as power) compared to positive emoji, dividing negative emoji into emoji of high power (top right, e.g., *pouting face* 😏, *face with symbols on mouth* 😬) and emoji low in power (bottom right, e.g., *face screaming fear* 😱, *crying face* 😭), which agrees with findings of previous results with Italian preadolescents (Sick et al., 2020). Both countries demonstrate similar dimensional meanings (see [Fig. 3](#)), with larger similarity for the positive emoji. Small differences were found for some negative emotions low in power, such as *exploding face* 💣 and *confounded face* 🤔 that were interpreted as slightly more negative by Italian children, and *face vomiting* 🤮 that was interpreted as slightly more negative by Norwegian children. The RV (=0.953) coefficient confirms overall high agreement between data of both countries. No major gender differences within the Norwegian preadolescents were found examining the RV coefficient (=0.93), confirming the results on the Italian preadolescents (RV = 0.93, see also Sick et al. (2020)).

Additional words (grouped by their meaning) were mentioned by $\geq 10\%$ of Norwegian children in the open-ended response option (see [Supplementary Materials Table S3](#)). In general, Italian children used more emotion words to describe the meaning of emoji compared to Norwegian preadolescents. Stated additional emotion words for each emoji were mostly overlapping between countries e.g., in both Norwegian and Italian children the *smiling face with heart-eyes* 😍 was described as expressing “in love” (12 % and 63 %, respectively) and the *zany face* 🤪 was described as expressing “crazy” (13 % and 23 %, respectively). Some differences between countries were also found, e.g., the *face vomiting* 🤮 was described as “nauseated” in Norwegian children (15 %) and as “feeling sick” by Italian children (12 %), which however both indicate a similar meaning of feeling a strong aversion against e.g., food. Consequently, it can be concluded that there is a good agreement how Norwegian and Italian preadolescents describe emoji with words. This indicates that the Emoji Pair Questionnaire originally developed with Italian preadolescents (Sick et al., 2022) may also be used in Norway.

3.2. Study 2: Testing the discriminant ability of emotions in response to food names

Based on the results of Study 1, the Emoji Pair Questionnaire was applied to measure emotional responses to food names in Norwegian preadolescents. As expected, the Spearman correlation coefficient test showed that familiarity and liking were positively correlated (0.66, $p < 0.0001$). Liking ranged between 3.9 and 5.5 in the vegetable category, between 4.6 and 6.6 in the dessert/juice category and between 5.3 and 6.6 in the fruit category, respectively.

Both liking and emoji pairs discriminated between food names in all food categories, and more importantly, they discriminated between food names despite similar liking in the vegetable ([Table 2](#)) and dessert/juice category ([Table 3](#)), but not in the fruit category ([Table 4](#)). For instance, in the vegetable category, no significant differences were found between liking of broccoli, spinach, and tomato, but differences in emoji pairs were reported. Broccoli was more associated with the emoji pair 😌😌 (“calm - quiet”), spinach was more associated with the emoji pair 😌😌 (“indifferent - calm”) (compared to tomatoes) and tomatoes were more associated with the emoji pair 🤮🤮 (“disgusted - nauseated”) (compared to spinach). This indicates that even if the acceptability of these products is similar (and close to “neither liked nor disliked”), they induce different emotional experiences. Emoji pairs

Table 1

Spearman's correlation on relative frequencies (resulting from Cochran's Q test) to compare correlation of emotion words ($n = 30$) between Norway and Italy; significant p-values ≤ 0.05 marked in bold; the word “afraid” was eliminated as it was not present in the Italian CATa word list.

Emotion words	Correlation	p-value	Emotion words	Correlation	p-value
annoyed	0.928	<0.0001	unhappy	0.850	<0.0001
calm	0.910	<0.0001	carefree	0.841	<0.0001
relaxed	0.910	<0.0001	amused	0.836	<0.0001
enthusiastic	0.902	<0.0001	confident	0.832	<0.0001
sad	0.896	<0.0001	guilty	0.824	<0.0001
worried	0.886	<0.0001	dissatisfied	0.814	<0.0001
energetic	0.884	<0.0001	at ease	0.783	<0.0001
cheerful	0.878	<0.0001	angry	0.780	<0.0001
disgusted	0.878	<0.0001	gratified	0.772	<0.0001
happy	0.864	<0.0001	bored	0.739	<0.0001
disappointed	0.860	<0.0001	melancholic	0.677	<0.0001
surprised	0.855	<0.0001	curious	0.560	<0.0001
satisfied	0.853	<0.0001	cuddled	0.542	<0.0001
serene	0.853	<0.0001	quiet	0.157	0.297
reassured	0.852	<0.0001	indifferent	-0.117	0.439

