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Children's selection of emojis to express food-elicited emotions in varied eating contexts

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1

2 *Research Article*

3

4 **Children's selection of emojis to express food-elicited emotions in** 5 **varied eating contexts**

6

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14

15

16 **Abstract**

17 Emojis were suggested for children to be used to measure food-elicited emotions. The present
18 study was aimed to explore the appropriateness of emojis to describe pre-adolescents' emotions
19 elicited by foods recalled in relation to different evoked eating contexts and to explore related
20 age- and gender differences. Fifty-five boys and forty-one girls aged 9-13 participated to the
21 study. First, subjects were asked to recall, by means of an open-ended question, the foods they
22 had in specific eating contexts: "Most liked food" and "Most disliked food", "Breakfast",
23 "Dinner", "Snack", "Birthday" and "Novel food". Then, they were asked to select the emojis
24 appropriate to describe their feelings for the context-related foods by selecting from a list of 92
25 facial emojis (CATA method). Emojis selected by more than 20% of children in at least one
26 eating context qualified as food-related. In total, 46 emojis resulted as appropriate to describe
27 emotions in different eating contexts. Pre-adolescents used mainly positive emojis, except for
28 the context "Most disliked food", where mainly negative emojis were used. Most food-related
29 emojis resulted from "Most liked food" and "Most disliked food", but the context "Birthday"
30 also added some context-specific emojis. The number of selected emojis varied across evoked
31 eating contexts eliciting different foods. Age and gender significantly affected emoji selection
32 across and within foods elicited by varied eating contexts, with girls and 9-11-year-old subjects
33 selecting some emojis more frequently across all contexts, but also within contexts. The
34 approach used in the present study has the potential to be used for the development of a food-
35 related emotion measurement tool for pre-adolescents. Future research aimed at interpreting the
36 meaning of facial emojis is needed and should consider age- and gender differences.

37

38 **Keywords**

39 Children, CATA, Emotions, Emoji, Food, Eating context.

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40 **1. Introduction**

41 **1.1. Background**

42 Emotions have been shown to play an important role in children's food preference assessment
43 as they can help to better discriminate between food products compared to the sole use of liking
44 measurements and to better predict product performance (Schouteten, Verwaeren, Lagast,
45 Gellynck, & De Steur, 2018). In addition, investigating children's emotional responses to foods
46 is important because emotional profiles can help to understand drivers of food choice in order
47 to promote healthier and tastier foods (Jiang, King, & Prinyawiwatkul, 2014; Macht, 2008), but
48 in order to measure food-related emotions, the development of a reliable emotion measurement
49 tool is required (Cardello & Jaeger, 2016). Self-reported questionnaires using words have been
50 the most common method for the evaluation of emotional responses to food products (see
51 Meiselman, 2016; Spinelli & Monteleone, 2018) with promising results to be used with children
52 (De Pelsmaeker, Schouteten, & Gellynck, 2013; Gallo, Swaney-Stueve, & Chambers, 2017b;
53 Jervis, Jervis, Guthrie, & Drake, 2014).

54
55 More recently emojis were shown to have the ability to describe emotional responses and to
56 discriminate between food products both in adults (Jaeger, Lee, et al., 2017, 2018; Jaeger,
57 Roigard, & Ares, 2018; Jaeger, Vidal, Kam, & Ares, 2017) and children (Gallo et al., 2017b;
58 Schouteten, Verwaeren, Gellynck, & Almli, 2019; Schouteten et al., 2018; Swaney-Stueve,
59 Jepsen, & Deubler, 2018). Emojis are small icons used in digital communication to express
60 emotions/feelings (Kaye, Malone, & Wall, 2017; Wikipedia, 2019) that are commonly used on
61 various social media platforms and smartphones worldwide (Lu et al., 2016). The use of social
62 media and digital communication is gaining more and more popularity among young adults and
63 children (Commonsensemedia, 2016), which makes emojis a medium that is already familiar
64 to them. Emojis could have the advantage to offer a non-verbal way of conveying meanings
65 that otherwise cannot be expressed with words or that would be expressed differently. This can
66 also be an advantage for younger children with reduced verbal skills and limited vocabulary,
67 but also for shy children that struggle to communicate information about their feelings. The use
68 of emojis implies a game-like situation and seems to be an easy and intuitive tool to measure
69 emotions/feelings in children (see Laureati & Pagliarini, 2018).

70 Intensive research on emojis in adults has been conducted by Jaeger and colleagues showing
71 that some emojis can discriminate between food stimuli, which included different samples of
72 muesli bars and popcorn as tasted stimuli and milk, water, red wine and chocolate as written
73 stimuli (Jaeger, Roigard, et al., 2018; Jaeger, Vidal, et al., 2017). However, as children differ
74 from adults in many developmental aspects, emoji lists have to be age-appropriate, hence, they
75 need to be specifically developed or adjusted for children. When assessing emotions through
76 self-report measures, it is inevitable to consider the children's age in the selection of emotions
77 as the developmental status affects the way the children respond to self-report measures
78 (Zeman, Klimes-Dougan, Cassano, & Adrian, 2007). In contrast to younger children (5-6 y.o.),
79 older children (8-12 y.o.) have already a more developed ability to conceive that multiple
80 emotions can be experienced concurrently (Larsen, To, & Fireman, 2007). Pre-adolescents
81 (aged 9-13) develop an increased drive for autonomy (Eccles, 1999) and an enhanced

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82 developmental ability to express themselves appropriately when responding to self-reported
83 questionnaires (see Laureati & Pagliarini, 2018). Additionally, pre-adolescents start to become
84 more familiar with social media and digital communication, with increasing familiarity with
85 age; 23% of children aged 8-12 have a social media account, in contrast to 80% of children
86 aged 13-18 (Commonsensemedia, 2016; Howard, 2018). This steep rise of social media usage
87 in the transition from early to late pre-adolescence and adolescence could affect how familiar
88 emojis are to children and the way in which they use them.

89

90 Although emojis seem to be a promising tool to be used in pre-adolescent's emotion
91 measurement in response to food, until now only a limited number of studies investigated pre-
92 adolescent's food-elicited emotions using emojis (Gallo, Swaney-Stueve, & Chambers, 2017a;
93 Gallo et al., 2017b; Schouteten et al., 2019, 2018; Swaney-Stueve et al., 2018). Additionally,
94 Schouteten et al. (2018) pointed out that it is still unclear how to use emojis to describe food
95 products with pre-adolescents, especially how they should be selected and which number of
96 emojis is appropriate to use.

