

Improvement of an emotional lexicon for the evaluation of beers

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ABSTRACT

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

KEYWORDS

Emotion; Lexicon; Beer; Consumers.

1. INTRODUCTION

The study of consumer emotional response elicited by food products has increased during the last years. Many methods have been developed to study emotions evoked by food and beverages. EsSense Profile™ (King & Meiselman, 2010) was the first emotional lexicon developed to measure emotions related to food products consumption and illustrated a

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59 29 methodological advance in consumer testing. Although this emotional lexicon was
60 30 recommended to determine the emotions elicited by food products, authors also
61 31 recommended to adapt this lexicon to the food category. Since EsSense Profile™ was
62 32 published, several methods to measure emotional response have been developed and
63 33 improved. For example, Ng, Chaya, & Hort (2013) highlighted in their study the importance
64 34 of a consumer defined lexicon as compared with EsSense Profile™. The authors showed
65 35 that a consumer defined lexicon was a list of positive and negative emotions more specific
66 36 to the product category than the EsSense Profile™. Spinelli, Masi, Dinnella, Zoboli, &
67 37 Monteleone (2014) used a list of full sentences for the study of cacao and hazelnuts spreads,
68 38 instead of a list of specific emotional terms. This method, called EmoSemio, resulted in
69 39 reduced ambiguity and improved understanding by the consumers.

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79 40 Regarding the study of emotional response to beer products, different authors have used
80 41 diverse lexicons and methods to analyse the emotions elicited by beers. Chaya et al. (2015)
81 42 developed, using consumers' focus groups methodology, the first published beer specific
82 43 lexicon for the Spanish population and grouped a lexicon of 44 single terms into 12
83 44 emotional categories. Using the same approach, Eaton (2015) established an English version
84 45 for British beer consumers. Ng et al. (2013) had previously developed an emotional lexicon
85 46 for black currant squashes using direct-one-to-one interviews with individual consumers.
86 47 The focus groups methodology proved to be more efficient than the method developed by
87 48 Ng et al.(2013), but the effort needed to generate consumer defined lexicons was still
88 49 considerable. Silva et al. (2016) also developed consumer led lexicons for beer Dutch and
89 50 Portuguese consumers by means of focus groups. Cardello et al. (2016) and Jaeger et al.
90 51 (2017) successfully applied a variant of the 12-point emotion circumplex method of Yik,
91 52 Russell, & Steiger (2011) in an attempt to reduce the time/effort to capture emotions
92 53 related to beer.

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103 54 In addition to the works mentioned above, other authors have developed consumer defined
104 55 emotional lexicons for specific product categories, such as chocolate spreads (Spinelli et al.,
105 56 2014), coffee (Bhumiratana, Adhikari, & Chambers, 2014), and wine (Danner et al., 2016;

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115 57 Silva et al., 2016). Van Zyl (2016) provides a detailed list of lexicons applied in beverages in
116 58 tables 19.3a to 19.3d.

119 59 In general, emotional lexicons are difficult to generate, they have to be understandable and
120 60 clear to consumers, and relevant to the product category (Gmuer, Guth, Runte, & Siegrist,
121 61 2015). One of the clues is to ensure that the terms generated by the consumers are true
122 62 feelings. Van Zyl & Meiselman (2015) proposed some basic rules for a procedure for the
123 63 development of consumer defined emotion lists. The authors proposed checking that the
124 64 terms generated by the consumers are found on the lists of Laros & Steenkamp (2005) and
125 65 Clore, Ortony, & Foss (1987). However, to date no references can be found using the
126 66 procedure proposed by van Zyl & Meiselman (2015) as a guide to ensure the suitability of
127 67 the emotional terms generated by consumers.

135 68 This study aimed to improve and test the Spanish consumer beer lexicon developed by
136 69 Chaya et al.(2015), following the procedure proposed by van Zyl & Meiselman (2015).

70 ***2. MATERIALS AND METHODS***

71 **2.1. Improvement of the emotional lexicon**

72 This research is based on a previous study presented by Chaya et al. (2015). The approach
73 is summarised in [figure 1](#).