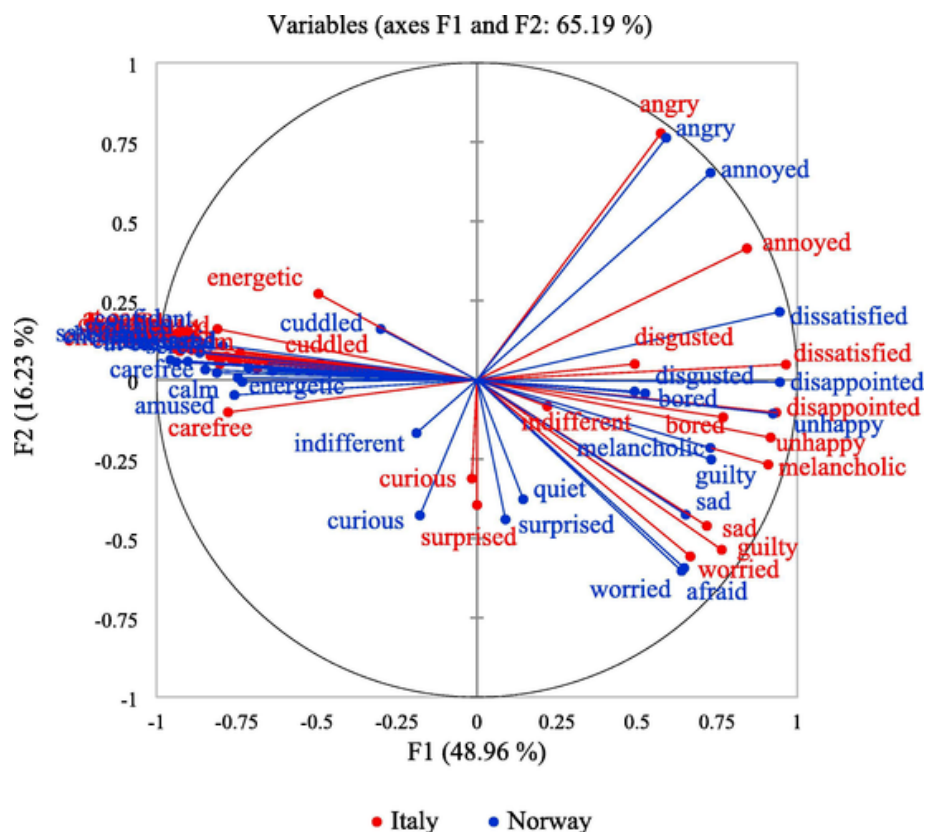


Fig. 2. Multiple factor analysis (MFA) on the total frequencies (n) of emotion words between Italy (red, children n = 92) and Norway (blue, children n = 109); overlapped emotion words (left side of the quadrant) include amused, at ease, cheerful, confident, enthusiastic, gratified, happy, quiet, reassured, relaxed, satisfied, serene. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