97 Due to the high number and diversity of available emojis, researchers followed different
98 procedures to develop emoji lists and scales and to select the appropriate number of emojis to
99 be tested in a reliable tool for food-related emotion measurement. The selection of emojis
100 ranged from conducting focus groups with 8-11 y.o. children (Gallo et al., 2017a) to relying on
101 pre-defined emoji lists of former studies based on adults (Schouteten et al., 2018) and on pre-
102 tests of a pre-defined list based on both responses of adults and 8-11 y.o. children (Schouteten
103 et al., 2019). Gallo et al. (2017a) developed an emoji list originating from focus groups with a
104 total of 17 children aged 8-11, who were asked how they felt about their favorite, least favorite
105 and "just okay" food in different eating contexts. The facial emojis used in the study were
106 obtained from an internet data base and pre-selected by a researcher to limit emojis that might
107 not be relevant when evaluating food. Based on children's use of emojis through discussion and
108 activities, a list of 38 emojis was considered appropriate for further emotion testing with
109 children aged 8-11, while other lists comprised of 28 (Gallo et al., 2017b) or even 20 emojis
110 (Schouteten et al. 2019) in the case of a product-specific list.

111

112 The papers reported above have the merit of pointing out the need of specifically developing
113 an emoji list that can be used to measure food-related emotions with an age-specific group of
114 children. However, given that there is a growing number of newly developed facial emojis, it
115 is important to consider the wide spectrum of emojis available that have the potential to measure
116 food-elicited emotions in children. This means that it is difficult to rely on pre-existing lists
117 when an emoji-based tool measuring food-related emotions has to be developed for a specific
118 age group of children. In addition, cross-cultural differences could be expected between
119 children of different countries as it was shown that emoji usage, preferences and their meanings
120 can differ across countries (Barbieri, Kruszewski, Ronzano, & Saggion, 2016; Lu et al., 2016).

121

122 Another point that needs to be considered is which and how food items should be presented to
123 children to select food-related emojis. As emotions are much influenced by interactions

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124 between the person and the environment, it is important to consider contextual aspects in
125 emotion research with children (Zeman et al., 2007). Foods evoke associated memories of
126 previous eating occasions and are thus linked to emotions experienced on these occasions
127 (Köster & Mojet, 2015), which highlights the importance of including situational factors when
128 evoking food-related emotions.

129

130 In addition to the general aspects presented above, a more specific research question in selecting
131 food-related emojis for consumer testing with children is: Is there a difference in the use of
132 food-related emojis in children of similar age? This question is particularly relevant in studies
133 conducted with pre-adolescents, since even within a limited age interval (9-13 years) subjects
134 may have profound changes in their social interaction (Eccles, 1999). For example, during pre-
135 adolescence, children make a transition from primary to secondary school, which means a
136 change of their social environment leading to important developmental advances such as
137 gaining more self-esteem and individuality (Eccles, 1999). Differences in emotion expression
138 have been previously found across childhood from toddler/preschool age into adolescence
139 (Chaplin & Aldao, 2013).

140

141 Furthermore, attention has to be paid to differences in emotion expression and non-verbal
142 communication between genders (Kring & Gordon, 1998). A meta-analytic review on emotion
143 expression in children demonstrated that boys and girls differed in emotion expression. Girls
144 expressed more positive emotions, which became even more evident with increasing age into
145 adolescence compared to boys. Girls also showed more internalizing emotions (e.g. sadness
146 and fear), whereas boys expressed more externalizing emotions (e.g. anger) (Chaplin & Aldao,
147 2013). Similar findings were shown in adults (Fischer, Rodriguez Mosquera, Van Vianen, &
148 Manstead, 2004). Women tend to use more emojis in their digital communication than men
149 (Chen et al., 2018), which could be explained by their increased emotion expression. However,
150 no gender differences were found in a study investigating if emoji questionnaires can be used
151 equally across gender and age groups in adults when characterizing stimuli with emojis with
152 Chinese and New Zealander participants (Jaeger, Xia, et al., 2018). However, more research is
153 needed to clarify if there are gender differences in emoji questionnaires in pre-adolescents.

154

155 The present study was aimed to explore the appropriateness of emojis, including facial emojis
156 that have never been studied before with pre-adolescents in this context, to describe pre-
157 adolescents' emotions elicited by foods recalled in relation to different evoked eating contexts.
158 Furthermore, the study aimed at exploring related age- and gender differences in how emojis
159 are selected for each evoked eating context. The purpose of this study is to select a list of emojis
160 used by pre-adolescents to describe their food experience to be used in further studies with self-
161 report measures (questionnaires).

162

163

164 **2. Methods**

165 **2.1. Participants**

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166 Ninety-six subjects (55 boys) aged 9-13 (mean age \pm SD of 10.9 \pm 1.5, in both gender groups)
167 were recruited in primary and secondary schools in Florence area, Italy. Children were grouped
168 into two age groups of 9-11-year-olds (24 girls and 31 boys) attending primary school and 12-
169 13-year-olds (17 girls and 24 boys) attending secondary school. Only children who returned a
170 signed consent form from their parents and who agreed to voluntarily participate in the study
171 by signing their own consent form were allowed to participate. There were no other exclusion
172 criteria set as no child should feel excluded from the study. Recruitment criteria and data
173 treatment were planned in accordance to the principles of the Declaration of Helsinki. The study
174 was approved by the Ethical Committee of the University of Florence, Italy.

175

176 **2.2. Data collection**

177 Testing took place in the regular classrooms of the schools by collecting data in one school
178 class at a time. The testing lasted approximately one hour and was conducted in the morning.
179 The children sat in their general seating order either in rows or in groups of 2-6 children.
180 During each testing session, one instructor and 3-4 assistants were present to ensure the
181 protocol-based procedure and helped to distribute the tablets. The teacher was present during
182 the session to ensure the children were less distracted and felt more at ease. Before each session,
183 the instructor explained the questionnaire and made sure all children were confident how to use
184 the tablets. Children were allowed to ask for assistance in case they had difficulties in how to
185 use the tablets. Data were collected on tablets (Acer Iconia One 10, Android 7.0) using the
186 software Compusense Cloud (Compusense, Inc., Guelph, Ontario, Canada).