74 **2.1.1. Samples**

75 For the present study, samples and sample preparation were the same as reported in Chaya
76 et al. (2015) ([table 1](#)). Two samples were 'control' commercial beer samples, one of which
77 was a commercial non-alcoholic beer. The other eight samples were based upon the control
78 samples and were each manipulated in a single sensory property. Several sensory
79 properties were chosen to represent key characteristic properties of beer (e.g. bitterness,
80 hoppiness, etc.) whilst others reflected off-flavours and/or hypothesised drivers of
81 emotional response (e.g. isoamyl acetate, dimethyl sulphide (DMS)). The commercial beers
82 were modified using ethanol (Merck Chemicals Ltd, UK), dextrose (Myprotein, UK), specific
83 flavour capsules (Cara Technology, UK), or controlled decarbonation. All 10 samples had

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171 84 been evaluated by the University of Nottingham's trained expert beer panel who had rated
172 85 each sample for the 8 sensory properties of interest (data not shown). The assessments
173 86 revealed significant differences between the spiked and control samples, indicating that the
174 87 samples differed in their sensory properties. From these results, it was anticipated that
175 88 subjects in subsequent studies would perceive the differences in relevant sensory
176 89 properties across samples. Samples were prepared by adding the relevant materials to
177 90 samples and 10 ml decanted into transparent closed screw cap universal containers 2–4 h
178 91 before assessment by consumers. This was with the exception of the Low CO₂ samples
179 92 which was decarbonated by leaving open and refrigerated (4 ± 1 C) for 3 h before re-sealing.
180 93 Low CO₂ samples were then decanted just prior to consumer assessment. Products were
181 94 presented blind (labelled with three-digit random codes) at 4 ± 1 C. Unsalted crackers
182 95 (Carrefour, Spain) and mineral water (Fuente Liviana, Spain) were provided as palate
183 96 cleansers.

194 97 **2.1.2. Procedure to improve the lexicon and terms grouping**

195 98 The initial list of the emotional terms generated by the focus groups in Chaya et al. (2015)
196 99 (table 2) was checked and verified following the method of van Zyl & Meiselman (2015). It
197 100 was compared with the emotional lists published by Clore et al. (1987) and Laros &
198 101 Steenkamp (2005) containing 564 and 50 terms respectively. The initial terms not included
199 102 in those lists were discarded.

200 103 After the terms were verified on the emotional list, beer samples were evaluated by a panel
201 104 of 17 subjects. The subjects tasted the beer samples, and rated each evoked emotional
202 105 term. A warm-up sample (the same as control) was tasted and rated to minimize first
203 106 position effect (Dorado, Pérez-Hugalde, Picard, & Chaya, 2016). Then, 10 beer samples were
204 107 served in random order according to a Balanced Incomplete Block design. Rating was done
205 108 on a 15 cm continuous line scale anchored at 1.5 cm from the line ends from 'very low' to
206 109 'very high'. To minimize bias, emotion terms were presented in a randomised order for each
207 110 consumer.

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227 111 A Hierarchical Cluster Analysis was applied on the average ratings for each emotional term
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229 112 of the 10 beer samples (Chaya et al., 2015) to group similar emotions into categories
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231 113 according to the consumers' assessment of the beer samples. Terms were grouped using
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233 114 Euclidean distance and the Ward's criterion of aggregation (XLSTAT Version 2009.6.03,
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235 115 Addinsoft, USA).

2.2. Test of the improved lexicon

2.2.1. Subjects

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240 118 A panel of 83 Spanish beer consumers (aged 18-60), who consumed beer at least once a
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242 119 week, participated in the tests of the new lexicon. Each consumer rated their liking and their
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244 120 emotional response to the 10 beer samples. Testing procedure

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246 121 To test the improved lexicon, the warm-up sample and the beer samples were served,
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248 122 randomizing the 10 samples according to a Balanced Incomplete Block design. After tasting
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250 123 each sample, consumers were first asked to rate the overall liking on a 9-point scale. Then,
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252 124 they had to read all of the terms associated with each emotion category, and to rate the
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254 125 intensity of their feelings on a 15 cm linear scale, anchored at 0.5 cm from the line ends
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256 126 from "very low" to "very high". To minimize bias, the order of emotion categories was
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258 127 randomised for each consumer.

2.2.2. Consumer data analysis

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261 129 Responses to the emotional terms were input to mixed ANOVA using beer samples as a
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263 130 fixed effect and consumer as a random effect. Post-hoc tests for sample effect were
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265 131 conducted using Tukey's HSD (Statgraphics Centurion XVII version).

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267 132 Principal Components Analysis (correlation matrix) was performed on the average ratings
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269 133 of each emotion category to explore relationships between emotion categories and beer
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271 134 samples (XLSTAT 2014.6.05 version). Liking was used as supplementary (non- active)
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273 135 variable in the analysis.

3. RESULTS

3.1. Improved lexicon

From the 44 terms of the emotional lexicon used in Chaya et al. (2015), a list of 28 words was kept, as shown in [table 3](#).

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

The cluster analysis of mean ratings of the remaining emotional terms resulted in 11 clusters. These clusters were reviewed with the aim of avoiding confusion and ambiguities, and therefore some words or categories were modified. For example INTENSITY category ([table 2](#)), with which consumers had some problems in the previous lexicon, was renamed VIGOUR ([table 3](#)). The final clusters were: VIGOUR, MILDNESS, DISSATISFACTION, INDIFFERENCE, EXCITEMENT, PLEASURE, NOSTALGIA, FUN, DISSAPOINTMENT, DESIRE and DISGUST.