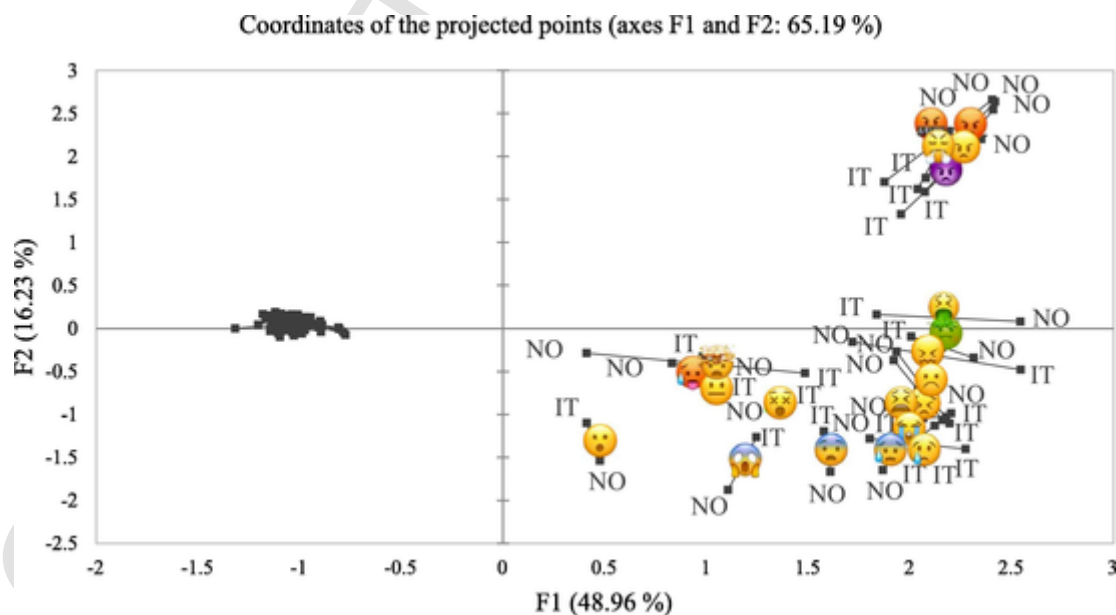


Fig. 3. Multiple Factor Analysis (MFA) of coordinates of the projected points comparing the meaning of emoji between countries. Emoji and labels are not shown on the left side of the figure due to overlapping of projected points.

😐, 😊, 😌, 😍, 😔, 😞, 😟, and 😠 did not discriminate between any of the items of the vegetable category.

Interestingly, in the dessert/ juice category (Table 3), natural yogurt (M = 5.5) and orange juice (M = 5.8) did not differ in liking but they differ in emoji pairs/emotions; natural yogurt was associated with the

emoji pair 😐😐 (“indifferent - calm”) (39 % vs 17 %, $p < 0.0001$), while orange juice was associated with the emoji pair 😌😌 (“calm - quiet”) (30 % vs 13 %, $p = 0.045$) and 😍😍 (“cuddled – in love”) (28 % vs 10 %, $p < 0.0001$) predicting a preference for the orange juice over natural yogurt. In the fruit category (Table 4), both liking

Table 2

Emotional (frequencies %) and mean hedonic responses to vegetables (n = 6) evaluated by 103 preadolescents. ^{a,b,c} different letters in a row indicate significant differences between vegetables according to post-hoc tests; in bold = frequencies (%) in the same row with different letters are significantly different at $p < 0.05$; in grey = emoji pairs discriminating between vegetables despite similar liking.

Emoji pairs	Peas	Spinach	Tomato	Broccoli	Corn	Carrots	p-value
	4 a	33 ab	8 ab	10 ab	13 ab	17 b	0.013
	7 a	9 ab	12 ab	11 ab	21 b	18 ab	0.010
	13	14	17	18	14	23	0.199
	3 a	2 a	11 ab	9 ab	20 b	19 b	<0.0001
	7	8	18	12	17	19	0.022
	15 a	17 a	22 a	40 b	28 ab	27 ab	<0.0001
	3	33	10	11	10	11	0.175
	35 ab	46 b	19 a	33 ab	22 a	27 a	0.000
	13	13	10	9	9	7	0.656
	8	12	13	33	33	4	0.111
	16 ab	7 a	20 b	9 ab	8 a	5 a	0.001
Mean liking	3.9 a	4.2 ab	4.4 ab	4.8 bc	5.4 c	5.5 c	<0.0001

Table 3

Emotional (frequencies %) and mean hedonic responses to desserts/fruit juices (n = 6) evaluated by 95 preadolescents. ^{a,b,c,d} different letters in a row indicate significant differences between desserts/fruits according to post-hoc tests; in bold = frequencies (%) in the same row with different letters are significantly different at $p < 0.05$; in grey = emoji pairs discriminating between desserts/juices despite similar liking.

Emoji pairs	Dark chocolate	Fruit yogurt	Natural yogurt	Orange juice	Vanilla ice cream	Milk chocolate	p-value
	5 a	10 a	3 a	15 a	40 b	47 b	<0.0001
	13 ab	13 ab	5 a	7 a	16 ab	23 b	0.001
	18 ab	19 ab	14 a	19 ab	27 ab	31 b	0.019
	16 ab	19 ab	13 a	23 ab	24 ab	31 b	0.011
	18 ab	16 ab	10 a	28 b	47 c	66 d	<0.0001
	16 ab	15 ab	11 a	20 abc	35 c	30 bc	<0.0001
	24 ab	28 ab	13 a	30 b	23 ab	26 ab	0.045
	11 a	13 ab	10 a	19 ab	22 ab	25 b	0.001
	22 a	20 a	39 b	17 a	7 a	7 a	<0.0001
	10 b	3 ab	5 ab	2 ab	2 ab	0 a	0.010
	14 b	2 a	7 ab	3 a	1 a	1 a	<0.0001
Mean liking	4.6 a	5.5 b	5.5 b	5.8 b	6.4 c	6.6 c	<0.0001

and emoji pairs discriminated between food items, however, in this case emoji were not discriminating in cases of similar liking between food items.