187

188 **2.3. Emoji**

189 Emojis were obtained from Apple iOS 12.2 (Apple, inc, Cupertino, CA) accessed through
190 Emojipedia on the 4th of April 2019 (Emojipedia, 2019). It was intended to only use facial
191 images for the selection of food-related emojis and to use all facial emojis that were available
192 at that time point. This approach was adopted due to the explorative nature of the study to let
193 only pre-adolescents select food-related emojis that they considered appropriate, contrary to
194 studies with pre-adolescents that conducted a pre-selection of emojis by adults (Gallo et al.,
195 2017a, 2017b; Schouteten et al., 2019; Swaney-Stueve et al., 2018). In total, 92 facial emojis
196 were considered for the study. One of the school classes acted as a pilot class to pre-test, if
197 children had any difficulties with the length of the emoji list and if boredom effects occurred.
198 Children did not express any problem with the emoji list and found the test easy to do. Emojis
199 are depicted in Table 1 with their names retrieved from Emojipedia (Emojipedia, 2019). The
200 names were not displayed to the children. The order of emojis was randomized for each child
201 and for every food context.

202

203 **2.4. Procedure**

204 The test was individual. Subjects were asked to recall foods associated to seven eating contexts
205 by using an open-ended response option (written response to an evoked context). The eating
206 contexts included "Breakfast" (breakfast of the morning before coming to school), "Dinner"
207 (yesterday's dinner), "Snack" (yesterday's snack consumed in the morning or in the afternoon),

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208 “Birthday” (a typical food consumed during their last birthday party), a “Novel food” (the
209 children were asked to recall a situation in which they were invited to taste a food they never
210 tasted before; e.g. at a friend’s or relative’s place) and “most liked/most disliked foods”. After
211 describing foods related to the first evoked eating context children were presented with the 92
212 facial emojis and asked to check those that apply (Check-All-That-Apply format) to describe
213 how they feel in response to the self-selected foods. The same two-step procedure was repeated
214 for all the considered eating contexts.

215 As soon as a child finished the first part of emoji selection, they were asked to solve a riddle
216 until the last child finished the emoji selection task. Then, children were asked about
217 demographics (gender and age) and to fill in a questionnaire (Supplementary materials 1 - Table
218 S1) about emoji usage and asked to evaluate the test. Several domains of emojis usage were
219 considered: Familiarity; Frequency of usage; Social use; Motivation; Valence of emojis;
220 Enjoyment in using emojis; Two more questions were asked to the children to know how
221 difficult the test was (*very difficult/a bit difficult/neither difficult nor easy/ easy/very easy*) and
222 how much they enjoyed it (*by no means/a bit/so and so/fairly/a lot*).

223

224 **2.5. Data analysis**

225 Data from the questionnaire on emoji usage were analyzed by computing frequencies (%) of
226 children that responded to each question. Gender and age effects on familiarity, frequency of
227 usage of emojis and enjoyment were tested by using Kruskal–Wallis One–Way Analysis of
228 Variance by ranks. Chi-squared test was applied to test differences between genders and age
229 groups in each item of the other domains.

230 For each eating context, the frequency of each emoji across subjects was determined. Emojis
231 selected by >20% of participants in at least one eating context qualified as food-related emojis.
232 Emojis ≤20% were not considered for further analysis as they did not qualify as food-related
233 emojis, with some exception of emoji that were assumed to be potentially relevant but not
234 sufficiently aroused by our stimuli (eating contexts).

235 Average emoji selection across eating contexts was calculated for genders and age groups
236 separately. Age- and gender differences in the frequency of selection of each emoji were tested
237 by using a Chi-square test for each eating context.

238 The level of significance for all the analysis was set at $p \leq 0.05$. Statistical analyses were
239 performed using XLSTAT (Version XLSTAT 2018.7, Excel 14.0.6024, Windows 10, Build
240 54971, XLSTAT-Sensory).

241 For each evoked eating context, the frequency of recalled foods was analyzed using the text-
242 analysis software T-LAB 2020.1 (Plus version 5.1.0.4; T-LAB di Lancia Franco, Italy). First,
243 words not relevant for analysis (stop words such as “and”, “the”, “a” and “an”) were removed.
244 Secondly, foods that were very similar were grouped (e.g. Italian “focaccia” and “panino” were
245 grouped into “sandwich”); when a food in a food category was frequently mentioned it was not
246 grouped under the category label but, instead, it was considered as a separate food item (e.g.
247 *broccoli*, *spinach* and other frequently mentioned vegetables in the context “Most disliked
248 foods” were counted separately, while all other vegetables were grouped under the *vegetable*
249 label). Frequency of foods (foods occurring only once were excluded) were visualized as a word

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250 cloud using XLSTAT. Foods stated more frequently were displayed in bigger letters and foods
251 stated less frequently were displayed in smaller letters.

252

253

254 3. Results

255 3.1. Emoji Usage Questionnaire (EUQ) and test evaluation questions

256 Most children found that the test was very easy (63%) or easy (22%) to do and enjoyed
257 participating in it a lot (76%) or fairly (18%) regardless of gender and age. No significant gender
258 differences were found for neither of the domains of the EUQ (see Supplementary materials 1
259 - Table S1). In contrast, a significant age effect was found for “familiarity with” and “frequency
260 of use” of emojis and for specific items of the domains “social use” and “valence of emojis”.
261 Emojis were shown to be very familiar across subjects. Overall, children reported to use them
262 regularly (68%) or occasionally (26%), but older children were more familiar with emojis than
263 younger ($p=0.006$). In general subjects used emojis a few times a week (42%) or every day
264 (24%), whereof 12-13-year-olds showed higher frequency of usage ($p=0.007$). Social use of
265 emojis was shown to be mostly popular among friends (75%), with relatives (57%) and with
266 parents (55%). Older children significantly differed from the younger ones for a higher
267 frequency of the items “send emojis to friends” ($p<0.0001$), “to parents” ($p=0.026$) and “to
268 teachers” ($p=0.017$).

269 Seventy % of subjects reported emojis being fun to use, which was the highest consensus among
270 children compared to the other items within the domain “motivation”. Lower percentages of
271 children reported that emojis can be used to express something that normally cannot be
272 described in words (45%), that they make text messages more understandable (45%) and that
273 they can be used instead of words (42%). Age did not affect responses for any item of the
274 motivation domain.

275 Children reported to use mostly positive emojis (72%) and enjoy using emojis a lot (65%) or
276 fairly (25%).

277

278 3.2. Foods recalled by each evoked context

279 Children reported foods that were consumed in seven eating contexts in response to an open-
280 ended question (e.g. Figure 1; see Supplementary materials 2 – Figure S1a-g for all eating
281 contexts). The type of foods was found to be specific for each eating context. For the “Most
282 liked food” the most occurring foods were *pizza* (40%) and *pasta* (28%); for the “Most disliked
283 food” it was *broccoli* (17%) and *spinach* (16%); for “Breakfast” it was *milk* (55%) and *biscuits*
284 (50%); for “Dinner” it was *pasta* (32%) and several other foods like *chicken*, *salad*, *vegetables*
285 and *fish* (14-16%); for “Snack” it was *bread* (31%) and *Nutella*, *sandwich* and *ham* (13-15%);
286 for “Birthday” it was *cake* (51%) followed by *pizza*, *chips* and *chocolate* (14-21%). For the
287 context “Novel food” foods were more specific for each child resulting in a wider variety of
288 foods e.g. *vegetables* (13%), *specific combinations of pasta with sauce* (11%), *other non-Italian*
289 *recipes* (10%), *oriental recipes* (7%) and *fish* (6%).

