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**Título artículo / Títol article:** Emotional eating and food intake after sadness and joy

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**Revista:** *Appetite*, v. 66 (2013)

**Versión / Versió:** Preprint de l'autor

**Cita bibliográfica / Cita bibliogràfica (ISO 690):** VAN STRIEN, T.; CEBOLLA, A.; ETCHEMENDY, E.; GUTIÉRREZ-MALDONADO, J.; FERRER-GARCÍA, M; BOTELLA, C.; BAÑOS, R. Emotional eating and food intake after sadness and joy. *Appetite*, v. 66 (2103), p. 20-25

**url Repositori UJI:** <http://repositori.uji.es/xmlui/handle/10234/89390>

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**Title:** Emotional eating and food intake after sadness and joy

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**Abstract:**

Do people with a high score on a scale for eating in response to negative emotions also show high food intake in response to positive emotions?. We studied these effects in 60 female students that were preselected on the basis of extreme high or low scores on an emotional eating questionnaire. Using a between subject design we experimentally tested the difference in food intake following a mood induction designed to induce joy or sadness (the joy vs. sad mood condition). The high and low emotional eaters did not differ in their food intake, but emotional eating significantly moderated the relationship between mood condition and food intake. Whereas low emotional eaters ate similar amounts after the sad and after the joy mood condition, high emotional eaters ate significantly more after the sad mood condition than after the joy mood condition. A further finding was that a similar moderator effect for emotional eating was found for intake of sweet food but not for intake of salty food. These findings would suggest that eating in response to negative and to positive emotions refer to two different constructs.

**Keywords:** emotional eating; food intake; DEBQ; virtual reality; mood induction.

## Introduction

Eating in response to positive emotions has been reported to occur as frequently as eating in response to negative emotions (Macht, Haupt & Salewski, 2004). However, do people with a high score on the scale for eating in response to negative emotions of the Dutch Eating Behavior Questionnaire (DEBQ) (DEBQ-E: DEBQ Emotional Eating Subscale) (Van Strien, Frijters, Bergers & Defares, 1986) also show high food intake in response to positive emotions?.

In a questionnaire study by Nolan, Halperin and Geliebter (2010), responses on the DEBQ-E were compared with those on scales of the Emotional Appetite Questionnaire (EMAQ) (Geliebter & Aversa, 2003), a questionnaire that includes scales on eating in response to both negative and positive emotions and situations. The two EMAQ positive emotion scales were both significantly and inversely correlated with the DEBQ-E, suggesting that eating in response to negative and to positive emotions may refer to different constructs. In contrast, in an experiment with a positive and a negative mood manipulation, positive or negative emotional eating status had no main effect or interaction effect with mood condition on food intake (Kenardy, Butler, Carter & Moor, 2003). Positive and negative emotional eating status was obtained by comparing scores on the positive and negative emotional eating subscales of the Emotional Eating Scale II (EES II). The EES II is an extension of the EES (Arnou, Kenardy & Agras, 1995) with questions on eating in response to positive emotions (Kenardy, et al., 2003). Participants were designated as negative emotional eaters when they had higher scores on negative emotional eating and as positive emotional eaters when they had higher scores on positive emotional eating. A problem with this procedure is that it may have resulted in insufficient participants with extreme scores on the moderating variable (positive or negative emotional eating). According to McClelland and Judd (1993), for detecting

interaction effects it is crucial to have sufficient extreme observations on the moderating variable.

In the present study we experimentally tested the difference in food intake following a mood induction designed to induce joy or sadness (the joy vs. sad mood condition) in people with high versus low scores on the DEBQ-E. Inspired by the results of Nolan et al. (2010), we hypothesized that people with high scores on the DEBQ-E would show higher food intake after the sad than after the joy mood induction. In contrast, low emotional eaters were expected to show the typical and predominant response to distress (Gold & Chrousos, 2002, Stone & Brownell, 1994) and eat less after the sad than after the joy mood induction. To enhance the chance of finding any interaction effect, which are easily missed in studies with a small number of subjects (Whisman & McClelland, 2005), we only used participants with scores from the extreme ends of the DEBQ emotional eating subscale. To control for the possible confounding effects of other eating styles (external and restrained eating) we controlled in all analysis for restrained eating (eating less than desired to maintain or loose body weight) and external eating (overeating resulting from a high susceptibility to tempting food cues), as measured by the other two DEBQ scales.