In some cases, emoji did not discriminate between foods, while liking did, which was the case in the fruit category but not in the vegetable and dessert/juice category. For example, apple and grapes were more liked than pineapple, clementine, and orange, while there was no discrimination in emotions.

4. Discussion

The current research investigated the semantic meaning of emoji used to describe food experiences comparing Italian and Norwegian preadolescents, which contributed with important insights by demonstrating a cross-national similarity in the interpretation of emoji related

to food. This was a necessary step to apply the Emoji Pair Questionnaire (previously developed with Italian preadolescents, Sick et al., 2022) that was used with Norwegian preadolescents by testing its discriminatory ability with various food names. The following sections will dive deeper into the specific findings.

4.1. The semantic meaning of emoji comparing Italian and Norwegian preadolescents

It was demonstrated that emoji meanings highly overlap between countries, with 28 out of 30 emotion words being significantly correlated. This is in agreement with prior studies comparing the semantic meanings of emoji across different languages in four countries in adults (English - USA and UK, Spanish - Spain and Italian - Italy) (Barbieri, Kruszewski, Ronzano, & Saggion, 2016). Barbieri et al. (2016) stated that despite the differences in emoji use across languages, the overall semantics of the most frequently used emoji are comparable. Also, Jaeger & Ares (2017) did not find major differences of emoji meanings between adults of different cultural backgrounds, even when comparing Chinese consumers to meanings reported in Western websites. As Norway and Italy are both European countries, cultural differences in emoji use may be small. Also, Novak et al. (2015) investigated the sentiment of emoji of 13 European languages with adults (Albanian, Bulgarian, English, German, Hungarian, Polish, Portuguese, Russian, Serbian/Croatian/Bosnian, Slovak, Slovenian, Spanish and Swedish) and reported agreement in emoji meaning with the highest agreements found among English- and Polish-speakers.

“Indifferent” and “quiet” were the only emotion words that were not correlated between countries. Both emotion words (“indifferent” and “quiet”) are low in activation level, which could be related to differences in the interpretation of the activation level in emotional expression between countries. As mentioned by Schouteten & Meiselman (2021) certain cultures might avoid expressing strong feelings and affect from other people as well as themselves. When we look at the emoji (Supplementary Materials Table S4), the largest differences were found for the emoji 😐 that 58 % of Italian children associated with “indifferent”, and the emoji 😊 that 50 % of Italian children associated with “quiet”, while these emoji were not associated with any specific word by Norwegian preadolescents. The Emoji Pair Questionnaire (Sick et al., 2022) includes 34 emoji (17 emoji pairs), and it was demonstrated that the meanings of these emoji highly overlap between these two countries (Table S4).

In the Italian study, most positive emoji were described by “happy”, while in the Norwegian study most positive emoji were described by “cheerful”. “Happy” and “cheerful” are both very positive and activated emotion words describing very similar emotional constructs. As this pattern was observed throughout most positive emoji, it may be that when translating the emotion words from English to Italian and Norwegian, the words resulted in a slightly different meaning for each country. As emotion word concepts (e.g., fear, anger, surprise, happiness) are influenced by language and culture, the translation of emotion words from one to another language may be accompanied by some variation of the core meaning of a given emotion word (Barrett, 2006a) and therefore a direct translation (with a word with the same level of familiarity of the original for the speakers) may not always be possible. Furthermore, Italian preadolescents used more emotion words to describe emoji, which could mean that Italian children are more granular compared to Norwegian preadolescents when describing the emotional meaning of emoji. A higher granularity is defined by individuals that describe their experiences in more precise, differentiated terms, thereby using discrete emotion labels that captures the distinctiveness in the words’ meaning (Barrett, 2006b). Another explanation could be that Italians do not differentiate very clearly between emoji meanings and/or between emotion words. While Norwegian preadolescents use less emotion words for each emoji, there is a clearer differentiation be-

Table 4

Emotional (frequencies %) and mean hedonic responses to fruits (n = 9) evaluated by 120 preadolescents. ^{a,b,c,d} different letters in a row indicate significant differences between fruits according to post-hoc tests; in bold = frequencies (%) in the same row with different letters are significantly different at $p < 0.05$.