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

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

3.2. Discrimination power of the improved lexicon

Univariate analysis showed that all emotion categories discriminated between samples. Post hoc analyses identified different groupings for each emotion category among beers (Table 4).

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339 163 The first two Principal Components of the PCA explained 91.63% of the data variance. [Figure](#)
340 164 [2a](#) shows the correlation plot of emotion categories with the first factorial plot (PC2 vs PC1).
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342 165 Liking, not included as active variable in the analysis, is projected in the same plot. In
343 166 general, the emotional space structure ([figure 2a](#)) was compatible with the circumplex
344 167 models of emotions (Larsen & Diener, 1992; Russel, 1980; Watson & Tellegen, 1985),
345 168 explained by two dimensions: the horizontal axis was associated with pleasantness, while
346 169 the vertical axis was related to activation.

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352 170 Post Hoc analyses allowed identifying the link between emotional categories and sensory
353 171 properties of beer samples ([table 4](#)). Control, Light Struck, and Isoamyl Acetate beer
354 172 samples elicited higher ratings on DESIRE, EXCITEMENT, FUN, NOSTALGIA, and PLEASURE
355 173 than the Hoppy sample, which evoked lower scorings in these emotional categories. On the
356 174 contrary, the Hoppy sample elicited significant higher scores than the Control and Light
357 175 Struck samples on unpleasant emotion categories: DISSATISFACTION, DISAPPOINTMENT,
358 176 and DISGUST. PCA confirmed the results of univariate analysis. As seen in [figure 2a](#), PC1
359 177 (74.16%) was strongly correlated to the pleasant emotions categories and liking, and
360 178 negatively correlated to unpleasant emotion categories. Position ([figure 2b](#)) of Control,
361 179 Isoamyl Acetate, and Light Struck samples was associated to DESIRE, EXCITEMENT, FUN,
362 180 NOSTALGIA and PLEASURE, while Hoppy was projected close to DISSATISFACTION,
363 181 DISAPPOINTMENT, and DISGUST.

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365 182 As seen in [table 4](#), the Low CO₂ sample elicited significantly higher intensities on the MILD
366 183 category; the High Alcohol sample produced the contrary effect on that category. VIGOUR
367 184 ratings were significantly higher on High Alcohol sample, and significantly lower on Sweet
368 185 sample. MILDNESS and VIGOUR were emotional categories related to engagement, but
369 186 their correlation to PC2 was opposite: positive and negative respectively. PC2 explained
370 187 17.46% of data variability ([figure 2a](#)). Low CO₂ and Sweet samples were associated with
371 188 unengagement or low activation. The high Alcohol sample was associated to VIGOUR and
372 189 related to high activation ([figure 2b](#)).

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395 190 Finally, Sweet, Low CO₂, and High Alcohol samples evoked significantly higher ratings on
396 191 INDIFFERENCE, while Light Struck evoked lower ratings on that emotion category (table 4).
397 192 INDIFFERENCE showed a relatively slight linear correlation to unpleasant emotions (0.645
400 193 DISSATISFACTION; 0.638 DISAPPOINTMENT; 0.575 DISGUST) while it was not correlated to
402 194 MILD (0.072) or VIGOUR (0.231). However, it was important for the discrimination by the
403 195 univariate analysis of Light Struck sample on the one hand, versus Sweet, Low CO₂, and High
404 196 Alcohol samples on the other hand (table 4). These results revealed the importance of using
405 197 emotional lexicons better than the models based on the circumplex model of emotions
408 198 (pleasure/displeasure; high/low activation) as the ones used by Cardello et al. (2016) and
409 199 Jaeger et al. (2017). In fact, INDIFFERENCE was independent of the pleasantness and
410 200 engagement axes, building its own third dimension. This result shows an important
413 201 contribution of the consumer defined lexicons.

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416 202 In summary, as compared to the previous version by Chaya et al. (2015), the importance of
417 203 the category INDIFFERENCE has been emphasized. As a result of the proposed lexicon
418 204 improvement, the relative position of samples was different. We hypothesize that the
419 205 reduction of the number of categories and the replacement of the category name
422 206 INTENSITY by VIGOUR could be related to this improvement.

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425 207 To conclude, the improved proposed lexicon has been tested with unbalanced beer
426 208 samples, spiked with different flavours, which made them suitable for eliciting different
427 209 emotional responses. The previous version of the lexicon was also applied to commercial
428 210 beer products (Chaya et al., 2015), where 5 out of 12 categories were discriminant among
431 211 commercial beers and helped to explain the differences in hedonic response (unpublished
432 212 results). According to these previous findings, the improved lexicon would also be suitable
433 213 for explaining the differences in evoked feelings during consumption of commercial beers.