290

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292 Please insert Figure 1 around here.

293

294

295 **3.3. Food-related emojis**

296 In total, 44 emojis were associated with a frequency of at least 20% to foods recalled by each
297 evoked eating contexts and thus were qualified as “food-related” (Table 1). *Neutral face* (😐)
298 and *face with open mouth* (😱) were selected less than 20%, but still considered for further
299 analysis because they were assumed to be potentially relevant for the association with the
300 emotions of “surprise” and “indifference”. They were also included in previous studies with 8-
301 11 y.o. pre-adolescents (Schouteten et al., 2019). Consequently, the complete food-related
302 emoji list comprised of 46 emojis.

303 During data analysis, significant age- and gender differences were detected, which are described
304 more in detail in the following sections.

305

306

307 Please insert Table 1. around here.

308

309

310 **3.4. Emojis associated to foods recalled by varied evoked eating contexts**

311 It was shown that the number of emojis associated to recalled foods varied across eating
312 contexts (Table 2). The highest number of emojis associated to foods recalled by the evoked
313 context resulted for “Most liked food” (23 emojis), followed by “Birthday” (21 emojis), “Most
314 disliked food” (19 emojis), “Snack” (10 emojis), “Novel food” (9 emojis), “Breakfast” (7
315 emojis) and “Dinner” (6 emojis).

316 Emojis associated to foods recalled by the contexts “Birthday”, “Snack”, “Novel food”,
317 “Breakfast” and “Dinner” were mostly positive. They were also associated to foods of the
318 context “Most liked food”. However, emojis selected to describe foods for “Birthday” included
319 two specific ones that did not appear in “Most liked food” such as *smiling face with halo* (😇)
320 and *squinting face with tongue* (😜). Frequencies of the most selected emojis in response to
321 foods recalled by these “positive” eating contexts varied from 30 (“Novel food”) to 58%
322 (“Birthday”).

323 As expected, subjects associated mostly negative emojis with their “most disliked food”. Within
324 this context, children also had the highest agreement for the use of the emoji *face vomiting* (🤮)
325), with 85% of respondents that defined this emoji as appropriate to describe their experience
326 of the foods recalled by this context.

327

328

329 Please insert Table 2. around here.

330

331

332 **3.5. Gender differences in emoji selection**

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333 In general, females selected food-related emojis more frequently than males (Figure 2). Girls
334 selected an average of 8.8 emojis across all evoked eating contexts in contrast to boys that
335 selected on average 7.3 emojis. Significant gender differences were also found in emoji
336 frequencies describing foods evoked by each eating context except for "Novel food".
337 Especially, emojis with hearts were selected more often by girls in general and in some specific,
338 eating contexts. Frequencies of the *smiling face with heart-eyes* (😍) were significantly higher
339 ($p<0.05$) in females than in males for the foods recalled by the contexts "Most liked food,
340 "Breakfast, and "Snack". The same significant ($p<0.05$) gender effect was found for the *face*
341 *blowing a kiss* (😘) in relation to the evoked contexts "Most liked food" and "Birthday", and
342 the *smiling face with hearts* (😍) for the context "Most liked food" ($p=0.010$). For "Most liked
343 food", girls selected significantly ($p<0.05$) more than boys also the emojis *zany face* (😜),
344 *hugging face* (🤗) and *smiling face* (😊). For foods evoked by the context "Dinner", females
345 selected *star-struck* (😍) significantly ($p=0.033$) more often than males. Finally, girls
346 associated the emojis *nauseated face* (🤢) ($p=0.008$) and *dizzy face* (😵) ($p=0.012$) more
347 frequently to foods recalled by the context "Most disliked food" than boys.

348

349 3.6. Age differences in emoji selection

350 In general, 9-11-year-olds tended to use emojis more frequently than 12-13-year-olds (Figure
351 3). Younger subjects selected an average of 6.9 emojis across all contexts in contrast to older
352 subjects with 4.4 emojis. Age differences were mainly related to the foods evoked by the eating
353 contexts "Birthday" and "Novel food", where younger subjects selected laughing/smiling
354 emojis (e.g. *grinning face with big eyes* (😄)) and emojis showing their tongue (e.g. *face with*
355 *tongue* (😜)) significantly ($p<0.05$) more frequently than older subjects. The emoji *star-struck*
356 (😍) was stated more frequently among 9-11-year-old subjects in response to foods of the
357 evoked contexts "Snack", "Birthday" and "Novel food" ($p<0.05$) and the *money-mouth face* (
358 🤑) was stated more frequently in the evoked contexts "Birthday" and "Most liked food"
359 ($p<0.01$). The *smiling face with halo* (😇) was stated more frequently by younger children for
360 foods of the context "Birthday" ($p=0.024$). For foods evoked by the context "Most disliked
361 food", the emojis *hot face* (😳) and *dizzy face* (😵) were stated more frequently by younger
362 subjects ($p<0.05$). Only one emoji, the *face savoring food* (😋), was stated more frequently by
363 12-13-year-old subjects for foods recalled by the context "Breakfast" ($p=0.028$).

364

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4. Discussion

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372 The present study explored the appropriateness of emojis to describe pre-adolescent's emotions
373 elicited by foods recalled in relation to different evoked eating contexts and to explore related
374 age- and gender differences. Forty-six emojis resulted as appropriate to describe emotions in
375 different eating contexts. The number of selected emojis varied across evoked eating contexts
376 eliciting different foods. As expected, age and gender significantly affected emoji selection
377 across and within foods elicited by varied eating contexts.

378

379 **4.2. Emoji Usage Questionnaire (EUQ) and test evaluation questions**

380 Children found the test easy to do, enjoyed participating in it and enjoyed using emojis to a
381 great extent. This is a very important information as it implies that children's involvement and
382 attention in the test was high and they were motivated to participate in the test. The fact that the
383 test was conducted on tablets engaged and motivated the children, turning the questionnaire
384 into a gamification task (Simões, Redondo, & Vilas, 2013). Verbal emotion lists can result in
385 boredom and fatigue (Jaeger, Cardello, & Schutz, 2013), whereas emojis might help to increase
386 the attention span. Children were able to fill out the questionnaire independently, which is
387 encouraged when conducting consumer tests with children (see Laureati & Pagliarini, 2018).