Emoji pairs	Pineapple	Clementine	Orange	Kiwi	Apple	Grapes	Raspberry	Watermelon	Strawberry	p-value
	19 ab	17 ab	13 a	11 a	14 a	18 ab	23 abc	33c	28 bc	<0.0001
	18	13	13	18	15	15	20	15	13	0.649
	20	17	20	19	24	18	22	26	28	0.342
	19	23	26	28	31	28	35	28	28	0.142
	21 ab	20 ab	17 a	23 ab	22 ab	34 bc	42 cd	53 d	55 d	<0.0001
	19	17	17	18	23	23	28	29	30	0.009
	23	32	26	30	24	25	26	27	28	0.788
	11	13	16	12	14	14	18	18	18	0.547
	27 b	14 ab	18 ab	23 ab	16 ab	20 ab	11 a	14 ab	8 a	0.001
Mean liking	5.3 a	5.5 a	5.5 a	5.7 ab	6.0 bc	6.1 bc	6.3 cd	6.3 cd	6.6 d	<0.0001

tween the emotion words and emoji with a more specific meaning for each emoji. Overall, the findings showed high agreement between Italian and Norwegian preadolescents, which allowed the application of the CATA Emoji Pair Questionnaire (Sick et al., 2022) with Norwegian preadolescents.

4.2. Study 2: Emotions discriminate between food names in Norwegian preadolescents

The current results showed that familiar foods presented as food names were discriminated in emotions (using the CATA Emoji Pair Questionnaire) as well as in liking. Furthermore, for some food names emotions discriminated, even when there was no significant difference in acceptability. This is particularly meaningful as the study was conducted only on familiar foods, thus reducing the hedonic variability among the products. The results indicate that even when differences between products are limited or absent in terms of acceptability and familiarity, the Emoji Pair Questionnaire may be able to discriminate the emotional experience of the products.

Studies using the CATA approach with emoji to measure emotional responses to foods in preadolescents found that emoji discriminated between different foods (Gallo et al., 2017; Schouteten et al., 2019; Schouteten, Verwaeren, Lagast, Gellynck, & De Steur, 2018), which supports the importance of using emoji in product discrimination. However, using emoji pairs (instead of single emoji) in the CATA questionnaire is a new method that has never been investigated before neither with adults nor children. Furthermore, the use of the Emoji Pair Questionnaire allowed to interpret the emotional responses described by the emoji thanks to its association with emotion words. Positive emoji/emotions were shown to have a better discriminant ability compared to negative emoji/emotions (see Tables 2-4), which is in accordance with previous findings with adults (Cardello et al., 2012; Schouteten et al., 2019).

In this study, foods were discriminated by both positive and negative emoji pairs. Food names elicited mainly positive emotions, which was observed within food categories, and which is coherent with the fact that only familiar foods were selected. These results confirm the hedonic asymmetry found in adults as described by Desmet and Schifferstein (2008) and support previous findings that people mainly use positive emotions to describe food and beverage products (Bhumiratana, Adhikari, & Chambers, 2014; Cardello et al., 2012). Also, some negative emoji pairs were significant discriminators between some food items. For example, the emoji pair (“disgusted - nauseated”) discriminated tomato from spinach despite similar liking and helped to further characterize the differences in affective responses between dark chocolate and fruit yogurt, while the emoji pair (“unhappy - annoyed”) helped to further characterize the differences in affective responses between dark chocolate and milk chocolate.

“unhappy - annoyed”) helped to further characterize the differences in affective responses between dark chocolate and milk chocolate.

The strongest discriminating dimension was the valence dimension dividing foods into products eliciting positive or negative emotions. It has been argued that valence positively correlates with liking, while activation does not show this straightforward relation with liking in adults (Gutjar et al., 2015). Instead, arousal seems to capture some particular information on how a food is experienced (Gutjar et al., 2015). Here, it has been found that food items were discriminated by emotions varying in arousal along the second dimension, which may be one of the components that explain why emotions discriminated better compared to liking in some cases. For example, tomato and spinach were discriminated by emoji pairs/emotions of different activation level; while tomato was associated with emotions higher in activation like (“disgusted - nauseated”), spinach was associated with emotions lower in activation like (“indifferent - calm”).