## Method

Participants were recruited from a pool of students taking courses at the University of Valencia and Barcelona (Spain), who had completed in class the Spanish (Castellan) version of the emotional eating scale of the DEBQ (see measures) (n=621). Participants with raw emotional eating scores (EE) below or equal 1.8 or above 2.6 were invited by phone to participate in the study (EE>2.6; n=177; EE<1.8; n=170). Those who agreed to participate (n= 97) filled out an additional questionnaire on exclusion

criteria. Exclusion criteria included a score higher than 15 on the Beck Depression Inventory (Beck et al., 1961) and a score higher than 20 on the EAT-26 (Garner, Olmsted, Bohr & Garfinkel, 1982) (n=7). For the present study, also males (n=18) were excluded. Of the 72 females who participated, 11 had missing data on additional measures (to be filled out at home) and of one person the food intake data turned out to be invalid. So our final sample had 60 female participants, 31 high and 29 low emotional eaters. The mean and standard deviations (SD) of age, body mass index (BMI=weight (kg)/height (m<sup>2</sup>)) and scores on emotional, external and restrained eating of the total sample and the subsamples may be found in table 1. The study protocol was approved by the ethical board of the University of Valencia.

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*Insert table 1*

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#### Procedure

Participants were instructed to refrain from food intake for at least two hours. Experimental sessions were scheduled at noon (1200 h) or in the afternoon (1700 h), which is well before lunch (which is in Spain between 1400 h and 1500 h) or dinner (in Spain: after 2100 h). Upon arrival participants filled out the BDI and the EAT-26 (Garner et al, 1986). Those with scores higher than 15 on the BDI (n=5) or with scores higher than 20 on the EAT-26 (n=2) were for ethical reasons not allowed to participate in the experiment.

Participants were told that they would take part in a mood induction procedure involving a virtual reality experience, where they had to make some exercises explained by a voice-over. Subsequently, the experimenter connected the software and left the participants alone in a Virtual reality room. Participants were assigned ad random to a

joy or sad mood induction condition using the program Random Allocation Software. The mood induction was done with a Virtual Reality (VR-MIP) system developed specifically for that aim; the system was adapted for the sad induction and for the joy induction. The scene where the VR-MIPS happen is an urban park. The movements around the park are made with a rumble pad. The efficacy of this MIP's-VR is described in previous work (Baños et al., 2006). Specifically, the emotional environment of VR to induce joy or sadness includes several methods to induce mood such as excerpts of music and movie scenes (for their effectiveness, see: Eich & Metcalfe, 1989; Gross & Levenson, 1995; Lang, Bradley & Cuthbert, 2001; & Velten, 1968). The mood induction for joy used an excerpt of the movie "Singing in the Rain" (Donen & Kelly, 1952) whereas for induction of sadness an excerpt of the movie "The Champ" was chosen (Lovell & Zeffirelli; 1979; Gross & Levenson, 1995). The VR-MIP was visualized through a projector, without stereoscopy.

After the mood induction participants were asked to fill out the questions on mood for the second time. Subsequently they were taken to a separate room with a table with on individual plates (always in the same order) a choice of high and low calorie foods: apple, banana, salty peanuts, sweet peanuts, chips, jellies, cereal bar, chocolate, rice diet bar, rosquilla (valencian snack made of toast bread). Participants were invited to smell the food and to indicate on a questionnaire their desire to eat each of the individual food items (not of relevance to the present study). Subsequently they were left alone for 5 minutes after they had been invited to eat as much as they wanted. After this, participants were asked to fill out the questions on mood for the third time in addition to questions about the eating experience (not of relevance to the present study). They also received a set of further questionnaires to fill out at home. Further, for ethical reasons, the participants that had received the sadness mood induction were invited to

receive the joy mood induction. After this, the participant was debriefed and thanked. The design of the study may be found in Figure 1.

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*Insert here figure 1*

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#### Measures.