388 All children, but especially older children, were already familiar with emojis and used them
389 frequently before the study, which was also observed previously among this age group (Gallo
390 et al., 2017a). Consistent with previous findings (Commonsensemedia, 2016; Howard, 2018),
391 it was found that 12-13 y.o. children have a more intense and structured social media usage of
392 emojis than 9-11 y.o. children. In fact, it was shown that especially older children send emojis
393 to friends, parents and teachers, which implies that they already have an increased social
394 network and that they communicate more digitally with these people compared to younger
395 children.

396 Overall these findings confirm the opportunity of testing the age effect among pre-adolescents
397 due to a varied familiarity with and a frequency of emoji usage. However, relevant age
398 differences in the valence domain of the EUQ did not emerge. Similarly, age did not affect
399 responses for any item of the motivation domain. This means that children aged 9-13 use emojis
400 for similar reasons, whereof the most important reason why emojis are used was that they "are
401 fun to use".

402 Children reported to use mostly positive emojis, which could be one of the explanations why
403 they used so many positive emojis when describing how they felt about their foods recalled by
404 various eating contexts.

405 Future research may extend the focus to further dimensions investigated in adults, such as
406 meaningfulness, visual complexity, and arousal (Rodrigues, Prada, Gaspar, Garrido, & Lopes,
407 2018).

408

409 **4.3. Foods recalled by each evoked context**

410 Pre-adolescents were able to recall foods for each evoked eating context. Each eating context
411 resulted in a unique collection of foods, of which some foods were stated very frequently and
412 specific for each context. For example, in the context "Most liked food" *pizza* and *pasta*, but
413 also several meat products were among the most frequently stated foods, which aligns with

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414 Beyer & Morris (1974). Various vegetables (especially *spinach* and *broccoli*) and vegetables
415 in general were stated as the most disliked foods, which is in accordance with previous research
416 showing that vegetables were among children's most disliked foods (De Moura, 2007). The
417 foods of the eating contexts "Breakfast", "Dinner" and "Lunch" represented foods that were
418 commonly consumed for these occasions (Monteleone & Dinnella, 2009). "Novel foods"
419 resulted in a wide variety of foods and showed only minor overlappings between children. This
420 could be explained by the fact that each child has a different idea of what food is most novel to
421 them, hence, resulting in very individual food choices.

422

423 **4.4. Food-related emojis**

424 Only facial images were used for the selection of food-related emojis. A similar approach was
425 adopted by Gallo et al. (2017a), but in contrast, we did not exclude any facial emojis previously
426 given the explorative nature of the study. Children did not show any difficulties in recalling
427 their previously consumed foods and expressing how they felt about them.

428 In total, 46 emojis qualified as food-related after children's selection. This number is slightly
429 higher than the number of emojis included in emoji lists used in previous studies on children
430 (Gallo et al. 2017; Schouteten et al., 2019, 2018). More interestingly, similarities and
431 differences with previously used lists were found. There were some similarities in specific
432 emojis used to describe emotions elicited by foods in children (Gallo et al., 2017a; Schouteten
433 et al., 2019), but also in adults (Jaeger, Vidal, et al., 2017). Although, the studies cannot directly
434 be compared due to differences in methodological approaches on how food-related emojis were
435 selected (e.g. focus groups or emoji lists based on adults), some emojis seem to be very popular
436 to describe emotions towards foods. For example, Gallo et al. (2017a) found 38 emojis to be
437 appropriate to describe foods, of which 25 overlap with our findings. Differently from this study
438 the following emojis were found to be food-related in our study with a selection of <20%: *face*
439 *without mouth* (😬), *anguished face* (😫), *kissing face with closed eyes* (😘), *frowning face*
440 *with open mouth* (😮), *flushed face* (😳), *pensive face* (😞), *unamused face* (😏), *worried face*
441 (😟), *confused face* (😕), *expressionless face* (😐), *disappointed face* (😞), *sleeping face* (😴)
442 and *grimacing face* (😬).

443 Schouteten et al. (2019) showed (using the standardized emoji list of Gallo et al. (2017a) the
444 *face savoring food* (😋), *winking face with tongue* (😜), *grinning face* (😄) and *smiling face*
445 *with sunglasses* (😎) were among the most frequently selected emojis to describe food samples
446 with a mean usage frequency >20%, which was also confirmed in our study (see Table 2). The
447 *face with tears of joy* (😂) and *smirking face* (😏) were not demonstrated to be useful to describe
448 the experience of food products, which is in line with Schouteten et al. (2018). On the other
449 hand, *weary face* (😓) included in the product-specific list was found to be discriminative
450 among speculoos biscuits by Schouteten et al. (2019), but was selected by less than the 20% of
451 children as food-appropriate in our study. All emojis of the product-specific list (Schouteten et
452 al., 2019) with exception of the *weary face* (😓) and the non-facial emojis were also part in our
453 food-related emoji list.

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454 These congruencies indirectly indicate that the proposed approach allowed us to select relevant
455 emojis assumed to describe emotions elicited by foods in pre-adolescents. In addition, all
456 available emojis at the time of data collection increased the list of existing food-related emojis
457 through newly developed or updated emojis. Our findings showed that some of these novel
458 images were used quite frequently when children described how they felt about their foods
459 recalled by various eating contexts. One of the most popular emojis was *star-struck* (🤩), which
460 was the most frequently stated emoji in 5 out of 7 eating contexts. Other examples of new food-
461 related emojis relevant to describe emotions elicited by foods included *exploding face* (💥),
462 *partying face* (🥳), *money-mouth face* (💰), *smiling face with halo* (😇), *drooling face* (🤤),
463 *nauseated face* (🤢), *face vomiting* (🤮), *angry face with horns* (😡) and *face with symbols on*
464 *mouth* (👄). Consequently, these novel emojis could have the potential to be used in an emotion
465 measurement tool to discriminate between real food products.