Even though both emotions and liking discriminated between products, emotions may still give more information about why a product may be preferred to another. For example, in the dessert/juice category, children disliked and felt more disgusted (, “disgusted - nauseated”) towards dark chocolate compared to fruit yoghurt. Emotions of disgust were shown to be associated with lower preference for bitter tasting solutions (Bredie, Tan, & Wendin, 2014), which can lead to food avoidance (Randler et al., 2017). In the same category, vanilla ice cream was more liked and elicited more emotions of love (, “cuddled - in love”) compared to orange juice. Vanilla ice cream tastes sweeter and less sour than orange juice and may be associated with emotions of stronger positive valence. Furthermore, vanilla ice cream may be associated with more positive and “special” food experiences (e.g., ice cream as a reward or on holidays) in children resulting in emotions of love. The highest selection frequency in emoji was for milk chocolate, where 66 % of children selected the emoji pair (“cuddled - in love”). These results are in line with Cardello et al. (2012), where chocolate was associated with the terms active, affectionate, energetic, happy, loving and satisfied in adults.

In the fruit category, emotions did not outperform liking in their discriminant ability and for this category liking even discriminated between some fruits when emotions did not discriminate at all. For example, apple and grapes were more liked than pineapple, clementine, and orange, while there was no discrimination in emotions. This may be due to smaller differences in liking among products evaluated in this category (mean liking ranged from 5.3 to 6.6, compared to 3.9 to 5.5 in the vegetable category and 4.6 to 6.6 in the dessert/juice category). Another explanation could be that the selected food names of the fruit category showed a rather high mean liking for all fruits thereby eliciting a range of positive emotions in general. Future research should investigate if these findings remain similar with different fruits and if present-

ing these fruits as written stimuli (food names) vs actually tasting the food stimuli influence the results as previously it was shown that this can impact emotional responses in preadolescents (Gallo et al., 2017). Therefore, this should also be tested for vegetables and desserts/juices. Lastly, it should be noted that in the current study acceptance was only measured in one way (7-point hedonic scale), hence, it would be interesting to measure the degree of liking of a product with other scales (e.g., other category scales, rating scales, or visual analog scales) to further investigate the discriminant ability compared to the Emoji Pair Questionnaire.

Lastly, we would like to mention some aspects that could be further expanded in future research. In Study 1, the sample size of around 100 participants for each country might not be fully representative of the target population. Therefore, future research could include a broader range of children so other factors could be considered such as differences in age, socio-economic classes, urban vs rural areas, parental feeding styles etc. Furthermore, the set ups in Study 1 differed between countries (instructors in presence in Italy vs video conference in Norway), which could have affected the way children experienced the test. In particular, children in Italy may have been more motivated and/or intimidated due to the presence of external visitors to the schools. Also, as mentioned in section 4.1., the translation of emotion words may be affected by differences in language as some emotion words exist in one language but not in another (Ares, 2018). Finally, even though we use the term cross-national study, one should be aware that cultural differences exist between Norway and Italy despite the fact that they are both European countries.

4.3. Conclusions

In summary, the general meanings of emoji overlap between Italian and Norwegian children with some minor differences for some emoji. This enables the application of the Emoji Pair Questionnaire with Norwegian children to describe emotional responses to foods. Future research should investigate if emoji meanings is shared with children of other countries/cultures, to allow using the questionnaire across different countries/cultures besides Italy and Norway. The CATA Emoji Pair Questionnaire was found to be a useful tool to measure preadolescents' emotional responses to food names and to discriminate between and within food categories of fruits, vegetables, desserts/juices and discriminated for the latter two despite similar liking of the products.

CRedit authorship contribution statement

J. Sick : Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **V.L. Almi** : Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Project administration, Funding acquisition. **C. Dinnella** : Methodology, Investigation, Data curation, Writing – review & editing. **I. Berget** : Formal analysis, Writing – review & editing. **E. Monteleone** : Conceptualization, Methodology, Writing – review & editing, Supervision, Project administration, Funding acquisition. **S. Spinelli** : Conceptualization, Methodology, Investigation, Data curation, Writing – review & editing, Supervision, Project administration.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

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Declarations of conflicts.

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodqual.2022.104791>.

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