- Eating behavior was assessed with a validated Spanish translation of the *Dutch Eating Behavior Questionnaire* (DEBQ; Van Strien et al., 1986; Cebolla et al., *submitted*). The DEBQ has 33 items with 5-choice answers (ranging from “never” to “very often”): 13 on “Emotional eating”, 10 on “External eating” and 10 on “Restrained eating”. The three scales have a good construct and predictive validity (van Strien, Herman, Engels, Larsen & van Leeuwe, 2007; Van Strien, Herman, & Anschutz, 2012; van Strien, Herman, Anschutz, Engels & deWeerth, 2012; Van Strien & van de Laar, 2008). Also the internal consistency is high. In the present study the Cronbach’s alphas were .96, .85 and .92 for emotional eating, external eating and restrained eating, respectively. The emotional eating scale was completed one to three months before the study. The other DEBQ scales were included in the questionnaire to be filled out at home.
- Mood was measured upon arrival and at two more time points: immediately after the mood induction and immediately after the food intake. A Visual Analog Scale (VAS; Gross & Levenson, 1997) was used for rating joy and sadness. Each emotion has to be rated on a 7-point scale ranging from 1 (not at all) to 7 (totally applicable).
- Food intake was measured as follows: Before and after the participants ate, the plates with the different food types were weighted with a professional balance.



We then translated weight into calories for each food type, and summed the caloric intake over all types of food, the sweet food and the salty food.

#### Analytic plan

All analyses were carried out using SPSS version 15.0 (SPSS inc. Chicago). Success of randomization was assessed by using one-way ANOVAs. With repeated measurement GLM we conducted various manipulation checks by assessing the effect of time on the VAS scale for sadness and for happiness in both the happiness and sad condition, in addition to the main effect of condition (sad vs. joy) on the Vas-scale responses over time. Second, with hierarchical regression analyses we tested the moderating effect of emotional eating (dummy coded as 0 (high EE) or 1 (low EE) on the relation between mood condition (dummy coded as 0 (joy condition) and 1 (sad condition)) and total intake of food (kcal) and intake of sweet and salty food (kcal). A significant moderator effect for emotional eating would be demonstrated by a significant interaction between emotional eating and the mood condition, whether or not there is a main effect for the moderator variable (emotional eating). Because of the high interrelations between emotional eating, external eating and dietary restraint ( $.35 < r_s < .50$ ,  $p < .01$ ), we corrected for external eating and dietary restraint in all analyses. To avoid multicollinearity in the regression analyses, all variables were centered before computing interaction terms (Aiken & West, 1991).

#### Results

##### Randomization check

There were no significant main effects of the mood condition for BMI, emotional eating or the scores on the Vas scales for joy or sadness before the mood induction, indicating

that random assignment to the mood conditions had been successful (mean (sd.): for the joy vs. the sad mood induction was for BMI: 21.7 (2.4) vs. 22.7 (3.6),  $p = .22$ ; emotional eating: 2.5 (.9) vs. 2.2 (.8),  $p = .17$ ; pre-VAS joy: 4.5 (1.3) vs. 5.1 (1.2),  $p = .10$ ; pre-VAS sadness: 1.6 (.8) vs. 1.5 (.8),  $p = .40$ .

Check of mood induction: Negative mood.

Only for the sad condition there was a significant effect of time on the values of the VAS scale for sadness (See Graphic 1) (sad condition:  $F(2,46) = 193.422$ ,  $p < .001$ ,  $\mu^2 = .802$ ; joy condition:  $F(2,70) = 11.129$ ,  $p = .329$ ,  $\mu^2 = .031$ ), with the quadratic model reaching the highest significance in the sad condition ( $F(1,23) = 147.458$ ,  $p < .001$ ,  $\mu^2 = .885$ ). There also was a significant overall moderator effect of the mood induction on values of VAS sadness over time ( $F(2,116) = 91.567$ ,  $p < .001$ ,  $\mu^2 = .612$ ). The mean (SD) of the negative VAS mood values at times 1 through 3 were for the sad vs. joy mood induction, respectively: T1: 1.46 (.78) and 1.64 (.83); T2: 4.54 (.88) and 1.47 (.831); T3: 2.21(.88) and 1.47(.81). Significant mean differences (Bonferroni corrected) in negative mood were obtained between time points 1 and 2 ( $p < .001$ ), and 2 and 3 ( $p < .001$ ).