466 3.2. Emojis associated to foods recalled by varied evoked eating contexts

467 Regarding context-specific differences it was demonstrated that the numbers of food-related
468 emojis differed between eating contexts. Foods recalled by the contexts “Most liked food”,
469 “Birthday” and “Most disliked food” elicited the highest frequencies of emojis (respectively
470 23, 21 and 19 emojis). This result was somehow expected and could be explained by the fact
471 that the foods eaten in these contexts evoked more emotions in pre-adolescents. The foods eaten
472 in the “Breakfast”, “Lunch” and “Dinner” contexts might resemble more general consumed
473 foods that only elicit a limited number and variety of emotions. In addition, the eating context
474 of “Birthday” activates more positive emotions than everyday meals. Interestingly, the foods
475 recalled by the eating context “Novel food” elicited mostly positive emojis. This was not
476 expected as novel foods are often rejected by pre-adolescents and usually lead to more negative
477 attitudes towards them (Damsbo-Svendsen, Frøst, & Olsen, 2017). An explanation could be
478 that pre-adolescents recalled primarily novel foods that they actually liked, thus, they associated
479 these foods with a positive context. Novelty has been proposed as a dimension, which structures
480 emotion meaning in addition to valence, arousal and control, and which is explicated by surprise
481 (Fontaine & Veirman, 2013). Additionally, pre-adolescents that like to taste novel foods could
482 be triggered by their curiosity to taste them (Sick, Højer, & Olsen, 2019). Also, curiosity has
483 been previously described as a positive emotion (Kashdan & Silvia, 2009), which might have
484 triggered more positive emotions in general.

485 The two contexts of “Most liked food” and “Most disliked food” elicited the majority of all
486 food-related emojis and contributed to a rather balanced distribution of positive and negative
487 emojis. An equal balance of positively and negatively associated emojis (38 emoji in total) was
488 also obtained in other research (Gallo et al., 2017a). However, we could not identify any
489 “neutral” emojis in our study in contrast to Gallo et al. (2017a), who found that the *relieved*
490 *face* (😌) was regarded as neutral; in our study this emojis was frequently elicited by foods
491 recalled by the context “Most liked food”.

492 3.3. Gender differences in emoji selection

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495 In this study, girls tended to select more emojis than boys. Similar findings were observed
496 previously, where girls mentioned emojis in their discussion about food-provoked emotions
497 more often than boys (Gallo et al., 2017a) and females used emojis in their text messages more
498 frequently (Chen et al., 2018). An explanation for this could be that females use more non-
499 verbal communication than males (Hall & Gunnery, 2013) and that females were found to have
500 a higher emotional expressivity (Diener, Sandvik, & Larsen, 1985; Kring & Gordon, 1998),
501 even if the findings about gender differences in the food emotion research are controversial
502 (Cardello & Jaeger, 2016).

503 Although gender differences were minor, it was demonstrated that girls and boys mostly
504 differed in their selection of emojis with hearts. For girls, emojis with hearts seemed to be more
505 relevant to describe positive emotions elicited by foods of recalled contexts. Girls might be able
506 to perceive or express more “lovable” and “endearing” emotions when describing their feelings
507 towards foods, which could be explained by findings showing that women were more probable
508 to communicate love in real life (Wilkins & Gareis, 2006). Boys might exhibit restrictive
509 emotionality for some particular emotions (Jansz, 2000) or they think that emojis with hearts
510 are something for females. These findings may be explained by the role of culture in shaping
511 gender identity and confirm how much gender stereotypes are rooted since childhood
512 (Martinez, Osornio, Halim, & Zosuls, 2019).

513 For other food-related emojis (e.g. *nauseated face* 🤢 and *dizzy face* 🤡) it was less clear why
514 they were selected more frequently by girls. Literature on gender differences in emoji selection
515 is very scarce, hence, future research should investigate differences between genders.

516

517 **3.4. Age differences in emoji selection**

518 On average, 9-11-year-olds selected a higher number of emojis and used them more frequently
519 to describe their feelings towards foods recalled in various contexts compared to older children.
520 An opposite trend would have been expected since older children are more familiar with and
521 more frequent users of emojis as shown in the EUQ. Especially, for foods recalled by the
522 contexts “Birthday” and “Novel food”, younger children significantly selected specific emojis
523 more often than older children. A previously conducted study by Pagliarini, Gabbiadini, & Ratti
524 (2005) found age-related differences in respect to liking scores, where younger children
525 generally gave higher liking ratings compared to older children. The results were explained by
526 the assumption that older children already have an increased self-confidence in their
527 preferences, and thus making more critical and selective choices with growing age. In the
528 current study it might be speculated that older children are also more selective towards
529 emotional responses, which might explain the results.

530

531 In respect to some specific emojis, younger children preferred laughing/smiling emojis and
532 emojis showing their tongue to describe their emotions towards foods that were recalled in
533 several eating contexts. A study showed that younger children tended to use more positive
534 emotions to describe their food-related emotions (Gallo et al., 2017a). Younger children were
535 also shown to differ in their emotion expression (Chaplin & Aldao, 2013), which could lead to
536 differences in how children feel about foods recalled by various contexts. Our findings suggest

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537 that attention should be paid to the children's age and gender when using emoji-based
538 approaches, but more research is needed to better understand differences related to gender and
539 age. In fact, the number of children in each age or gender group in our study was relatively
540 small (between 41-55 children per group), thus studies with bigger sample sizes would be
541 beneficial to generalize these findings.

542

543 **4. Conclusions**

544 An approach based on recalled food evoked by varied eating context was applied to select
545 emojis used by pre-adolescents to represent how they feel in response to food. The CATA
546 method using emojis was shown easy to apply and allowed to define a large list of food-related
547 emojis including facial emojis that were never used in previous studies in this respect. However,
548 as the current list of food-related emojis might contain emojis with very similar meanings, a
549 deep investigation of their meaning is recommended. Significant age- and gender differences
550 were found in the selection of food-related emojis and therefore, future research should
551 investigate if there are differences in the interpretation of food-related emojis.

552

553 **Author contributions**

554 Julia Sick: Writing – original draft preparation, Conceptualization; Investigation, Formal
555 analysis, Visualization, Methodology. Sara Spinelli: Writing – review and editing;
556 Investigation; Conceptualization; Methodology. Caterina Dinnella: Writing – review and
557 editing. Erminio Monteleone: Writing – review and editing, Conceptualization; Supervision;
558 Project administration; Funding acquisition.

559

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564

565 **Declarations of conflicts**

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

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726 **Tables and Figures**

727

728 **Figure 1.** Self-reported foods recalled by the evoked contexts a) Most disliked and b) Novel food.