214 ***4. CONCLUSION***

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441 215 Following the procedure of van Zyl & Meiselman (2015) allowed for an easy filtering of
442 216 terms for the study of the emotional response. As a consequence, the test was shorter,

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451 217 clearer, and easier to understand and to complete by consumers. The interpretation of the
452 218 emotional map obtained after the improvement of the lexicon was clearer than the one
453 219 obtained from the complete-non reduced lexicon. The new emotional lexicon of beer
454 220 improved 1) the efficiency of the research in terms of discrimination among samples, 2) the
455 221 simplicity of use by the consumers.

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460 222 Using both univariate and multivariate statistical analysis complemented each other in the
461 223 understanding of emotional response to beer products.

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464 224 Caution should be taken concerning the representativeness of consumers' sample.
465 225 Although the method has improved the initial lexicon, the number of respondents in this
466 226 study is relatively low and more research is needed to guarantee the generation of
467 227 sufficiently robust data.

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471 228 Future research is needed to test the improved lexicon in commercial beers. The real benefit
472 229 would be to understand how this emotion lexicon can be used to differentiate between
473 230 commercially available beers and whether it can give an insight about consumers'
474 231 liking/disliking reasons.

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676 298 ***TABLES CAPTIONS***
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678 299 Table 1. Samples and treatments used
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680 300 Table 2. Original emotion lexicon proposed by Chaya et al. (2015) in Spanish and English.
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682 301 Table 3. Modified emotion lexicon in Spanish and English.
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684 302 Table 4. Means scores and p-values for the 11 emotion categories and liking across 10
685 303 samples.
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Table 1. Samples and treatments used

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

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312 **Table 2.** Original emotion lexicon proposed by Chaya et al. (2015) in Spanish and English.

Spanish		English	
Suave	Ligero/suave/flojo	Mildness	Mild
Indiferencia	Aburrido/ Indiferente	Indifference	Bored/ indifferent
Placer	Agradable/amistoso/ Apetecible/placentero/ Positivo/relajado/ tranquilo/ fresco/ satisfecho/conforme	Pleasure	Nice/friendly/ appetized/ agreeable/ positive/relaxed/ fresh/pleasant/ satisfied
Clásico	Auténtico/esperado/ clásico/natural/ normal/tradicional	Classic	Authentic/ classic/natural/ normal/ traditional
Diversión	Alegre/contento/animado chispeante/divertido curioso/festivo /	Fun	Happy/lively/ curious/festive/ enjoyment
Deseo	Deseoso/ansioso	Desire	Eager
Disgusto/ Negatividad	Asqueado/disgustado/ contrariado/ desagradable/ desmotivado/ engañado/ indeseable/ mal/negativo/ reacio/rechazo/ Repulsion	Disgust/ Negative feelings	Disgusted/ annoyed/ unpleasant/ unmotivated/ cheated/bad/ objectionable/ negative/ repulsed/ shocked
Desilusión	Desilusionado/ extrañado desencantado/inesperado Sorprendido negativamente/ raro/ atípico/inapetente	Disillusionment	Disillusioned/ disenchanted/ unusual lacking in appetite
Decepción	Decepcionado/ incómodo/ Inatifecho	Disappointment	Disappointed/ uncomfortable/ dissatisfied
Intensidad	Fuerte/potente/ Intenso	Intensity	Strong/ powerful/ intense
Nostalgia	Nostalgico	Nostalgia	Nostalgic
Entusiasmo	entusiasmado/ Emocionado	Excitement	Excited

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313 **Table 3.** Modified emotion lexicon in Spanish and English.

Spanish		English	
Ligereza	Ligero/suave/flojo	Mildness	Mild
Indiferencia	Aburrido/ Indiferente	Indifference	Bored/ indifferent
Placer	Amistoso/ Placentero/positivo/ tranquilo/relajado/ satisfecho	pleasure	Friendly/ pleasant/ positive/ relaxed/ satisfied
Diversión	Alegre/contento/ Chispeante/animado/ Curioso/divertido/ festivo	Fun	Happy/lively/ curious/ festive/ enjoyment
Deseo	Deseoso	Desire	Eager
Disgusto	Asqueado/disgustado, Contrariado/ Mal	Disgust	Disgusted/ annoyed/ bad
Decepción	Decepcionado/ Incómodo/ Desmotivado/ Engañado/ inesperado/ Sorprendido/ negativamente	Disappointment	Disappointed/ uncomfortable/ unmotivated/ cheated/ shocked
Insatisfacción	Desilusionado/ insatisfecho	Dissatisfaction	Disillusioned/ dissatisfied
Entusiasmo	Emocionado	Excitement	Excited
Nostalgia	Nostálgico	Nostalgia	Nostalgic
Vigor	Fuerte/potente	Vigour	Strong/ powerful

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