The increase in perceived sadness after the mood manipulation designed to induce sadness indicates the effectiveness of this mood manipulation to induce sadness.

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*Insert here Graphic 1*

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Check of mood induction: Positive mood.

For both the sad condition and for the joy condition there was a significant effect of time on the VAS scale for joy (sad condition:  $F(2,46) = 38.727$ ,  $p < .001$ ,  $\mu^2 = .633$ ; joy

condition:  $F(2,70) = 20.130, p < .001, \mu^2 = .365$ ) (See Graphic 2), with the quadratic model reaching the highest significance in the sad condition ( $F(1,23) = 62.349, p < .001, \mu^2 = .743$ ). There also was a significant overall moderator effect of the mood induction on values of Vas scale for joy over time ( $F(2,116) = 59.226, p < .001, \mu^2 = .505$ ). The mean (SD) of the positive VAS mood values at times 1 through 3 were for the sad vs. joy mood induction, respectively: T1: 5.04 (1.160) and 4.50 (1.254); T2: 3.04 (1.398) and 5.42 (1.105); T3: 4.74(.88) and 5.22(1.290). Significant mean differences (Bonferroni corrected) in positive mood were obtained between time points 1 and 2 ( $p < .001$ ), and 2 and 3 ( $p < .001$ ). The increase in perceived joy after the mood manipulation designed to induce joy indicates the effectiveness of this mood manipulation to induce joy.

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*Insert here Graphic 2*

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#### Moderator effects

With hierarchical regression analysis we tested the interaction of emotional eating with the mood condition on food intake (kcal) (controlling for dietary restraint and external eating). There was no significant effect for emotional eating on food intake ( $p = .484$ ) but there was a borderline significant effect for mood condition on food intake (unstandardized coefficient (B) = 57.935,  $p = .051$ ). Participants tended to eat more in the sad than in the joy mood condition. There also was a significant moderator effect of emotional eating on the relation between mood condition and food intake (B = -117.593,  $p = .038$ ;  $R^2$  change = .068).

In a post-hoc hierarchical regression analysis we determined the nature of this significant interaction effect between the dichotomous variable high vs. low emotional

eating (dummy coded as 0 and 1) and mood condition (joy=0; sad=1). Prior to these analyses, we computed conditional moderator variables, where low emotional eating was assigned a value of 0 in one analysis and high emotional eating was assigned a value of 0 in the other analysis. The regression for low levels of emotional eating indicated that mood condition was not significantly associated with kcal,  $B=3.077$ ,  $p=.936$ . In contrast, results of the regression for high levels of emotional eating indicated that mood condition was significantly positively associated with kcal,  $B=121.597$ ;  $p=.005$ . In other words, whereas low emotional eaters ate similar amounts after the sad and after the joy condition, high emotional eaters ate significantly more after the sad condition than after the joy condition.

The adjusted means [SE] in kcal for low emotional eaters after the joy and the sad mood induction were, respectively: 128.498 [26.877] (n=15) vs. 130.075 [30.102] (n=14). The adjusted means [SE] in kcal for high emotional eaters after the joy and the sad mood induction were, respectively: 107.582 [24.224] (n=21) vs. 226.752 [33.481] (n=10).

We also assessed possible significant effects for intake of sweet and for salty food (in kcal). There were no main effects for emotional eating or mood condition on intake of sweet food or salty food (kcal). Only for intake of sweet food there was a significant moderator effect of emotional eating on the relation between mood condition and food intake ( $B = -118.130$ ,  $p=.021$ ;  $R^2$  change=.085). The adjusted means [SE] in kcal for intake of sweet food for low emotional eaters after the joy and the sad mood induction were, respectively: 99.58 [24.19] (n=15) vs. 80.08 [27.09] (n=14). The adjusted means [SE] in kcal for high emotional eaters after the happy and the sad mood induction were, respectively: 70.64 [21.80](n=21) vs. 169.29 [30.13] (n=10).

## Discussion

The principal finding was that the scale for eating in response to negative emotions of the DEBQ (DEBQ-E) showed no main effect on food intake and significantly moderated the relationship between mood condition and food intake. Whereas low emotional eaters ate similar amounts after the sad and after the joy mood condition, high emotional eaters ate significantly more after the sad mood condition than after the joy mood condition. A further finding was that a similar moderator effect for emotional eating was found for intake of sweet food but not for intake of salty food.