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730 a) Most disliked food



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733 b) Novel food

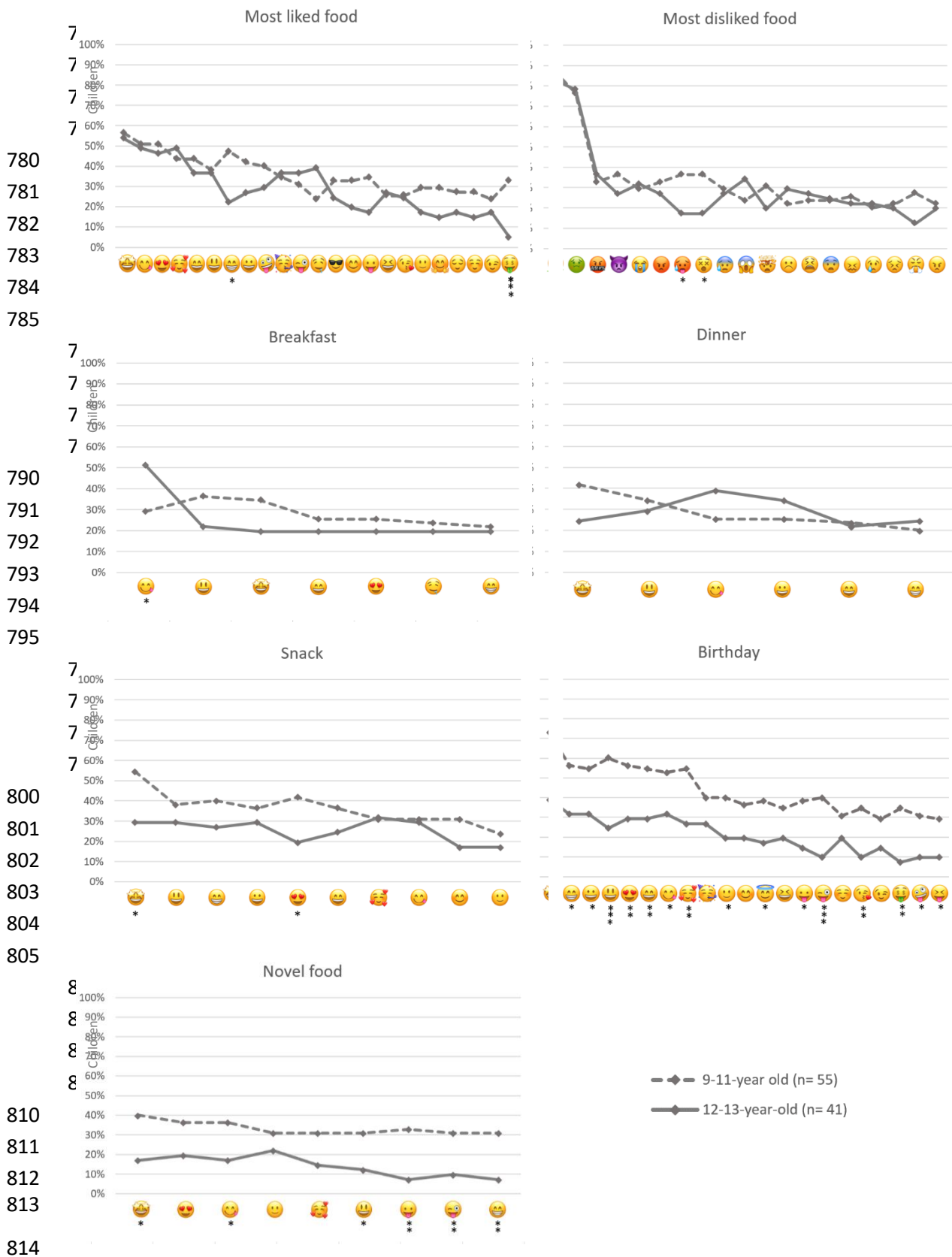


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815 **Figure 3.** Food-related emojis shown for each context divided by age; most selected emojis in each context are shown from
 816 left to right; *= $p \leq 0.05$, **= $p \leq 0.01$, ***= $p \leq 0.001$.

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817 **Table 1.** Full 92-item emoji list included in the CATA questionnaire with frequencies (%) of children (n=96) that selected
 818 emojis to describe the foods recalled by each eating context; ● = selected food-related emojis * = emojis selected by ≤20% of
 819 children, but still included as food-related emojis for further analysis.

Emojis	Breakfast	Dinner	Snack	Most liked food	Most disliked food	Birthday	Novel food
● 😊 grinning face	18	29	33	35	0	45	20
● 😄 grinning face with big eyes	30	32	34	38	0	45	23
● 😁 grinning face with smiling eyes	23	23	31	41	0	44	18
● 😂 beaming face with smiling eyes	21	22	34	36	0	46	21
● 😏 grinning squinting face	8	7	14	26	0	28	16
😓 grinning face with sweat	3	6	11	8	0	20	13
😂 rolling on the floor laughing	4	6	11	10	0	20	9
😭 face with tears of joy	6	7	13	14	1	20	9
● 😊 slightly smiling face	19	17	21	24	0	31	27
😓 upside-down face	7	7	11	10	1	20	8
● 😜 winking face	13	8	14	21	0	23	16
● 😊 smiling face with smiling eyes	16	9	25	27	0	29	16
● 😇 smiling face with halo	8	11	13	20	1	29	16
● 😍 smiling face with hearts	23	19	31	46	1	43	24
● 😍 smiling face with heart-eyes	18	20	32	49	1	45	29
● 😍 star-struck	28	34	44	55	1	58	30
● 😘 face blowing a kiss	9	3	14	25	0	24	20
😘 kissing face	3	3	6	8	0	14	9
● 😊 smiling face	15	9	15	22	0	26	17
😘 kissing face with closed eyes	5	4	7	14	0	18	13
😘 kissing face with smiling eyes	7	5	4	13	0	15	10
● 😋 face savoring food	39	31	30	50	0	44	28
● 😜 face with tongue	13	10	11	27	0	28	22
● 😜 winking face with tongue	13	6	13	33	0	27	22
● 😜 zany face	11	6	13	35	0	22	16
● 😜 squinting face with tongue	6	7	7	19	1	21	19
● 😜 money-mouth face	7	8	14	21	1	23	13
● 😊 hugging face	17	8	15	23	0	19	16
😜 face with hand over mouth	5	1	2	1	11	1	5
😜 shushing face	1	3	3	4	1	3	4
😜 thinking face	5	9	3	1	2	0	9
😜 zipper-mouth face	2	3	3	2	13	1	2