The significant higher food intake of the participants with high scores on the DEBQ-E after the sad mood induction is as hypothesized. In combination with the absence of a main effect of emotional eating on food intake it indicates that people with high scores on the scale for eating in response to negative emotions of the DEBQ do not also show high food intake after a positive mood induction. This finding supports the conclusion by Nolan et al. (2019), that eating in response to negative emotions and eating in response to positive emotions may refer to two different constructs.

The moderator effect of emotional eating on sweet food and not on salty food is consistent with other studies. For example, Oliver, Wardle and Gibson (2000), also found that stressed emotional eaters ate more sweet food than did unstressed and non emotional eaters in the distress condition (see also Van Strien et al., 2012b, footnote 7, p283).

Contrary to our hypothesis, the low emotional eaters did not eat less after the sad compared to the joy mood induction. This is remarkable, because the typical and predominant response of people is to eat less when being in a sad mood (Gold & Chrousos, 2002, Stone & Brownell, 1994). However, on close inspection and when comparing the food intake of the low emotional eaters in the present study with those of

a different study with a distress manipulation (Van Strien et al, 2012b, study 2, p282) the low emotional eaters ate comparable amounts in the distress condition. The adjusted means [SE] in kcal for low emotional eaters in the present study and in the van Strien et al, 2012b study were, respectively: 130.075 [30.102] (n=14) vs. 121.29 [43.25] (n=23). (Cohens  $d=.23$ ). In contrast, when comparing the food intake of the low emotional eaters in the joy versus the neutral mood condition, the adjusted means [SE] in kcal for low emotional eaters in the present study and in the van Strien et al, 2012b study were for the joy versus neutral mood condition, respectively: 107.582 [24.224](n=21) vs. 180.34 [33.41] (n=23). (Cohens  $d= 2.4$ ). So, in the present study it may not be the case that the low emotional eaters ate so much in the sad mood condition, but that they ate so little in the joy mood condition. Earlier, Turner, Luszczynska, Warner & Schwarzer (2010) found that compared to a control (neutral mood) condition, a positive mood enhancement condition resulted in consuming less calories.

#### Strengths and limitations.

Strengths of the study are that the use of groups with extreme scores on emotional eating is associated with higher efficiency of detecting interaction effects (McClelland & Judd, 1993). Another strength is that for the mood induction procedure a VR system was selected which had good effectiveness for inducing sadness and joy (see also Baños et al., 2006). A further strength is that participants with above threshold depressive pathology and/or eating disorder pathology had been excluded from participation. A final strength is that in all analyses we controlled for the other eating styles, so the present moderator effect of emotional eating on the relation between the mood condition and food intake appears to be a robust, independent effect.

With respect to limitations, the relatively small sample size may have reduced the power to reveal small (interaction) effects. It had, however, sufficient power to reveal

the present moderator effects on intake of food and sweet food. Another limitation is that the present experiment was conducted on predominantly normal weight females, so the study needs replication with low and high emotional eaters with overweight. A further limitation is that we had to exclude males from the present study, because of their low number. It remains to be seen whether the same results would hold for men. Further, the present findings need replication, also with other types of mood inductions or inductions of other kinds of positive and negative mood. Also a replication in a field study would be of interest, for example by using field stressors and assessing post/stressor food intake by means of snack intake diaries in the hours following the stressor.

#### Conclusion

Whereas low emotional eaters ate similar amounts after the sad and after the joy mood condition, high emotional eaters ate significantly more after the sad than after the joy mood condition. These findings would suggest that eating in response to negative and to positive emotions refer to two different constructs and that the incorporation of items on eating in response to positive emotions in the DEBQ- E would probably lower its present good dimensional and construct validity.

#### Conflict of interest

Tatjana van Strien has a copyright and royalty interest in the DEBQ and manual.

#### Acknowledgement

CIBERobn is an initiative of ISCIII. This study has been supported in part by the Ministerio de Ciencia e Innovación (Plan Nacional de Investigación Científica,

Desarrollo e Innovación Tecnológica 2008-2011) in the project (PSI2008-04392/PSIC).