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















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		<i>face with raised eyebrow</i>	1	4	2	1	7	0	5
*		<i>neutral face</i>	5	6	3	0	14	1	8
		<i>expressionless face</i>	4	7	4	1	10	2	2
		<i>face without mouth</i>	4	6	2	1	8	2	5
		<i>smirking face</i>	7	6	6	10	1	4	5
		<i>unamused face</i>	1	4	1	0	14	1	2
		<i>face with rolling eyes</i>	1	5	1	0	7	1	4
		<i>grimacing face</i>	1	3	1	0	9	0	1
		<i>lying face</i>	2	3	0	0	2	0	1
●		<i>relieved face</i>	10	6	8	23	1	11	9
		<i>pensive face</i>	2	2	1	0	9	0	1
		<i>sleepy face</i>	2	3	0	0	9	0	0
●		<i>drooling face</i>	22	17	20	30	1	19	8
		<i>sleeping face</i>	8	5	3	1	1	0	0
		<i>face with medical mask</i>	1	1	0	0	20	0	3
		<i>face with thermometer</i>	1	1	0	1	13	0	2
		<i>face with head-bandage</i>	1	2	0	0	14	0	1
●		<i>nauseated face</i>	3	4	4	0	77	1	17
●		<i>face vomiting</i>	3	6	3	1	85	1	15
		<i>sneezing face</i>	1	1	0	0	11	0	4
●		<i>hot face</i>	2	3	2	0	28	1	10
		<i>cold face</i>	5	5	4	2	13	1	9
		<i>woozy face</i>	5	3	3	9	6	4	2
●		<i>dizzy face</i>	1	3	2	1	28	1	1
●		<i>exploding face</i>	6	4	3	8	26	4	6
		<i>cowboy hat face</i>	8	1	5	13	2	17	9
●		<i>partying face</i>	16	9	16	35	2	34	11
●		<i>smiling face with sunglasses</i>	13	7	14	29	1	17	10
		<i>nerd face</i>	2	3	5	5	0	3	1
		<i>face with monocle</i>	1	5	0	2	2	1	1
		<i>confused face</i>	1	3	0	0	16	2	2
		<i>worried face</i>	1	1	0	1	18	1	1
		<i>slightly frowning face</i>	2	4	2	0	20	0	2
●		<i>frowning face</i>	1	4	1	0	25	0	1
*		<i>face with open mouth</i>	6	3	4	4	7	1	3
		<i>hushed face</i>	3	1	2	1	6	2	3
		<i>astonished face</i>	2	5	3	7	6	0	2
		<i>flushed face</i>	2	1	0	1	8	2	2
		<i>pleading face</i>	4	4	6	6	17	5	5

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		<i>frowning face with open mouth</i>	1	1	0	1	11	0	1
		<i>anguished face</i>	1	2	1	1	10	1	0
●		<i>fearful face</i>	1	2	1	2	24	0	5
●		<i>anxious face with sweat</i>	1	2	1	0	28	0	6
		<i>sad but relieved face</i>	1	1	0	0	17	1	4
●		<i>crying face</i>	1	1	1	1	21	0	0
●		<i>loudly crying face</i>	2	4	2	2	30	0	3
●		<i>face screaming fear</i>	2	3	1	1	28	0	7
●		<i>confounded face</i>	1	2	0	0	24	0	3
●		<i>pensive face</i>	1	1	1	0	21	0	3
		<i>disappointed face</i>	1	6	1	0	19	0	1
		<i>downcast face with sweat</i>	1	1	0	0	15	0	1
		<i>weary face</i>	1	4	0	1	15	1	1
●		<i>tired face</i>	1	1	0	1	25	2	2
		<i>yawning face</i>	9	3	2	1	11	0	1
●		<i>face with steam from nose</i>	2	4	2	0	21	1	1
●		<i>pouting face</i>	3	4	3	1	30	1	3
●		<i>angry face</i>	1	3	2	0	21	1	0
●		<i>face with symbols on mouth</i>	1	3	1	0	34	1	4
		<i>smiling face with horns</i>	5	6	3	5	16	5	3
●		<i>angry face with horns</i>	3	2	2	1	32	1	5

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825 **Figure S1.** Self-reported foods recalled by each evoked context; a) Most liked food b) Most disliked food c) Breakfast d)
826 Dinner e) Snack f) Birthday g) Novel food.

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828 a) Most liked food



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832 b) Most disliked food



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852 e) Snack



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856 f) Birthday



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867 g) Novel food



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872 **Table S1.** EUQ: Total frequencies (%) and frequencies divided by genders (females and males) and age (9-11 and 12-13) of Familiarity, Frequency of usage, Social use, Motivation, Valence of emojis,
873 and Enjoyment in using emojis.

Question	Domain	Scale categories/items	Frequency (%)						
			Total (n=96)	Gender			Age		
				Female (n=41)	Male (n=55)	<i>p</i> value	9-11 (n=55)	12-13 (n=41)	<i>p</i> value
1 Did you know what emojis were before participating in this study?	Familiarity	I never heard of them	0	0	0	0.437*	0	0	0.006*
		I had heard of them but had never used them	4	5	3		5	2	
		I had used them but only once	2	3	2		4	0	
		I use them occasionally	26	29	24		35	15	
		I use them regularly	68	63	71		56	83	
2 How often do you usually use emojis?	Frequency of usage	every day	24	29	20	0.714*	20	29	0.007*
		a few times a week	42	27	53		33	54	
		a couple of times a month or less	20	29	13		25	12	
		never	14	15	14		22	5	
3 To whom do you send emojis?	Social use	friends	75	71	78	0.404	58	98	< 0.0001
		siblings	32	27	36	0.323	27	39	0.223
		parents	55	59	53	0.571	45	68	0.026
		relatives	57	59	56	0.831	56	59	0.831
		teachers	7	10	5	0.423	2	15	0.017
		other	18	22	15	0.347	16	20	0.689
4 Why do you use emojis?	Motivation	they are fun	70	61	76	0.104	75	63	0.240
		I can use emoji instead of words	42	46	38	0.422	47	34	0.197
		they make my text messages more understandable	45	44	45	0.880	38	54	0.131
		to save time when sending messages	25	27	24	0.721	27	22	0.551
		they highlight a part of the message	23	32	16	0.077	22	24	0.767
		they express something I normally can't describe in words, e.g. how I feel	45	49	42	0.497	38	54	0.131
		they are quick to use	26	29	24	0.534	27	24	0.750
5 Do you use more emoji with positive or negative meaning?	Valence of emojis	positive	72	76	69	0.482	69	76	0.482
		negative	4	7	2	0.182	5	2	0.465
		almost the same	17	12	20	0.310	13	22	0.230
		I don't know	7	5	9	0.432	13	0	0.018
6 How much do you like using emojis?	Enjoyment	by no means	1	0	2		2	0	
		a bit	2	2	2		2	2	

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			so and so	7	5	9	0.255*	5	10	0.164*
			fairly	25	22	27		20	32	
			a lot	65	71	60		71	56	

874 Depending on data analysis *p* values refer to Kruskal Wallis (*) or Chi-square test. In bold *p* values ≤ 0.05 .

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