Tatjana van Strien was supported by the Radboud University Nijmegen

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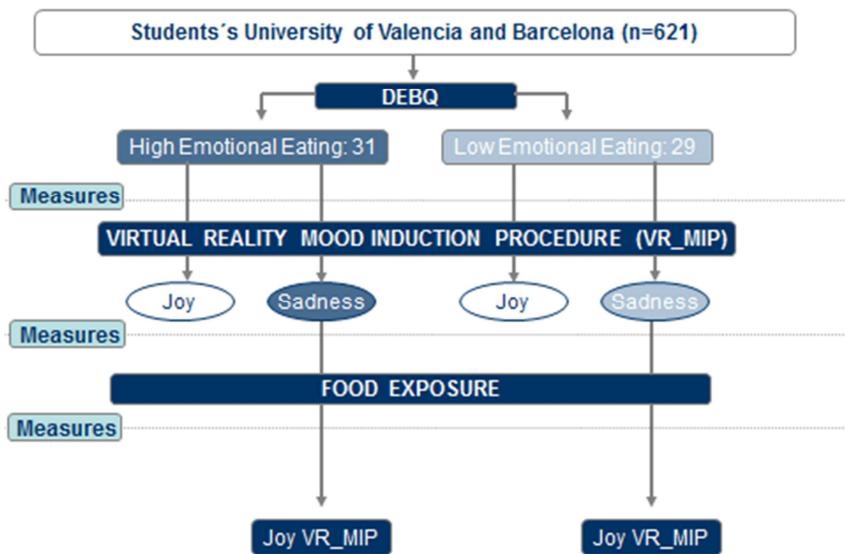
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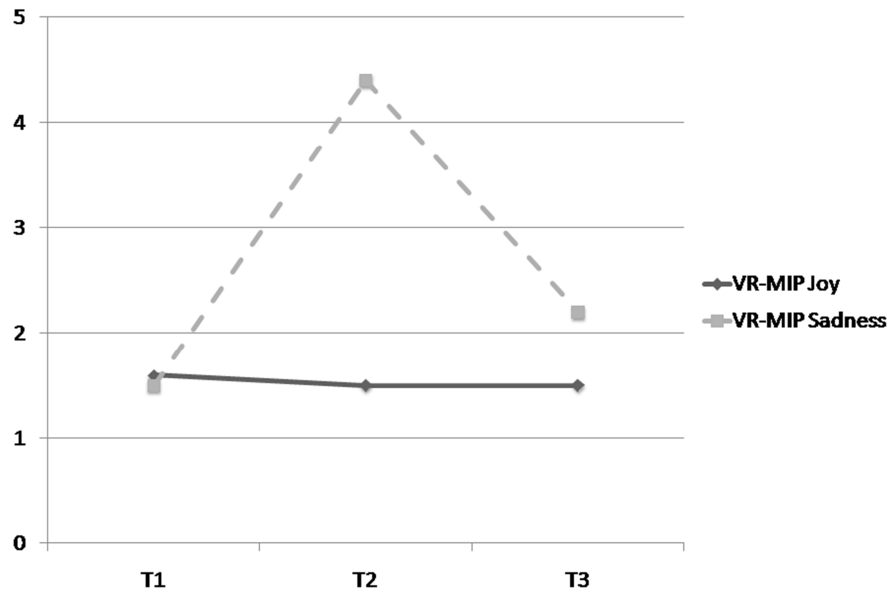
Table 1. Characteristics of total sample and the subsamples of low and high emotional eaters.

	Total Sample N=60		Low emotional eating N=29		High emotional eating N=31	
	Mean	SD	Mean	SD	Mean	SD
Age	23.9	6.9	25.4	9.2	22.6	3.3
BMI	22.1	2.9	21.6	3.0	22.5	2.8
Emotional eating	2.4	.9	1.5	.3	3.1	.5
External eating	3.3	.6	2.9	.6	3.5	.4
Restrained eating	2.5	.9	2.2	.8	2.8	.8

Figure 1. Design of the experiment.



Graphic 1. Effects of the VR-MIP's over VAS Sadness scores.



Graphic 2. Effects of the VR-MIP's over VAS Happiness scores.

